



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
GREAT LAKES NATIONAL PROGRAM OFFICE
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

Teresa Seidel, Director
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
525 W Allegan St.
P.O. Box 30028
Lansing, MI 48909-7528

Dear Ms. Seidel:

Thank you for your January 25, 2023 request to remove the *Loss of Fish and Wildlife Habitat* and *Degradation of Fish and Wildlife Populations* Beneficial Use Impairments (BUIs) from the Muskegon Lake Area of Concern (AOC) located in Muskegon, Michigan. As you know, we share your desire to restore all the Great Lakes AOCs and to formally delist them.

Based upon a review of your submittal and supporting information, the U.S. Environmental Protection Agency (EPA) hereby approves your request to remove these BUIs from the Muskegon Lake AOC. EPA will notify the International Joint Commission of this significant positive environmental change at this AOC.

We congratulate you and your staff as well as the many federal, state, and local partners who have been instrumental in achieving this environmental improvement. Removal of these BUIs will benefit not only the people who live and work in the AOC, but all the residents of Michigan and the Great Lakes basin as well.

We look forward to the continuation of this productive relationship with your agency and the Muskegon Lake Watershed Partnership Public Advisory Council as we work together to delist this AOC in the years to come. If you have any further questions, please contact me at (312) 353-8320 or your staff can contact Leah Medley at (312) 886-1307.

Sincerely,

Chris Korleski, Director
Great Lakes National Program Office

cc: Phil Argiroff, EGLE
Mike Alexander, EGLE
Melanie Foose, EGLE
Stephanie Swart, EGLE
Raj Bejankiwar, IJC



GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING



DANIEL EICHINGER
ACTING DIRECTOR

January 25, 2023

VIA EMAIL

Mr. Chris Korleski, Director
Great Lakes National Program Office
United States Environmental Protection Agency, Region 5
77 West Jackson Boulevard (G-9J)
Chicago, Illinois 60604-3507

Dear Mr. Korleski:

The Michigan Department of Environment, Great Lakes, and Energy's (EGLE) Water Resources Division (WRD) requests concurrence of the United States Environmental Protection Agency's (USEPA) Great Lakes National Program Office (GLNPO) with the removal of the Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations Beneficial Use Impairments (BUI) from the Muskegon Lake Area of Concern (AOC). The WRD has assessed the status of these BUIs in accordance with the *Guidance for Delisting Michigan's Great Lakes Areas of Concern* and recommends that the BUIs be removed from the list of impairments in the Muskegon Lake AOC.

Attached please find documentation to support this recommendation, including the BUIs removal recommendation prepared by WRD's technical staff. The Muskegon Lake Watershed Partnership passed a motion supporting this recommendation on September 12, 2022, which is included as Appendix C.

We value our continuing partnership in the AOC Program and look forward to working with the GLNPO in the removal of BUIs and the delisting of AOCs. If you would like further information concerning this request, please contact Ms. Stephanie Swart, Muskegon Lake AOC Coordinator, Great Lakes Management Unit, Surface Water Assessment Section, WRD, at 517-331-3779; SwartS@Michigan.gov; or EGLE, P.O. Box 30458, Lansing, Michigan 48909-7958; or you may contact me.

Sincerely,

Teresa Seidel, Director
Water Resources Division
517-284-5470

Attachment

Mr. Chris Korleski

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January 25, 2023

cc/att: Ms. Amy Pelka, USEPA, Region 5
Ms. Leah Medley, USEPA, Region 5
Mr. Mark Loomis, USEPA, Region 5
Mr. Phil Argiroff, EGLE
Mr. Mike Alexander, EGLE
Mr. Richard Hobrla, EGLE
Ms. Stephanie Swart, EGLE

Removal Recommendation
Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife
Populations Beneficial Use Impairments
Muskegon Lake Area of Concern

Issue

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division (WRD), Areas of Concern (AOC) Program, recommends removal of the *Loss of Fish and Wildlife Habitat* and *Degradation of Fish and Wildlife Populations* Beneficial Use Impairments (BUI) for the Muskegon Lake AOC. The recommendation is made with the support of the Muskegon Lake Watershed Partnership (MLWP), which serves as the Public Advisory Council for the AOC. This request is made in accordance with the process and criteria set forth in the *Guidance for Delisting Michigan's Great Lakes Areas of Concern (Guidance)* (Michigan Department of Natural Resources [DNR], 2018).

Background

Muskegon Lake is a 4,150-acre drowned river mouth located in Muskegon County. The Muskegon Lake AOC includes Muskegon Lake and portions of its tributaries: the Muskegon River, Ruddiman Creek, Ryerson Creek, Green Creek, Four Mile Creek, Little Bear Creek (including an unnamed tributary), and Bear Lake. Muskegon Lake was listed as an AOC primarily due to historic discharges of industrial process wastewater, municipal wastewater treatment plant effluent, combined storm sewer overflows, alterations of shoreline, excessive shoreline filling, and urban runoff. These discharges introduced elevated levels of polychlorinated biphenyls, heavy metals, nutrients, oils, and other contaminants into the AOC (DNR, 1987).

Four BUIs remain for the Muskegon Lake AOC: the two listed above, plus *Eutrophication or Undesirable Algae* and *Degradation of Benthos*. This document pertains only to the *Loss of Fish and Wildlife Habitat* and *Degradation of Fish and Wildlife Populations* BUIs.

According to the 1987 Remedial Action Plan (RAP), the elimination of fish habitat and elimination of the brook trout fishery resulted in impaired uses (DNR). After the 1987 amendment to the Great Lakes Water Quality Agreement, which identified beneficial use impairments, the 1994 RAP update included the *Loss of Fish and Wildlife Habitat* and *Degradation of Fish and Wildlife Populations* BUIs along with seven others (Canadian and United States Governments; Public Sector Consultants). These BUIs were listed because private, municipal, and industrial development contributed to shoreline filling and elimination of wetlands and shallow water areas that served as prime fish and wildlife habitat (MDNR, 1987). Additionally, chemical contamination from industrial discharges and municipal storm water and the resulting impacts to benthos and other food sources also contributed to the extent of population and habitat degradation.

Removal Criteria

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Loss of Habitat and Degradation of Populations BUIs Muskegon Lake AOC

In 2009, the Department of Environmental Quality ([DEQ] now EGLE) accepted a locally developed target for these BUIs after working with the MLWP and technical experts, including Grand Valley State University (GVSU) researchers. The *Guidance* states that “restoration of this BUI requires that a local aquatic habitat or population restoration plan be developed and implemented” (DNR, 2018). The restoration plan contains the following components required by the *Guidance* for the two BUIs:

- A short narrative on historical fish and wildlife habitat or population issues in the AOC.
- A description of the impairment(s) and location for each aquatic habitat or population site(s) to address the issues that had been identified in the RAP updates.
- A locally derived restoration target for each impacted habitat or population site.
- A list of all other ongoing habitat or population planning processes in the AOC.
- A scope of work for restoring each impacted aquatic habitat or population site.
- A component for reporting on habitat or population restoration implementation action(s) to EGLE.

Muskegon Lake Fish and Wildlife Habitat Restoration and BUI Removal Strategy

Per the requirement for restoring the fish and wildlife populations and habitat BUIs, a *Fish and Wildlife Habitat Restoration and Beneficial Use Impairment Removal Strategy* (*Strategy*) was developed for the AOC in 2008 (MLWP). The *Strategy* notes that the greatest impact to the fisheries in the lake was the result of shoreline filling and elimination of wetlands. The Muskegon Lake Aquatic Habitat Plant Assessment (Luttenton, 1995), the Muskegon Lake Habitat Assessment (Day & Associates, 1995), and a GVSU 2004 inventory of hardened shoreline provided the baseline conditions for the lake’s littoral zone macrophyte and shoreline habitat.

Specifically, the *Strategy* sets up targets which are divided into four focus areas. The targets are reducing hardened shoreline edge, creating emergent and upland wetlands, creating open water wetlands, and removing unnatural lake fill. By arranging the criteria in this manner, restoration targets were set based on the unique aquatic habitat characteristics and differences in the feasibility of restoration. The *Strategy* indicates that the BUIs will be restored when restoration work for each of the habitat focus areas meets targeted goals. The *Strategy* identifies (1) quantifiable habitat restoration targets for each focus area, (2) potential landowner restoration partners, (3) restoration sites within each focus area, (4) feasible restoration practices to restore sites within each focus area, (5) timetables, and (6) estimated funding needs. The *Strategy* for these linked BUIs is based on the above removal criteria for the habitat BUI with a focus on creating habitat types needed at each individual site. The population BUI removal is based on availability of this created habitat.

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In Table 1 below, the current condition represents the baseline as of the date of the Strategy (2008). The BUI target represents the desired improved condition. For instance, the current condition (or existing condition) of open water wetlands was 89.09 acres in 2008, and the target increase for removal of the BUI was for 19 additional acres restored for a total of 108.09 acres (Table 1).

Table 1. Muskegon Lake AOC Focus Area/Whole Lake Targets (MLWP, 2008).

Muskegon Lake AOC Focus Areas	Hardened Shoreline Edge		Emergent and Upland Wetland		Open Water Wetlands		Unnatural Lake Fill	
	<i>Current Condition</i>	<i>BUI Target</i>	<i>Current Condition</i>	<i>BUI Target</i>	<i>Current Condition</i>	<i>BUI Target</i>	<i>Current Condition</i>	<i>BUI Target</i>
Focus Area 1 – Southwest Muskegon Lake Shoreline	80.3%	48% (soften 11,850 linear feet)	4.11 acres	9.11 acres	14.58 acres	19.58 acres	128.42 acres	103.42 (remove and/or improve 25 acres)
Focus Area 2 – Ruddiman Creek and Nearby Shoreline	76.6%	50% (soften 6,194 linear feet)	18.22 acres	36.5 acres	39.71 acres	39.71 acres	89.98 acres	47.98 acres (remove and/or improve 42 acres)
Focus Area 3 – Downtown Shoreline and Ryerson Creek	87.4%	76% (soften 2,775 linear feet)	11.36 acres	14.69 acres	1.45 acres	6.45 acres	144.71 acres	137.71 acres (remove and/or improve 7 acres)
Focus Area 4 – Muskegon Lake East and River Mouth	47.7%	34.6% (soften 3,267 linear feet)	134.5 acres	181 acres	33.35 acres	42.35 acres	426.52 acres	376.92 acres (remove and/or improve 47 acres)
Totals	73%	52.15%	168.19 acres	241.3 acres	89.09 acres	108.09 acres	789.63 acres	666.03 acres

* Shoreline softening and fill removal/improvements are intended to result in wetland restoration at as many restoration sites as feasible

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Although specific sites were recommended within the four zones, the *Strategy* notes that achievement of the targets is not dependent on work being completed at every identified site. Rather, other suitable sites within the focus areas, or in the tributaries within the AOC boundary could be utilized to achieve the targets. This flexible approach allowed for restoration to occur anywhere within the AOC, while also focusing on the zones and targets. Additional monitoring in the future may be conducted on a volunteer basis as outlined in the strategy plans adopted at each site. Monitoring details and strategy plans can be found in reports referenced.

The targets are associated with either monitoring or measurement to demonstrate a positive trajectory for restoration. For hardened edge and unnatural fill, the approach is spatial analysis and visual observations to ensure survival rate of native plant species is suitable to establish a trajectory for recovery of habitat. The approach for emergent wetland is spatial analysis, visual observation, as well as volunteer monitoring at representative habitats with the Great Lakes Marsh Volunteer Monitoring Program. Diversity and abundance of amphibian species was assessed at 10 sites within the AOC. Additionally, volunteers went to one site to determine bird species abundance and four sites to assess marsh characteristics and emergent vegetation.

A GVSU assessment of the fisheries index of biotic integrity (IBI) is the monitoring method for open water wetlands, which takes several aspects of fish populations into account (indicator species, groups with similar feeding habits, and the number and composition of species, among others) and results in a scoring system that indicates relative ecosystem health (Reutz *et al.*, 2007; Reutz, 2011). The numerical target IBI for fish was measured as an average score with the goal to improve the overall health of the ecosystem over a longer period.

Supporting Data and Analysis

Activities

Habitat sites in the AOC were chosen to achieve the *Strategy* targets. Some of the habitat sites were outside the original *Strategy* Focus Areas to achieve the targets (Figures 1 and 2).

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Figure 1. Locations of Muskegon Lake AOC habitat restoration sites.

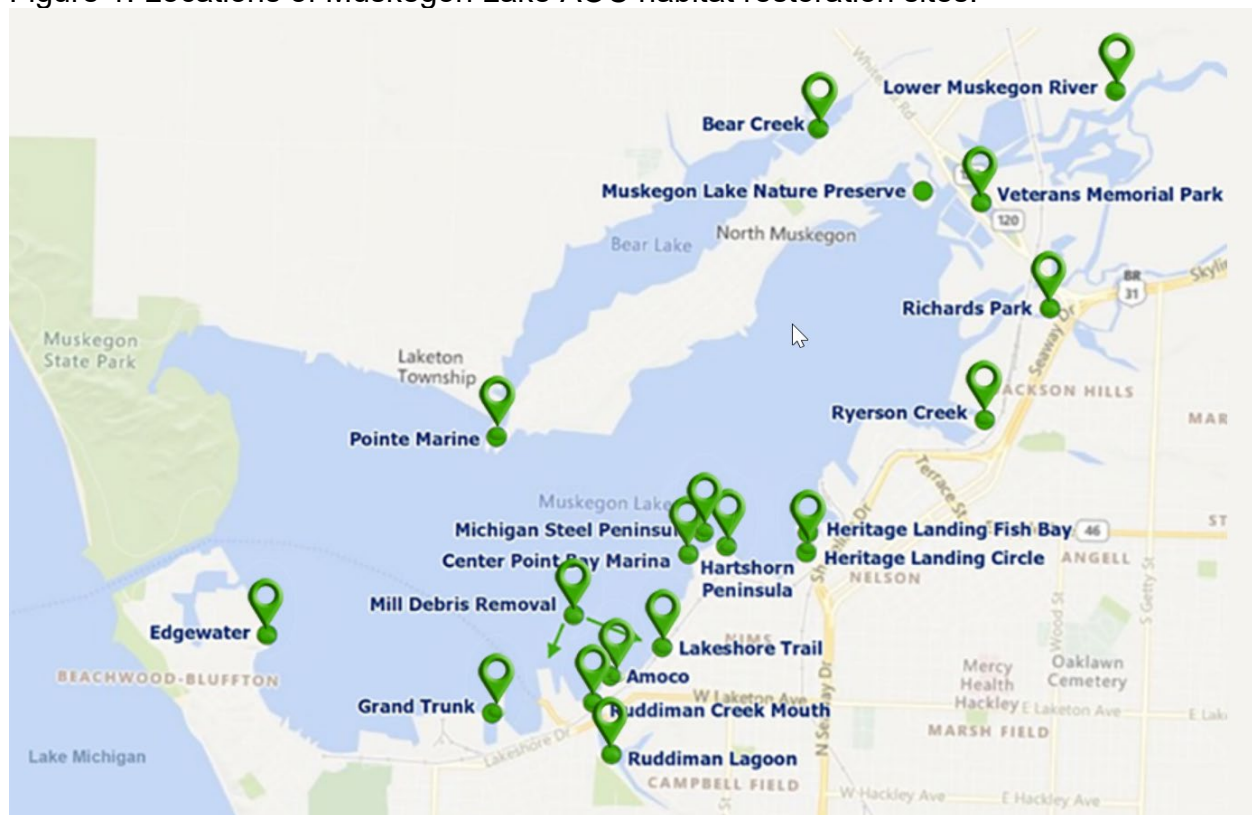
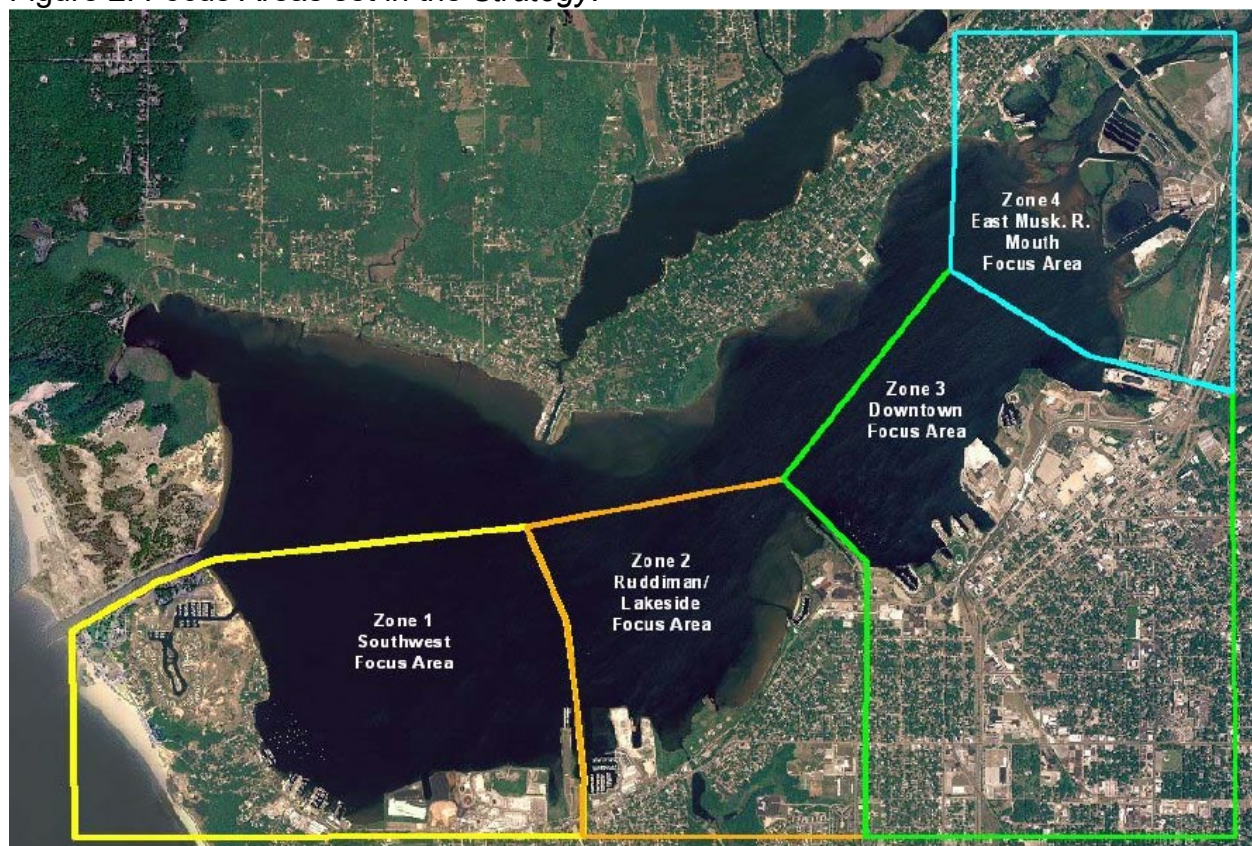


Figure 2. Focus Areas set in the Strategy.



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Amoco

The Amoco site is located on the south shore of Muskegon Lake just east of the mouth of Ruddiman Creek. Foundry fill and a man-made peninsula impacted lake bottomlands and the nearshore. As part of this site restoration, over 22,000 cubic yards of concrete and other rubble were removed from the shoreline and the shoreline stabilized. Native plants were added to the upland areas and emergent and open water wetlands were created along with habitat structures. Restoration took place over a period from 2011 to 2021.

Shoreline softening: 2,050 linear feet (combined with Ruddiman Creek shoreline)
Open water wetland restored: 1 acre
Emergent wetland restored: 1.6 acres (combined with Ruddiman Creek shoreline)
Upland buffer (space to reduce impact) restored: 1.65 acres (combined with Ruddiman Creek shoreline)
Fill removed: 2 acres

Figure 3. Construction along the lake bike trail (left) and final restoration aerial of Amoco facing east with Ruddiman Creek along the bottom (right).



Bear Creek

The Bear Creek hydrologic reconnection project is on the north side of the AOC near Bear Lake. Historically Bear Creek was straightened and separated from two ponded areas for celery farming. The ponds contained a significant amount of phosphorus which was concentrated in the muck soils. To restore the site, the ponds were drained, and water treated at the Muskegon County Wastewater Treatment Plant to remove much of the phosphorus. Over 182,000 tons of soil was removed in an effort to reduce phosphorus and the site was graded to create a variety of habitat types. After refilling the ponds, portions of the berms were removed to hydrologically connect the ponds with Bear Creek and native plants and habitat structures were installed. Restoration took place from 2016 to 2018.

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Shoreline softening: 2,015 linear feet
Open water wetland restored: 27.2 acres
Emergent wetland restored: 9 acres
Upland buffer restored: 1.05 acres
Fill removed: 2 acres

Figure 4. Bear Creek restoration removal of sediments (left) and post-restoration after berm removal (right).



Center Point Bay Marina

This site is a peninsula along the south central shoreline of Muskegon Lake constructed of foundry fill, slag, concrete, and miscellaneous debris. Restoration removed 3,034 cubic yards of foundry fill and 272 tons of slag and metal debris around the shoreline and replaced it with natural buffer and native plants. Selective gaps in the buffer area were created to allow for wildlife passage across the land-water interface and an osprey nesting platform was installed. An osprey was seen on the platform and largemouth bass, smallmouth bass, panfish, and yellow perch have been seen along the restored shoreline (B. Majka email communication, 2022). Restoration took place at this site from 2011 to 2013.

Shoreline softening: 1,314 linear feet
Emergent wetland restored: 1.3 acres
Upland buffer created: 1 acre
Fill removed: 2.3 acres

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Figure 5. Center Point Bay Marina pre-restoration piles of rubble (left) and post-restoration facing north (right).



Edgewater

Like many sites in the AOC, this site had hardened shoreline due to historically placed concrete and debris. Restoration of the shoreline included removal of the concrete and installation of a stone toe at the waterline. Above the stone toe, bioengineered lifts were installed with native plants and logs were placed perpendicular to the shoreline to break up ice and create habitat. Restoration at this site took place in 2012.

Shoreline softening: 64 linear feet
Open water wetland created: 0.01 acres
Emergent wetland restored: 0.02 acres
Upland buffer restored: 0.03 acres
Fill removed: 0.1 acres

Figure 6. Edgewater pre-restoration shoreline (left) and post-restoration shoreline (right).



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Foundry Park

On the south shore of Muskegon Lake this peninsula was created using a combination of foundry fill, concrete, slag, and miscellaneous debris. The site was restored by removing 1,318 tons of debris from the shoreline and 9,217 cubic yards of fill. Stone and native plantings were placed along the shoreline and selective gaps between plantings were created to allow for wildlife passage across the land-water interface. A survey of the restored shoreline found largemouth bass, smallmouth bass, panfish, and yellow perch (B. Majka email communication, 2022).

Shoreline softening: 2,377 linear feet
Emergent wetland restored: 1.9 acres
Upland buffer restored: 2.2 acres
Fill removed: 4 acres

Figure 7. Foundry Park during restoration after fill removal and before planting (left) and after restoration (right).



Grand Trunk

A peninsula was constructed of foundry fill with trash, debris, and slab wood dumped along the shoreline. The site was restored with several different efforts. Volunteers removed the trash and debris and concrete. Slab wood and debris was removed in the adjacent bays and three acres of wetlands were restored and a rain garden installed. This site was restored from 1995 to 2013.

Shoreline softening: 2,034 linear feet
Open water wetland restored: 6.3 acres
Emergent wetland created: 1.8 acres
Upland buffer created: 2.13 acres
Fill removed: 8.7 acres

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Figure 8. Grand Trunk before restoration facing Muskegon Lake to the north (left) and after restoration at the Area B restored wetlands facing Muskegon Lake to the northwest (right).



Hartshorn Peninsula

This peninsula is on the south shoreline and constructed of foundry fill with a section of sheet pile wall, concrete, and miscellaneous debris. The site was restored by dredging and removing the sheeting and fill to create open water wetlands. The site was planted with native plants and a stone toe placed along the shoreline. This site was restored from 2011 to 2013.

Shoreline softening: 1,000 linear feet
Open water wetland created: 0.8 acres
Emergent wetland created: 0.1 acres
Upland buffer restored: 0.05 acres
Fill removed: 1 acre

Figure 9. Hartshorn Peninsula before restoration with piles of debris (left) and after restoration (right).



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Heritage Landing Circle and Fish Bay

This site is a publicly owned park on the south shore of Muskegon Lake. The natural areas were disturbed from historic development including placement of debris, scrap metal, and tires. The debris was removed and replaced with bioengineered shorelines and native plants. Submerged habitat features in the form of whole trees and logs were added as well for use by reptiles and fish.

Shoreline softening: 1,800 linear feet
Open water wetland created: 0.8 acres
Emergent wetland created: 0.7 acres
Upland buffer restored: 0.95 acres
Fill removed: 2.4 acres

Figure 10. Heritage Bay before restoration facing north toward Muskegon Lake (left) and after restoration facing south into the inlet (right).



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Lakeshore Trail

The trail contains wetlands and uplands between a bike path and Muskegon Lake. The space between the trail and Muskegon Lake was full off fill and invasive species. Restoration of the site included invasive species management and installation of native trees, shrubs, grasses, and flowers. This site was restored from 2011 to 2013.

Emergent wetland restored: 5.5 acres
Upland buffer restored: 1.5 acres
Fill removed: 7 acres

Figure 11. Phragmites along the shoreline of Muskegon Lake along the Lakeshore Trail before restoration (left) and after restoration (right).



Lower Muskegon River

This location is a former celery farm on the north side of the Muskegon River, just east of Muskegon Lake. Extensive soil and water sampling for contaminants and nutrients took place during the design phase as well as 2-dimensional hydrologic monitoring to determine how water would flow through the restored wetland. The site restoration included hydrologic reconnection of 54 acres of wetlands to the Muskegon River as well as reshaping and planting. Excavation of 101,850 cubic yards of soil took place to remove high-phosphorus soils while creating an emergent, southern wet meadow, southern shrub-carr, and floodplain forested wetlands. Large woody debris, osprey platforms, and reptile hibernacula were also installed. An osprey has been using the habitat structure and a bobcat has been seen roaming the site. This site was restored from 2020 to 2021 (GEI, 2021).

Shoreline softening: 2,739 linear feet
Emergent wetland restored: 49 acres
Upland buffer restored: 5.3 acres
Fill removed: 5 acres

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Figure 12. Lower Muskegon River aerals during Muskegon River restoration on the upper right (left) and after restoration Muskegon River on the left (right)



Mill Debris Removal

The lumber era in Muskegon resulted in miscellaneous piles of lumber mill debris in several locations throughout the lake. During low water periods the piles could be seen out in the lake. To restore the lake bottom and improve in-lake habitat the debris was removed at several locations along the south shore. Over 9,000 cubic yards of foundry fill, 87,652 tons of sawmill waste, and 1,318 tons of slag and metal debris were removed. These sites were restored from 2012 to 2018.

Shoreline softening: 335 linear feet
Open water wetland restored: 5.5 acres
Emergent wetland created: 0.06 acres
Fill removed: 43 acres

Aquatic plants were surveyed in the mill debris removal locations and at a reference site (Progressive AE, 2018). After mill debris removal the number of species remained relatively the same prior to removal, with the majority being native.

Figure 13. Mill debris before removal facing west in Muskegon Lake (left) and after removal when mill debris was placed on shore (right).



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Muskegon Lake Nature Preserve

The site is located on the northeast side of Muskegon Lake near the north channel of the Muskegon River. Historically the site has been host to both a lumber mill and an industrial dump. More recently it has become a nature preserve held by the Muskegon Environmental Research and Education Society for use by the public. Restoration work at this site included a three phase invasive species removal effort covering more than 7.7 acres, the establishment of over four acres of native upland habitat, and over 3.5 acres wetland habitat in eight areas of both emergent vegetation and ephemeral ponds. Fish passage was enhanced by the replacement of a failed culvert and a deepened channel between Muskegon Lake and an adjacent river bayou. Access to the preserve is via the culvert crossing at the existing footbridge. Over 10 acres of native plants, shrubs, and trees were planted. This site was restored from 2020 to 2021.

Emergent wetland restored: 3 acres
Fill removed: 11.1 acres

Surveys for herpetofauna at the site pre- and post-restoration indicate that species diversity stayed the same (GEI, 2022). However, the total relative abundance of species almost tripled compared the cumulative total of previous years. The site management recommendation is to maintain proper habitats for breeding, feeding, nesting, and overwintering (GEI, 2022).

Figure 14. Nature preserve during wetland drawdown (left) and after drawdown. Muskegon Lake is beyond the tree line (right).



Pointe Marine

The two peninsulas that form this marina were constructed with a combination of foundry fill, slabs of broken concrete, and miscellaneous debris. Restoration included removal of 9,217 cubic yards of foundry fill and 2,042 tons of concrete, installation of a rock toe, and planting of native plants. This site was restored in 2013.

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Shoreline softening: 1,433 linear feet
Emergent wetland created: 0.54 acres
Upland buffer created: 0.9 acres
Fill removed: 1.4 acres

Figure 15. Pointe Marine pre-restoration (left) and post-restoration (right).



Richards Park

The habitat along the south branch of the Muskegon River was degraded due to the encroachment of woody invasive species such as honeysuckle and autumn olive. Concrete and miscellaneous debris had been placed along the shoreline. The site was restored by removing the debris and installing a bioengineered shoreline of native shrubs. Invasive species were removed, and trees and native plants added to the riverbank to filter stormwater and create a riparian habitat corridor.

Shoreline softening: 395 linear feet
Fill removed: 8.6 acres

Figure 16. Richards Park pre-restoration (left) and post-restoration (right).



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Ruddiman Creek Mouth and Lagoon

The mouth of Ruddiman Creek consisted of foundry fill, slag, and concrete debris. The slag and concrete were removed from the shoreline and replaced with native plants. Bioengineered lifts were installed at the northernmost end to buffer for high wave energy. Marine debris (e.g., slab wood, tires) was removed from a four-acre area in Muskegon Lake at the mouth of the creek. This site was restored in 2010.

The Ruddiman lagoon forms where Ruddiman Creek crosses under Lakeshore Drive. It is a small, drowned river mouth, akin to Muskegon Lake. Historically the lagoon was filled with contaminated sediments and a blockage was created with concrete preventing fish passage during low water periods. The lagoon was surrounded by invasive species like honeysuckle and autumn olive. As part of a Great Lakes Legacy Act project the contaminated sediments were removed in 2006. In 2011, additional restoration efforts removed the invasive species and created a native plant buffer. The concrete blockage was removed to allow for fish passage.

Mouth

Shoreline softening: 2,050 linear feet (combined with Amoco)
Open water wetland: 4.0 acres
Emergent wetland: 1.6 acres (combined with Amoco)
Upland buffer: 1.65 acres (combined with Amoco)
Fill removed: 6.3 acres

Lagoon

Shoreline softening: 540 linear feet
Open water wetland: 1.8 acres
Emergent wetland: 0.3 acres
Fill removed: 2.1 acres

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Figure 17. Ruddiman mouth before restoration along the lakeshore trail (left) and after restoration facing northeast toward Muskegon Lake (right).



Ryerson Creek

The creek is on the south shore of Muskegon Lake, it was impacted by a failed culvert which created a blockage. Much of the floodplain contained historical fill and invasive species. The culvert was replaced and a portion of the creek daylighted. Invasive species were controlled along the corridor and numerous native grasses, wildflowers, shrubs, and trees were installed. A rain garden was added to filter storm water from the adjacent parking lots prior to entering the creek.

Shoreline softening: 2,246 linear feet
Emergent wetland: 3.1 acres
Fill removed: 4.2 acres

Figure 18. Ryerson Creek daylighting during (left) and after (right).



Veterans Memorial Park

This park was originally created between 1928 and 1934 and was established as a memorial to Muskegon area veterans who lost their lives during World War I. The park includes two ponds that are split by the Muskegon River. The ponds provide critical

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nursery space and habitat for fish and wildlife, but were historically degraded from sedimentation, nutrient enrichment, and the 1970s installation of a water control structure that cut off the south pond from the Muskegon River. Restoration of the site included modification of the water control structure and installation of a clear span bridge to allow fish passage during all but high-water periods. High phosphorus sediments were removed, and numerous underwater fish habitat structure were installed as well as over 50,000 native wetland plants. The riparian zones of both ponds were enhanced with native vegetation and native trees.

Shoreline softening: 6,025 linear feet
Open water wetland: 4.6 acres
Emergent wetland: 6.4 acres
Upland buffer: 3.43 acres
Fill removed: 16.4 acres

Figure 19. Veterans Memorial Park drone shots during drawdown and habitat creation (left) and after drawdown (right).



Each of the habitat sites has a management plan which calls for volunteer monitors to assess each site 2-3 times a year for issues such as erosion and invasive species (Progressive AE, 2012; Cardno JFNew 2011, 2012a-e, 2013; GEI, 2018).

Assessment of Target Achievement

The removal target for restoration of the *Loss of Fish and Wildlife Habitat* BUI is based on four criteria (1) reduction in hardened shoreline edge, (2) creation of emergent and upland wetland, (3) creation of open water wetlands, and (4) reduction in unnatural lake fill. Each of the projects/management actions developed to meet the criteria had assessment efforts to demonstrate a positive trajectory for the planned habitat improvements and to indicate progress for the *Degradation of Fish and Wildlife Populations* BUI. In the *Strategy*, the original target of emergent wetland acreage was

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established in the hope that the unnatural fill areas would be returned to emergent wetland. The unnatural fill target allowed for 'improvement' or 'removal'. This allowed some upland transitional habitats to be restored along shorelines where a lower elevation could not be attained to be restored to actual emergent wetland.

Assessment of the hardened and restored softened shorelines took place with visual review after restoration, Geographic Information System surveys of restored acreages, and through aerial photo evaluation. The work was compared to the 'as built' designs and engineered designs and the acreages confirmed as part of grant requirements. The final result achieved for reduction in hardened shoreline is 26,367 linear feet, which is 2,281 feet greater than the *Strategy* goal (Table 3). The unnatural lake fill target was also assessed as improved via visual confirmation and spatial data review based on the 'as built' designs and confirmed acreages by the consultants on the projects. The result achieved for removal of unnatural fill is 125 acres which is 1.43 acres above the *Strategy* goal (Table 3).

Emergent wetland targets were assessed by volunteers with the Great Lakes Marsh Monitoring Program. GVSU Annis Water Resources Institute and GEI Consultants assessed the fisheries, vegetation, and macrophytes at some of restored areas as well as comparison to the 'as built' designs. The result achieved for emergent wetland is 84.3 acres which is 11.2 acres above the goal of 73.11 acres (Table 3). Open water wetlands were assessed using similar methods as the emergent wetland target as well as the targeted fishery IBI. The result achieved for open water wetlands is 51.01 acres which is 32.82 acres above the original *Strategy* goal (Table 3).

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Loss of Habitat and Degradation of Populations BUIs Muskegon Lake AOC

Table 2. Totals for each habitat metric for each habitat site. The numbers for each site represent the increases in the target categories.

Sites	Shoreline Softening (linear feet)	Emergent Wetland (acres)	Open Water Wetland (acres)	Fill Removed (acres)
Amoco	2,050	1.6	4	6.3
Bear Creek	2,015	9	27.2	2
Center Point Bay Marina	1,314	1.3	-	2.3
Edgewater	64	0.02	0.01	0.1
Foundry Park	2,377	1.9	-	4
Grand Trunk	2,034	1.8	6.3	8.7
Hartshorn Peninsula	1,000	0.1	0.8	1
Heritage Landing	1,800	0.7	0.8	2.4
Lakeshore Trail	-	5.5	-	7
Lower Muskegon River	2,739	49	-	5
Mill Debris	335	0.06	5.5	43
Muskegon Lake Nature Preserve	-	3	-	11.1
Pointe Marine	1,433	0.54	-	1.4
Richards Park	395	-	-	8.6
Ruddiman Creek	540	0.3	1.8	2.1
Ryerson Creek	2,246	3.1	-	4.2
Veterans Memorial Park	6,025	6.4	4.6	16.4
Final Restoration Total	26,367	84.3	51.01	125.6

Removal Recommendation

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Table 3. Habitat site totals as compared to criteria goals and original conditions.

Targets	Shoreline Softening (linear feet)	Emergent Wetland (acres)	Open Water Wetland (acres)	Fill Removed (acres)
2008 Condition	73%	168.19	89.09	789.63
BUI Target (previous condition + restoration work)	52.15%	241.3	108.09	666.03
Restoration Goal	24,086	73.11	18.91	123.6
Final Restoration Total	26,367	84.3	51.01	125.6

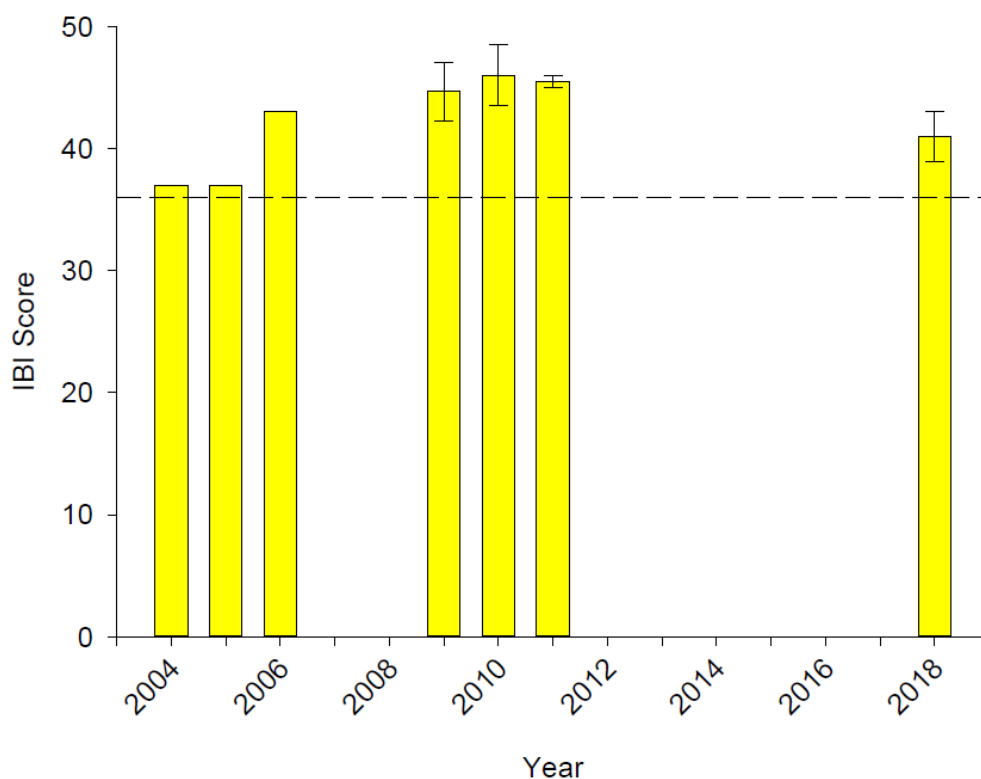
The Great Lakes marsh volunteer monitoring program evaluated amphibian populations at 10 Muskegon sites from 1995-2021 (Appendix A). Nine amphibian species were noted at these sites by listening for calls and relative abundance (very common, common, rare) was determined based on the ability to distinguish between calling individuals. Over the period of assessment, the abundance of most species remained unchanged. American toads were heard at the bike path site in later years, where they had not been heard previously. It is expected that some species will increase in abundance following restoration implementation over time as long as necessary habitat characteristics are maintained, as was seen after monitoring at the Muskegon Lake Nature Preserve site (GEI, 2022).

A study of the restoration impact on the fishery at Veterans Memorial Park revealed that water quality had improved, specifically total phosphorus and turbidity were lower than in 2015 (Reutz *et al.*, 2018a). Fish assemblages in the south pond of the park showed few to no low water quality species (e.g., carp and brown bullhead) and higher numbers of species prized by anglers (e.g., largemouth bass and crappie). Fish assemblages were comprised of 18 species near two restoration sites and a comparison site (Grand Trunk and Heritage Landing, Figure 1) post restoration on Muskegon Lake (Reutz *et al.*, 2018b). Although there was no detectable response of the fish assemblages due to restoration in Muskegon Lake, the IBI scores for the sites do meet the recommended BUI criteria of 38 ± 2 and the overall health of the ecosystem is expected to improve, especially over a longer period. There is a possibility that the lack of a detectable response of fish assemblages could be due higher water levels and location of net placement (Reutz *et al.*, 2018b).

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Figure 20. Scores from the fish based IBI for Muskegon Lake (Reutz et al., 2018b). The dashed line represents the numerical delisting target of 36 for the AOC. Pre-restoration IBIs are before 2010.



Macrophyte community surveys indicated that the C values improved at both Grand Trunk (3.9 to 4.2) and Heritage Landing (3.1 to 3.6) (Steinman et al., 2019). Additionally, relative abundance of wild celery (*Vallisneria americana*) increased at Grand Trunk and narrowleaf cattail (*Typha angustifolia*) decreased at Heritage Landing, which is indicative of improved habitat (Steinman et al., 2019). A vegetative monitoring survey at Grand Trunk and Heritage Landing revealed that the restorations were successful, in large part due to the monitoring and maintenance completed by an active volunteer base (GEI, 2019). The highest C value observed was 4.4 with several sites below 4, which indicates the species present in Muskegon Lake are more tolerant to degradation than the average condition in Great Lakes coastal wetlands (Steinman et al., 2019). For example, a species with a C-value of 0 is more likely to be found in highly degraded areas, while a species with a C-value of 10 is usually found in higher quality undisturbed areas (Herman et al., 2001). Wetlands with a native mean C-value greater than 3.5 are considered high-quality aquatic resources. There were species with C values of 8 and above at the reference site indicating that species of high quality are growing in Muskegon Lake (Steinman et al., 2019). Thus, if the appropriate environmental conditions are provided in the restored areas there are readily available flora and fauna in the region. A 2018 survey of aquatic plants also indicated that removal of the mill debris would increase light penetration and therefore allow plant growth at those sites (Progressive AE).

Removal Recommendation

Loss of Habitat and Degradation of Populations BUIs Muskegon Lake AOC

The Muskegon Lake Action Plan (Plan) is a “community-based plan, designed to facilitate the continuation of coordinated, natural resources stewardship of Muskegon Lake and Lower Muskegon Watershed” (West Michigan Shoreline Regional Development Commission, 2019). The Plan is intended to guide the community in ecosystem management and replace the RAP and includes implementation recommendations for fish and wildlife habitat, including “track and map the presence and integrity of all habitats and species”. Each of the restored sites under these BUIs has a monitoring and maintenance plan and local volunteer coordinator, which, as noted, will contribute to habitat restoration successes over the next 10 years and as long as there are volunteers interested in maintaining the sites.

Conclusion

The status of these BUIs was assessed by comparing restoration work to established local targets. The habitat and population impairments in the Muskegon Lake AOC were largely the result of historical fill and destruction of wetlands. Based on restoration at 18 habitat sites and supporting information which indicate the improvements, habitats and populations in the Muskegon Lake AOC have improved especially when compared to original observations (DNR, 1987). EGLE's AOC Program staff recognize that habitat and population locations in the Muskegon Lake AOC are meeting the local criteria.

Recommendation

EGLE recommends removal of the *Loss of Fish and Wildlife Habitat* and *Degradation of Fish and Wildlife Populations* BUIs in the Muskegon Lake AOC.

The MLWP Habitat Technical Committee reviewed the documentation on June 22, 2022, then the removal recommendation was discussed with the MLWP at their regular meeting on October 4, 2022 (Appendix B). The MLWP submitted a formal letter of support for removal of the BUI dated September 12, 2022 (Appendix C). This proposed action was public noticed for 30 days via EGLE's Environmental Calendar and postings to the Mich-RAP listserv and MLWP email list. No written comments were received.

Prepared by: Stephanie Swart, Muskegon Lake AOC Coordinator
Great Lakes Management Unit
Surface Water Assessment Section
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
October 3, 2022

Removal Recommendation

Loss of Habitat and Degradation of Populations BUIs Muskegon Lake AOC

Appendices:

A – Amphibian Diversity and Abundance. Muskegon Lake Marsh Monitoring Program Results, 2005-2021

B – Muskegon Lake Watershed Partnership October 4, 2022, public meeting announcement

C – Muskegon Lake Watershed Partnership letter supporting BUI removal, September 12, 2022

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Muskegon Lake Marsh Monitoring Program Results

	Very Common - present nearly every year and in large numbers; so many calling simultaneously it is impossible to count or even estimate numbers
	Common - present in most years but usually in small numbers that can be estimated by listening
	Rare - not detected most years and never in large numbers
	Not Identified - Species not heard at date and time of survey

[illegible]

[illegible]

	Chorus Frog	Wood Frog	Spring Peeper	American Toad	Northern Leopard	Gray Tree Frog	Green Frog	Bull Frog	Pickrel Frog	Fowler's Toad	Blanchard's Cricket Frog
Ruddiman Creek (MI 136) 2008											
Ruddiman Creek (MI 136) 2009											
Ruddiman Creek (MI 136) 2010											
Ruddiman Creek (MI 136) 2011											
Ruddiman Creek (MI 136) 2012											
Ruddiman Creek (MI 136) 2013											
Ruddiman Creek (MI 136) 2017											
Ruddiman Creek (MI 136) 2018											
Ruddiman Creek (MI 136) 2019											
Ruddiman Creek (MI 136) 2021											
Grand Trunk (MI 150) 2008											
Grand Trunk (MI 150) 2009											
Grand Trunk (MI 150) 2010											
Grand Trunk (MI 150) 2011											
Grand Trunk (MI 150) 2012											
Grand Trunk (MI 150) 2013											
Grand Trunk (MI 150) 2014											
Grand Trunk (MI 150) 2015											
Grand Trunk (MI 150) 2016											
Grand Trunk (MI 150) 2017											
Grand Trunk (MI 150) 2018											
Poulson Road End/LMR (MI 187) 2018											
Poulson Road End/LMR (MI 187) 2018											
Poulson Road End/LMR (MI 187) 2019											
Poulson Road End/LMR (MI 187) 2021											

*** Data supplied by Marsh Monitoring volunteer directly to MLWP.



Web Site: <https://muskegonlake.org/>
Face Book Page: *Muskegon Lake Watershed Partnership*

Tuesday, October 4, 2022; 6 PM

Join Zoom Meeting: <https://us02web.zoom.us/j/83074373458?pwd=ajJQLzlqdVVvcld2Nm5MN05SRzZrZz09>

Meeting ID: 830 7437 3458

Passcode: 828411

Agenda

A. Welcome

- *Dennis Kirksey, Chair*

B. Introductions

- *Brief introductions by all in attendance*

C. Meeting Summary

- *Lea Markowski, Secretary*

D. Treasurer's Report

- *Mark Evans, Treasurer*

E. Discussion of Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations BUIs Removal Document

Stephanie Swart, EGLE

F. Standing Updates by Committee Chairs and other MLWP Members

- Habitat Committee, Kathy Evans, Committee Chair
- Technical Committee, Dusty Tazelaar, Committee Chair
- Non-Point Source Committee, Fallon Chabala, Acting Committee Chair
- Public Access to Natural Resources Committee, Lea Markowski, Acting Committee Chair
- Social Media/Outreach Committee, Catherine Swiatek, Committee Chair

G. Review list of voting members

H. Public Notices

I. Public Input and Announcements (Round Robin)

J. Adjourn

- **Next meeting November 1st, 2022 at noon**



316 Morris Ave., Suite 340 – Muskegon, MI 49440

Website: www.muskegonlake.org

September 12, 2022

Ms. Stephanie Swart
Great Lakes Management Unit
Water Resources Division
Michigan Department of Environment, Great Lakes, and Energy
Lansing, Michigan

Dear Ms. Swart,

The Muskegon Lake Watershed Partnership (MLWP), as the Public Advisory Council (PAC) for the Muskegon Lake Area of Concern (AOC), has reviewed the attached, Michigan Department of Environment, Great Lakes, and Energy (EGLE) Draft Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations Beneficial Use Impairments Removal Document.

The document was reviewed by the Technical Committee and emailed to the MLWP's officers. The Muskegon Lake AOC Coordinator will present a summary of the document and answer any questions during the October meeting. A list of interested stakeholders and its voting membership will receive the document in advance of the October meeting, along with the meeting agenda.

The MLWP (Muskegon Lake PAC) is pleased to provide this letter in support of EGLE's recommendation to remove the Loss of Fish and Wildlife Habitat and Degradation of Fish and Wildlife Populations Beneficial Use Impairments. We look forward to the October meeting and postings to the Mich-RAP listserv.

Sincerely,

A handwritten signature in black ink, appearing to read "Dennis Kirksey", is written over a faint rectangular box.

Dennis Kirksey, Chair
Muskegon Lake Watershed Partnership

CC: Mark Loomis, U.S. EPA GLNPO
Fallon Chabala, PAC Support Staff, WMSRDC