

Missaukee Lake

Water Quality Report & Recommendations 2016



Prepared by:

Jaimee Conroy, Manager of Technical Services
PLM Lake & Land Management Corp.
P.O. Box 132
Caledonia, MI 49316



Missaukee Lake Water Quality Report & Recommendations, 2016

Water Quality

Water quality monitoring is a critical part of lake management. Water quality monitoring provides an ongoing record of conditions in a waterbody. Changes in water quality can indicate threats from sources such as failed or inadequate septic systems, agricultural and lawn runoff, burgeoning development and erosion from construction site. Prompt identification of threats to water quality makes it possible to remedy them before irreversible harm has been done. Riparian's enjoyment of the water resource and the value of their property depend on maintaining water quality.

Missaukee Lake is within the Muskegon River Watershed. The Muskegon River Watershed drains approximately 2,350 square miles of land throughout several counties. Approximately 94 main tributaries flow into the watershed including Houghton, Higgins and the Little Muskegon River.



Water quality in Missaukee Lake was evaluated on April 25, July 6 and September 6, 2016. On each occasion, (1) a depth profile of water temperature and dissolved oxygen concentrations was measured at one-meter (approximately three foot) intervals at the Deep Hole (Site #1) and the Secchi disk depth was measured at all three sites of the lake, (2) samples for LakeCheck™ analysis were collected from all three sites of the lake (surface water), and (3) a depth-integrated water sample (from the surface to two Secchi disk depths) was collected from all three sites for chlorophyll analysis. LakeCheck measures conductivity, total dissolved solids, pH, alkalinity, total phosphorus, and nitrates. E.Coli testing was added to the program for the 2014 season at all 3 sites.

Temperature and Dissolved Oxygen Profiles

Depth profiles of temperature and dissolved oxygen indicate that on April 25 the lake was not stratified. At this time Missaukee Lake was well oxygenated throughout the entire water column, with an oxygen concentration in the Deep Hole Site of 12.1 mg/L (109% saturation) at the surface and 11.2 mg/L (105% saturation) at 7 meters. At this time, the dissolved oxygen concentration at site #2 and #3 were around 12.0 mg/L (100% saturation).

On July 6, the lake was still not stratified which is atypical for a lake this size during peak summer months. Dissolved oxygen concentrations were adequate for good fish populations at and near the surface. Oxygen concentrations at this time were also very good in the deep water. Surface dissolved oxygen levels that are less than 4.0 mg/L can cause fish kills. Dissolved oxygen levels were above 6.9 mg/L throughout the entire water column, therefore, the chance of depleted oxygen affecting the fisheries did not occur. The other two sites had dissolved oxygen concentrations at saturation (8.1 & 7.0 mg/L) at this time.

On September 6, the lake was still un-stratified and well oxygenated from top to bottom. September dissolved oxygen concentrations at the surface were 8.2 mg/L (84% saturation), and the concentration at 7 meters' depth was 6.3 mg/L (62% saturation). At this time, the dissolved oxygen concentration at site #2 was 8.1 mg/L (82% saturation) and 8.2 mg/L (83% saturation) at site #3.

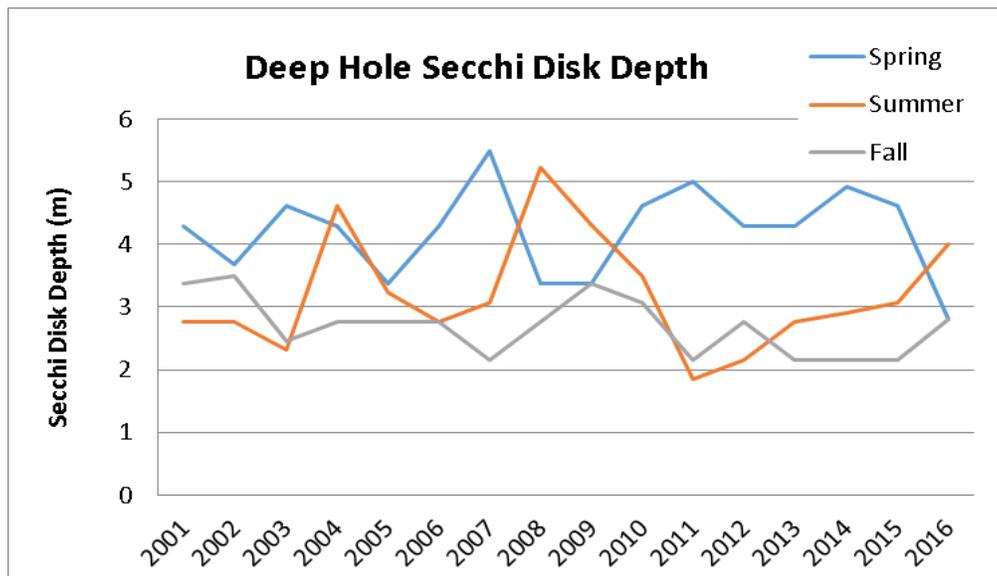
Based on the three sampling dates it appears that the lake did not stratify this season. The benefit of not stratifying is that oxygen was present throughout the water column, even in deeper water, the entire season.

Conductivity Total Dissolved Solids, pH and Alkalinity

Conductivity and Total Dissolved Solids (TDS) measure the total concentration of dissolved salts in the water. Values for Missaukee Lake indicate low concentrations of dissolved materials. Alkalinity and pH measure the amount of dissolved bases and the balance of acids and bases in the water. Alkalinity values were moderately low indicating that Missaukee Lake has soft water. The pH values were within normal ranges for a soft water lake.

Secchi Disk Depths

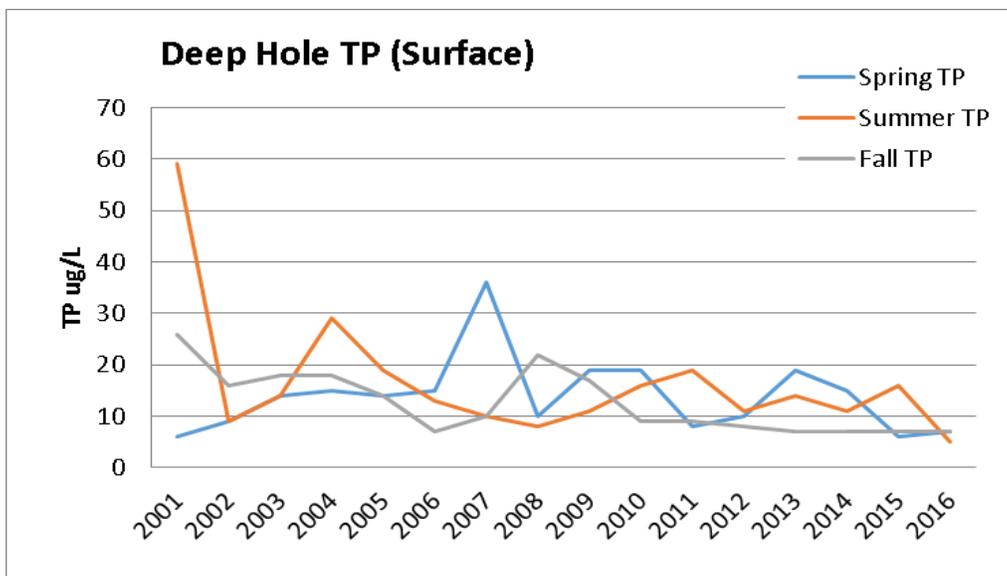
The Secchi disk depth is a measure of water clarity, determined by measuring the depth to which a black and white disk can be seen from the surface. (Larger numbers represent greater water clarity.) In April, the Secchi disk depth was 2.8 meters (9 feet), which is average water clarity. In July the Secchi disk depth in the Deep Hole had increased to 4.0 meters (12.0 feet). Water clarity decreases throughout the remainder of the summer, with a Secchi disk depth at 2.8 meters (9 feet) in September. What clarity can fluctuate throughout the season due to rain events, turbidity from recreational watercraft, algae blooms etc.



Total Phosphorus

Total phosphorus measures the total amount of phosphorus in the water. Phosphorus is an important plant nutrient (i.e., fertilizer) and the nutrient most likely to limit algal growth. Elevated phosphorus inputs to lakes caused by human activities are a major cause of cultural eutrophication. Overall, phosphorus concentrations in the lake were low to moderate. The total phosphorus concentration at the surface in the Deep Hole in April was 7 µg P/L, with similar concentrations measured at site #2 (6 µg P/L) site #3 (6 µg P/L, respectively). In July the phosphorus concentration in the Deep Hole Site decreased slightly to 5 µg P/L in the surface water. The remaining 2 sites had similar concentrations as the Deep Hole (5 µg P/L & 7 µg P/L). By September, the phosphorus levels had increased only slightly at the all three sites (7 µg P/L) but remained at very low concentrations.

Phosphorus concentrations overall in the lake this season were very good for a developed lake. The average Deep Hole phosphorus reading for the season was 6 µg P/L, which is considered to be oligotrophic or not enriched.



Nitrates

Nitrates measure the total amount of in-organic nitrogen in the water. Nitrogen is an important plant nutrient (i.e., fertilizer) and the nutrient most likely to limit the growth of rooted plants. Overall, nitrate concentrations in the lake were low throughout the season.

Based on years of sampling it is evident that the overall concentration of nitrates in Missaukee Lake is stable. The concentrations do not fluctuate that much from year to year which indicates that nitrogen enrichment from the surrounding watershed is not an issue.

Chlorophyll

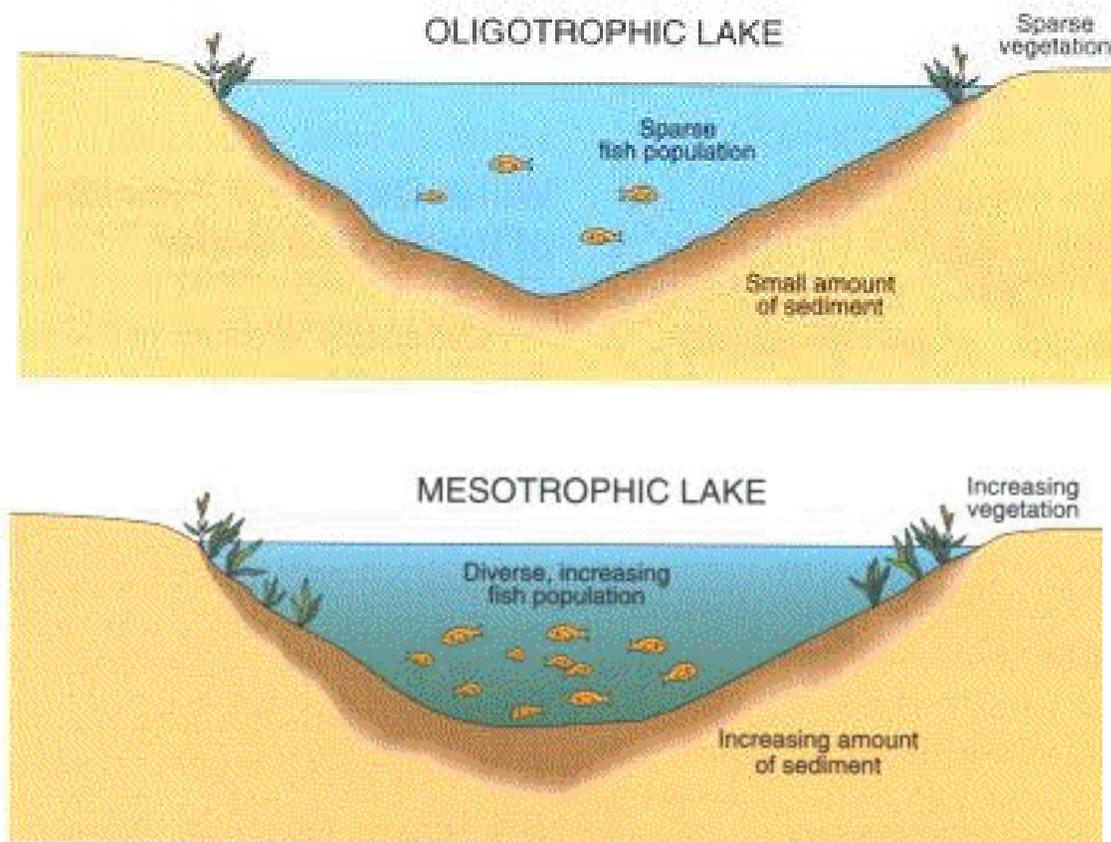
Chlorophyll measures the amount of algae in the water. Some algal growth is essential to support the growth of other organisms (e.g., fish) in the lake, but human activities often lead to excessive algal growth; thus, lower concentrations of chlorophyll are usually considered desirable. In April the Deep Hole Site had a Chlorophyll level of .1 µg/L, which represents very low algae growth. The other two sites were low concentrations as well at .83 µg/L and .15 µg/L. Mid-summer readings increased from the April concentrations but still indicated low algal production. The Deep Hole site had a low concentration of 2.31 µg/L and with the other two sites at 1.15 µg/L & 3.2 µg/L. September readings continued to be low with, 1.57 µg/L at the Deep Hole Site, and .605 µg/L at Site #2 and Site #3 at 2.28 µg/L, respectively.

Table 1. Trophic State Index (TSI) Average Values

Evaluation of Trophic Status

Carlson’s Trophic State Index (TSI) calculated from Secchi disk depth total phosphorus and chlorophyll measurements made in April, July and September yielded values between 8 and 45 (see Table 1) for the Deep Hole Site which categorizes Missaukee Lake as meso-oligotrophic.

	TSI from Secchi Disk Depth	TSI from Total Phosphorus	TSI from Chlorophyll
April	45	28	8
July	40	23	39
September	45	28	35



2016 Water Quality Recommendations

Overall the water quality in Missaukee Lake continues to remain meso-oligotrophic which is great for a developed lake. Conditions in Missaukee Lake should not be allowed to deteriorate below present levels. Efforts to reduce nutrient and sediment loading should begin, with the realization that they will help prevent further deterioration but probably not improve water quality. An extensive management program should continue in an effort to decrease exotic plant growth. To support such responses, an annual record of vegetation, water quality and management should be maintained.

Lakeshore residents should be encouraged to manage their waterside landscapes according to the recommendations outlined in publications on this topic available from the MSU Extension.

If organic material (muck) accumulates to undesirable levels in shoreline areas, bacterial treatments should be considered as a way to alleviate the buildup. PLM MD (Muck Digestion) Pellets are a combination of natural beneficial bacteria, enzymes, and vitamins that stimulate the biological activity of the lake bottom. This stimulation allows the bacteria to feed on the organic sediment, therefore reducing the muck levels over time.