

# **The Development of Delisting Criteria for the Muskegon Lake Area of Concern**

Richard R. Rediske, Ph.D.  
Annis Water Resources Institute  
Grand Valley State University

## **Introduction**

In the early 1970s, concerns about the increasing pollution of the Great Lakes prompted the United States and Canada to establish the International Joint Commission (IJC) to oversee the protection and restoration of these important resources. Working with the Environmental Protection Agency (EPA) and the Michigan Department of Environmental Quality (MDEQ) the IJC identified 42 areas in the Great Lakes basin that were severely degraded and posed a threat to the integrity of the entire system. These locations were called Areas of Concern (AOCs). Beneficial Use Impairments (BUIs) were established that identified the nature of the environmental degradation. Remedial Action Plans (RAPs) also were developed for each AOC to restore the Beneficial Uses and resolve environmental quality problems.

Muskegon Lake was listed as an AOC in 1987 due to severe environmental problems that impaired the public's use of the lake related to loss of fisheries and wildlife habitat, degraded benthos and fisheries, contaminated sediments, and restrictions on fish consumption. The historic discharge of industrial and municipal wastewater, in addition to extensive shoreline filling, created conditions that led to fish kills, poor fisheries, degraded benthic invertebrate (bottom-dwelling organisms) and wildlife populations, contaminated sediments, and hypereutrophic (high levels of nutrients in the water and excessive plant growth) conditions.

Since the establishment of the AOC, considerable restoration efforts have improved the environmental quality of Muskegon Lake. In the mid 1970s, municipal and industrial wastewater discharges were removed from the lake for the most part by the construction of an advanced land treatment system. The new wastewater system, coupled with aggressive industrial pretreatment and hazardous waste site remediation programs, reduced excessive nutrients and contaminants. Fish and benthic populations have rebounded to the extent that Muskegon Lake currently supports an economically important fishery and is the site of annual sport fishing tournaments. Contaminated sediment areas have been identified and Ruddiman Creek's remediation was completed in 2006. In addition, the Muskegon Lake Public Advisory Council (MLPAC) has completed numerous programs to reduce non-point source pollution and enhance the aquatic and terrestrial habitats of Muskegon Lake.

## **The Delisting Process**

The IJC, EPA, and MDEQ have collectively established a process for removing an AOC from the list of severely impaired sites. The process is called delisting and involves the following steps:

- Establish a list of indicators and numerical criteria for the restoration of each BUI (called targets).
- Monitor the indicators to demonstrate restoration progress.
- Submit a petition for delisting with supporting data when restoration has been achieved.

In September 2003, a group of MLPAC members, federal, state and local governmental officials, scientists, and citizens met to discuss the status of the Muskegon Lake AOC and the process of setting targets for restoration criteria. The consensus of the group was that considerable progress towards restoration of the BUIs had occurred and that the process of target setting should move forward. Scientists at the Annis Water Resources Institute (AWRI) worked with the MLPAC and developed a process for establishing the delisting targets that involved the integration of scientific information, site specific data, stakeholder values, and scientific peer review.

In the fall of 2004, AWRI obtained grant funding from the EPA's Great Lakes National Program Office to develop delisting targets for 5 BUIs. The MLPAC obtained additional funding from the MDEQ to facilitate the target setting process and support the scientific peer review. A group of 5 preliminary targets were developed by AWRI and approved by the MLPAC in March 2005. The targets were presented to the public during two meetings on April 25, 2005 and approved with minor revisions. Scientific peer review of the targets was conducted during the summer and fall of 2005 and final versions were prepared by AWRI. In January, 2006, the MDEQ issued their guidelines for the development of delisting criteria and the Muskegon targets were modified to reflect the latest requirements. The targets for the 5 BUIs were formally adopted in final form at the May 2006 MLPAC meeting and submitted to the MDEQ for review. Targets for the remaining 4 BUIs still need to be established.

## **Targets for Delisting 5 BUIs in the Muskegon Lake AOC**

The numerical delisting targets for the 5 BUIs are summarized below. A more detailed discussion of each target will be posted on the MLPAC web site.

### **1. Target for Delisting the "Degradation of Aesthetics" Beneficial Use Impairment**

**Impairment Description:** Excessive amounts of metal scrap and concrete rubble were discarded along the shoreline and in the lake by historical industrial activity. These deposits impede the safe access and enjoyment of Muskegon Lake by the public and the ability to conduct shoreline habitat improvement efforts.

**Restoration Progress:** Shoreline development and cleanup projects including Ruddiman Creek and Grand Trunk

**Delisting Target:** The BUI will be considered restored when:

Public areas in the Muskegon Lake AOC do not contain quantities of contaminants, submerged rubble, and metallic debris that impede the safe access and enjoyment of the resource. Locations targeted for restoration include: Ruddiman Creek (including the Amoco property), Ryerson Creek, Grand Trunk, Heritage Landing, and Michigan Steel Bay.

The Muskegon PAC will work with the City of Muskegon, Muskegon County, community groups, citizens, and the MDEQ to remove debris and restore the shoreline in these priority areas.

## **2. Target for Delisting the “Beach Closings” Beneficial Use Impairment**

**Impairment Description:** In 1999, 2000, and 2001, excessive quantities of raw sewage were discharged into Muskegon Lake due to the failure of sewers and lift stations. Human contact advisories were posted during these events and millions of gallons of untreated sewage were discharged. In addition to sewage overflows, a tributary of Muskegon Lake, Ruddiman Creek, is on the MDEQ 303(d) list for pathogens.

**Restoration Progress:** Major improvements to the sewer system

**Delisting Target:** The BUI will be considered restored when:

Ruddiman Creek is not included on the Michigan 303(d) list for pathogens and the bathing beaches at Harbor Towne and Muskegon State Park (Muskegon Lake) meet the water quality standards for total body contact for two consecutive years.

The Muskegon PAC will work with the Muskegon Department of Public Health to coordinate monitoring activities. The investigation and remediation of the pathogen problem in Ruddiman Creek will be addressed by the individual municipalities in the watershed as part of their stormwater management program and by the MDEQ.

## **3. Target for Delisting the “Eutrophication and Undesirable Algae” Beneficial Use Impairment**

**Impairment Description:** Historic discharges of wastewater and stormwater runoff have created problems related to excessive algae blooms, oxygen depletion, and poor fisheries.

**Restoration Progress:** Major improvements to the wastewater system and non-point source pollution control programs

**Delisting Target:** The BUI will be considered restored when:

Average annual concentrations/values are achieved for Muskegon Lake and Bear Lake:

<b>Indicator</b>	<b>Target</b>	<b>Reasoning</b>
<b>Surface Total Phosphorus Concentration</b>	<b>30 ug/l</b>	<b>MDEQ guidance</b>
<b>Chlorophyll <i>a</i></b>	<b>10 ug/l</b>	<b>U.S. EPA</b>
<b>Secchi Disk depth</b>	<b>~ 2.0 m</b>	<b>Pentwater Lake as reference</b>
<b>Trophic Status Index</b>	<b>50-55</b>	<b>Pentwater Lake as reference</b>

Four indicators were selected for the eutrophication BUI. Total phosphorus is the main nutrient responsible for excessive plant growth and Chlorophyll *a* is a measure of the amount of plant pigments present in the water. Secchi Disk depth is a measurement of water clarity that includes plankton and other suspended materials. The Trophic Status Index is a system based on the three previous indicators for ranking the degree of eutrophication present in lakes and used by many states as an indicator of water quality. The MLPAC accepted AWRI's recommendation to use water quality guidelines from the MDEQ and EPA for total phosphorus and Chlorophyll *a*, respectively. The current water quality in Pentwater Lake was used as a reference to establish targets for Secchi Disk depth and the Trophic Status Index. Sites in Muskegon Lake currently are monitored (since 2003) as part of program supported by the Muskegon Lake Monitoring Endowment Fund and AWRI. Bear Lake will be monitored in the future by the MDEQ as part of the 303(d) program.

#### **4. Target for Delisting the “Restrictions on Fish Consumption” Beneficial Use Impairment**

**Impairment Description:** Elevated PCB levels in carp and mercury in walleye and bass were reported by the MDEQ.

**Restoration Progress:** Wastewater treatment improvements, industrial pretreatment programs, contaminated sediment remediation, and hazardous waste site cleanups.

**Delisting Target:** The BUI will be considered restored when:

The edible portion analyses of key fish species (walleye, small mouth bass, and carp) are not significantly different from the pooled reference site data (Pentwater Lake and Mona Lake) for 2 consecutive sampling periods (5 years). If a significant difference between Muskegon Lake and the reference systems remains at the end of the monitoring period, all the data for Muskegon Lake will be evaluated for a statistically significant decreasing trend in concentration. In this situation, the BUI will be considered restored when edible

portion analyses of key fish species in Muskegon Lake show a significantly different decreasing trend from 1986 to the end of the monitoring period.

AWRI has obtained grant funding to conduct fish tissue monitoring in 2006. Additional monitoring will be required in 2011.

## 5. Target for Delisting the “Degradation of Benthos” Beneficial Use Impairment

**Impairment Description:** Sediment toxicity related to heavy metals and organic chemicals and impacts to species diversity from the discharge of municipal sewage.

**Restoration Progress:** Wastewater treatment improvements, industrial pretreatment programs, contaminated sediment remediation, and hazardous waste site cleanups.

**Delisting Target:** The BUI will be considered restored when:

The average benthic macroinvertebrate populations in Muskegon Lake and Bear Lake reflect the following conditions:

	1972	1999	Target
<b>Sediment Toxicity</b>	No data	Present at 3 locations	Amphipod Survival >60%
<i>Hexagenia</i>	Not present	Present	Present in river mouth littoral zone
% Oligochaeta	89	68	< 75%
Chironomidae (#/m <sup>2</sup> )	158	677	> 500
Diversity (SW)	0.68	1.66	> 1.5

For Muskegon Lake, compliance with the sediment toxicity indicator will be determined by review of pre and post remediation data for Ruddiman Creek, Ryerson Creek, and the Division Street Outfall. AWRI/NOAA conducted an investigation of benthic invertebrates in Muskegon Lake during 1999. The targets listed above were established based on the results of the 1999 study. *Hexagenia* is a mayfly larvae and an indicator of good water quality. Oligochaeta (worms) are tolerant of low dissolved oxygen while Chironomida (fly larvae) have moderate tolerance. The numbers selected for these organisms reflect improve sediment quality conditions and are consistent with the eutrophication targets. AWRI has obtained grant funding to conduct a benthic invertebrate survey in 2006. Future grant funding will be necessary to establish the targets for Bear Lake.

## **Future Actions**

These targets will serve as a roadmap and an assessment tool to measure progress toward delisting. Using these targets as restoration endpoints, the MLPAC can proceed in a focused manner to restore each BUI and ultimately document sufficient progress to petition for the delisting of the Area of Concern. This focus will result in a cost effective approach to achieve successful and lasting restoration of the BUIs that have impacted the AOC. These targets will incorporate the RAP/Community Action Plan, and progress will be reported on an annual basis. Restoration targets for the remaining 4 BUIs still need to be established. Targets for Loss of Fisheries and Wildlife Habitat and Degradation of Fish and Wildlife Populations are currently being developed as part of a grant from the National Fish and Wildlife Foundation. The MLPAC is currently discussing target setting options for the Restrictions on Dredging and Restrictions on Drinking Water Consumption BUIs.

We celebrate the efforts of all individuals who have participated in the target setting and restoration process. The health and restoration of Muskegon Lake will benefit the Great Lakes Ecosystem, the local economy, and enhance the quality of life for all who enjoy this important resource.

## **Acknowledgements**

The author would like to thank the following organizations and individuals for their support of this project:

Mark Elster - Great Lakes National Program Office/ Environmental Protection Agency  
Dr. Al Steinman – Grand Valley State University  
Michigan Department of Environmental Quality  
Muskegon Lake Public Advisory Council  
Kathy Evans – Timberland RC&D Area Council  
Renee Briggs