Muskegon Lake Action Plan

2018 – 2025
This plan was developed with the input and support of Muskegon Lake/River Watershed stakeholders, the public and the following organizations:

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*The Muskegon Lake Watershed Ecosystem Master Plan was developed by the West Michigan Shoreline Regional Development Commission with support from the Michigan Department of Environmental Quality Office of the Great Lakes Area of Concern Program and the U.S. Environmental Protection Agency and the Great Lakes Restoration Initiative*
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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, including the delisting of Muskegon Lake as a Great Lakes Area of Concern.

The MLWP’s geographic focus is primarily within the immediate watershed area of Muskegon Lake, its tributaries and the Cedar Creek, Mosquito Creek and Brooks Creek watersheds.

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 concerning Muskegon Lake watershed issues of interest. The MLWP provides a forum for discussion of those issues, initiates, facilitates, coordinates and implements plans and actions to improve the Muskegon Lake ecosystem.

The Muskegon Lake Watershed Partnership (MLWP) strives to maintain a diverse and balanced representation of voting stakeholders to reflect the nature and the needs of the Muskegon Lake watershed community. Membership categories include academia, business and industry, conservation and natural resources, general public, public sector, volunteer and philanthropic interests. MLWP membership is available to Muskegon Lake watershed stakeholders, including but not limited to property owners, municipal staff, elected officials, economists, agriculturalists, recreationalists, environmentalists, scientists 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 a community-based plan, designed to facilitate the continuation of coordinated, natural resources stewardship of Muskegon Lake and Lower Muskegon River Watershed. It builds upon the restoration progress made under the Great Lakes Areas of Concern (AOC) program and other voluntary and regulatory cleanup programs.

The management actions contained in the Muskegon Lake AOC Remedial Action Plan (RAP) will be met in 2019. The lake will be removed from the list of Great Lakes AOCs by 2020, once final cleanups and restoration projects have been completed. The RAP, an ecosystem-based plan, addresses priorities for contaminated sediment cleanup, habitat restoration, water quality improvements and more. However, the RAP does not set long-term goals for everything needed to restore and protect the lake’s water resources. Great Lakes RAP goals are short term, by design. While the Muskegon Lake RAP process has been very effective, it was meant only to bring Muskegon Lake to an environmental condition similar to other non-AOC water bodies.

The Muskegon Lake EMP will seamlessly replace the RAP as the watershed community’s guiding document for ecosystem management of the Muskegon Lake watershed and for the protection of its natural resources.

The action plan is to be used, both now and into the future. It can be used to plan watershed improvement projects 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 plan projects are developed and carried out. Monthly public meetings will be held to take public input, collaborate with partners and report on progress.

The plan was created with broad input from the general public, scientists, natural resources managers, landowners and other stakeholders. It can be used by organizations who wish to design, implement and fund water quality and natural resources improvement projects, and to demonstrate community input and support for projects designed to meet the plan’s desired outcomes. Many of the plan’s goals, outcomes, indicators and targets support the goals of other Great Lakes restoration plans, including the Great Lakes Action Plan II, 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 the Michigan Department of Natural Resources Fisheries Management Plans for the Muskegon River, Muskegon Lake and the Lake Michigan watershed.
Muskegon Lake Watershed

Background, Current Status and Progress

Muskegon Lake is 4,232-acres in size 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 because several of its beneficial uses were impaired. Impairments were caused by historic industrial disposal practices and shoreline land use alterations and practices that filled shallow shoreline waters and adjacent 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 nongovernmental organizations have worked collaboratively to improve water quality, remediate contaminated sediments and restore and protect fish and wildlife species and their habitats. Strong partnerships and stakeholder forums exist in the AOC to support, guide and sustain the habitat restoration projects, including technical assistance for monitoring. The AOC 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. During that time, approximately $40 million was invested. From 2015-2020, an additional $33 million from the Great Lakes Restoration Initiative (including Great Lakes Legacy Act) will implement the final projects needed to remove Muskegon Lake’s Great Lakes AOC designation.
**Muskegon River Watershed**

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

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. It identifies designated uses, best management practices and educational needs. The Muskegon Lake Stormwater Management Plan, Remedial Action Plan and other sub-watershed plans also address water quality and the best management practices needed to improve fish and wildlife habitat and other ecosystem assets.
**Action Plan Overview**

**Outcomes, Recommendations, Indicators, 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 components will help guide planning, monitoring and implementation of Best Management Practices for the continued improvement and sustainability of the Muskegon Lake watershed ecosystem:

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

The following chapters include “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.

The Action Plan can be used by individuals and organizations 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. Resilience is the ability to prevent a short-term hazard event from turning into a long-term community-wide disaster.

Resilient watersheds and shorelines also provide ecological services that are freely gained from the natural environment such as flood control, air quality, 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 recent countywide Flood Insurance Rate Map (FIRM) updates under the Federal Emergency Management Agency’s (FEMA) Map Modernization Program. Many 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

<table>
<thead>
<tr>
<th>#</th>
<th>Implementation Recommendations</th>
<th>Indicators</th>
<th>MLWP with Partners</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete resiliency and adaptive management plans for Muskegon River sub-watersheds and shorelines</td>
<td>Land use policies support resiliency projects; Assets are managed and monitored</td>
<td>Local Governments, WMSRDC, Delta Institute, Michigan Association of Planners</td>
</tr>
<tr>
<td>3</td>
<td>Protect and maintain recreational, commercial, port and green infrastructure assets (built and natural)</td>
<td>Survey results from recreational and port users</td>
<td>Private Landowners, Local Governments, WMSRDC</td>
</tr>
<tr>
<td>4</td>
<td>Develop an infrastructure asset management plan to ensure a safe, healthy, resilient harbor</td>
<td>Plan is completed and assets are monitored and managed</td>
<td>West Michigan Port Operators, Local Governments, WMSRDC</td>
</tr>
<tr>
<td>6</td>
<td>Establish funding for ongoing monitoring and maintenance</td>
<td>Funding availability</td>
<td>Local Governments, Donors, Community Foundations,</td>
</tr>
<tr>
<td>7</td>
<td>Update land use policies to provide ecological services through natural resources setbacks, buffers</td>
<td>Amount of development plans with natural features included</td>
<td>Business Community, WMSRDC, Local Governments,</td>
</tr>
<tr>
<td>8</td>
<td>Seek Michigan’s Natural Rivers designation for the Muskegon River or appropriate sections of river</td>
<td>Protected River Segment</td>
<td>MRWA, MDNR, Townships</td>
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<tr>
<td>9</td>
<td>Utilize Farmland Open Space Preservation Programs &amp; USDA NRCS programs to reduce pollution loadings</td>
<td>Acres protected</td>
<td>USDA-NRCS, MDARD, Conservation Districts, Townships, Landowners</td>
</tr>
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<td>10</td>
<td>Amend and implement zoning ordinances to protect sensitive areas from development-related alterations</td>
<td>Acres of wetlands and lengths of riparian areas protected</td>
<td>Local Governments, Townships, WMSRDC</td>
</tr>
<tr>
<td>11</td>
<td>Upgrade stormwater infrastructure to prevent damage from severe weather (vegetative and built)</td>
<td>Storage capacity; Reduced financial and resource impacts</td>
<td>Local Governments, USACE, Developers, MDOT</td>
</tr>
<tr>
<td>12</td>
<td>Identify wetland restoration/creation areas; Reduce flashy drainage flows through green infrastructure.</td>
<td>Percent impervious surface; Green infrastructure and wetland effectiveness</td>
<td>Local Planning Commissions, Drain Commissioners, WMSRDC, MDEQ</td>
</tr>
<tr>
<td>13</td>
<td>Recreational areas provide for seasonal water flows and storage.</td>
<td>Gallons of water storage capacity at recreational sites</td>
<td>WMSRDC, Planning Commissions, MDEQ</td>
</tr>
<tr>
<td>14</td>
<td>Develop forest stewardship plans to maintain stable watershed hydrology in urban and rural areas.</td>
<td>Forest stewardship plans for priority sub-watersheds</td>
<td>WMSRDC, GVSU, MRWA, Conservation Districts</td>
</tr>
</tbody>
</table>
Muskegon River Land Use Map and Location of Muskegon Lake, Courtesy GVSU AWRI
2. Great Lakes Literacy and Natural Resource-Based Education

*Background, Need and Status:*

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

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

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

The GVSU Annis Water Resources Institute offers the [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 the [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 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 water literacy principles.

Outcome: Individuals and communities understand their responsibility for and make informed and responsible decisions regarding water resources

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<th>Implementation Recommendations</th>
<th>Indicators</th>
<th>MLWP with Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Landowner education and training on natural resources Best Management Practices (BMP)</td>
<td>Number of landowners with shoreline buffers and wetlands</td>
<td>Conservation Districts, MRWA</td>
</tr>
<tr>
<td>2</td>
<td>Integrate water literacy and experiential learning into State of Michigan and ISD curriculum standards</td>
<td>Number of K-12 schools in MAISD Math/Science GLSI</td>
<td>MAISD/GLSI, AWRI, Sea Grant, Michigan Legislature</td>
</tr>
<tr>
<td>3</td>
<td>Citizens and officials receive education to increase water literacy knowledge and understanding</td>
<td>Number of people attending educational trainings</td>
<td>Conservation Districts, MRWA, MSU-E, Sea Grant</td>
</tr>
<tr>
<td>4</td>
<td>Land use planners are educated on low impact development and green infrastructure policies</td>
<td>Sustained public education for adult decision-makers</td>
<td>Local Governments, WMSRDC, WMEAC, Delta Institute, MSU</td>
</tr>
<tr>
<td>5</td>
<td>Sustain public awareness and information on historic locations with known environmental conditions</td>
<td>Topic of an annual, MLWP public meeting presentation</td>
<td>Lakeshore Museum Center, GVSU AWRI, NOAA, WMSRDC</td>
</tr>
<tr>
<td>6</td>
<td>Non-native, invasive plant management education is available to landowners and park maintenance staff</td>
<td>Community organizations provide education, annually</td>
<td>MCD, WMCN, MERES, MLWP Shoreline Stewards</td>
</tr>
<tr>
<td>7</td>
<td>Technical support and funding is available for volunteers and landowners to perform hands-on restoration and maintenance of natural resources</td>
<td>Community organizations provide support, annually</td>
<td>MCD, CFFMC, WMCN, MLWP Partner Grants</td>
</tr>
<tr>
<td>8</td>
<td>W.G. Jackson Research Vessel education programs serve K12 and adult audiences</td>
<td>Number of K-12 and adult trips, annually</td>
<td>GVSU AWRI, Sea Grant</td>
</tr>
<tr>
<td>9</td>
<td>Muskegon Community College environmental curriculum and undergraduate education is promoted</td>
<td>Number of students registered for Life Science biology classes and summer programs</td>
<td>MCC Life Science Dept., MAISD, High Schools</td>
</tr>
<tr>
<td>10</td>
<td>Expand and promote student, natural resource-related internships</td>
<td>Number of students involved</td>
<td>GVSU AWRI, MCC, Schools, WMSRDC, NOAA, NRCS</td>
</tr>
<tr>
<td>11</td>
<td>Assess and define a baseline and goal for environmental literacy</td>
<td>Education level of environmental literacy</td>
<td>GVSU, MAISD Math/Science Center, Muskegon Area Sustainability Coalition</td>
</tr>
</tbody>
</table>
3. Fish and Wildlife Habitat

Background, Need and Status:

Muskegon Lake has very diverse fisheries. Muskegon Lake and its fish and wildlife habitat are also 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 will be needed to guide future actions for a healthy fishery. The existing Muskegon Lake AOC Fish & Wildlife Habitat Restoration & BUI Removal Strategy addresses only the AOC needs. Most 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 are exploring the potential for a 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 2017. This resulted in the restoration of 60.9 acres of open water wetland, 27.6 acres of emergent wetland, removal and improvement of 86.6 acres of unnatural lake fill and the softening of 24,776 feet of shoreline with native, emergent wetland and shoreline buffer zone plantings.

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 6.6-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 healthy, naturally diverse, and sufficient to sustain viable biological communities

**Outcome:** Sustainable and abundant aquatic life – habitat and populations are stable or increasing

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<tbody>
<tr>
<td>1</td>
<td>Coldwater species are present and thriving with no net loss of cold water habitat due to water withdrawals and habitat manipulations; Cold water systems are identified and quantified</td>
<td>Critical habitat is identified, restored and preserved (amount and biodiversity)</td>
<td>Trout Unlimited, MRWA, Federal Agencies, MDNR Fisheries, Tribes, Conservation Districts, GVSU AWRI</td>
</tr>
<tr>
<td>2</td>
<td>Sturgeon populations are rehabilitated in Muskegon Lake and its tributaries (in support of Michigan’s Lake Sturgeon Rehabilitation Strategy)</td>
<td>Fish and wildlife populations and abundance are restored and protected</td>
<td>MDNR Fisheries, MRWA, Great Lakes Tribes, Federal Agencies, Muskegon Conservation District, GVSU AWRI, Sea Grant</td>
</tr>
<tr>
<td>3</td>
<td>Dredging, filling and disposal are regulated by local, state and federal policies to prevent degraded bottom habitat and water quality</td>
<td>Aquatic habitat is restored and protected (emergent wetlands, benthos and macrophytes)</td>
<td>Local Governments, State and Federal Regulatory Agencies, WMSRDC</td>
</tr>
<tr>
<td>4</td>
<td>Increase and improve fish and wildlife habitat for warm water, game and forage species</td>
<td>Fish and wildlife meets the subsistence needs of local community and economy; Populations are self-sustaining</td>
<td>Sportfishing associations, MDNR Fisheries, MDEQ, Tribes, MRWA, Muskegon Conservation District, WMSRDC, Federal Agencies</td>
</tr>
<tr>
<td>5</td>
<td>Local land use policies protect restored habitats and other habitats to ensure that life cycle needs of native fish and wildlife are met</td>
<td>Fish and wildlife habitat and travel corridors are identified and critical habitats protected or restored</td>
<td>MSU-E, Sea Grant, WMSRDC, Delta Institute, local governments, Land Conservancies, WMSRDC</td>
</tr>
<tr>
<td>6</td>
<td>Track and map the presence and integrity of all habitats &amp; species (wetlands, open water, terrestrial)</td>
<td>Habitat change (integrity, loss/gain) (AL says too ambitious)</td>
<td>WMSRDC, TNC, GVSU AWRI, MRWA, State &amp; Fed. Agencies</td>
</tr>
<tr>
<td>7</td>
<td>Coordinate with natural resources agencies to ensure a robust population of fish, accessible and free of contaminants</td>
<td>Public satisfaction of fisheries, (Creel Census and Angler Surveys)</td>
<td>MDHHS/Eat Safe Fish, Health Departments, State &amp; Fed. Agencies, AWRI, Tribes</td>
</tr>
<tr>
<td>8</td>
<td>Protect, monitor and restore cold water tributaries to support native fisheries (more specificity to restore-AL)</td>
<td>Water temperature, chemistry, sedimentation, and hydrology</td>
<td>State &amp; Fed. Agencies, TU, GVSU AWRI, NOAA GLERL</td>
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<tr>
<td></td>
<td>Description</td>
<td>Supporting Records</td>
<td>Responsible Entities</td>
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<td>9</td>
<td>Lake trout are naturally reproducing and supporting wild-fish based fisheries in Lake Michigan (outside purvue of Muskegon Lake-AL)</td>
<td>Stocking records indicate self-sustaining populations</td>
<td>Great Lakes Tribes, MDNR Fisheries, Sea Grant, NOAA, Commercial and Sport Fisheries, GVSU AWRI, MSU</td>
</tr>
<tr>
<td>10</td>
<td>Formal and informal educational experiential programs are provided to all watershed stakeholders</td>
<td>A citizenry that is involved and educated on the fundamentals of healthy habitats – HOW?</td>
<td>GVSU AWRI, MAISD, MLWP Conservation Districts, MSU, U of M, TNC, MDNR</td>
</tr>
<tr>
<td>11</td>
<td>Monitoring supports a self-sustaining native sport fishery and a healthy commercial fishery</td>
<td>Fisheries diversity and abundance</td>
<td>MDNR Fisheries, GVSU AWRI, NOAA, USFW, MSU, U of M, TNC</td>
</tr>
<tr>
<td>12</td>
<td>Implement greenways and wildlife corridors to connect isolated and fragmented habitats, wetlands and water resources</td>
<td>Shoreline/Stream Corridor Setbacks; Connectivity of natural resources</td>
<td>Local Governments, WMSRDC, Landowners, MDOT, MDNR, Land Conservancy of West Michigan, TNC</td>
</tr>
<tr>
<td>13</td>
<td>Identify, prioritize and protect quality native habitats in critical, functioning sub-watershed areas</td>
<td>Biodiversity/floristic quality assessment</td>
<td>Land Conservancy of West Michigan, TNC, Landowners</td>
</tr>
</tbody>
</table>
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. Efforts to integrate 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. The Watershed Management Plan focused on the urban storm drainage system along the south shoreline of Muskegon Lake and the sub-watersheds of Ruddiman Creek and Division Street Outfall (historically, Beidler’s Creek).

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

<table>
<thead>
<tr>
<th>#</th>
<th>Implementation Recommendations</th>
<th>Indicators</th>
<th>MLWP with Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitoring indicates attainment of water quality standards</td>
<td>Nutrients, dissolved oxygen, temperature, E.coli, etc.</td>
<td>MDEQ, AWRI, Health Departments</td>
</tr>
<tr>
<td>2</td>
<td>Beach monitoring indicates swimmable access</td>
<td>Number of no partial body or full body contact postings</td>
<td>Public Health Muskegon County, MDEQ, AWRI</td>
</tr>
<tr>
<td>3</td>
<td>Waters of the state meet Water Quality Standards for being swimmable, fishable and drinkable</td>
<td>Toxicity of surface water, groundwater and sediment</td>
<td>MDEQ, Health Departments, AWRI</td>
</tr>
<tr>
<td>4</td>
<td>Reduce soil erosion and sedimentation, flashy flows, nutrient inputs and unstable hydrology</td>
<td>Percent impervious surface, benthic diversity and water quality of tributary streams</td>
<td>Local Governments, WMSRDC, MCD, AWRI, MDEQ, EPA, NOAA, MSUE</td>
</tr>
<tr>
<td>5</td>
<td>Implement watershed management plans (Muskegon River 319; Muskegon Lake: Ruddiman/DSO/South Shoreline; MS4 Phase II; Bear Creek 319)</td>
<td>Number of Best Management Practices Implemented</td>
<td>MRWA, WMSRDC, MCD, AWRI, MDEQ, EPA, MSUE, Local Governments</td>
</tr>
<tr>
<td>6</td>
<td>Illicit connections between storm and sanitary sewers continue to be investigated and corrected</td>
<td>MS4 monitoring is within permit compliance limits</td>
<td>Muskegon Lake Watershed Cities,</td>
</tr>
<tr>
<td>7</td>
<td>Land use planning incorporates green space and integrates native habitat into development designs</td>
<td>Diversity and abundance of native, aquatic wildlife</td>
<td>WMSRDC, Local Governments, Business community, MSUE</td>
</tr>
<tr>
<td>8</td>
<td>Public drinking water supply is safe</td>
<td>Assessment of Source Water Intake Protection Plans</td>
<td>Water Systems Managers, Local Governments, MDEQ</td>
</tr>
<tr>
<td>9</td>
<td>Public perception is sampled through statistically significant method/s</td>
<td>Public Perception of water resources</td>
<td>GVSU, MSU, WMSRDC</td>
</tr>
<tr>
<td>10</td>
<td>Promote LID green infrastructure, rain gardens, native landscape lawn alternatives, green space to restore hydrology and to prevent storm water runoff</td>
<td>Eutrophication and undesirable algae is reduced and surface waters are in attainment with water quality standards</td>
<td>MDEQ, Local Governments, Bear Lake Board, GVSU-AWRI, Business Community</td>
</tr>
<tr>
<td>11</td>
<td>Work with agricultural community to address nutrient runoff into surface drains</td>
<td>Nutrient reduction into surface water bodies</td>
<td>NRCS, MDARD, Conservation Districts</td>
</tr>
</tbody>
</table>
5. Groundwater Resources

Background, Need and Status:

The MLWP identified groundwater quality and quantity as important to the health of aquatic habitats, fisheries and public health throughout the watershed. Groundwater moves slowly, discharging into lakes, streams and wetlands. It helps provide cool water that supports aquatic life and it is used as a source of drinking water.

The Muskegon Lake watershed’s sandy soils provide opportunities to use green infrastructure for filtration of stormwater runoff. But, sandy soils 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

<table>
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<th>MLWP with Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protect drinking and source water from contamination and spills</td>
<td>Assessment of Source Water Protection Plans</td>
<td>Water Systems Manager/Local Governments, MDEQ, Health Departments</td>
</tr>
<tr>
<td>2</td>
<td>Pass a statewide sanitary code and inspection requirements for on-site septic systems</td>
<td>Water Quality</td>
<td>MDEQ, Health Departments, State Legislature</td>
</tr>
<tr>
<td>3</td>
<td>Ensure the integrity and availability of groundwater resources across the watershed</td>
<td>Quantity, availability, functionality</td>
<td>MDEQ, Local Governments, Business, Industry, Agriculture, Watershed Stakeholders</td>
</tr>
<tr>
<td>4</td>
<td>Maintain database of potentially unknown landfills, soil, groundwater and sediment contamination sites</td>
<td>Creation and use of database</td>
<td>MDEQ, AWRI, WMSRDC, Health Departments</td>
</tr>
<tr>
<td>5</td>
<td>Survey, locate and map abandoned oil wells and historic petroleum infrastructure</td>
<td>Update Westshore Oil Well Report</td>
<td>MDEQ, OGMD, WMSRDC</td>
</tr>
<tr>
<td>6</td>
<td>Map and track known groundwater plumes and identify their potential for affecting water resources</td>
<td>Map and database established</td>
<td>GVSU AWRI, MDEQ, OGMD, Local Governments, Health Departments</td>
</tr>
<tr>
<td>7</td>
<td>Assess the effectiveness of Wellhead Protection Programs</td>
<td>Groundwater protected in source water areas</td>
<td>MDEQ, Local Governments,</td>
</tr>
<tr>
<td>8</td>
<td>Identify and protect groundwater sources to headwater streams and cold water resources</td>
<td>Maintain adequate temperatures and base flow</td>
<td>MDNR, MDEQ, Drain Commissioners</td>
</tr>
<tr>
<td>9</td>
<td>Large groundwater withdrawal users efficiently manage systems to prevent local water table impacts.</td>
<td>Sustainable water tables</td>
<td>MDARD, MDEQ, MSU-E, NRCS, Conservation Districts</td>
</tr>
<tr>
<td>10</td>
<td>Drains are managed to protect year-round base flows</td>
<td>Sustainable water tables</td>
<td>Drain Commissioners, Road Commissions, Landowners</td>
</tr>
<tr>
<td>11</td>
<td>Monitor nutrient loading from groundwater to surface waters</td>
<td>Receiving waters do not exceed standards</td>
<td>AWRI, MDEQ, WMSRDC, Health Departments</td>
</tr>
<tr>
<td>12</td>
<td>Utilize green infrastructure for infiltration and protection of groundwater resources</td>
<td>Creation and protection of wetlands, prairies, other BMPS</td>
<td>Local Governments, MDEQ, Landowners, WMSRDC</td>
</tr>
</tbody>
</table>
6. Site Remediation and Revitalization

**Background, Need and Status:**

Contaminated sediment cleanups, shoreline brownfield cleanup and redevelopment, and the cleanup of contaminated soils and groundwater are priorities for the MLWP. As the official Public Advisory Council for the Muskegon Lake Area of Concern (AOC), the MLWP has 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.

Contaminated sediment cleanup projects include a 2006 cleanup of Ruddiman Creek, a 2012 cleanup of Muskegon Lake at the Division Street Outfall, and the 2018 Muskegon River cleanup at the former Zephyr Oil Refinery. The MLWP and the West Michigan Shoreline Regional Development Commission (WMSRDC) is also working with public and private partners to advance the cleanup of Muskegon Lake at the mouth of Ryerson Creek. Information about these Great Lakes Legacy Act projects is available at [www.greatlakesmud.org](http://www.greatlakesmud.org). The projects are implemented in partnership with the State of Michigan and the U.S. EPA Great Lakes Legacy Act (GLLA), now part of the Great Lakes Restoration Initiative.

The MLWP also determined the need to continue to evaluate post remediation monitoring information for the GLLA cleanups, and to initiate additional action to support the remediation of environmental conditions that could not be remediated under the GLLA.

The MLWP developed a list of sites that will need to be addressed under existing public/private initiatives and state and federal remediation programs. This list was developed in association with the identification of the final management actions needed to delist the AOC. 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, LUST sites and historic landfills.
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

<table>
<thead>
<tr>
<th>#</th>
<th>Implementation Recommendations</th>
<th>Indicators</th>
<th>MLWP with Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Maintain integrity of the contaminated sediment cleanup sites (Ruddiman Creek, Muskegon Lake/Division Street Outfall, Muskegon River/Zephyr, and Muskegon Lake/Ryerson)</td>
<td>Sediment quality</td>
<td>EPA, MDEQ, MDNR OGL, GVSU AWRI</td>
</tr>
<tr>
<td></td>
<td>Prioritize, monitor and remediate sites with known environmental conditions (e.g., Part 201, LUST, NPL, brownfield redevelopment sites)</td>
<td>Reduction of acres and numbers of degraded sites</td>
<td>Landowners, MDEQ, Health Departments, EPA, WMSRDC</td>
</tr>
<tr>
<td>2</td>
<td>Map all historic lake and lower river “fill” locations and quantify acreages (including Bear Lake)</td>
<td>Sites quantified and mapped</td>
<td>GVSU AWRI, WMSRDC</td>
</tr>
<tr>
<td>3</td>
<td>Map historic dump sites and unregulated landfills for assessment or remediation (private, commercial and public lands)</td>
<td>Sites identified and public health protected</td>
<td>WMSRDC, MDEQ, Health Departments, AWRI</td>
</tr>
<tr>
<td>4</td>
<td>Integrate stakeholder engagement into planning processes</td>
<td>Iteratively revisit stakeholder survey documents</td>
<td>Local government, WMSRDC</td>
</tr>
<tr>
<td>5</td>
<td>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)</td>
<td>Diversity of uses and ecosystem services provided</td>
<td>Developers, MDEQ, Landowners, Local Government, WMSRDC</td>
</tr>
<tr>
<td>6</td>
<td>Iteratively revisit master plans and community visions to integrate the interests of all stakeholders into site remediation and revitalization.</td>
<td>Review developments and master plans</td>
<td>Developers, MDEQ, Landowners, Local Government, WMSRDC</td>
</tr>
<tr>
<td>7</td>
<td>Reassess AOC remediation sites for completeness, effectiveness, and further needs.</td>
<td>Monitoring</td>
<td>GVSU AWRI, WMSRDC, EPA, MDEQ, MDNR OGL</td>
</tr>
</tbody>
</table>
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.
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 and to delist Muskegon Lake as an AOC. 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.

<table>
<thead>
<tr>
<th>Phragmites Density Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sparse</strong></td>
</tr>
<tr>
<td><strong>Patchy</strong></td>
</tr>
<tr>
<td><strong>Dense</strong></td>
</tr>
<tr>
<td><strong>Monoculture</strong></td>
</tr>
</tbody>
</table>
## 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

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

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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The public has access to abundant open space, shorelines, and natural areas</td>
<td>Number of acres and access points available to the public</td>
<td>Local governments, Private landowners, Schools</td>
</tr>
<tr>
<td>2</td>
<td>The public has enhanced opportunities for interaction with the Muskegon Lake watershed ecosystem</td>
<td>Number of events and educational opportunities available to the public</td>
<td>Local governments, MDNR, MERES</td>
</tr>
<tr>
<td>3</td>
<td>Expand real-time monitoring of beaches</td>
<td>Reduction in no contact warnings/beach closings</td>
<td>Health Departments, MDEQ, Public landowners</td>
</tr>
<tr>
<td>4</td>
<td>Develop and implement a water trails system</td>
<td>Citizen use</td>
<td>Lake Michigan Water Trail Partners, Local governments, WMSRDC, MDNR, National Park Service, Businesses</td>
</tr>
<tr>
<td>5</td>
<td>Develop a comprehensive strategy to prevent nuisance and harmful blue green algal blooms</td>
<td>Number of algal blooms, area of impacted waters, residential complaints</td>
<td>GVSU-AWRI, MDEQ, Local governments, Lake Boards, Lake Associations, Landowners</td>
</tr>
<tr>
<td>6</td>
<td>Provide fishing access points from shorelines and tributaries</td>
<td>Angler hours, creel census</td>
<td>Local Governments, MDNR, Great Lakes Fisheries Trust, Michigan Land Trust</td>
</tr>
<tr>
<td>7</td>
<td>Opportunities are available for non-extractive / non-motorized recreation (e.g., birding, biking, hiking, canoeing, kayaking)</td>
<td>Recreational and educational usage</td>
<td>Audubon, Local Governments, MERES, MDNR – State Game Area &amp; State Parks, USFS</td>
</tr>
<tr>
<td>8</td>
<td>Public small boat access throughout watershed</td>
<td>Number of public landings</td>
<td>General Public, Anglers, Boaters</td>
</tr>
<tr>
<td>9</td>
<td>Information Clearinghouse for public site &amp; access Information</td>
<td>Media hits and inquiries</td>
<td>Muskegon County, Chamber of Commerce</td>
</tr>
<tr>
<td>10</td>
<td>Access signage at key locations</td>
<td>Signage at locations</td>
<td>Local Governments</td>
</tr>
</tbody>
</table>
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

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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Action Alerts / notification of opportunities for timely public input (e-mails, texts, social media)</td>
<td>Number of notifications sent out and responses</td>
<td>MLWP Volunteers, NGOs, Local Government, Media Outlets</td>
</tr>
<tr>
<td>2</td>
<td>Methods for providing public input to decision makers (social media, websites, Youtube video)</td>
<td>Number of comments, hits, visitors</td>
<td>Internet, Facebook, Twitter, E-mail</td>
</tr>
<tr>
<td>4</td>
<td>App to engage people to interface, provide input, rank projects (gamification to make it fun)</td>
<td>Number of officials, youth, public, using/engaged</td>
<td>MLWP Volunteers</td>
</tr>
<tr>
<td>5</td>
<td>Face to face engagement with officials, (breakfast meetings, speaking engagements, happy hours)</td>
<td>Number of events and participants</td>
<td>Chamber Breakfasts, Local Governments, WMSRDC, Public</td>
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<td>6</td>
<td>Support participation in sustainability programming and environmental justice initiatives (social, environmental, economic)</td>
<td>Numbers and diversity of people involved</td>
<td>Local, State, Federal Governments</td>
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<td>7</td>
<td>Host an annual State of Muskegon Lake Forum</td>
<td>Number of forums and participants; Evaluations</td>
<td>WMSRDC, GVSU-AWRI, Muskegon County</td>
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<td>8</td>
<td>Create integrated system water management at the local level (water quality and quantity)</td>
<td>Establishment of multi-stakeholder system</td>
<td>Local, State, Federal Governments, WMSRDC, Business, Power, NGOs</td>
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<td>9</td>
<td>Link to existing public input notifications (public hearings, permits, legislation)</td>
<td>Notifications are timely, fair and legal</td>
<td>Local Government, Partners, Media</td>
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<td>10</td>
<td>Attend local government council and board meetings to learn about issues and provide input</td>
<td>Number of participants and officials reached at meetings</td>
<td>Local Government, General Public</td>
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<td>11</td>
<td>Pass a statewide sanitary code and inspection requirements</td>
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<td>12</td>
<td>Implement outcome-based asset management plans</td>
<td>Progress toward true cost of service for water utilities</td>
<td>Community Foundations, Private Consultants, Universities</td>
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<td>13</td>
<td>Trainings on effective input and support for elected officials</td>
<td>Number of trainings and participants</td>
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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 AOC 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, 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.
The **NOAA Muskegon Lake Habitat Focus Area Implementation Plan** Implementation Team is seeking to formalize a NOAA-AWRI led research collaboration framework over the next five years. 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 development of a hydrodynamic model for Muskegon Lake.

![Fyke Net Fisheries Monitoring](image1.png)

**Fyke Net Fisheries Monitoring**
Photo and Maps, Courtesy of GVSU AWRI
## 10. Research and Monitoring – Goal: We have enough information, data, understanding, and indicators to inform the decision-making process

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

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<tr>
<th>#</th>
<th>Implementation Recommendations</th>
<th>Indicators</th>
<th>MLWP with Partners</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitoring systems are in place at a scale and frequency to ensure water quality and quantity are maintained to support diverse uses and values</td>
<td>3-D hydrodynamic model</td>
<td>GVSU, NOAA, GLERL, MDNR, WMSRDC</td>
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<tr>
<td>2</td>
<td>Real-time monitoring of beaches is implemented</td>
<td>Expansion and frequency of monitoring</td>
<td>Public Health Muskegon County, GVSU, MDEQ</td>
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<td>3</td>
<td>Develop a water conservation and reuse strategy</td>
<td>Numbers and quantities of water withdrawals and number of integrated water systems plans</td>
<td>Local governments, regional planning, water systems managers, universities</td>
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<td>4</td>
<td>Groundwater and surface waters are monitored and reported to the public</td>
<td>Funding support is available and utilized</td>
<td>MDEQ, USGS, GVSU, Health Departments</td>
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<td>5</td>
<td>Engage volunteers in citizen scientist monitoring programs – Great Lakes Marsh Monitoring Program, MI Corp River &amp; Stream Monitoring, Clean Lake Monitoring Program, Others</td>
<td>Useable data produced, number of volunteers involved</td>
<td>MiCorp, MRWA, MLWP, Bird Studies Canada, WMGLSI, Issac Walton League, MSU, MSUE, GVSU-AWRI, MISIN,</td>
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<td>6</td>
<td>Volunteer Invasive Plant Monitoring (Aquatic and Terrestrial) and early detection and response to invasive species</td>
<td>Public is engaged and using MISIN</td>
<td>MISIN, MRWA, MLWP, MAISD, MCC</td>
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<td>7</td>
<td>Pre and post-AOC contamination cleanup and habitat restoration monitoring and reporting out</td>
<td>Monitoring data determines AOC site status and informs stakeholders/partners</td>
<td>WMSRDC, GVSU-AWRI, MDEQ, USEPA, NOAA, Muskegon County Health Dept.</td>
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<td>8</td>
<td>Track and monitor the amount and integrity of native habitat (natural shorelines, wetlands, forests, fish, wildlife, benthos)</td>
<td>Land coverage change; Community ordinances</td>
<td>USDA-USFS, USDA-USFW, MDNR, AWRI, WMSRDC</td>
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<td>9</td>
<td>Research and evaluate the availability and effectiveness of water quality improvement technologies. Example: Incremental Sampling Methodologies</td>
<td>Stakeholders informed of most cost effective BMPs and technologies</td>
<td>MDEQ, NOAA, AWRI, MSU, U of M</td>
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<td></td>
<td>Description</td>
<td>Number of integrated meetings with scientists, resource managers, stakeholders</td>
<td>Organisations</td>
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<tr>
<td>10</td>
<td>Muskegon Lake Science Collaborative is established</td>
<td>Number of integrated meetings with scientists, resource managers, stakeholders</td>
<td>NOAA, GVSU AWRI, WMSRDC, MLWP, Public Sector, Private Sector, Universities, LMMCC</td>
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<tr>
<td>11</td>
<td>Economics – Use and Value (Property, Eco-system Services)</td>
<td>Resource values are understood within Community</td>
<td>AWRI, Chamber of Commerce, Realtors</td>
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<td>12</td>
<td>Fish and wildlife consumption – iterative review of advisory resources</td>
<td>Eat Safe Fish and Eat Safe Wild Game guides</td>
<td>MDNR, MDDHS</td>
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<tr>
<td>13</td>
<td>Fish population monitoring</td>
<td>Fish Community Index Netting Program</td>
<td>MDNR, MDEQ,</td>
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<tr>
<td>14</td>
<td>Wildlife population monitoring</td>
<td>Migratory bird studies</td>
<td>MDNR</td>
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<td>15</td>
<td>Aquatic Invasive Species Program</td>
<td></td>
<td>MDEQ</td>
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<tr>
<td>16</td>
<td>Sediment monitoring to support dredging activities</td>
<td>Review of Agency or academic data</td>
<td>USEPA, NOAA, academia</td>
</tr>
</tbody>
</table>
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 kathy@muskegonlake.org or contact the MLWP volunteer leaders through the website at www.muskegonlake.org. To volunteer for the Muskegon River Trash Bash, contact the Muskegon River Watershed Assembly at http://mrwa.org/mrwa-home/.

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

- **West Michigan Great Lakes Stewardship Initiative** – The Muskegon Area Intermediate School District administers this K-12 educational program. Community volunteers provide meaningful, real-world projects for student involvement.

- **Clean Marina Program** – Muskegon Lake marinas can become certified to implement Best Management Practices that protect water quality through this program that is supported by Michigan Sea Grant and NOAA.

- **Bird Studies Canada Great Lakes Marsh Monitoring Program** - Volunteers learn to monitor the health of wetland marshes, using protocols for amphibians, marsh birds and wetland marsh habitat.

- **Aquatic Invasive Species (AIS) Educational Events** – The State of Michigan organizes this program each summer. Volunteers are needed to distribute information and host events at parks with public boat launch sites.

- **Eat Safe Fish Program** – This educational program was developed by the Michigan Department of Health and Human Services. Volunteers assist by providing outlets for information at community festivals and other venues.

- **Midwest Invasive Species Information Network (MISIN)** – Volunteers report the presence of non-native invasive plants to the MISIN website with a phone app or computer. The West Michigan Conservation Network monitors the information and provides trained professionals to implement control measures, when resources are available.

- **Michigan Natural Shoreline Partnership** – This is a train the trainer program for green, native shoreline landscaping and bio-engineering.

- **Michigan Lakes and Streams Association** – This organization provides annual training programs for lake management.
11. Stewardship and Hands On Opportunities – Goal: A culture of environmental stewardship is established and stewardship activities are common and undertaken by public and private organizations

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

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<tr>
<th>#</th>
<th>Implementation Recommendations</th>
<th>Indicators</th>
<th>MLWP with Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Form committee to develop a strategy and establish a dedicated fund for stewardship activities</td>
<td>Dedicated funds are available for stewardship</td>
<td>CFFMC, MLNP, Neighborhood Associations</td>
</tr>
<tr>
<td>2</td>
<td>Organize watershed cleanups, native plantings and monitoring activities</td>
<td>Volunteer hours and public participation increases</td>
<td>United Way, Neighborhood Associations, WMSRDC, MRWA, MCD, Jay Cees</td>
</tr>
<tr>
<td>3</td>
<td>Identify critical land protection and land restoration locations and opportunities</td>
<td>Natural areas and restored natural resources are protected</td>
<td>WMSRDC, GVSU AWRI, TNC, MDNR, Land Conservancy</td>
</tr>
<tr>
<td>4</td>
<td>Hold monthly MLWP public meetings to engage partner organizations and the public</td>
<td>Community meetings are held for public education and volunteer engagement</td>
<td>WMSRDC, GVSU AWRI, MRWA, MCECC, WMEAC, MLNP, MCD</td>
</tr>
<tr>
<td>5</td>
<td>Complete baseline land coverage surveys on a sub-watershed and/or neighborhood scale</td>
<td>Land coverage indicates “no net gain” of impervious surface</td>
<td>GVSU, WMSRDC, Muskegon County, MCC, Students</td>
</tr>
<tr>
<td>6</td>
<td>Evaluate recreation plans for public access, stewardship opportunities and community input</td>
<td>Residents and volunteers engaged in stewardship</td>
<td>Neighborhood Associations, Recreational User Groups</td>
</tr>
<tr>
<td>7</td>
<td>Quarterly planning sessions are held to implement Muskegon Lake Vision 2020</td>
<td>Multi-stakeholder, land use planning meetings</td>
<td>WMSRDC, Port Operators, Local Governments, CVB, Neighborhood Associations</td>
</tr>
<tr>
<td>8</td>
<td>Survey public perception every 3-5 years</td>
<td>Public perception of environmental quality</td>
<td>GVSU, MCC, Lakeshore Chamber of Commerce</td>
</tr>
<tr>
<td>9</td>
<td>Landowner Incentives are established for setbacks</td>
<td>Development setbacks protect water resources</td>
<td>Local Governments</td>
</tr>
<tr>
<td>10</td>
<td>Community groups and volunteers adopt sites to perform regular stewardship activities</td>
<td>Number of areas adopted and number of volunteers involved</td>
<td>K-12, Rotary, Northside Lions, Jay Cees, Businesses</td>
</tr>
<tr>
<td>11</td>
<td>Public notices for state and federal land and water wetland permit applications are monitored</td>
<td>Comments are submitted for proposed permit applications</td>
<td>WMSRDC, MDEQ, Local Governments</td>
</tr>
<tr>
<td>12</td>
<td>Monitor and control non-native invasive plants</td>
<td>Species are controlled</td>
<td>WMSRDC, MCD, TNC, MCC</td>
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## Correlation of Muskegon Lake Ecosystem Master Plan Goals and Outcomes with Overarching Great Lakes Restoration and Protection Plans

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Action Plans Topics 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 and groundwater resources support the health of surface waters, wetlands and the public.

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:** There is an increase in the public’s understanding of, appreciation for and stewardship of the watershed’s natural resources. The public has access to natural areas and enhanced opportunities for interaction with the Muskegon Lake/Muskegon River/Lake Michigan ecosystem.
   
   **Outcome:** The public has access to Muskegon Lake 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 supports 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
MDEQ – Michigan Department of Environmental Quality
MDNR – Michigan Department of Natural Resources
MDARD – Michigan Department of Agriculture and Rural Development
MDOT – Michigan Department of Transportation
MDHHS – Michigan Department of Health and Human Services
OGL – Office of the Great Lakes

Local, County and Regional Governmental Agencies and Organizations
GLC – Great Lakes Commission
MCD – Muskegon Conservation District
MSUE- Michigan State University Extension
PHMC – Public Health Muskegon County
WMSRDC – West Michigan Shoreline Regional Development Commission

Non-Governmental Organizations
BSC – Bird Studies Canada
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