Assessment of White Lake to Determine the Status of Targets for Delisting the Eutrophication and Undesirable Algae Beneficial Use Impairment

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Introduction

White Lake was listed as an Area of Concern (AOC) by the International Joint Commission (IJC) in 1987 because of severe environmental impairments related to the historic discharge of municipal and industrial wastes. The Beneficial Use Impairment (BUI), Eutrophication or Undesirable Algae, was listed because of high nitrogen and phosphorus levels were present in the lake due to the discharge of municipal sewage and tannery wastes. Surface water total phosphorus (TP) concentrations averaged 50 µg/L in 1972, chlorophyll *a* averaged 12 µg/L, and Secchi disc transparencies were below 1.7 m (Freedman et al 1979). White Lake was in the middle of the eutrophic range as listed by the Trophic Status Index (TSI; 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 (Luttenton et al 2007). Transparency in White Lake during 2003-04 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, White Lake is currently at the mesotrophic/eutrophic border line based on the TSI (Carlson 1977).

Delisting Targets

White Lake and its tributaries within the AOC boundary are not included on the 2006 303(d) and 305(b) lists for nutrient pollution or algal growths. Mean surface total phosphorus concentrations are near the MDEQ's recommendation of 30 µg/l for White Lake (Luttenton et al 2007). Improvements in the water quality of White 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 from cultural eutrophication. Because of the importance of White Lake as a recreational resource and public concern related to sustaining the current trend of improving water quality, the White Lake Public Advisory Council (WLPAC) voted to adopt targets for delisting the Eutrophication or Undesirable Algae BUI that exceed the State of Michigan criteria.

> 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) monitoring results the following parameters continue to meet these criteria 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**

[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.

The water quality monitoring sites are shown in Figure 1. 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 near the narrows to approximately 19m at Sites 2 and 3.

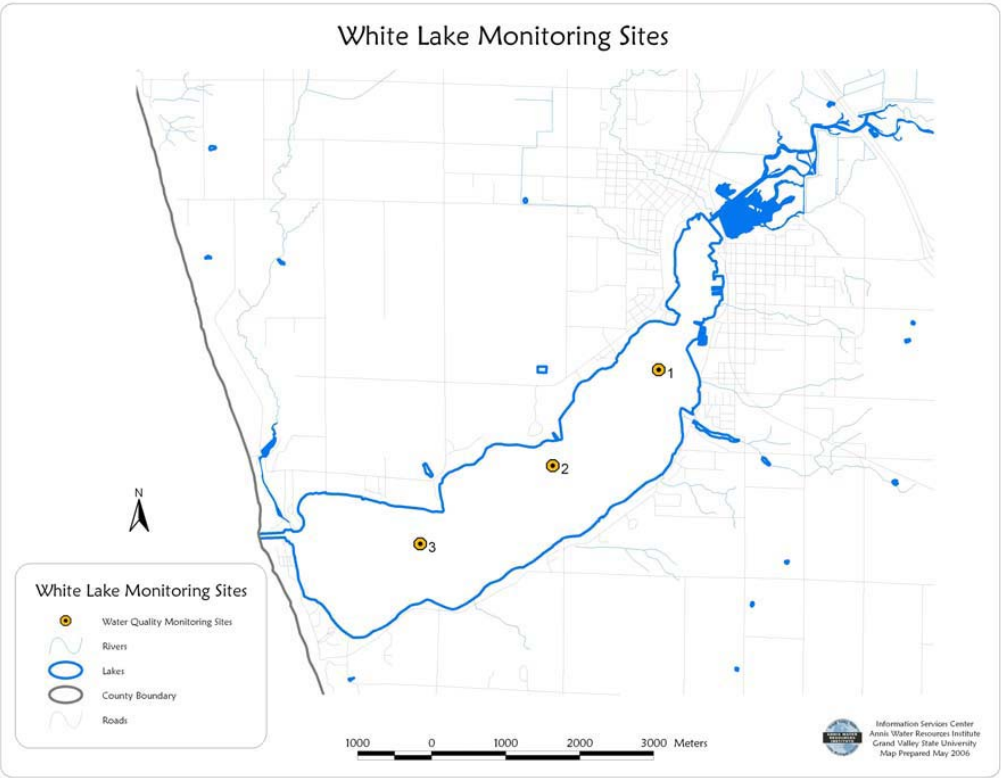

Figure 1. White Lake Water Quality Monitoring Stations.

2011 Monitoring Program

Water quality samples were collected on July 19 (summer) and October 24 (fall turnover) at the locations shown in Figure 1. Samples for TP were collect at 0.5 m depth using acid washed plastic bottles and preserved with H_2SO_4. TP was analyzed on a BRAN+LUEBBE

Autoanalyzer according to Standard Methods (Method 365.4). Chlorophyll *a* was measured with a YSI 6600 multi-probe sonde equipped with a Wet Lab fluorometer at 0.5 m depth. The fluorometer was calibrated before each sampling event using Rhodamine dye as described in the user's manual. Secchi Disc depth also was measured in duplicate at each location. TSI values were calculated according to Carlson (1977).

The results of the water quality samples are shown in Table 1. Mean TP and chlorophyll a results were below the target values during the summer and fall sampling events. Secchi Disc depth exceeded the target values. The 2011 results were similar to 2005 data (Luttenton et al 2007) and are below target values.

Table 1. 2011 Water Quality Results

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		

The results indicate that the restoration progress of White Lake has achieved the target values for removal of the Eutrophication or Undesirable Algae BUI.

References

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