**Target for Delisting the Eutrophication and Undesirable Algae Beneficial Use Impairment in the Muskegon Lake Area of Concern**

Introduction

Improvements in the water quality of Muskegon Lake have resulted in increased public usage of the resource and community interest in sustaining the progress of restoration and preventing future adverse environmental impacts. At the time of AOC listing, the Michigan Department of Environmental Quality (MDEQ) did not include the Eutrophication or Undesirable Algae Beneficial Use Impairment (BUI) however mentioned historical water quality degradation. Surface water total phosphorus (TP) concentrations averaged nearly 70 µg/L in 1972, chlorophyll *a* averaged 25 µg/L, and Secchi disk transparencies were below 1.5 m (Freedman et al 1979). The lake also experienced frequent, late summer, blooms of cyanobacteria. The BUI for the AOC was listed by the PAC in 2002 because of concerns related to historical non point source pollution in the Muskegon Lake watershed and the water quality of Bear Lake. **C**urrent water quality data for Muskegon Lake and Bear Lake was not available at the time of the BUI listing. Due to the establishment of an endowment by the community for the monitoring of Muskegon Lake in 2003, recent water quality data are available (AWRI 2006). Muskegon Lake was in the middle of the eutrophic range as listed by the Carlson Index (Carlson 1977). The lake also experienced frequent, late summer blooms of cyanobacteria. Surface water TP concentrations in 2003-05 averaged < 30 µg/L, chlorophyll *a* averaged 5 µg/L, and Secchi disk transparency was greater than 2 m, indicating that water quality had improved in the lake. Transparency in Muskegon Lake during 2003-05 exceeded that of nearby Pentwater Lake while total phosphorus and chlorophyll *a* concentrations were similar. Pentwater is a drowned river mouth lake with a rural watershed that can be considered as a reference site. Based on the above data, Muskegon Lake is currently at the mesotrophic/eutrophic border line based on the Carlson index (Carlson 1977). The preliminary results of water quality sampling by the MDEQ in 2006 indicated that surface water total phosphorus concentrations averaged 48 µg/l (range 33 µg/l –76 µg/l).

Available Guidance

The IJC criteria for listing the Eutrophication or Undesirable Algae is provided below:

> "When there are persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity, etc.) attributed to cultural eutrophication."

The MDEQ provides the following guidance for delisting:

> "This BUI will be considered restored when:

• no waterbodies within the AOC are included on the list of impaired waters due to nutrients or excessive algal growths in the most recent Clean Water Act *Water Quality and Pollution Control in Michigan: Section 303(d) and 305(b) Integrated Report* (Integrated Report), which is submitted to U.S. EPA every two years."

Delisting Target

Muskegon Lake is currently not included on the 303(d) listing as requiring a TMDL or on the 305(b) lists for nutrient pollution or algal growths. Bear Lake, however, is included on the 303(d) listing as not meeting standards due to elevated phosphorus concentrations and nuisance algal growths. Because of the importance of Muskegon Lake as a recreational resource and public concern related to sustaining the current trend of improving water quality, the Muskegon Lake Public Advisory Council (MLPAC) voted to adopt targets for delisting the Eutrophication and Undesirable Algae BUI that exceed the State of Michigan Delisting Guidance. The target is presented below:

The **Eutrophication and Undesirable Algae BUI** will be considered restored when will be considered restored when: (1) no waterbodies within the AOC are included on the list of impaired waters due to nutrients or excessive algal growths in the current Clean Water Act Water Quality and Pollution Control in Michigan: Section 303(d) and 305(b) Integrated Report and (2) the following average annual concentrations/values are achieved in Muskegon Lake for two consecutive annual monitoring events:

| Indicator | Target | Reasoning |
|---|---|---|
| **Surface Total Phosphorus Concentration** | **30 µg/l** | **MDNR Recommendation for the 1987 RAP[1]** |
| **Chlorophyll *a*** | **10 µg/l** | **U.S. EPA[2]** |
| **Secchi Disk depth** | **~ 2.0 m** | **Pentwater Lake as reference** |
| **Trophic Status Index** | **50-55** | **Pentwater Lake as reference** |

[1] A total phosphorus concentration of 30 µg/l (during spring and fall turnover) was recommended to maintain water quality at levels that will not produce nuisance algal blooms.

[2] A Chlorophyll a target of 10 µg/l (during the summer) was recommended to maintain water quality at levels that will not produce nuisance algal blooms.

Bear Lake is the only waterbody listed in the AOC on the 2006 303(d) and 305(b) Integrated Report for nutrients or excessive algal growths. The MLPAC will use the 2006 Integrated Report as the reference document to determine which waterbodies require restoration to meet the MDEQ delisting guidance.

- The proposed locations of water quality monitoring sites are shown in Figure 2. The sites in Muskegon Lake currently are monitored by the Annis Water Resources Institute (AWRI) in May, July, and late September (since 2003) as part of program supported by the Muskegon Lake Monitoring Endowment Fund. The MLPAC will work with the MDEQ to develop the monitoring and

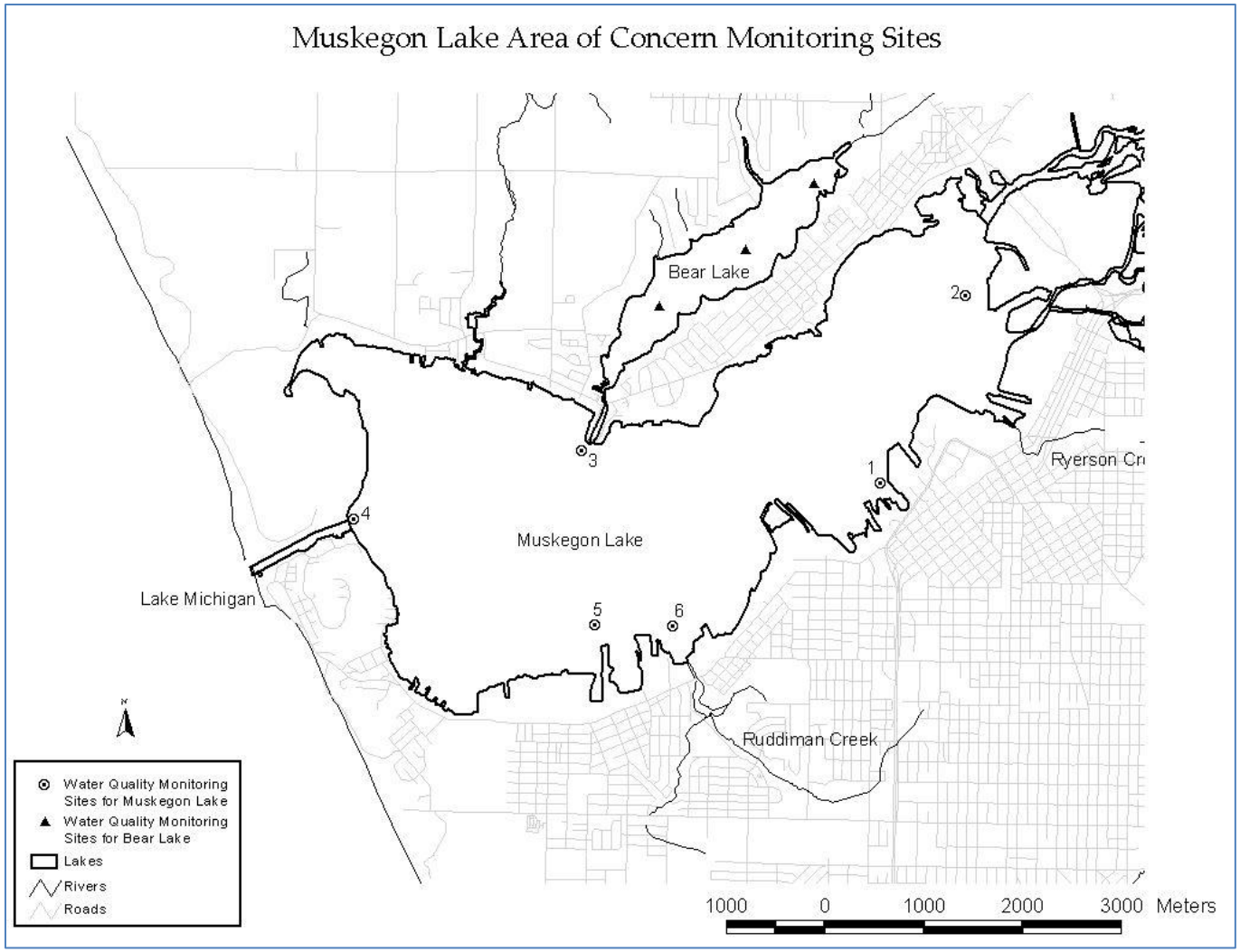


**Figure 2. Proposed Water Quality Monitoring Sites in Muskegon Lake and Bear Lake.**

assessment program for Bear Lake as part of the TMDL process. Targets for Bear Lake will be established to be consistent with the TMDL. Suggested monitoring locations for Bear Lake are shown in Figure 2.

Public concerns were expressed regarding the recent occurrence of late summer cyanobacteria blooms and the presence of the toxin, microcystin. Cyanobacteria blooms are becoming more frequent in the Great Lakes basin due to nonpoint source pollution, cultural eutrophication, and the selective feeding of zebra mussels. A detailed investigation of cyanobacteria and their toxins will be conducted by AWRI in 2006 as part of a MDEQ Grant. The MLPAC will review these data and determine if numerical targets for cyanobacteria and their toxins are necessary.

Functional Equivalence

The proposed targets for the Muskegon Lake AOC are functionally equivalent to the MDEQ guidance in that it requires the removal of Bear Lake from the 303(d) list as a condition for delisting. No other waterbodies in the AOC are included in the 2006 Integrated Report for phosphorus and/or excessive algal growth. The targets exceed the MDEQ guidance as they require specific concentrations/values for water quality parameters to be achieved in Muskegon Lake, which is not included on the 303(d) list.

Programs for Monitoring and Assessing Restoration Success

The MLPAC and/or the Annis Water Resources Institute (AWRI) will obtain funding for the monitoring program for the delisting targets by the submission of grants and requests for assistance from the following sources:

- Muskegon Lake Monitoring Endowment Fund
- Michigan Department of Environmental Quality Clean Michigan Initiative (CMI) Fund Local Monitoring Grants

Environmental Protection Agency Great Lakes National Program Office (GLNPO)

The Annis Water Resources Institute (AWRI) will conduct the monitoring and assessment of Muskegon Lake as part of the program developed for the Muskegon Lake Monitoring Endowment Fund. AWRI will prepare a Quality Assurance Project Plan for Muskegon Lake monitoring activities and obtain MDEQ approval for the methods and data quality objectives associated with the program. Funding for the monitoring and assessment of Bear Lake will be provided by the MDEQ as part of the TMDL process. If necessary, additional funds will be solicited by the MLPAC and/or AWRI from the MDEQ CMI Program and GLNPO for supplemental monitoring and outreach programs. Quality Assurance Project Plans will be prepared for all supplemental assessment activities and agency approval will be obtained for all monitoring programs.

After two successive years of monitoring data meet the above targets for Muskegon Lake, the MLPAC will submit a summary report to the MDEQ along with the acknowledgement that the BUI no longer applies to Muskegon Lake. The report will include monitoring and quality assurance data demonstrating that the data quality objectives of the QAPP and the delisting targets were achieved. The MLPAC will submit a request for formal delisting of the

Eutrophication and Undesirable Algae BUI to the MDEQ when the TMDL process results in the removal of Bear Lake from the 303(d) list and the targets for Muskegon Lake are achieved.

References

AWRI 2006. Muskegon Lake Monitoring Program Data. Annis Water Resources Institute. Grand Valley State University. Muskegon, MI.

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Freedman, P. L., R. P. Canale and M. T. Auer. 1979. Applicability of land treatment of wastewater in the Great Lakes area basin: Impact of wastewater diversion, spray irrigation on water quality in the Muskegon County, Michigan, lakes. EPA-905/9-79-006-A. Great Lakes National Program Office, U.S. Environmental Protection Agency, Chicago, IL.

USEPA 1975. National Eutrophication Survey of Muskegon Lake, Muskegon County, Michigan. Working Paper No. 203. Pacific 'Northwest Environmental Research Laboratory, Corvallis, Oregon. 38 pp.