Removal Recommendation
Eutrophication or Undesirable Algae Beneficial Use Impairment
White Lake Area of Concern

Issue

Michigan Department of Environmental Quality (MDEQ), Office of the Great Lakes, Areas of Concern (AOC) program staff recommend the removal of the Eutrophication or Undesirable Algae Beneficial Use Impairment (BUI) for the White Lake AOC based on the review of relevant documentation pursuant to the process and criteria set forth in the *Guidance for Delisting Michigan's Great Lakes Areas of Concern* (*Guidance*) (MDEQ, 2008). This recommendation is made with the support of staff from the United States Environmental Protection Agency (USEPA) Great Lakes National Program Office, the MDEQ, and the White Lake Public Advisory Council (PAC).

Background

White Lake is a 10.4 km^2 drowned river mouth lake located in western Michigan. The lake was listed as an AOC in 1987 because of severe environmental impairments related to the historic discharge of municipal and industrial wastes. The Eutrophication or Undesirable Algae BUI was listed for White Lake because high nutrient levels were present in the lake due to the discharge of municipal sewage and tannery wastes. Surface water total phosphorus (TP) concentrations averaged nearly 50 µg/L in 1972, chlorophyll *a* averaged 12 µg/L, and Secchi disk transparencies were below 1.7 m (Freedman et al 1979). White 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. Water quality studies in 2005 found that surface water TP concentrations averaged 30 µg/L, chlorophyll *a* averaged 8 µg/L, and Secchi disk transparency was near 2 m (AWRI 2007).

Seven BUIs remain associated with the White Lake AOC: Eutrophication or Undesirable Algae, Loss of Fish and Wildlife Habitat, Degradation of Fish and Wildlife Populations, Degradation of Aesthetics, Restrictions on Drinking Water Consumption or Taste and Odor Problems, Restrictions on Fish Consumption, and Degradation of Benthos. This document pertains only to the Eutrophication or Undesirable Algae BUI.

Removal Criteria

According to the State's *Guidance*, the Eutrophication and Undesirable Algae 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.

On March 28, 2009 the MDEQ accepted a locally-developed target for the Eutrophication and Undesirable Algae BUI as being functionally equivalent to the MDEQ's restoration criteria in the *Guidance*, while remaining within the scope of the ACO program. The White Lake PAC's AOC-specific criteria are as follows:
The Eutrophication and Undesirable Algae BUI 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 meet criteria (Table 1) in White Lake after 5 years.

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

Table 1. Eutrophication and Undesirable Algae BUI Delisting Targets and Indicators.
[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 minimize nuisance algal blooms.

Supporting Data

MDEQ staff searched the 2010 Clean Water Act Water Quality and Pollution Control in Michigan: Section 303(d) and 305(b) Integrated Report, as well as the 2012 draft version of the report and found that no waterbodies within the AOC are included in either list of impaired waters due to nutrients or excessive algal growths. Therefore, achievement of criterion number 1 is met.

Beginning in 2009, Dr. Richard Rediske at Grand Valley State University's Annis Water Resources Institute (AWRI) worked with the White Lake Public Advisory Council to evaluate existing nutrient-related data (Table 2). Early in the process, it was determined that previously collected data showed White Lake had met the State's delisting criteria, in addition to meeting the more specific locally-developed criteria, between 2004 and 2006. Although the mean values for some parameters (i.e., Chl *a* in 2006) slightly exceeded the local criteria (10.3 µg/l vs 10 µg/l), data averaged over three years showed that the delisting targets were met. The grand mean for the Trophic Status Index (TSI) during 2004-2006 was 50, indicating that White Lake was in the target range (50 - 60). Since the TSI integrates Chlorophyll *a*, Total Phosphorus, and Secchi Disk Depth, these data demonstrated that water quality was significantly improved and that eutrophication was no longer an impairment in White Lake.

Summer Means	TP-P (ug/L)	TSI TP	Chl *a* (ug/L)	TSI Chl a	Secchi Disk	TSI Secchi Disk	TSI Total
2004	33	54	9.98	51	1.9	51	52
2005	22	48	4.8	45	2.7	46	47
2006	25	50	10.3	53	2.0	50	51
Grand Mean	**27**	**51**	**8**	**50**	**2.2**	**49**	**50**

Table 2. White Lake Water Quality Indicators, 2004-2006 (Luttenton et al, 2007).

One aspect of the local criteria specified by the White Lake Public Advisory Council for meeting annual water quality standards was that a five year interval between samplings be used for the assessment. This requirement was meant to ensure that water quality targets are being met

over a longer period of time, rather than merely during a single annual sampling. Therefore, additional monitoring was scheduled for 2011.

2011 Monitoring Program

Water quality sampling was coordinated by Dr. Rediske in 2011. Samples were collected on July 19 (summer) and October 24 (fall turnover) at the locations shown in Figure 1. The results of the water quality samples are shown in Table 3. Mean total phosphorous (TP) and chlorophyll a results were below the target values during the summer and fall sampling events. Secchi Disc depth exceed the target values. The 2011 results were similar to 2005 data (Luttenton et al, 2007) and are below target values. The Trophic Status Index Total was calculated to be 50 during the summer and 48 for the fall sampling event, both consistent with the target value developed by the PAC. The results indicate that the restoration progress of White Lake has achieved the target values for removal of the Eutrophication or Undesirable Algae BUI.

Station	Summer July 19, 2011			Fall October 24, 2011		
	TP (µg/l)	Chlor *a* (µg/l)	Secchi Disc (m)	TP (µg/l)	Chlor *a* (µg/l)	Secchi Disc (m)
1	27	7.8	1.8	28	5.5	2.2
2	25	7.2	2.2	22	5.8	2.5
3	21	7.0	2.1	24	4.3	2.1
Mean	24	7.3	2.0	25	5.2	2.3
Target	30	< 10	≥ 2	30	< 10	≥ 2
2005 Mean	28	8	1.8	20	7	2.2
TSI Index	50	50	50	50	47	48
TSI Total	50			48		

Table 3. White Lake Water Quality Indicators, 2011 (Rediske, 2011).

Analysis

Evaluation of the available data was a straightforward, comparative process. MDEQ AOC program staff shared the data with EPA Great Lakes National Program Office staff and the MDEQ Water Resources Division Aquatic Biologist with responsibility for the geographic area that includes White Lake. The White Lake Public Advisory Council has reviewed the data, in addition to Dr. Rediske. All are in agreement that the local targets have been met and all are in support of removing the Eutrophication or Undesirable Algae BUI.

Water quality data from 2004 to 2006 meets the locally-established criteria for BUI removal. Five years later, data collected in 2011 demonstrates that White Lake continues to meet the water quality targets set by the White Lake PAC. None of the federal or state agency staff, or local PAC members expressed any reservations about the data or these conclusions. All are in agreement that the Eutrophication or Undesirable Algae BUI can be considered restored in the White Lake AOC.

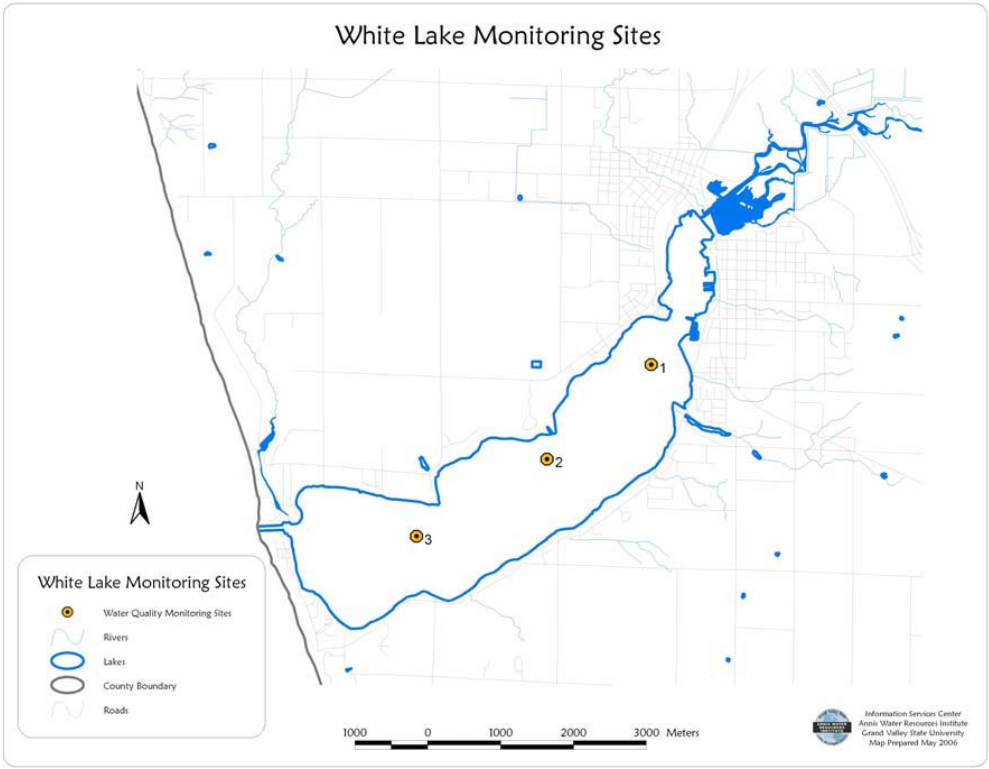

Figure 1. White Lake water quality monitoring stations. These locations represent the entire east to west gradient of the lake and associated depth gradients. Sample sites ranged in depth from 6 m at Site 1 to approximately 19 m at Sites 2 and 3. (Rediske, 2011)

Recommendation

Based upon review of the data and technical input from AWRI, MDEQ and EPA staff, removal of the Eutrophication or Undesirable Algae BUI in the White Lake AOC is recommended. The data and this Removal Recommendation were shared and discussed with the White Lake PAC. The PAC submitted a formal letter of support for removal of the BUI, dated February 3, 2012.

This proposed action will be public noticed for 30 days via posting to the Mich-RAP listserv, listing in the MDEQ Calendar, and posting to the White Lake PAC's email list. Supporting documents will be posted on the MDEQ's AOC program web page for public review and comment through March 27, 2012. Submit written comments to John Riley, Michigan Department of Environmental Quality, Office of the Great Lakes, PO Box 30273, Lansing, Michigan, 48909-7773, or to rileyj2@michigan.gov by midnight on March 27, 2012. If requested in writing, a public hearing may be scheduled. All comments received by March 27, 2012 will be considered prior to final action. Additional details on this proposed action may be obtained from: John Riley, Office of the Great Lakes, 517-335-4122, rileyj2@michigan.gov.

References

Carlson. R.E. 1977. A trophic state index for lakes. Limnology and Oceanography 22:361-369.

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.

International Joint Commission. 1987. Revised Great Lakes Water Quality Agreement of 1978.

Luttenton, M., A. Steinman, and R. Rediske. 2007. Summary Report of the White Lake Water Quality Assessment. Annis Water Resources Institute. Grand Valley State University. Muskegon, MI.

Michigan Department of Environmental Quality. 2008. *Guidance for Delisting Michigan's Great Lakes Areas of Concern,* revised. MI/DEQ/WB-06-001.

Rediske, R. R. 2011. Assessment of White Lake to Determine the Status of Targets for Delisting the Eutrophication and Undesirable Algae Beneficial Use Impairment. Annis Water Resources Institute.

White Lake Public Advisory Council. 2008. Target for Delisting the Eutrophication and Undesirable Algae Beneficial Use Impairment Delisting.

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