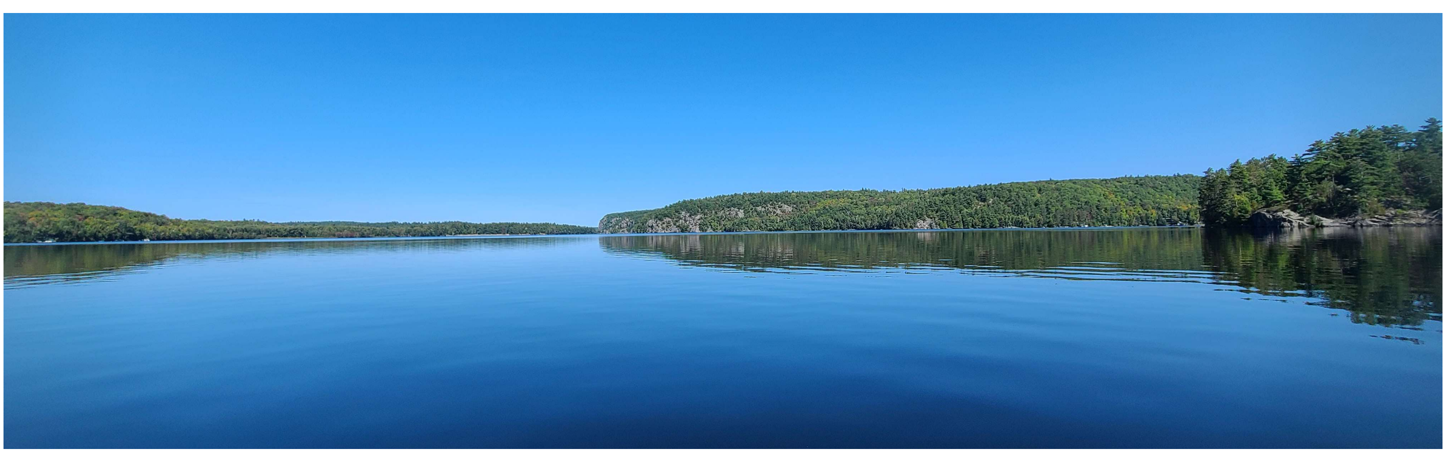
Integrated Monitoring Report
2023 Season

Mazinaw and Upper Mississippi Subwatersheds

Mississippi Valley Conservation Authority



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Cover photos
Top: Kiskebus Lake, September 2023
Bottom: Mazinaw Lake, September 2023

1.0 Executive Summary

The purpose of this integrated monitoring report is to present an overview of the environmental monitoring that Mississippi Valley Conservation Authority (MVCA) completed during the 2023 season. The emphasis of this report is on results of the lake monitoring program but also includes water levels and flow, snow pack, and stream monitoring data. MVCA samples each of its 10 subwatersheds on a 5-year rotation. The Mazinaw and Upper Mississippi watersheds were the primary focus for 2023.

The watershed saw a long-drawn-out snow melt event, resulting in multiple above average spring peaks. The most significant factor affecting the lakes and streams in the summer of 2023 was the above average spring. This helped the lakes and streams to sustain normal conditions throughout the summer months; leaving no threat of drought conditions. Refer to Pages 6-16.

Lakes sampled in 2023 include Kiskebus Lake, Shabomeka Lake, Mazinaw Lake and Marble Lake in the Mazinaw Watershed, and Kashwakamak Lake, Big Gull Lake, Adoch Lake, Malcolm Lake, and Mosque Lake in The Upper Mississippi River Subwatershed. Additionally, Dalhousie Lake and Mississippi Lake were monitored in 2023 which represents the water quality sampled within the main Mississippi River. The sampled lakes maintained their typical nutrient profile characteristics as well as typical dissolved oxygen and temperature profiles for the seasons of which samples were obtained. Refer to Pages 17-36.

Through the stream monitoring program several sites were selected for thermal habitat assessment in 2023. These sites include, 12 sites within the Mississippi River Watershed and 8 sites from the Carp River and Ottawa Tributaries Watersheds. Eight of these sites were found to support cool water fish habitat, four were classified as having cool-warm water habitat, and five were classified as having warm habitat. Performing these monitoring programs annually aids in accounting for the impacts of variable climate influences through analysis of long-term datasets. Refer to Pages 39-40.

This report emphasizes the value of the combined monitoring operations conducted through MVCA's Water Management, Lake Monitoring, and Stream Monitoring programs. The information gathered through these efforts supports MVCA's Stewardship program (Page 41) as well as the initiatives within the Planning and Regulations department (Page 42).

2.0 Introduction

The goal of the Lake Monitoring program is to accumulate reliable environmental data on the lakes within the watershed. Despite various adjustments to the protocol throughout the years, the program has remained a fundamental part of MVCA's environmental monitoring program. It continues to provide valuable baseline data while promoting stewardship within the watershed.

This is achieved by collecting water quality data and monitoring the lakes for changing trends. Due to the large number of lakes monitored within the MVCA area (45 lakes monitored out of over 300 lakes in total), a rotational sampling program is undertaken with the goal of collecting baseline data and monitoring general trends. MVCA collects data on parameters that are easy to repeat and are important indicators in water quality assessments. Many of the lakes not sampled on a regular basis by MVCA are sampled/monitored through other programs, such as the Ministry of Environment, Conservation and Parks' Lake Partner Program (LPP). Relying on volunteer effort, this program provides equipment and a valuable framework for yearly data collection. It is also an excellent method in encouraging and promoting awareness and ownership of lake health to the lake communities. If lake stewards are interested in more detailed yearly assessments of their lake, they should consider the LPP which is coordinated through the Dorset Environmental Science Centre.

MVCA's Stream Monitoring program also collects valuable information on stream temperature, fish communities, and benthic communities of the watershed's many tributaries. It follows the Ontario Stream Assessment Protocol (OSAP) methods to conduct stream site identifications, electrofishing, benthic surveys, and temperature monitoring at various sites throughout the year.

The goal of MVCA's fish data collection is to determine the presence or absence of cold or cool water species. These species are indicators of the thermal regime of a stream as they require very specific conditions to thrive, and thus are sensitive to changes caused by climate change or nearby development pressure. Limited fish sampling was carried out in the summer of 2023, with a focus on sites within the City of Ottawa. MVCA was able to monitor the water temperature at select sites throughout the watershed to confirm the potential thermal habitat available for fish populations. The results are also used for tracking thermal trends for longer-term climate analysis.

3.0 Water Quantity Monitoring

3.1 Summary

Three types of water quantity monitoring occurred in the Mississippi Lakes subwatershed in 2023: snow pack, water levels and flow, and precipitation. Figure 1 shows the locations of the various gauges used to collect water level and flow data, the locations of snow courses where snow pack water content is measured, and the lakes monitored in 2023. There are 3 flow stations, 8 level gauges, 4 precipitation gauges and 4 snow courses in the Mazinaw and Upper Mississippi River subwatersheds.

The watershed experienced an above average spring freshet/thaw in 2023. The rainfall received on April 5th triggered the spring freshet and brought levels in some parts of the watershed to above average flood conditions quite quickly. A Flood Watch was issued on April 6th, followed by a Flood Warning for Dalhousie lake and the Clyde river on April 7th. Similar to the spring of 2017 the watershed saw two peaks, Ferguson's Falls' flow peaked on April 16th at 194.483 cm/s and again on May 6th at 172.08 cm/s; which are both above the historical peak average of 150 cm/s.

Going into the freshet, the watershed had significantly above average snowpack. For the first peak, the weather was favorable with multiple, slightly warm days without rain. These conditions resulted in a large percentage of the significant snow-pack gradually melting and entering the river system at a slow pace. This gradual melt resulted in most rivers experiencing a long, drawn-out, lower peak instead of a quick sharp one.

Significant rainfall forecasted for early May resulted in another Flood Watch for the Mississippi watershed. Early May saw 5 consecutive days of rainfall adding almost 150 mm of rain water to an already full system. A Flood Warning for the Mississippi River for Dalhousie Lake, Clyde river and Mazinaw/Little Marble and Marble Lakes was issued on May 3rd.

July and August both had average rainfall levels; eliminating any concerns for a summer drought in the system and leaving the watersheds at normal flows going into the fall months. September to December were extremely dry months leaving water levels and flows slightly below normal at the end of the year.

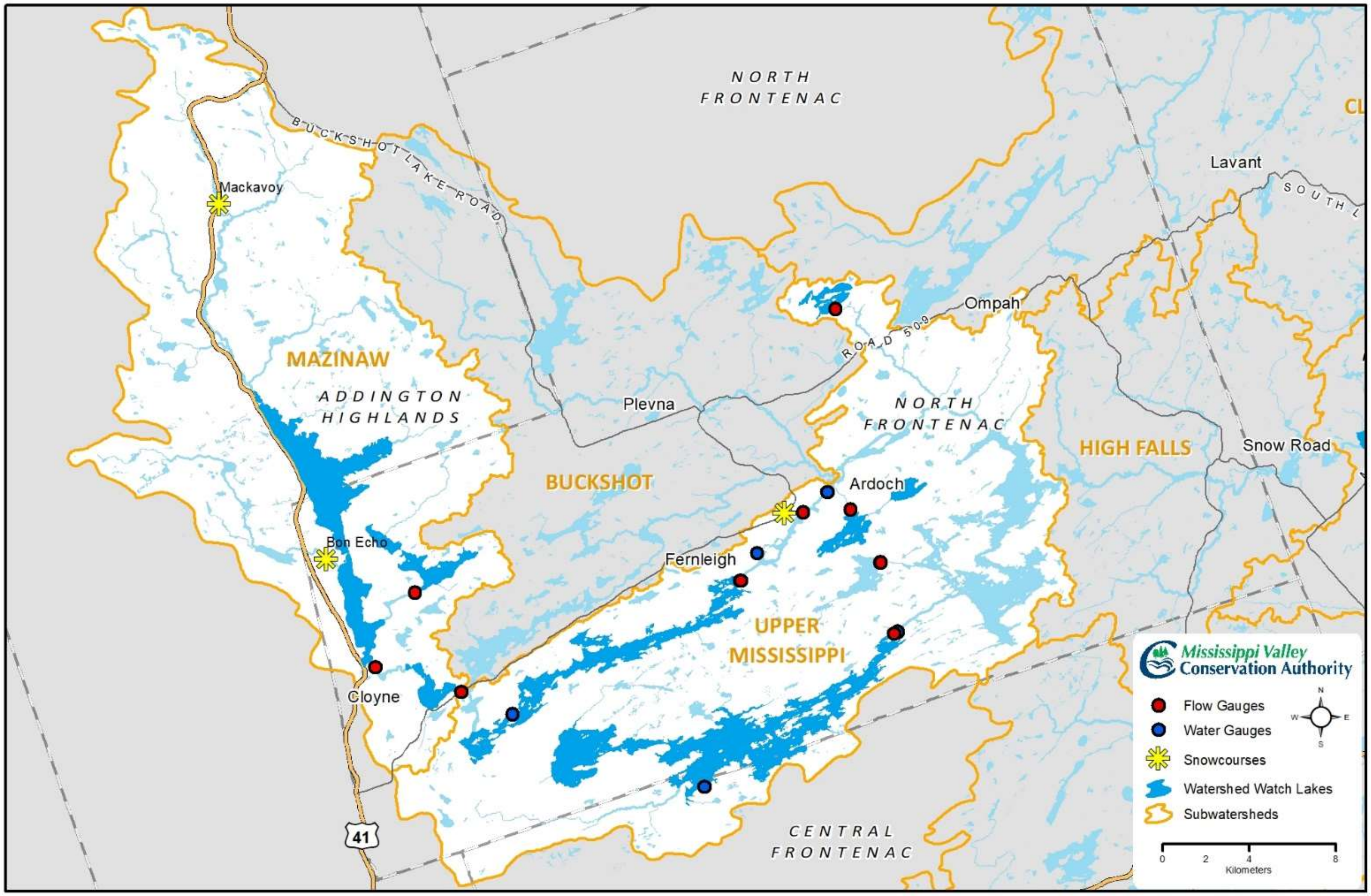


Figure 1: The various water quantity monitoring sites in the Mazinaw and Upper Mississippi subwatersheds, plus the lakes within the subwatershed that were monitored in 2023.

3.2 Snow Pack

Snow pack is measured at 16 sites within MVCA's jurisdiction. This provides MVCA with information on the expected spring runoff for that year; thus, assisting in decisions related to dam operations and flood forecasting. These water management efforts are critical to minimizing flood damage, maintaining flows and water levels for fish and wildlife, and meeting the target levels for summer recreational activities. Results from four snow course stations have been interpreted to describe the diversity of snowpack conditions across the Mississippi Valley watershed which contribute to the observed spring water levels. The four sites were selected for analysis due to their proximity to lakes that were studied in 2023 (Figure 1, Figure 5). MacAvoy is upstream of Mazinaw Lake and BonEcho is downstream of Mazinaw Lake, while Ardoch is downstream of Kashwakmak Lake, and Innisville is upstream of Mississippi Lake. Results from these stations can be seen in Figures 2a and 2b.

Measuring snow depth and equivalent water content

Due to a rainy December and January the 2023 study area saw higher than normal flows, but precipitation turned to snow; enabling more average conditions to occur by early February. The snow courses throughout the rest of the Mississippi Valley presented a similar 'early winter' trend. Throughout February to the end of March snowpack increased to significantly above average conditions. April temperatures were favorable for a slow, controlled melt and there was hardly any rainfall. Runoff flows began in late March and slowly continued into April which developed into the first spring peak in water levels.

It can be seen in Figure 2b that snow water equivalent levels in the Mississippi River subwatershed maintained an above average trend at the end of winter of 2023.

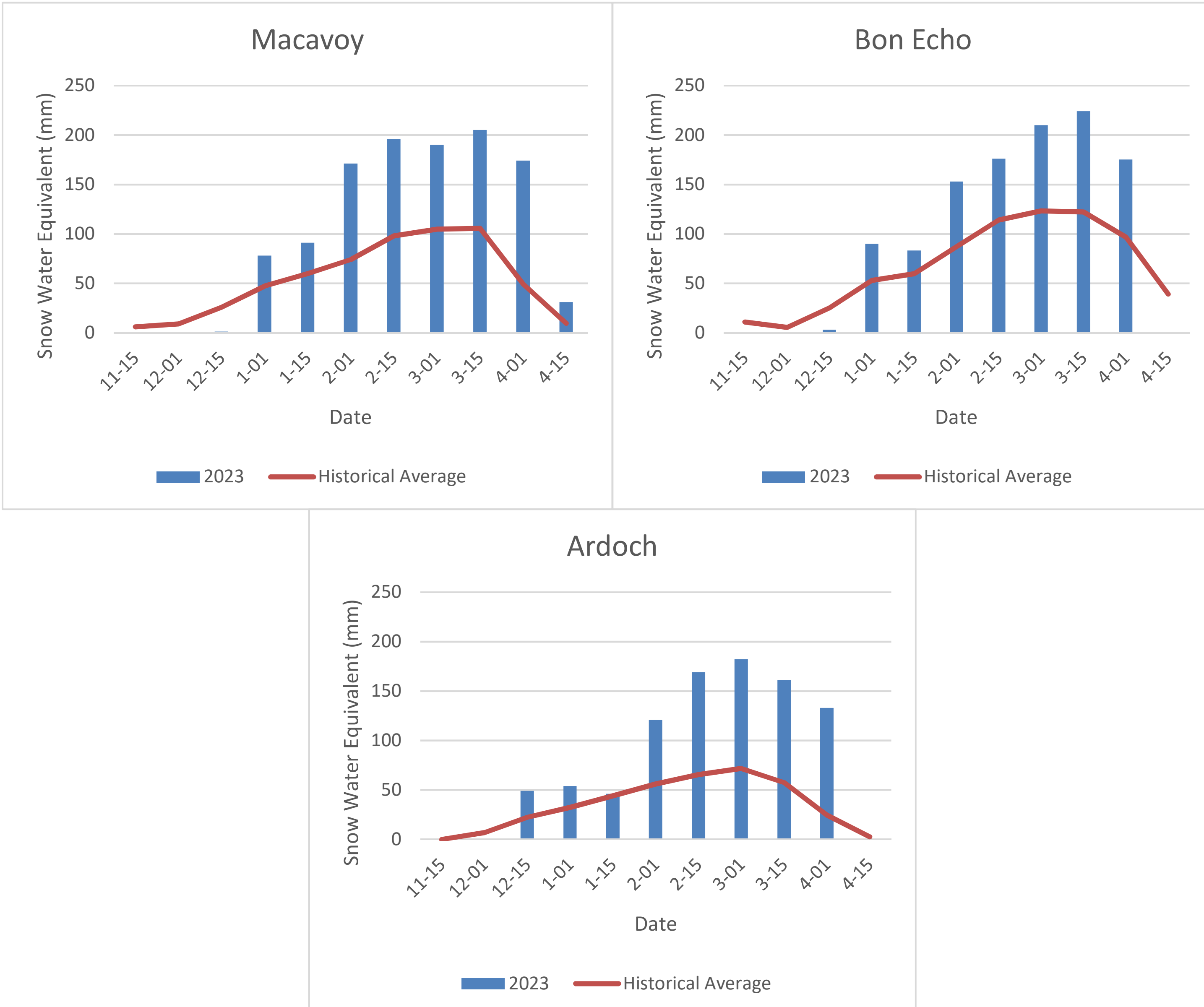


Figure 2a: 2023 snow water equivalent levels vs. historical averages sampled within the Mazinaw (Macavoy and Bon Echo sites) and Upper Mississippi River (Ardoch site) subwatersheds.

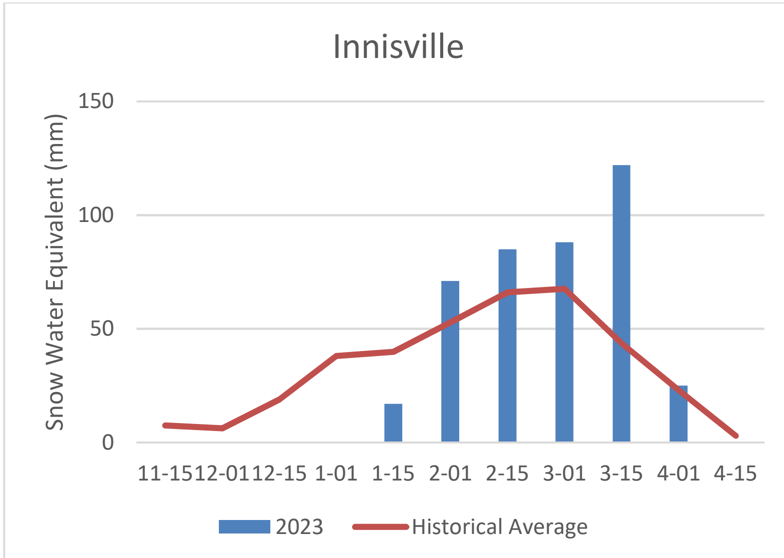


Figure 2b: 2023 snow water equivalent levels vs. historical averages sampled at the more downstream Innisville snow course stations within the Mississippi Lakes subwatershed.

3.3 Stream Flow and Precipitation

Precipitation gauges are located with streamflow gauge stations across the watershed. These gauges provide information on weather events and climactic conditions which influence water levels in the Mississippi River Watershed. This report focuses on 2023 data from the stream flow and rain gauge station at the outlet of Marble Lake, the outlet of Dalhousie Lake, and in the community of Ferguson's Falls (upstream of Mississippi Lakes). The daily total precipitation and the daily mean flows at these stations are included in Figures 3a, 3b and 3c respectively.

The Figures show two peak flows occurring on April 16th and May 6th during the above average spring freshet. Significant rainfall forecasted for early May resulted in a Flood Watch for the Mississippi watershed. Early May saw 5 days in a row of rainfall, adding almost 150 mm of rain to an already full system. A Flood Warning for the Mississippi River, Dalhousie Lake, Clyde River, Mazinaw/Little Marble and Marble Lakes areas was issued on May 3rd.

Figures 3a, 3b and 3c also illustrate the precipitation events which occurred throughout the year. The largest precipitation event occurred the last week of June. The months of July and August remained wet with frequent rain events, while the months of September and October were extremely dry.

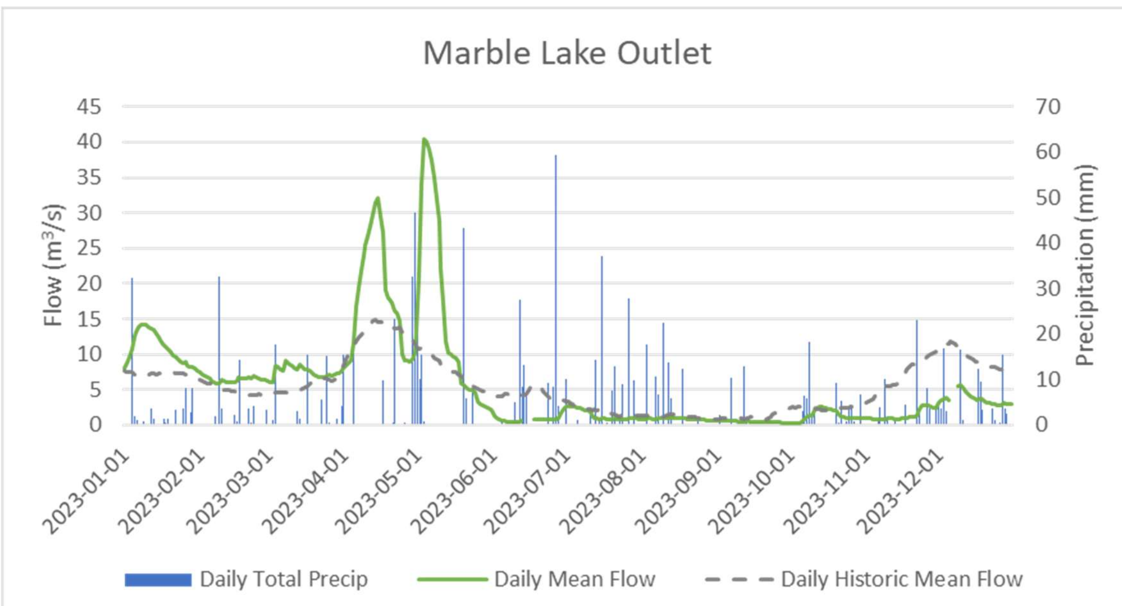


Figure 3a: Daily total precipitation and daily mean water flows at the Marble Lake gauge station (at the outlet of the Mazinaw subwatershed) for 2023 compared to the historic daily mean flows for the site.

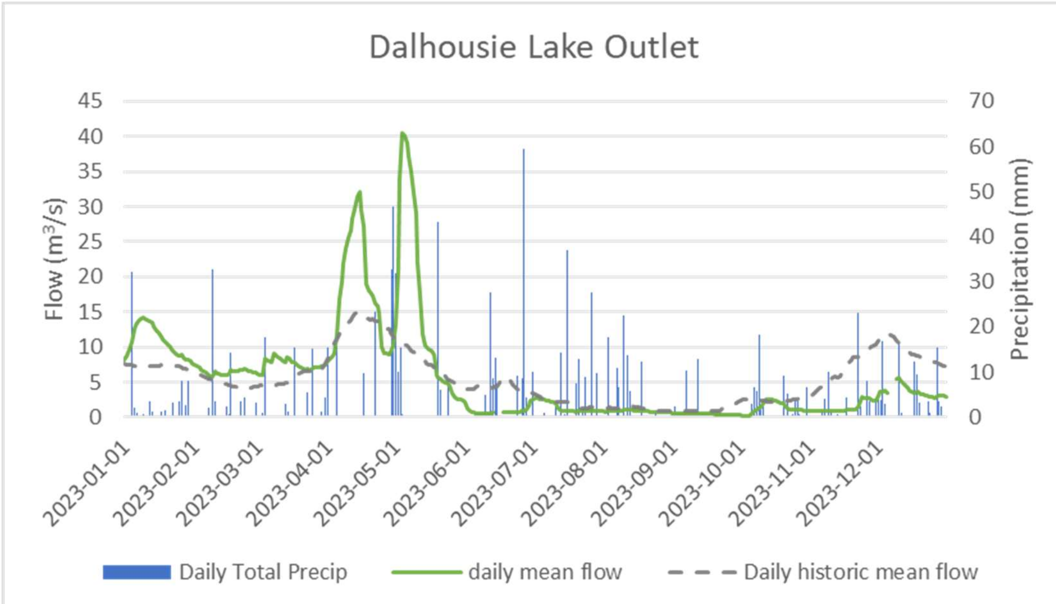


Figure 3b: Daily total precipitation and daily mean water flows at the Dalhousie Lake gauge station for 2023 compared to the historic daily mean flows for the site.

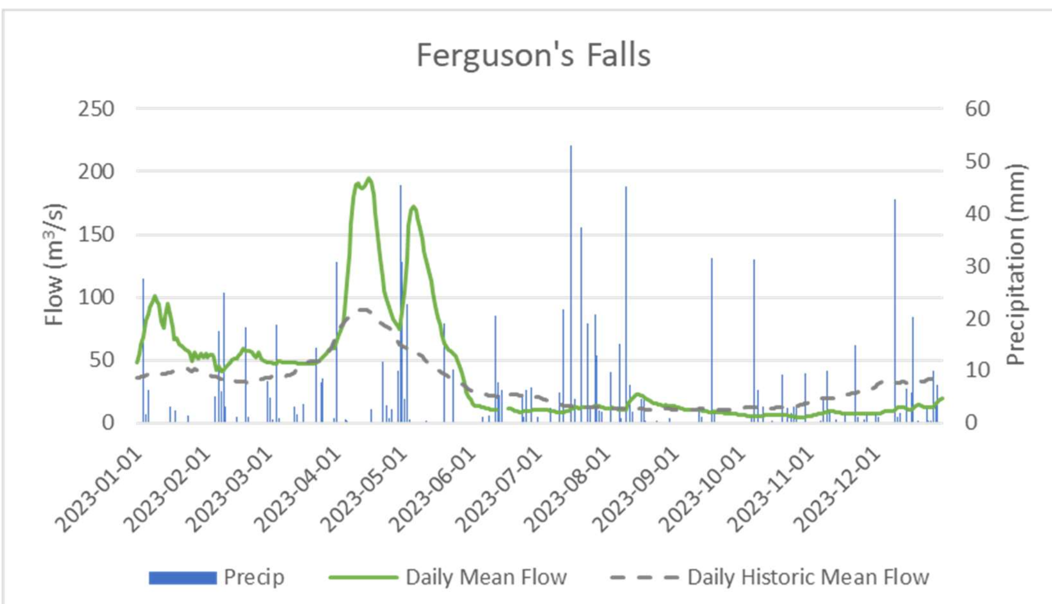


Figure 3c: Daily total precipitation and daily mean water flows at the Ferguson’s Falls gauge station for 2023 compared to the historic daily mean flows for the site.

3.4 Lake Water Levels

Water levels are measured from gauges which are installed at several dams and gauge stations throughout the watershed. Lakes such as Kiskebus and Ardoch do not have control structures nor gauge stations so they are not discussed further in this section, whereas lakes such as Dalhousie and Mississippi do not have control structures but they do have gauge stations.

MVCA operates 18 dams throughout the watershed. Water levels in nine of the lakes monitored in 2023 are managed by a dam; Mazinaw, Shabomeka, Marble, Kashwakamak, Pine, Big Gull, Malcolm, Mosque (Figures 4a-e). Water levels in Dalhousie Lake Mississippi Lakes (Figure 4f and 4g) are not controlled by a dam.

Water Survey of Canada Gauge stations installed throughout the watershed contribute data to our flow and water level analysis. For example, Marble Lake has a Water Survey of Canada gauge station at its outlet which provides us with water flow and precipitation information for the upper part of our watershed.

Due to the above average freshet, all of the lakes started the season with above average water levels. The lakes were able to be near the normal levels throughout the summer season with no issues of drought.

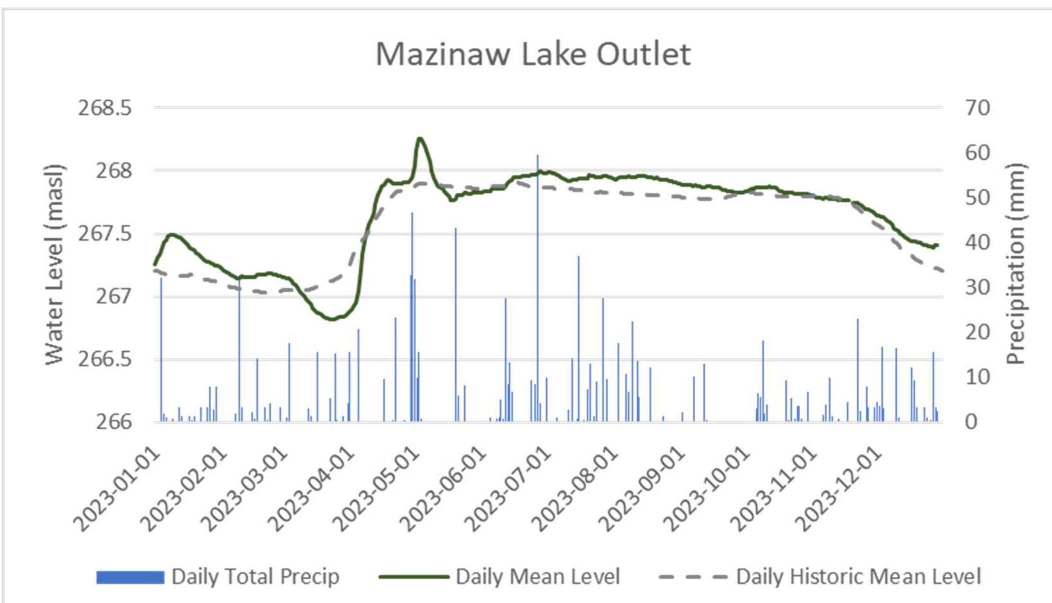


Figure 4a: 2023 and historic daily mean water levels (meters above sea level - MASL) at Mazinaw Lake compared to the 2023 daily total precipitation at the Marble Lake stream gauge station.

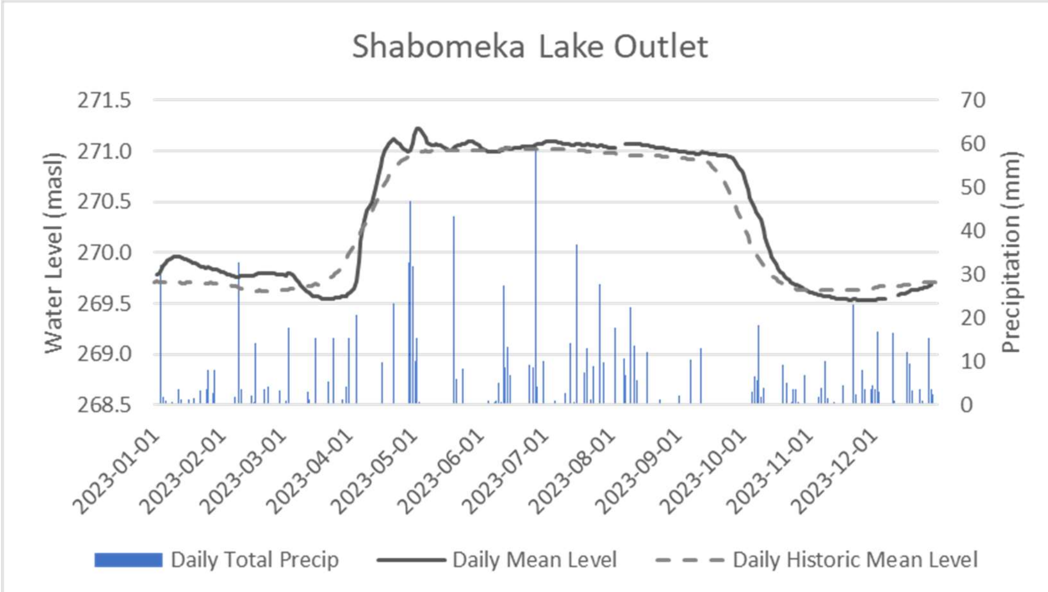


Figure 4b: 2023 and historic daily mean water levels (meters above sea level - MASL) at Shabomeka Lake compared to the 2023 daily total precipitation at the Marble Lake stream gauge station.

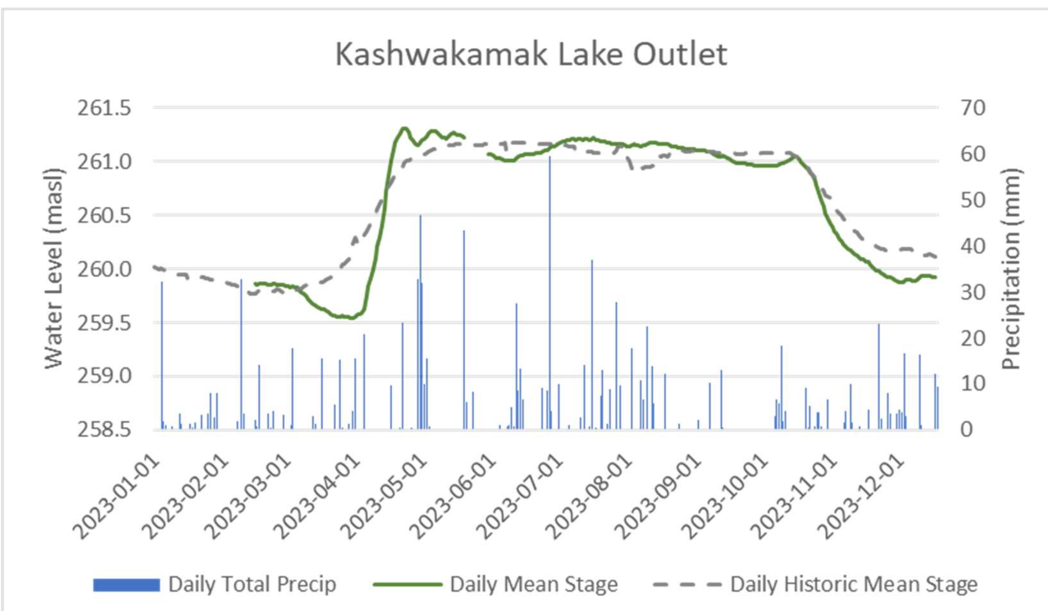


Figure 4c: 2023 and historic daily mean water levels (meters above sea level - MASL) at Kashwakamak Lake compared to the 2023 daily total precipitation at the Marble Lake stream gauge station.

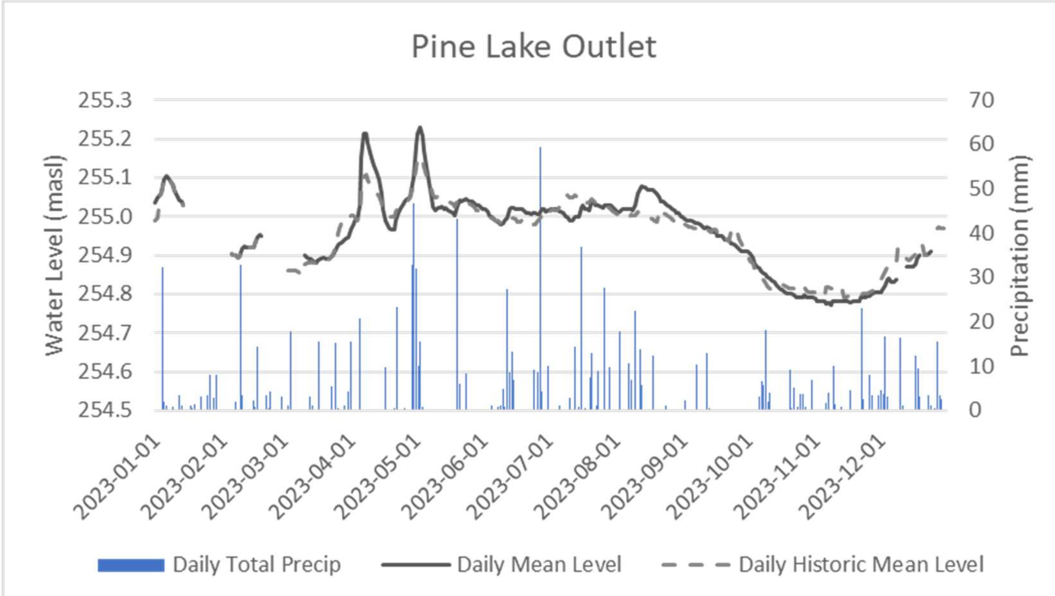


Figure 4d: 2023 and historic daily mean water levels (meters above sea level - MASL) at Pine Lake compared to the 2023 daily total precipitation at the Marble Lake stream gauge station.

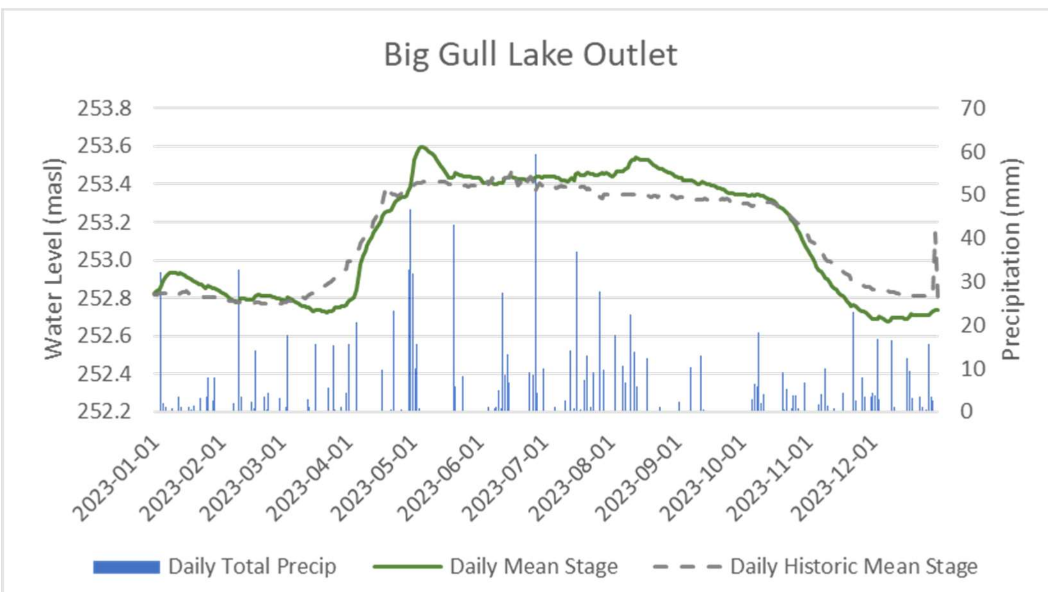


Figure 4e: 2023 and historic daily mean water levels (meters above sea level - MASL) at Big Gull Lake compared to the 2023 daily total precipitation at the Marble Lake stream gauge station.

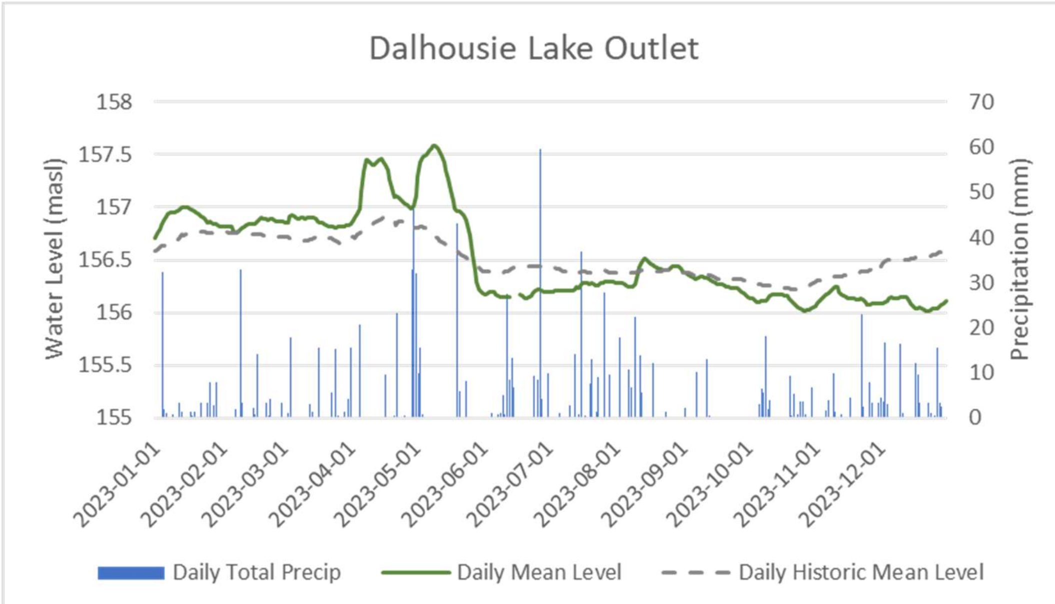


Figure 4f: 2023 and historic daily mean water levels (meters above sea level - MASL) at the Dalhousie Lake gauge compared to the 2023 daily total precipitation at the same gauge.

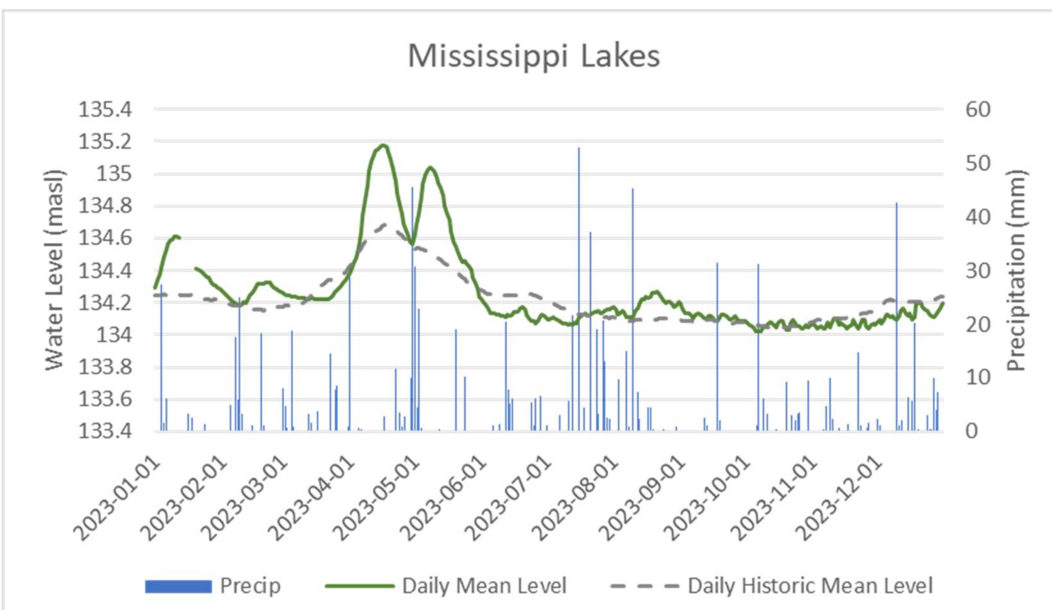


Figure 4g: 2023 and historic daily mean water levels (meters above sea level - MASL) at the Mississippi Lakes gauge compared to the 2023 daily total precipitation at the nearby Ferguson's Falls gauge.

4.0 Lake Monitoring Program

In 2023, the sampling focus was on the Mazinaw and Upper Mississippi subwatersheds. Table 1 lists the lakes sampled by subwatershed in order from upstream to downstream. Figure 5 highlights the lake sites where sampling occurred in 2023. Due to modifications in the sampling rotation not all Mazinaw or Upper Mississippi River lakes on our sampling list were visited this year.

- Located in the north-west portion of the watershed, the Mazinaw subwatershed represents the headwaters of the Mississippi River and is located near Cloyne. This watershed has an area of 358 km^2; four lakes were sampled in 2023.
- The Upper Mississippi subwatershed starts at the outlet of Marble Lake (near Myer's Cave) and extends to the outlet of Crotch Lake. This area includes the Mississippi River as it flows through Kashwakamak Lake, as well as a number of tributaries fed by lakes such as Big Gull Lake, Malcolm Lake and Mosque Lake. This watershed has an area of 381 km^2; five of its lakes were sampled in 2023.
- Lastly, two lakes were sampled representing the main Mississippi River within the Mississippi Lakes' subwatershed within our south-central area.

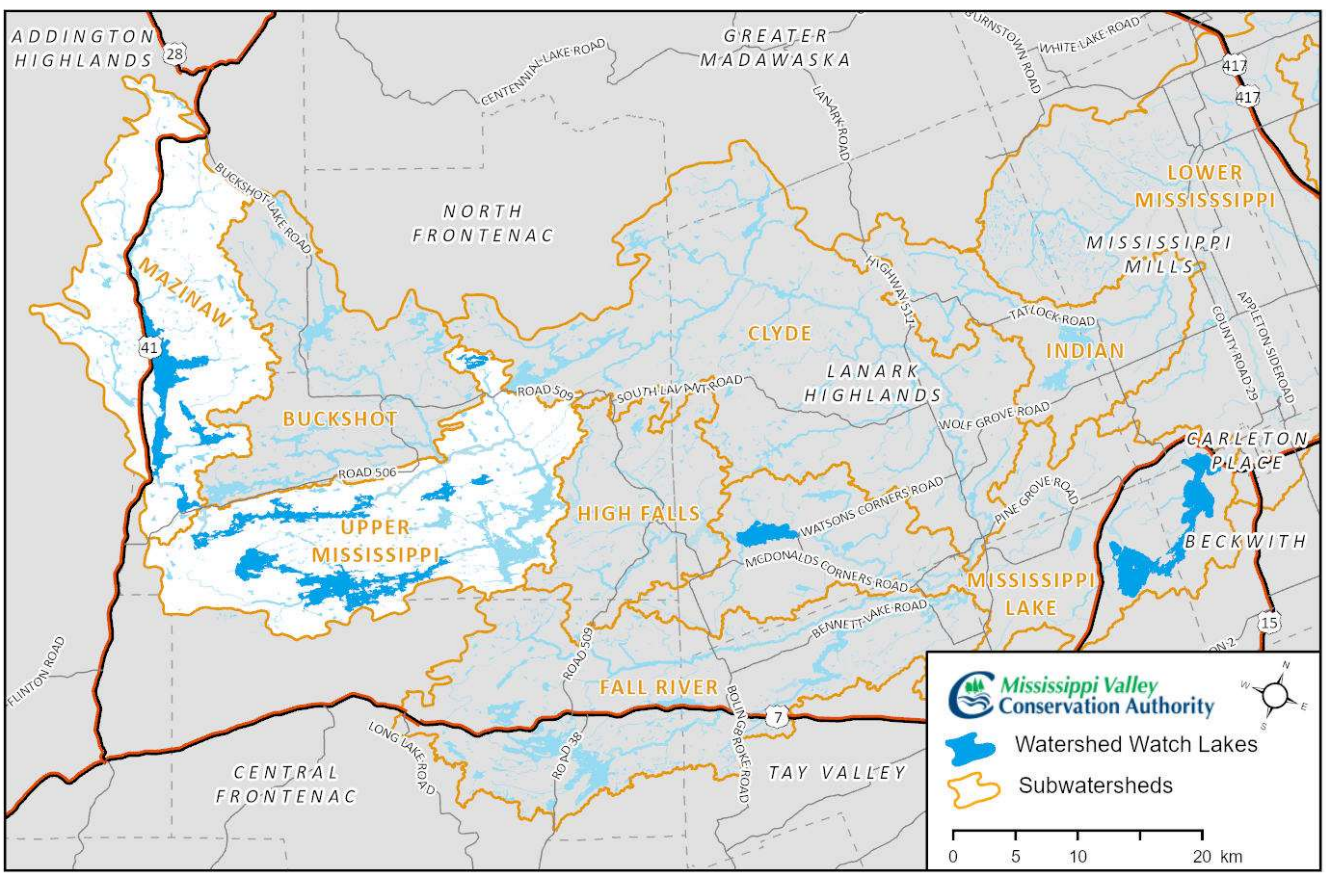


Figure 5: The lakes shown in darker blue are the 11 lakes monitored in 2023. The Mazinaw and Upper Mississippi River subwatersheds are shown in white.

Table 1: Lakes sampled in 2023.

Mississippi Main Stem	Mazinaw Subwatershed	Upper Mississippi Subwatershed
Dalhousie Lake	Kiskebus Lake	Kashwakamak Lake
Mississippi lake	Shabomeka Lake	Big Gull Lake
	Mazinaw Lake	Malcolm Lake
	Marble Lake	Ardoch Lake
		Mosque Lake

4.1 Results Summary

Overall, the lakes sampled in 2023 were consistent with historic trends for Total Phosphorus (TP) levels, Secchi depth and trophic status. The lakes will continue to be sampled as part of the regular rotation to further support the establishment of a long-term data set characterizing the condition of watershed lakes.

To help interpret and display the results of the lake monitoring program, box and whisker plots have been used. This type of chart illustrates the middle 50% of all data points within the box, and the additional 50% is shown by the lines (whiskers) extending from the top and bottom of the box, 25% of the dataset respectively. The median value of the dataset is indicated with a line the middle of the data spread. Outliers are any data points which fall outside of the reach of the box and whisker area. This type of data plot shows if any results are considered outliers from the data set as dots above/below the whiskers; as seen in the examples below (Figures 6 and 7).

MVCA has chosen to use Box and Whisker plots in order to help interpret the TP results seen in 2023 against the full data set for each of the sampling locations. If a result is between the minimum and maximum values, it would tend to indicate that the value was a part of the natural variance in the lake. When a TP result is determined to be beyond the minimum or maximum values, it is classified an outlier- indicating that the result could be attributed to sampling error or contamination. The lakes will continue to be monitored as part of the regular sampling rotation which enhances the robustness of MVCA's long-term data set and improves understanding of yearly results.

Filtering a bottom sample

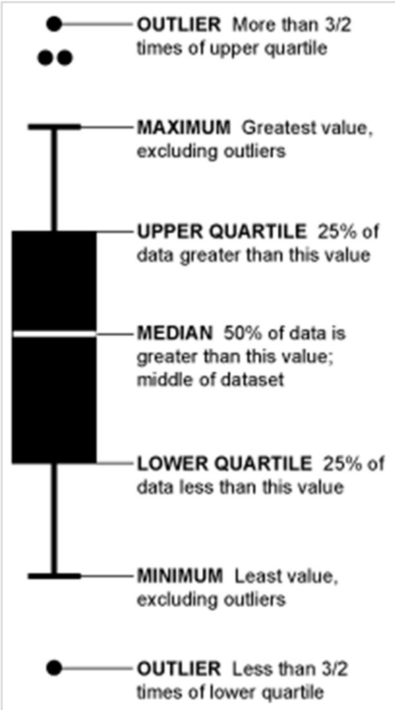


Figure 6: How to interpret a Box and Whisker Plot.

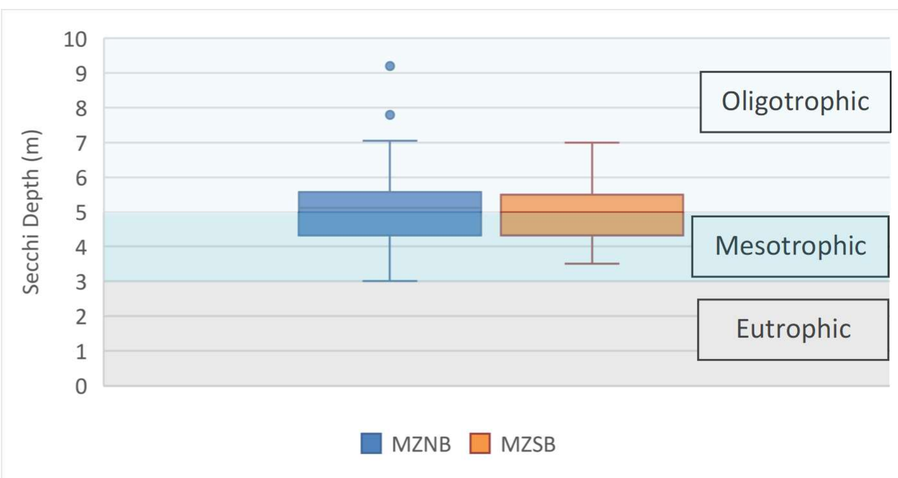


Figure 7: An example of a box and whisker plot from Mazinaw Lake's 2019 Secchi depth results compared to trophic statuses.

4.2 Lake Monitoring Indicators and Methodology

The Lake Monitoring Program tests for six water quality parameters. These parameters are selected for their relative simplicity of collection, reproducibility, and ability to determine trophic status. These parameters are further described below.

Calcium

Calcium in lakes is a measure of the levels of calcium (Ca^{2+}), magnesium (Mg^{2+}) and bicarbonate (HCO_3^-) ions in the water. Higher levels of these ions classify the water as 'hard' water, and lower levels as 'soft' water. This can be measured in various ways but is usually done either as the concentration of free calcium ions (Ca^{2+}) (mg/L) or, calcium hardness because most hard water ions stem from calcium carbonate ($CaCO_3$ in mg/L). For this program, MVCA measures calcium hardness in the field, the result is then multiplied by 0.4 to determine the concentration of calcium freely available in the water. Calcium in freshwater usually falls within the range of 4 to 100 mg/L.

Calcium enters a lake largely through the mineral weathering of rocks (especially marbles and limestones). It is then either used by aquatic organisms for bones or shells or as a component in the cell walls of aquatic plants, and eventually deposits into the sediment of the lake. Because of its importance in shell/body coverings, calcium has been shown to influence zooplankton (small planktonic invertebrates) communities, which are an important food source for many baitfish species. Higher calcium levels are also required for zebra mussels to thrive.

Calcium sampling only occurs as part of the spring sampling protocol.

Secchi Depth

Secchi depth is a measure of water clarity and is collected using a Secchi disc. The Secchi disc is a black and white disc that is lowered into the water on the shady side of the boat to the point where it can no longer be seen. The greater the Secchi depth, the clearer the lake is. The Secchi depth also helps determine the euphotic zone (the depth of water through which light is able to penetrate). Secchi depth can be influenced by the concentration of algae or the presence of other suspended materials in the water. The presence of zebra mussels can also influence Secchi depth as they filter the water and feed on the algae and zooplankton; making the water clearer and possibly increasing Secchi depths. Often a decrease in Secchi depth occurs in unison with an increase in phosphorus. The guideline shown in Table 2 is used to determine a lake's nutrient status according to Secchi depth.

Secchi disc

Table 2: Interpreting Secchi disc results.

Secchi Depth	Lake Nutrient Status
≥ 5 meters	Oligotrophic – unenriched, few nutrients
3.0 – 4.9 meters	Mesotrophic – moderately enriched, some nutrients
< 3.0 meters	Eutrophic – enriched, higher levels of nutrients

Total Phosphorus

Phosphorus is an essential nutrient for all living organisms as it plays a role in numerous aspects of biological metabolism. It is also the limiting nutrient in biological activity and therefore when phosphorus levels get too high there tend to be adverse effects such as algae blooms. Phosphorus can be found naturally in the environment, as well as in many man-made products such as soaps, detergents, fertilizers and septic waste. Total phosphorus (TP) is measured in micrograms per liter (µg/L).

Kemmerer Bottle

As part of the Lake Monitoring program, two types of total phosphorus levels are measured at each sampling location: euphotic zone phosphorus (TPA) and bottom phosphorus (TPB). All TP samples are filtered through an 80-micron mesh to remove zooplankton which could skew results. The euphotic zone is defined as twice the Secchi depth and is the depth to which light can reach and influence plant growth.

The bottom phosphorus sample is collected at sites that have a depth greater than the euphotic zone, using a device called a Kemmerer Bottle. The bottle is sent down to the appropriate depth, approximately 1 meter off the bottom of the lake, with both ends open. A weight on the rope is then dropped, causing both ends to close when the weight hits the bottle, sealing the sample water in the bottle, providing a discrete volume of water from the appropriate depth.

Total phosphorus levels provide an accepted standard to characterize a lake's trophic status following the general guidelines as seen in Table 3. It should be noted that while these numbers provide an idea of a lake's current trophic status, lakes naturally progress over time from oligotrophic to eutrophic, so an 'ideal' trophic status does not exist. Furthermore, natural variation can cause a great deal of change from year-to-year and even within years, so it is important to look at larger trends rather than one or two exceptional years.

Table 3: Interpreting total phosphorus results.

Total Phosphorus Level	Lake Trophic Status
≤ 10 µg/L	Oligotrophic – unenriched, few nutrients
10.1 – 19.9 µg/L	Mesotrophic – moderately enriched, some nutrients
≥ 20 µg/L	Eutrophic – enriched, higher levels of nutrients

The Provincial Water Quality Objective (PWQO) for total phosphorus in lakes is 20 µg/L (*Water Management, Policies and Guidelines, Provincial Water Quality Objectives of the Ministry of the Environment and Energy. MOE. 1994*). The goal is to keep phosphorus below this level in order to maintain aquatic health and the recreational value of watershed lakes.

pH

The pH scale is a logarithmic measure of the concentration of hydrogen ions in solution. It is a measure of the acidity of a solution and ranges from 0 to 14. A pH of 7 is considered neutral, values above 7 are basic, and values below 7 are acidic. The logarithmic scale means that a change from pH 7 to pH 8 is a ten-fold decrease in the concentration of hydrogen ions in solution.

The acidity of a water body affects all chemical reactions within the water. Even small changes in pH can have a large influence on the solubility of some nutrients, including phosphorus, which in turn can influence plant growth. The PWQO for pH in lakes is 6.5 – 8.5, which ensures optimal conditions for most aquatic species.

Dissolved Oxygen and Water Temperature

Dissolved oxygen (D.O.) is essential to all aquatic life, including fish, invertebrates and bacteria. Many factors can influence dissolved oxygen concentrations in a lake, but two key factors are lake stratification (water temperature) and the amount of phytoplankton (microscopic algae) produced in the lake.

Lake stratification is the separation of the lake into three layers: the epilimnion (top layer), metalimnion (middle layer) and the hypolimnion (bottom layer). Stratification is caused by changes in water temperature with depth, and occurs from late spring to early fall.

Optical Dissolved Oxygen Probe

Deeper water D.O. is at its lowest during the late summer and early fall. This is when the water in the hypolimnion cannot recharge its oxygen concentrations because it is isolated from the atmosphere by the epilimnion and the thermocline (the steep temperature gradient between the warm sunlight epilimnion water and the cooler hypolimnion water below). Also, during the fall the phytoplankton that have been active during the summer months begin to die and settle to the bottom of the lake. The bacteria that decompose the phytoplankton consume large amounts of dissolved oxygen, further depleting levels in the hypolimnion. The low levels of D.O. in the bottom depths of a lake decrease the amount of critical habitat available for cool water fish species to thrive, noting that they can be stressed by the warmer temperatures in the oxygen rich epilimnion.

Dissolved oxygen (D.O.) and water temperature are measured using an Optical Dissolved Oxygen Probe. This instrument (pictured above) is lowered through the water at one-meter intervals, where it takes both water temperature and D.O. readings. This creates a dissolved oxygen profile where changes in temperature and D.O. can be recorded as depth increases. Table 4 shows the optimal temperature/D.O. combinations for cold, cool, and warm water fish habitat. Results from the D.O. and water temperature profiles for each of the 2023 lake monitoring sites are available in Appendix A.

Table 4: Optimal conditions for different fish habitat.

	Dissolved Oxygen		Water Temperature
Cold Optimal	>6 mg/L	AND	<10 °C
Cool Optimal	>4 mg/L	AND	<15.5 °C
Warm Optimal	>4 mg/L	AND	<25 °C

Source: Coker, G.A., Portt, C.B., & Minns, C.K.(2001). Morphological and Ecological Characteristics of Canadian Freshwater Fishes. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2554.

5.0 Lake Results: Main Mississippi River

5.1 Dalhousie Lake

Dalhousie Lake is the last main river lake before the Clyde and Fall Rivers join the Mississippi River near Lanark. It is located at the transition between the Canadian Shield and the St. Lawrence lowlands geologic zones. It is a wide and shallow lake with the deepest area measuring 11 meters and located in the western portion of the lake. The lake provides warm water habitat to northern pike, small and large mouth bass, walleye and other fish species.

A summary of the 2023 sampling results are shown in Table 5 and are compared to past years' results in Figure 8. In 2023 results returned a higher level of euphotic zone total phosphorous in the May sample while the two other samples were quite low. These results combined with the Secchi depth readings show that over the course of the year the lake has maintained a mesotrophic status, which is comparable to past sampling years. In context with past sampling results there is no indication of a change in trophic classification.

As a large main river lake, Dalhousie will continue to be monitored frequently to track the lake's condition.

The water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 5: 2023 sampling summary for Dalhousie Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
Main Basin	18-May-23	4	20	11	60
Main Basin	23-Jun-23	5.5	3	24	
Main Basin	5-Sep-23	4.5	4		

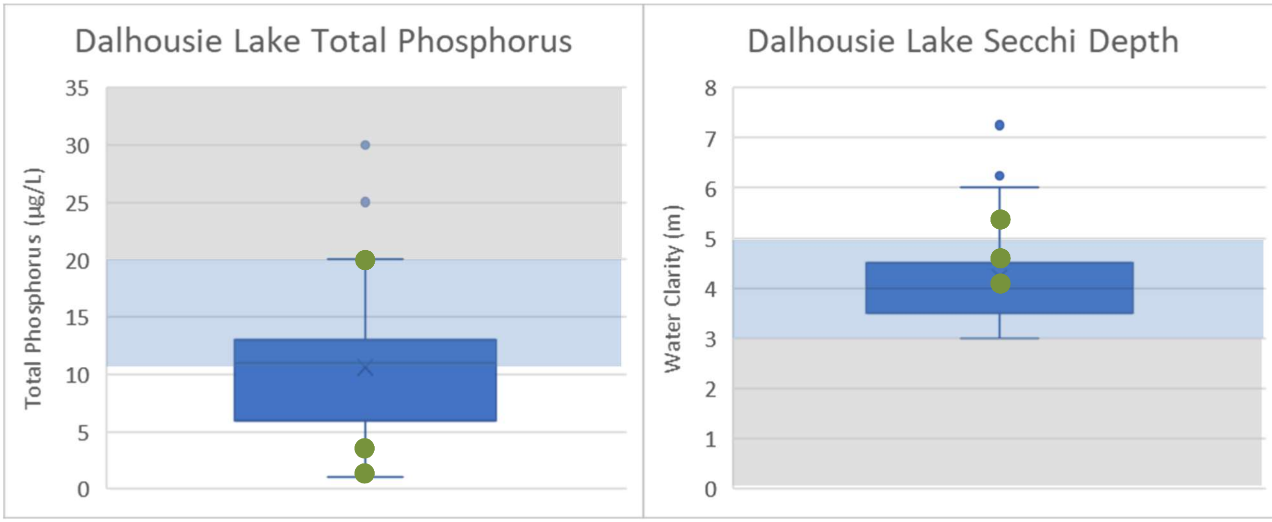


Figure 8: Secchi Depth and Euphotic Zone Total Phosphorus results from ten sampling years for the main basin of Dalhousie Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

5.2 Mississippi Lake

Mississippi Lake is a large and shallow warm-water-lake in Lanark County. It is the furthest downstream lake on the main stem of the Mississippi River system and its outlet is at the town of Carleton Place. It has a maximum depth of 10 meters. MVCA has now monitored it through 19 ice free seasons. A summary of the results from the 2023 survey are presented in Table 6.

Figure 9 illustrates how this year's results for Secchi depth and euphotic zone total phosphorus samples compare with the overall data set for each of the four sampling locations on the lake. While three euphotic zone total phosphorus results were above the 20 µg/L threshold for eutrophic classification, they are still within the typical range for the lake. As shown in Table 6 this year's euphotic zone total phosphorus results were predominately lower than the mesotrophic range (10-20 µg/L), the Secchi depth data fits within the overall historic mesotrophic range. In context with past sampling results there is no indication of a change in trophic classification.

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 6: 2023 sampling summary for Mississippi Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L) *	Calcium (Ca2+) (mg/L)
Inlet (MLI)	9-May-23	7	12	20	80
Inlet	30-Jun-23	3	4	14	
Inlet	12-Sep-23	3.5	8	177	
Burnt Island (MLB)	9-May-23	4	6	<2	N/A
Burnt Island	30-Jun-23	4	5	6	
Burnt Island	12-Sep-23	4	8	14	
Pretties Island (MLP)	9-May-23	3	22		60
Pretties Island	30-Jun-23	3	20		
Pretties Island	12-Sep-23	3.5	9		
Outlet (MLO)	9-May-23	3	2		120
Outlet	30-Jun-23	2.5	34		
Outlet	12-Sep-23	2	7		

*Total phosphorus samples are only taken from 1 m off of the bottom of the lake, and only if the euphotic zone does not extend to the bottom.

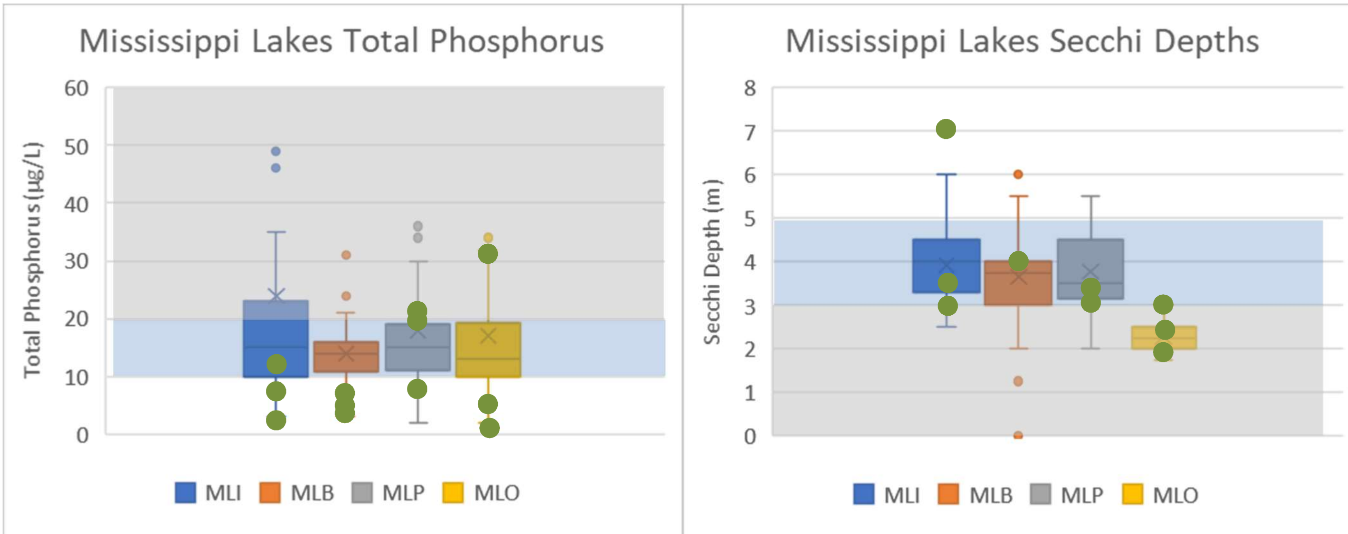


Figure 9: Secchi Depth and Euphotic Zone Total Phosphorus results from 19 sampling years for all four sites. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours. Note: The maximum Secchi depth possible at the outlet site (MLO) is limited by the water depth (3 m) and by a thick bed of aquatic plants inhabiting the area.

6.0 Lake Results: Mazinaw Subwatershed

6.1 Kishkebus Lake

Kishkebus Lake is a small cold-water lake located entirely within the boundaries of Bon Echo Provincial Park in the Mazinaw subwatershed. It is a headwater lake which outlets into Shabomeka Lake, which then flows into Lower Mazinaw Lake. It has one basin with a maximum depth of 32.9 meters and a perimeter of 4.9 kilometers. According to its lake plan, Kishkebus is considered to be at capacity for development around the lake.

Euphotic zone total phosphorus results from 2023 indicate an oligotrophic status for the lake, while Secchi depth readings were more in the mesotrophic range (Table 7). The results from 2023 are in keeping with past sampling as shown in Figure 10. In context with past sampling results, there is no indication of a change in trophic classification.

As a cold-water lake, Kishkebus has been known to support a cold-water fishery; in particular Lake Trout. D.O. profiles reveal excellent conditions for these fish, with plenty of suitable habitat in the lower depths of the lake. Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 7: 2023 sampling summary for Kishkebus Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
Main Basin	29-May-23	2.5	8	8	40
Main Basin	12-Jul-23	3.5	4	10	
Main Basin	28-Sep-23	4	8	13	

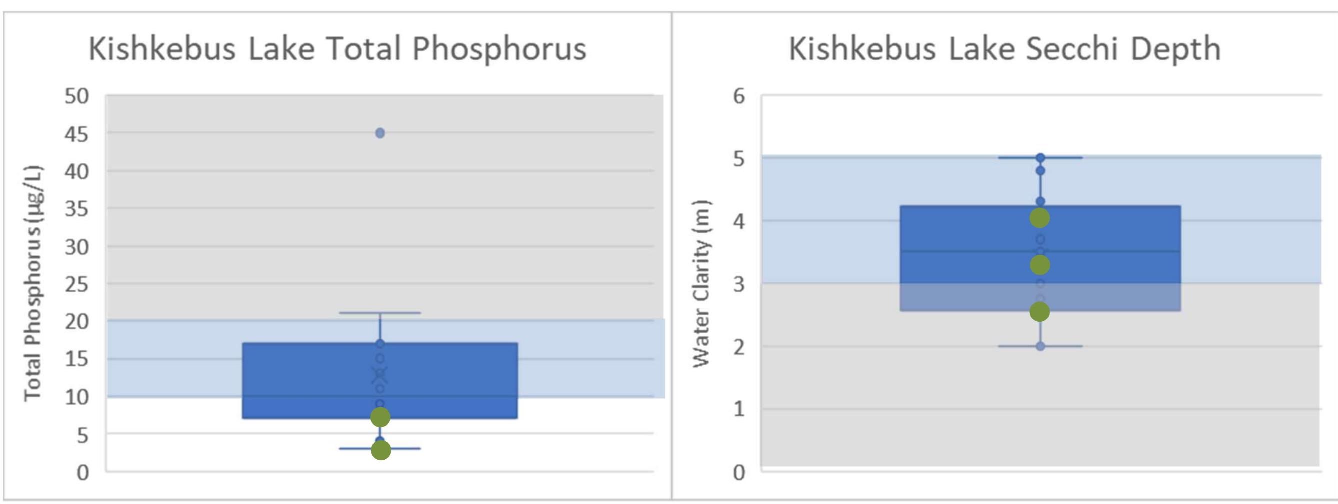


Figure 10: Secchi Depth and Euphotic Zone Total Phosphorus results from five sampling years for the main basin of Kiskebus Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

6.2 Shabomeka Lake

Shabomeka Lake is a deep, cold water lake located just downstream of Kishkebus Lake. It has a perimeter of 14 kilometers and its deepest point is 32 meters. The outlet of Shabomeka Lake is outfitted with a dam and feeds into Lower Mazinaw Lake.

As can be seen in Figure 11 the euphotic zone total phosphorus values and Secchi depth measurements have indicated a predominately oligotrophic status. The 2023 results shown in Table 8 show that the lake maintains this classification with no change in trend over time.

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 8: 2023 sampling summary for Shabomeka Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
Main Basin	29-May-23	4	<2	9	40
Main Basin	12-Jul-23	4	5	7	
Main Basin	28-Sep-23	4	5	13	

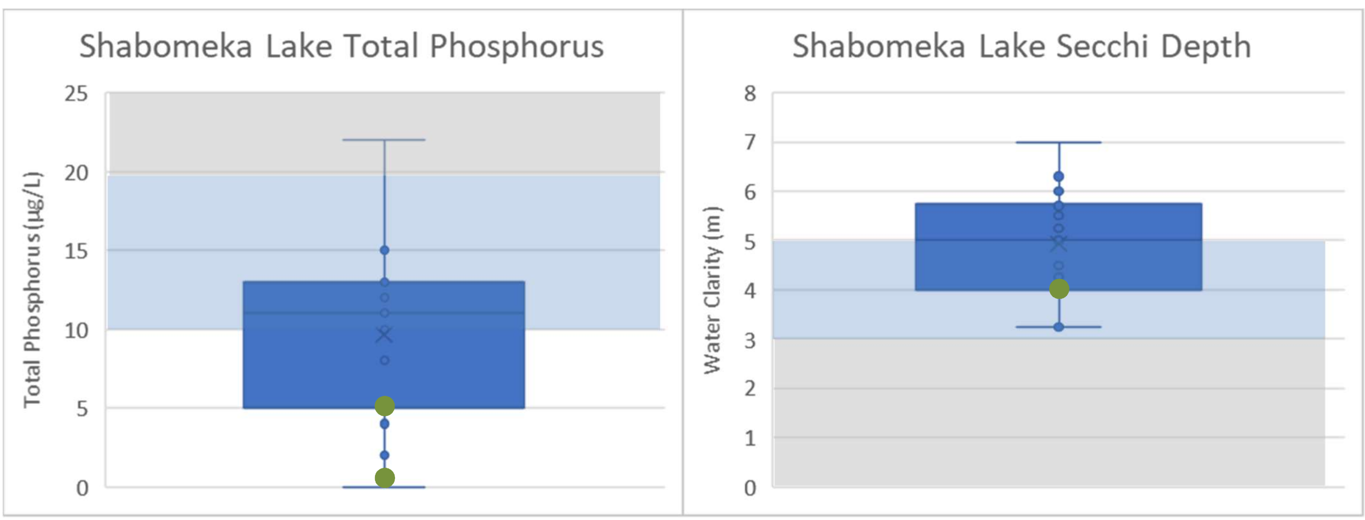


Figure 11: Secchi Depth and Euphotic Zone Total Phosphorus results from four sampling years for the main basin of Shabomeka Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

6.3 Mazinaw Lake

Mazinaw Lake is a large and deep lake on the western edge of the Mississippi Valley watershed. A large section of the lake is part of Bon Echo Provincial Park. It has a maximum depth of 145 meters, making it the seventh deepest lake in Ontario and the deepest lake in the Mississippi Valley watershed. It also features a picturesque rock wall standing over 100 m tall on the eastern side of the lake.

As can be seen in Table 9 the three euphotic zone total phosphorus results for the south basin were above the 10 µg/L threshold, putting it in the mesotrophic classification range. Given the lake's history of having low nutrient concentrations, and the low values reported in the North Basin for 2023, these higher values are likely outliers in the dataset, and there is no statistically significant change in trend over time. Mazinaw Lake is sampled every two years and this enhanced effort will help us put this year's results into the context of the long-term lake status.

The Seccchi depth readings for both basins ranged across the oligotrophic-mesotrophic zones which are similar to past readings as shown in Figure 12.

Mazinaw Lake maintains optimal and critical cold-water fish habitat throughout the ice-free season into the fall. The water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 9: 2023 sampling summary for Mazinaw Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca^{2+}) (mg/L)
North Basin	9-May-23	3.5	4		40
North Basin	30-Jun-23	4	6	3	
North Basin	12-Sep-23	5	3	3	
South Basin	9-May-23	4	28	4	40
South Basin	30-Jun-23	5	11	7	
South Basin	12-Sep-23	5	17	7	

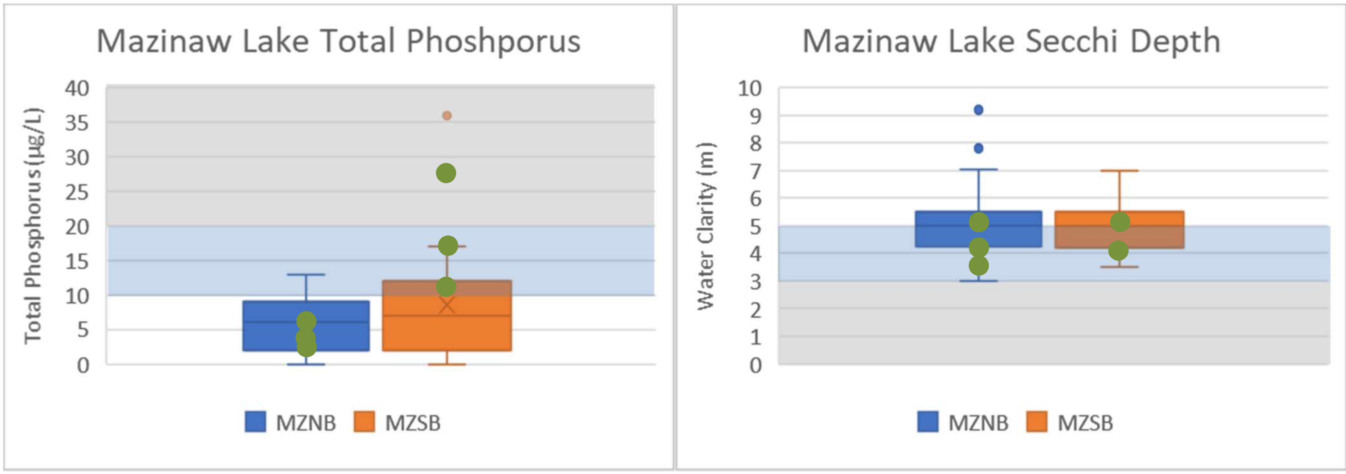


Figure 12: Secchi Depth and Euphotic Zone Total Phosphorus results from six sampling years for Mazinaw Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

6.4 Marble Lake

Marble Lake is a relatively small lake located downstream of Mazinaw Lake at the community of Myers Cave. It has a maximum depth of 20 meters.

As seen in Table 10 and Figure 13, Marble Lake maintains a consistent oligotrophic status according to Total Euphotic Zone Phosphorus results. In context with past sampling results there is no indication of a change in trophic classification.

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 10: 2023 sampling summary for Marble Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
Main Basin	9-Jun-23	4	9	8	40
Main Basin	7-Jul-23	3.5	6	<2	
Main Basin	28-Sep-23	6	6	7	

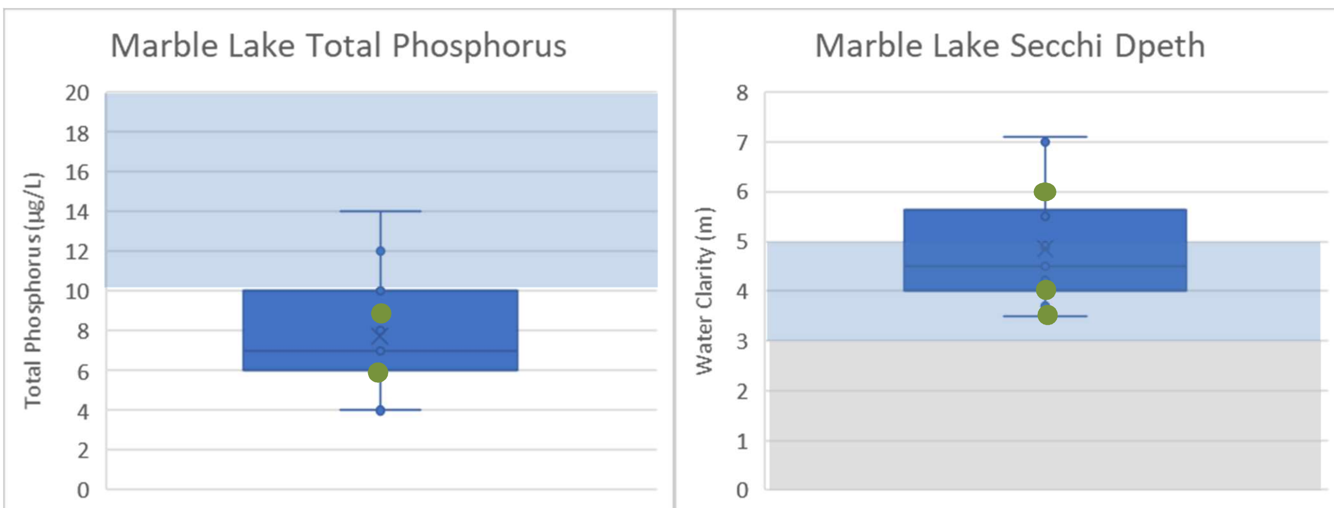


Figure 13: Secchi Depth and Euphotic Zone Total Phosphorus results from five sampling years for the main basin of Marble Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

7.0 Lake Results: Upper Mississippi River Subwatershed

7.1 Kashwakamak Lake

Kashwakamak Lake is a deep cold-water Canadian Shield lake along the main Mississippi River. It is 25 meters deep in the west end and supports cold-water fish species such as lake herring, lake whitefish and brook trout. Warmer water fish such as northern pike, walleye, yellow perch, small and large mouth bass can also be found here.

Based on Secchi depth and surface water total phosphorus results in 2023 (Table 11, Figure 14) the lake maintains its oligotrophic status. In context with historical sampling results there is no indication of a change in trophic classification

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 11: 2023 sampling summary for Kashwakamak Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
West Basin	12-May-23	3	8	18	
West Basin	14-Jul-23	3.5	6	6	
West Basin	8-Sep-23	3.5	3		
East Basin	12-May-23	4.5	<2	<2	60
East Basin	14-Jul-23	3.5	8	<2	
East Basin	8-Sep-23	3.5	<2	5	

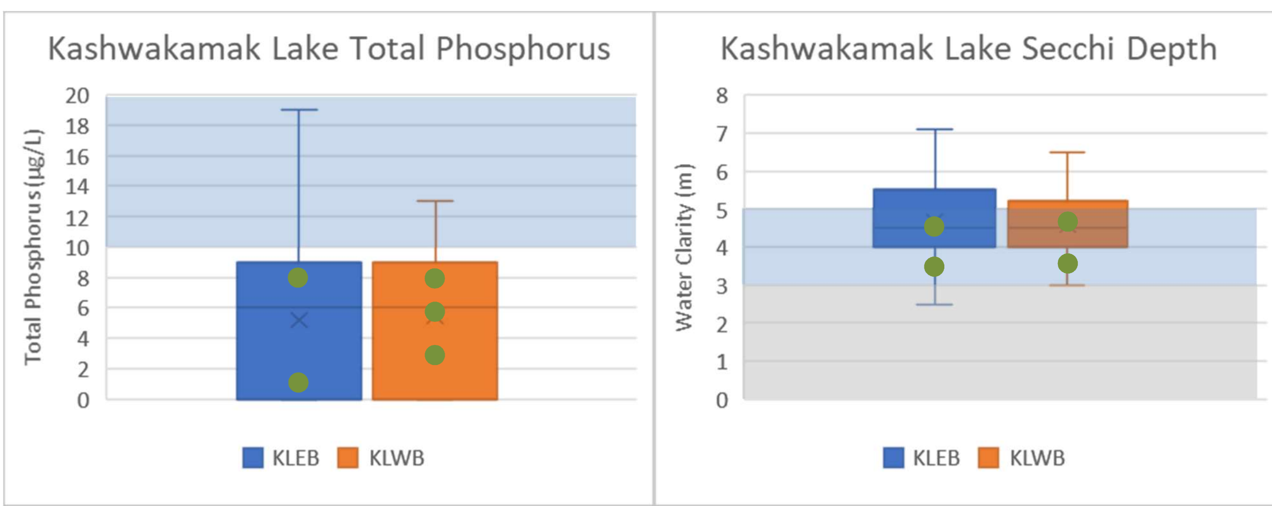


Figure 14: Secchi Depth and Euphotic Zone Total Phosphorus results from five sampling years for both basins in Kashwakamak Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

7.2 Big Gull Lake

Big Gull Lake is a large headwaters cold-water lake in North Frontenac that flows into the south basin Crotch Lake. It has a maximum depth of 26 meters.

The 2023 results (Table 12) returned low to moderate euphotic zone total phosphorus concentrations and moderate Secchi depth measurements. To date, MVCA has monitored Big Gull through four ice free seasons and it has consistently had an oligotrophic classification for total phosphorus and a mesotrophic classification for Secchi depths (Figure 15). In context with past sampling results there is no indication of a change in trophic classification. Figure 15 also helps illustrate that the high reading (37 µg/L TP) from the West Basin September sample is an outlier in the data set.

The water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 12: 2023 sampling summary for Big Gull Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
West Basin	31-May-23	3	5		40
West Basin	25-Jul-23	3	14		
West Basin	20-Sep-23	3	37		
Main Basin	31-May-23	3.5	5	11	
Main Basin	25-Jul-23	5	16	8	
Main Basin	20-Sep-23	4	12	18	
East Basin	31-May-23	3	6	<2	40
East Basin	25-Jul-23	4.5	11	22	
East Basin	20-Sep-23	4	8	9	

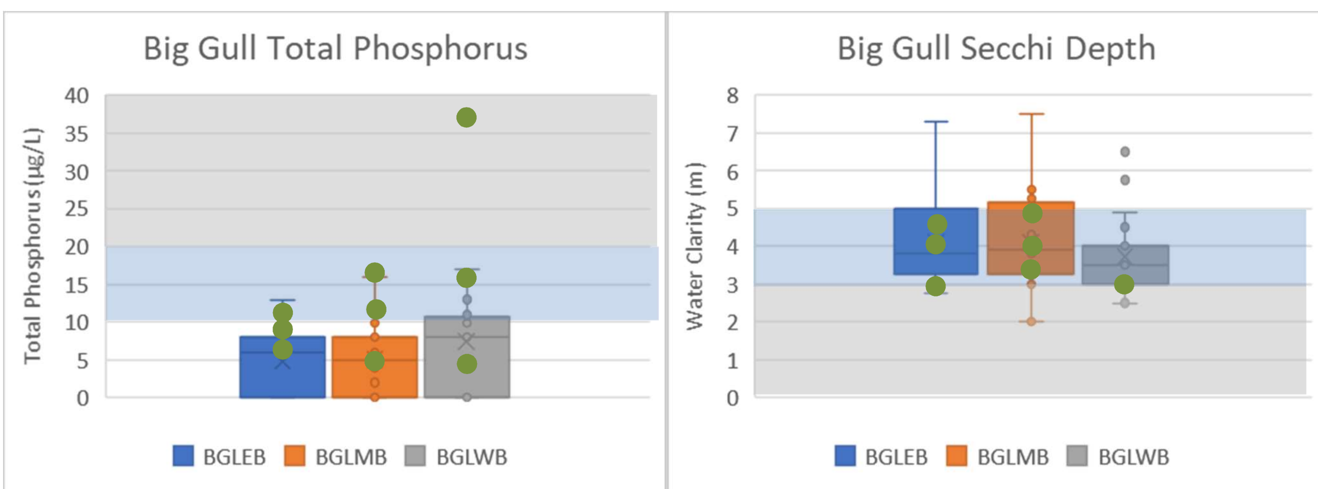
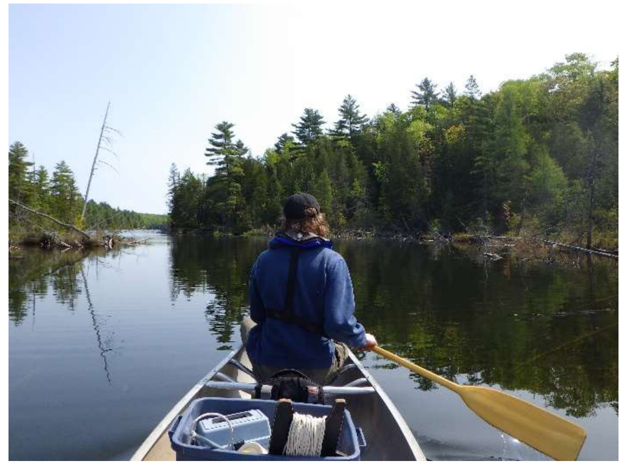


Figure 15: Secchi Depth and Euphotic Zone Total Phosphorus results from three sampling years for the main basin of Big Gull Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

7.3 Ardoch Lake

Ardoch Lake is a small headwaters lake that flows into Malcolm Lake in North Frontenac. It has a maximum depth of 17.4 meters.



MVCA has now monitored this lake through eight ice free seasons and it has consistently had an oligotrophic classification. The 2023 results in Table 13 show that while 2 readings were above the 10 µg/L threshold for mesotrophic status, the Secchi depths across the three sample dates were very deep, indicating a sustained oligotrophic condition. Figure 16 shows the 2023 results in context with past data. There is no indication of a change in trophic classification trend.

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 13: 2023 sampling summary for Ardoch Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
Main Basin	23-May-23	7.5	13	<2	120
Main Basin	5-Jul-23	5	6	6	
Main Basin	27-Sep-23	6.5	12		

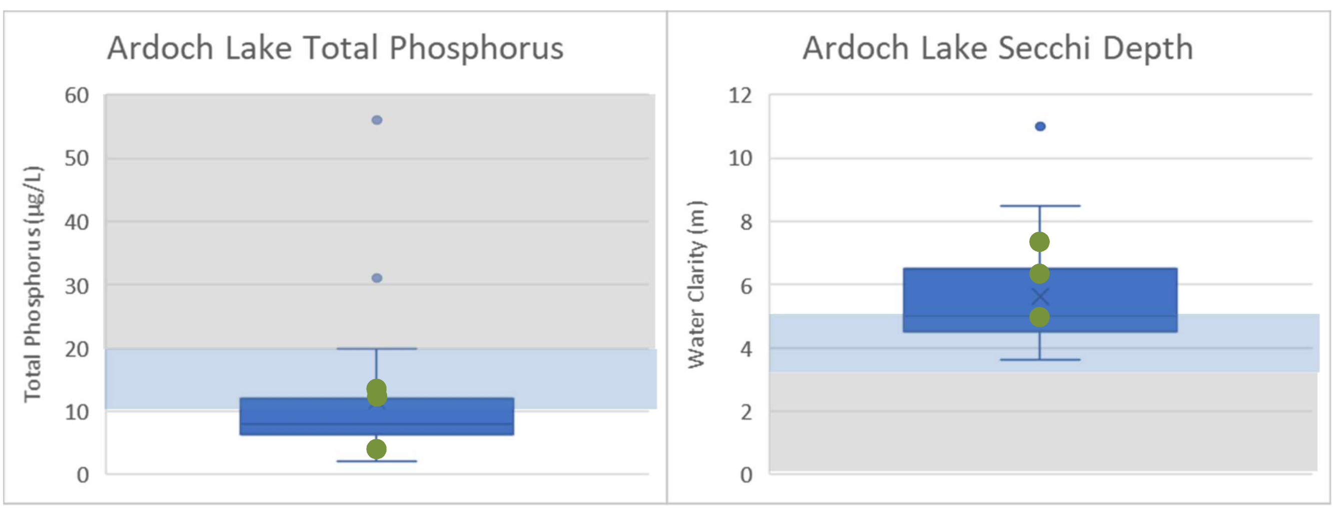


Figure 16: Secchi Depth and Euphotic Zone Total Phosphorus results from three sampling years for the main basin of Ardoch Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

7.4 Malcolm Lake

Malcolm Lake is a shallow warm water lake in North Frontenac that flows into the Mississippi River at the village of Ardoch. It has a maximum depth of 4.6 meters.

The 2023 data (Table 14) shows a high euphotic zone total phosphorus reading for the spring sample, and then low readings in subsequent samples indicating an overall oligotrophic condition. The Secchi depths observed in 2023 indicate a mesotrophic condition for the lake. MVCA has now monitored Malcolm Lake through five ice free seasons and with the exception of an occasional extreme value, it has averaged a meso-oligotrophic status. Figure 17 shows the results from 2023 compared to the results from past sampling efforts, showing that in context with past sampling results there is no indication of a change in trophic classification.

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 14: 2023 sampling summary for Malcolm Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
Main Basin	23-May-23	4.5	27		120
Main Basin	5-Jul-23	4	3		
Main Basin	27-Sep-23	3.5	8		

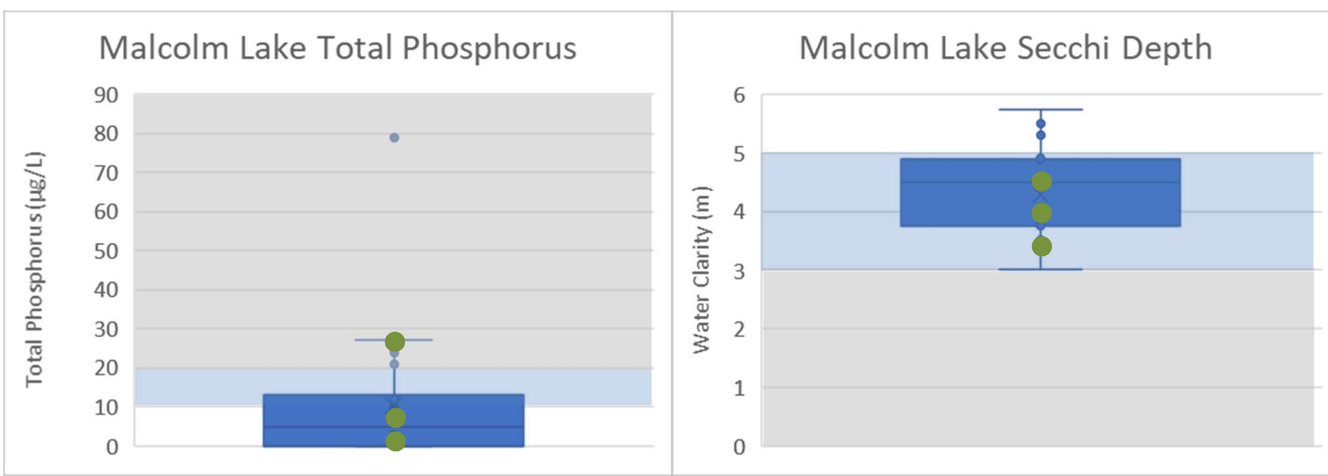


Figure 17: Secchi Depth and Euphotic Zone Total Phosphorus results from three sampling years for the main basin of Malcolm Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours. Note: the maximum extent of Secchi depth is limited by the depth of the lake.

7.5 Mosque Lake

Mosque Lake is a headwater cold-water lake in North Frontenac that flows into Conn's Creek, which outlets into the Mississippi River south of Ompah. It has a maximum depth of 34 meters.

The 2023 data (Table 15) shows low levels of total phosphorus and moderate to deep Secchi depth measurements throughout the lake. MVCA has now monitored it through six ice free seasons and with the exception of inconsistent data from 2000, it has maintained a low to moderate total phosphorus result. Results from 2023 are compared to past data in Figure 18 showing the lake maintaining a primarily oligotrophic classification. In context with past sampling results there is no indication of a change in trophic classification.

Water temperature and dissolved oxygen profile data from the 2023 sampling events are available in Appendix A.

Table 15: 2023 sampling summary for Mosque Lake.

Site	Date	Secchi Depth (m)	Total P – Euphotic Zone (µg/L)	Total P – Bottom Sample (µg/L)	Calcium (Ca2+) (mg/L)
North Basin	11-May-23	4	18	33	
North Basin	20-Jul-23	5.5	4	132	
North Basin	13-Sep-23	5.5	6	9	
South Basin	11-May-23	5	5	31	40
South Basin	20-Jul-23	5	4	22	
South Basin	13-Sep-23	5.5	3	11	
West Basin	11-May-23	4	<2	28	
West Basin	20-Jul-23	4	3	132	
West Basin	13-Sep-23	5	<2	156	

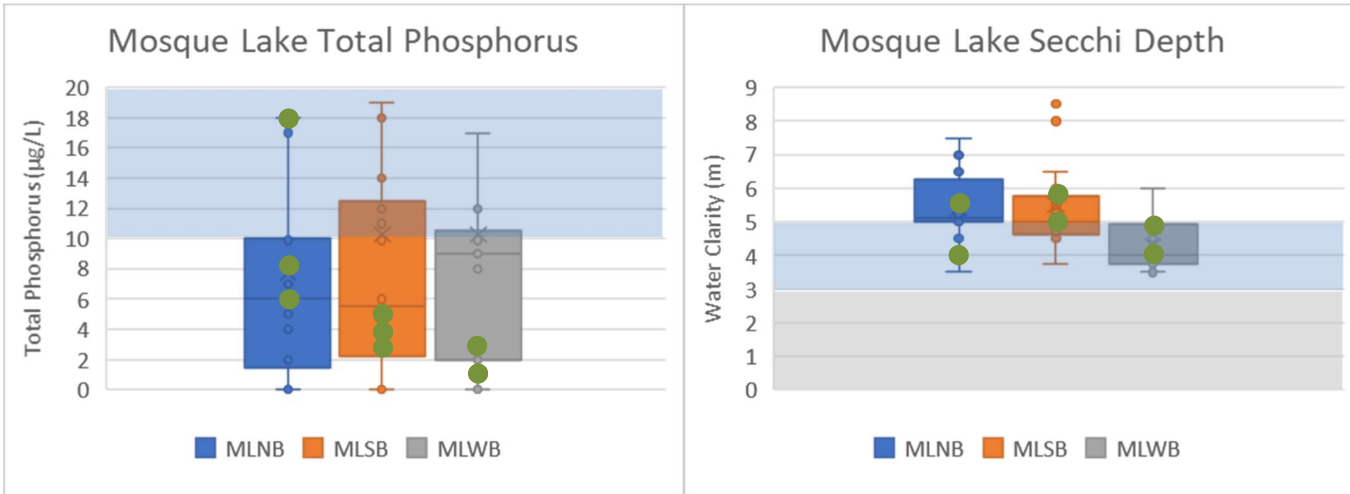


Figure 18: Secchi Depth and Euphotic Zone Total Phosphorus results from three sampling years for the main basin of Mosque Lake. The 2023 results are shown with a green dot, and the trophic level classifications are shown with the blue to grey background colours.

8.0 Stream Monitoring Program

8.1 Summary

While the lake monitoring program focusses efforts on particular subwatershed(s) each year on a rotational basis; stream sampling is also conducted at select additional sites throughout the Mississippi River watershed to help expand MVCA's knowledge of these smaller systems. A limited number of sites within the City of Ottawa were assessed for their fish populations. The remainder of our stream monitoring focused on stream water temperature assessments at sites across our jurisdiction. Figure 19 illustrates the locations of these sites across the Mississippi River watershed and Tables 16a and b summarize the stream site thermal results for 2023.

Brook Trout

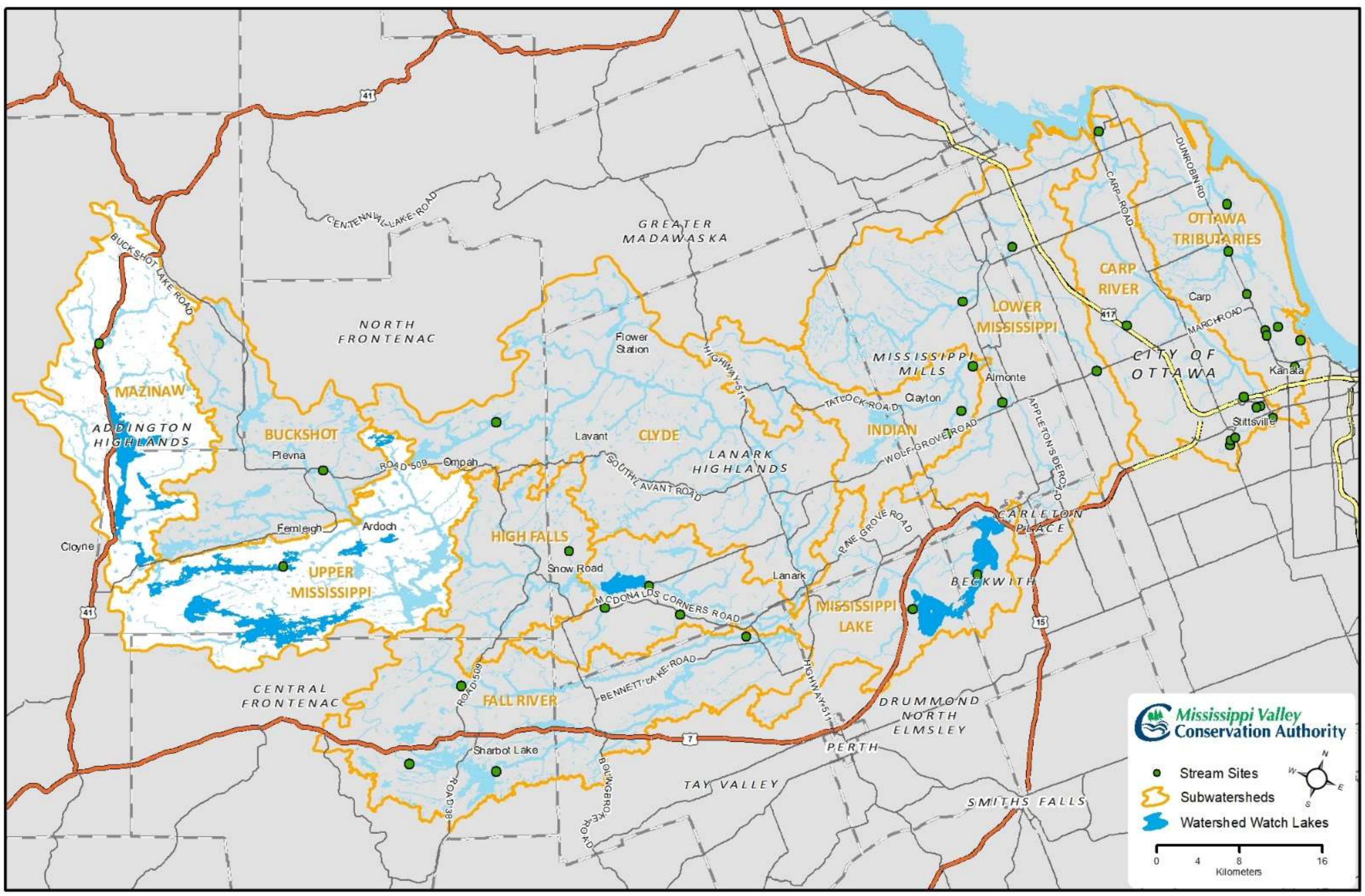


Figure 19: 2023 stream monitoring site locations.

8.2 Temperature Monitoring

Deploying a temperature logger

Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes, and stream shading from riparian vegetation. The natural year-to-year variations of water temperatures can be influenced by many factors (duration and frequency of rain events, flow rates from springs, changes in stream shading, etc.) and can have many impacts on the stress levels and success rates of the cold to cool water fish species that are found in the creek. Both water temperature and maximum air temperature are used (using the revised Stoneman and Jones method by Cindy Chu *et al, 2009*) to classify a watercourse as either cold, cold-cool, cool, cool-warm, or warm water.

Temperature loggers were launched at 12 stream sites in the Mississippi River watershed, and at 7 sites within the City of Ottawa Catchments of the Carp River and Ottawa River Tributaries. These loggers were used to investigate thermal habitat availability and to continue monitoring known cold to cool water streams for potential variations over time. As discussed above in the Water Quantity Summary (Section 3.1), 2023 had two flood warning events in the spring, and average rain fall amounts throughout July and August resulting in a well hydrated system through the hottest part of the year.

Analysis of the temperature logger data indicates that the frequent summer showers in July and August contributed water to the system which likely prevented sites from drying out and resulted in many sites maintaining previous thermal classifications. Four of the sites monitored in 2023 were slightly warmer than the last time they were monitored, while a different four were cooler than previous results. The presence of this variability in the long-term sites shows the short-term sensitivity of each catchment to seasonal weather patterns and the need for long term monitoring to understand the potential for shifts in climate impacts. The overall thermal condition for each 2024 site is summarized in Figures 16a and b.

For example, water temperature in Paul's Creek has now been monitored for eight consecutive ice-free seasons. In 2017 the creek was classified as cool, then, from 2018-2020 the system warmed to a cool-warm system and then has remained in a cool range since 2021.

Not far from Paul's Creek, the downstream reach of Long Sault Creek held an overall cool status since 2015 and has multiple years where portions of the season were noted as cold-cool.

MVCA has monitored the downstream reach of Bolton Creek for seven summer seasons and while the first year (2017) was predominately cool, subsequent years have had more warm days; shifting its classification. While the maximum temps are within the warm classification, every summer has over 50% cool readings and the creek likely has cool refuges which support the fish communities' needs. MVCA has been monitoring the upper reach of Bolton Creek since 2021. That site has had both warm and cool classifications. Unfortunately for the 2023 season the logger was damaged; therefore no 2023 data is available for inclusion in the long-term assessment. This is a very long creek that flows through a diverse landscape of wetlands and forests and it is beneficial to be able to learn more about its varied character through our monitoring efforts.

Mosquito Creek has been monitored for six consecutive years now and results have shown it to fluctuate between being a cool to a cold-cool habitat, with a longer-term cool habitat dominance.

Monitoring water temperatures in 2023 wasn't without its challenges as some sites had out of water events, and other sites had equipment failures part way through the season. This reinforces the importance of maintaining a robust long-term monitoring program so that enough data is captured over time to indicate if changes are occurring.

Table 16a: A summary of the Mississippi River watershed stream sites sampled in 2023 with their thermal classification results. *Note, it may take many years of classification analysis to account for annual weather influences.

Subwatershed	Stream Name	Thermal Classification	Number of Years Monitored
Buckshot Creek	Buckshot Creek	Cool-Warm	3
Fall River	Bolton Creek DS	Warm	7
Fall River	Bolton Creek US	Warm	3
High Falls	Mosquito Creek	Cool	6
Lower Mississippi	Union Hall Creek	Cool	1
Lower Mississippi	Wolf Grove Creek	Cool	1
Lower Mississippi - Off shield	Indian Creek	Cool-Warm	3
Lower Mississippi - On shield	Indian River	Warm	4
Mississippi Lakes	Long Sault Creek	Cool	8
Mississippi Lakes	McIntyre Creek	Warm	3
Mississippi Lakes	Paul's Creek	Cool	8
Upper Mazinaw	Donnelly Creek	n/a	2

Table 16b: A summary of the Carp River and Ottawa Tributaries' stream sites sampled in 2023 with their thermal classification results. *Note, it may take many years of classification analysis to account for annual weather influences.

Subwatershed	Stream Name	Thermal Classification	Number of Years Monitored
Carp River	Carp River at Fitzroy Harbor	Warm	1
Carp River	Corkery Creek	Cool-Warm	3
Carp River	Upper Carp Creek	Cool	3
Constance Creek	Harwood Creek	Cool	4
Ottawa Tribs	Shirley's Brook – Klondike	Cool	2
Ottawa Tribs	Shirley's Brook – North Branch	Cool	2
Ottawa Tribs	Watt's Creek – Downstream	Cool-Warm	3

9.0 Shoreline Stewardship

MVCA's Tree Planting Programs

Shoreline tree planting is an effective way to protect water quality, combat erosion, clean the water, and create healthy habitat for fish, birds, pollinators and other wildlife.

MVCA administers a small-scale shoreline planting program where MVCA staff conduct a site visit then work with the property owners to design a shoreline planting plan that will suit their property's needs. MVCA then orders, delivers and installs the plants according to the agreed upon plan. In 2023, this program resulted in 430 trees and shrubs being planted across 10 properties.

For the past seven years, MVCA has been working with a select number of lake associations on a rotational basis to pilot a tree day event, where property owners are offered up to 15 shoreline plants per property. In 2023, MVCA partnered with the Palmerston Lake Association, Canonto Lake Association, and Malcom and Ardoch Lake Association to distribute 517 plants to 32 properties. Due to the continued success of this program within the lake community, MVCA will be working with Kashwakamak Lake and Sunday Lake in the spring of 2024.

10.0 Lake Planning

2023 Activity Summary

MVCA has a mandated role to address natural hazard issues, such as flooding and erosion in the review of planning applications under the Planning Act. MVCA also administers Ontario Regulation 153/06. The purpose of this regulation is to prevent loss of life and property due to flooding and erosion, and to conserve and enhance natural resources. In MVCA regulated areas (floodplains, shorelines and wetlands), permission is required from MVCA for development, interference with wetlands, and alterations to shorelines and watercourses.

Having reliable information about the health of a lake is essential for providing appropriate and effective recommendations on development applications. The monitoring information is often used in the review of planning applications and may assist in developing mitigation recommendations so impacts of development are minimized.

Monitoring of our lakes also informs shoreline residents, both seasonal and permanent, of the lake health which encourages them to become stewards of their lake by taking an active role in restoring and enhancing their shoreline. Stewardship initiatives that protect and enhance water quality include temporarily storing water (eg. rain barrels), directing runoff away from the lake (e.g. installing properly working eavestroughs), creating or enhancing surfaces to allow more water to infiltrate rather than run off along the surface (e.g. rain gardens), and planting trees and shrubs along the shoreline.

Appendix A: Water Temperature and Dissolved Oxygen Profile Details

The results from the 2023 temperature and dissolved oxygen profiles from all the lake sampling events are presented below in alphabetical order. For the lakes with appropriate cool to cold water conditions, a colour code has been applied to the table representing optimal cold-water habitat conditions (in blue) and the fringe vital conditions for survival (in pink) as defined in Table A-1. Some of the warm water lakes may be shown to have these conditions periodically but they do not last throughout the season and thus the lake only supports a warm water fishery.

Table A-2 summarizes the thermal classifications for the lakes sampled in 2023. Some of the cold-water lakes may no longer support certain cold-water fish species (such as Lake Trout) due to historical stocking activities or water level management efforts.

Table A-1: Optimal and vital habitat conditions for cold water fish species such as Lake Trout.

(blue)	Optimal Habitat for Cold Water Fisheries (Trout) = DO > 6 mg/L at < 10°C
(pink)	Vital Habitat for Cold Water Fisheries (Trout) = DO > 4 mg/L at < 15.5°C

Table A-2: List of cold water and warm water lakes monitored in 2023.

Cold Water Lakes	Warm Water Lakes
Big Gull Lake	Marble Lake
Kiskebus Lake	Kashwakamak Lake
Mazinaw Lake	Malcolm Lake
Mosque Lake	Ardoch Lake
Shabomeka Lake	Dalhousie Lake
	Mississippi Lake

Rainbow Trout

Ardoch Lake

Main Basin

ALMB	23-May-23		05-Jul-23		27-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	15.4	10.21	25.5	8.32	18.9	9.51
1	15.4	10.22	25.1	5.45	18.6	9.52
2	15.1	10.24	24.7	8.50	18.6	9.52
3	15.0	10.21	23.8	8.58	18.6	9.51
4	14.8	10.21	22.1	10.24	18.5	9.53
5	13.8	10.38	19.4	12.01	18.5	9.52
6	11.3	10.88	14.7	12.18	18.5	9.48
7	9.4	10.74	11.9	11.57	18.2	9.41
8	7.8	9.74	8.9	10.53	14.7	9.33
9	6.9	8.87	7.9	9.56	11.3	6.67
10	6.5	8.05	7.2	7.58	9.8	4.36
11	6.3	7.60	6.9	6.25	8.8	2.19
12	6.1	7.21	6.6	4.60	8.0	0.92
13	5.9	6.49	6.4	2.81	7.7	0.70
14	5.8	0.94				

Big Gull Lake

West Basin

BLGWB	31-May-23		25-Jul-23		20-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	26.3	8.39	27.1	8.22	19.0	9.07
1	21.6	8.78	25.4	8.14	19.1	9.05
2	20.1	8.96	25.0	8.05	18.9	9.02
3	19.0	8.79	24.8	0.53	18.9	9.05
4					19.3	0.69

Main Basin

BLGMB	31-May-23		25-Jul-23		20-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	20.9	9.30	25.7	8.42	19.2	8.78
1	18.2	9.72	24.7	8.52	19.3	8.74
2	17.8	9.73	24.2	8.51	19.3	8.68
3	17.0	9.70	23.8	8.51	19.3	8.66
4	16.2	9.62	23.7	8.35	19.4	8.64
5	14.8	9.69	21.9	7.62	19.4	8.63
6	13.5	9.45	18.1	6.72	19.4	8.60
7	12.5	9.52	15.4	6.37	19.4	8.60
8	11.7	9.35	13.4	6.15	19.4	8.55
9	10.2	9.23	11.9	6.24	19.3	8.43
10	9.8	9.11	10.8	6.52	13.4	3.16
11	9.1	9.19	10.0	6.82	11.8	3.34
12	8.7	9.01	9.7	7.04	11.3	3.49
13	8.5	9.09	9.3	6.99	10.4	3.89
14	8.1	9.19	9.0	7.09	10.0	4.29
15	7.8	9.19	8.6	7.26	9.5	4.91
16	7.7	9.18	8.2	6.62	9.1	4.80
17	7.6	9.09	8.0	6.19	8.7	4.65
18	7.5	9.02	7.8	6.48	8.3	4.32
19	7.4	8.92	7.7	6.12	8.0	2.54
20	7.1	8.08	7.5	4.79	7.8	2.74
21	6.8	0.58	7.3	3.54	7.7	1.96
22					7.6	1.75
23					7.5	0.68

East Basin

BLGEB	31-May-23		25-Jul-23		20-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	20.2	9.31	25.8	8.28	19.7	8.68
1	19.9	9.32	25.2	8.30	19.7	8.67
2	18.4	9.59	25.0	8.31	19.7	8.65
3	16.8	9.73	24.9	8.29	19.7	8.63
4	15.7	9.77	24.9	8.28	19.7	8.61
5	13.3	9.70	23.6	7.74	19.7	8.59
6	12.6	9.57	17.6	6.43	19.7	8.57
7	11.5	9.29	15.2	5.79	19.7	8.55
8	10.2	9.05	12.7	5.21	19.7	8.43
9	9.8	8.88	11.2	4.87	18.4	4.43
10	9.5	8.74	10.2	4.93	14.2	1.84
11	9.3	8.82	9.8	4.98	11.8	1.42
12	9.2	8.72	9.6	5.01	11.2	1.54
13	9.0	8.55	9.6	4.99	10.6	1.66
14	8.9	8.43	9.6	4.96	10.4	1.73
15	8.7	8.11	9.5	4.94	10.3	1.76
16	8.7	7.97			10.2	1.78
17	8.6	7.97			10.2	1.79
18					10.1	1.81
19					10.1	1.82

Dalhousie Lake

Main Basin

DLMB	18-May-23		23-Jun-23		05-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	14.2	10.99	25.6	8.41	24.8	8.83
1	13.9	10.99	23.6	8.48	23.7	8.91
2	13.9	10.98	23.1	8.72	22.5	8.88
3	13.8	11.00	21.6	8.77	22.0	8.80
4	13.8	10.98	20.1	8.16	21.5	8.37
5	13.8	10.96	18.9	7.16	21.3	8.20
6	13.7	10.95	18.3	6.59	21.2	8.05
7	13.7	10.92	17.4	5.84	21.1	8.14
8	13.6	10.86	16.6	5.39	19.9	3.70
9	13.6	10.82	15.2	4.49	17.0	0.83
10	13.6	10.72	14.0	2.81	15.4	0.66
11	13.4	10.63	13.6	1.74	14.1	0.60
12	13.2	10.48	13.4	1.33		
13	12.4	9.84				
14	12.2	9.70				
15	11.7	9.30				

Kashwakamak Lake

West Basin

KLWB	12-May-23		14-Jul-23		08-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	15.7	11.75	24.3	8.31	23.0	8.91
1	14.5	11.92	24.1	8.33	23.0	8.91
2	13.4	12.03	23.8	8.33	23.0	8.90
3	12.6	12.11	23.8	8.29	23.0	8.88
4	11.1	12.25	23.4	8.30	22.4	8.87
5	9.9	12.12	20.9	8.93	21.8	8.82
6	9.7	12.06	18.3	8.45	21.5	8.80
7	9.1	11.84	15.1	8.47	20.9	8.29
8	8.7	11.75	12.7	8.02	15.1	6.12
9	8.5	11.72	10.1	6.58	11.3	4.89
10	8.3	11.69	9.0	6.22	9.5	3.94
11	7.8	11.30	8.1	5.57	8.8	3.21
12	7.2	10.85	7.9	42.60	8.3	1.95
13			7.6	4.20	8.1	1.37
14			7.4	2.37	7.7	0.61

East Basin

KLEB	12-May-23		14-Jul-23		08-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	14.8	11.96	24.1	8.22	23.8	8.82
1	13.6	12.09	24.0	8.24	23.8	8.80
2	13.4	12.11	23.9	8.23	238.0	8.78
3	13.1	12.12	23.9	8.22	23.8	8.76
4	12.7	12.15	23.8	8.20	23.3	8.72
5	10.8	12.37	22.9	8.31	22.3	8.79
6	9.4	12.43	19.1	8.39	21.0	8.45
7	8.7	12.13	18.9	8.42	18.4	7.54
8	8.3	11.96	15.9	8.18	15.2	7.46
9	7.9	11.82	13.2	9.08	11.6	7.35
10	7.5	11.58	10.5	8.65	9.7	7.37
11	7.2	11.46	9.0	7.89	8.9	6.35
12	6.9	11.32	8.3	7.00	8.3	5.05
13	6.7	11.25	7.9	7.07	8.1	5.27
14	6.6	11.14	7.8	7.04	7.9	5.31
15	6.5	11.07	7.6	7.72	7.7	6.04

16	6.4	10.97	7.4	8.19	7.5	5.87
17	6.3	10.84	7.3	8.12	7.4	5.89
18	6.1	10.82	7.1	7.52	7.2	5.29
19	6.0	10.62	6.8	6.74	7.0	4.24
20	5.8	10.32	6.7	5.67	6.9	3.19
21	5.8	9.80	6.6	4.76	6.8	2.20
22			6.4	3.39	6.6	0.99

Kiskebus Lake

Main Basin

KKMB	29-May-23		12-Jul-23		28-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	20.1	9.29	25.1	8.32	17.7	9.25
1	19.9	9.33	25.0	8.32	17.6	9.22
2	18.0	9.48	24.8	8.25	17.4	9.21
3	15.3	9.40	19.9	8.39	17.4	9.19
4	13.7	9.03	14.9	7.87	17.3	9.17
5	9.2	8.66	10.1	7.66	16.1	7.96
6	7.8	8.65	8.5	7.73	11.9	7.02
7	6.5	8.54	7.2	7.86	9.1	6.40
8	5.7	8.46	6.3	7.93	7.6	6.41
9	5.1	8.36	5.3	7.99	6.5	6.56
10	4.6	8.31	5.1	7.99	5.6	6.75
11	4.5	8.17	4.7	8.00	5.2	6.79
12	4.3	8.04	4.5	7.85	4.8	6.88
13	4.3	7.95	4.4	7.77	4.6	6.80
14	4.2	7.90	4.3	7.71	4.4	6.71
15	4.2	7.82	4.2	7.60	4.3	6.59
16	4.2	7.72	4.2	7.43	4.2	6.18
17	4.1	7.57	4.1	7.35	4.2	5.98
18	4.1	7.39	4.1	7.15	4.1	5.40
19	4.1	7.24	4.1	6.99	4.1	5.10
20	4.1	6.86	4.0	6.46	4.1	4.47
21	4.0	6.62	4.0	6.01	4.1	2.80
22	4.0	6.14	4.0	5.33	4.1	1.82
23	4.0	5.33	4.0	4.60	4.1	1.59
24			4.0	3.79	4.1	1.41
25			4.1	0.66		

Malcolm Lake

Main Basin

MLMB	23-May-23		05-Jul-23		27-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	17.2	9.92	26.8	8.46	18.2	9.74
1	16.4	10.17	26.3	8.53	18.0	9.78
2	16.1	10.11	25.3	8.64	17.8	9.69
3	16.1	10.10	24.6	8.51	17.7	9.78
4	15.9	10.31	23.6	6.97	17.7	9.90
5	14.6	0.78	20.5	5.90	18.0	0.67
6					18.3	0.58

Marble Lake

Main Basin

MRMB	09-Jun-23		07-Jul-23		28-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	18.0	9.36	26.6	8.06	17.8	9.23
1	18.0	9.34	26.6	8.05	17.8	9.22
2	18.0	9.30	26.5	8.01	17.8	9.20
3	18.0	9.29	23.9	8.81	17.8	9.19
4	17.3	9.32	21.1	8.51	17.8	9.15
5	14.1	9.62	17.0	7.48	17.8	9.09
6	11.3	9.95	12.7	7.68	17.7	8.97
7	9.6	10.23	10.5	8.09	15.6	5.15
8	7.8	10.18	8.3	7.98	11.1	3.71
9	6.8	10.00	7.1	7.83	8.8	3.25
10	6.4	9.78	6.4	7.40	7.4	2.52
11	6.1	9.64	6.1	7.25	6.7	3.13
12	5.9	9.30	6.0	7.06	6.4	2.30
13	5.8	9.05	5.9	6.84	6.2	2.53
14	5.6	8.67	5.8	6.58	6.1	2.16
15	5.6	8.49	5.7	5.94	6.0	1.81
16	5.5	8.33	5.6	5.93	5.9	1.46
17	5.5	63.60	5.6	5.77	5.9	1.25
18	5.4	8.01	5.6	5.28	5.8	0.96
19	5.4	7.91	5.5	5.00	5.8	0.84
20	5.4	7.79	5.4	0.58		
21	5.4	7.54				
22	5.4	7.30				
23	5.2	0.68				

Mazinaw Lake

North Basin

MZNB	09-May-23		30-Jun-23		12-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	18.5	9.11	22.8	8.95	19.8	9.30
1	18.3	9.14	22.8	8.95	19.3	9.31
2	18.1	9.17	22.8	8.94	19.1	9.28
3	17.8	9.18	22.8	8.92	19.0	9.31
4	16.8	9.59	22.7	8.93	19.0	9.30
5	14.4	97.40	22.7	8.91	18.9	9.24
6	12.5	10.14	19.8	9.00	18.7	9.20
7	11.3	10.16	13.5	9.58	18.7	9.15
8	10.2	10.23	10.9	9.96	17.1	8.71
9	9.9	10.22	8.6	10.29	13.5	8.94
10	8.7	10.26			10.9	9.31
11	7.0	10.35			8.9	9.51
12	6.9	10.35			7.7	9.87
13	5.6	10.42			7.3	9.98
14	5.4	10.37			7.1	10.05
15					6.8	10.04
16					6.3	10.06
17					6.0	0.91
18					6.0	0.75

South Basin

MZSB	09-May-23		30-Jun-23		12-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	19.5	8.93	22.7	8.76	19.1	9.20
1	19.5	8.92	22.7	8.75	19.0	9.17
2	19.4	8.92	22.7	8.70	18.9	98.40
3	18.6	9.17	22.6	8.70	18.9	9.12
4	14.2	10.33	22.6	8.66	18.9	9.12
5	12.9	10.21	22.5	8.62	18.8	9.12
6	11.8	9.95	18.3	8.62	18.8	9.10
7	10.7	9.89	13.1	8.84	18.8	9.07
8	9.8	9.95	9.8	9.39	18.7	9.04
9	8.9	9.98	9.4	9.47	13.3	8.08
10	8.5	9.98	8.5	9.59	10.4	8.40
11	8.0	10.00	7.9	9.59	8.9	8.54

12	7.3	10.02	7.6	9.63	8.3	8.44
13	7.1	10.00	7.4	9.53	7.8	8.72
14	6.6	10.04	7.2	9.55	7.6	8.63
15	6.3	10.05	7.0	9.66	7.4	8.60
16	6.2	10.06	6.9	9.67	7.1	8.64
17	6.1	10.09	6.8	9.68	7.0	8.69
18	6.0	10.09	6.7	9.75	6.9	8.80
19	5.9	10.05	6.5	9.81	6.7	8.90
20	5.8	10.05	6.4	9.83	6.5	8.93
21	5.6	10.09	6.2	9.83	6.4	8.93
22	5.6	10.08	6.2	9.81	6.3	8.86
23	5.5	10.05	6.1	9.80	6.2	8.87
24	5.4	10.05	6.0	9.89	6.2	8.88
25	5.3	10.05	5.9	9.90	6.1	8.91
26	5.2	10.04	5.8	9.88	6.0	9.10
27	5.2	10.02	5.7	9.91	5.9	9.11
28	5.2	10.00	5.7	9.91	5.7	9.08
29	5.2	9.98	5.6	9.91	5.6	9.07
30	5.2	9.96	5.6	9.91	5.5	9.15
31	5.1	9.97	5.5	9.93	5.5	9.14
32	5.1	9.95	5.5	9.89	5.5	9.13
33	5.1	9.92	5.5	9.83	5.5	9.11
34	5.1	9.91	5.4	0.85	5.5	9.10
35	5.0	9.90	5.4	0.75	5.5	9.08
36	5.0	9.88	5.3	0.70	5.4	9.12
37	5.0	9.86	5.3	0.68	5.4	9.11
38	5.0	9.83	5.3	0.65	5.4	9.08
39	5.0	9.81	5.3	0.63	5.4	9.07
40	5.0	9.78	5.3	0.62	5.4	9.04
41	4.9	9.78	5.4	0.59	5.4	9.02
42	4.9	9.76	5.4	0.58	5.4	8.99
43	5.0	9.72	5.4	0.57	5.4	8.97
44	5.0	9.70	5.4	0.56	5.4	8.93
45	4.9	9.71	5.4	0.56	5.3	8.90
46	4.9	9.67	5.4	0.55	5.3	8.91
47	4.9	9.65	5.4	0.55	5.3	8.89
48	4.9	9.63	5.4	0.54	5.3	8.88
49	4.9	9.62	5.4	0.54	5.3	8.87
50	4.9	9.55			5.3	8.85

Mississippi Lake

Inlet

MLI	09-May-23		30-Jun-23		12-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	14.3	9.65	23.8	7.48	22.9	8.81
1	14.0	9.56	23.8	7.43	23.0	8.75
2	14.0	9.52	23.8	7.38	23.0	8.63
3	14.0	9.48	22.9	6.23	22.9	8.50
4	14.0	9.48	20.9	4.48	22.5	7.42
5	14.0	9.49	19.8	3.95	21.5	6.44
6	14.0	9.48	18.3	3.19	20.7	4.95
7	14.1	9.48	16.6	0.96	19.6	2.50
8			15.5	0.53	16.5	0.74
9			14.4	0.47	14.4	0.63
10			14.2	0.46	13.6	0.63

Burnt Island

MLB	09-May-23		30-Jun-23		12-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	13.9	10.44	23.4	7.95	22.0	9.82
1	13.8	10.42	23.2	7.93	22.1	9.79
2	13.7	10.32	23.0	7.97	22.1	9.74
3	13.5	10.17	22.9	7.92	22.1	9.65
4	13.1	10.01	22.4	6.87	22.0	9.52
5	13.0	9.85	20.7	4.26	21.9	9.42
6	13.0	9.75	19.9	3.28	21.4	6.80
7	12.9	9.71	19.6	3.06	21.1	5.80
8	12.3	9.41	19.5	2.86	21.0	5.92
9			19.4	2.72	20.9	5.45
10			18.8	1.83	20.6	4.20

Pretties Island

MLP	09-May-23		30-Jun-23		12-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	13.6	10.44	23.6	8.30	22.4	9.91
1	13.5	10.43	23.6	8.09	22.5	9.87
2	13.3	10.38	23.3	7.68	22.4	9.67
3	13.2	10.36	22.9	7.21	22.3	9.46
4	13.2	10.32	20.8	3.59	21.6	6.86
5	13.2	10.27	20.0	2.42	21.4	6.15
6	12.5	9.91	19.6	1.63	21.3	5.76
7	12.4	9.28	19.2	0.45		

Outlet

MLO	09-May-23		30-Jun-23		12-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	13.2	10.75	23.4	8.16	22.3	10.22
1	13.2	10.73	23.3	8.24	22.3	10.19
2	13.1	10.74	23.2	7.93	22.4	10.22
3	13.1	10.73				

Mosque Lake

West Basin

MLWB	11-May-23		20-Jul-23		13-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	15.2	11.85	24.7	8.26	21.4	8.80
1	14.0	11.99	24.6	8.27	21.5	8.77
2	12.1	13.11	24.2	8.29	21.5	8.74
3	10.6	13.14	23.9	8.08	21.5	8.72
4	9.5	12.95	23.0	8.10	21.5	8.66
5	7.5	12.03	16.2	11.96	20.7	7.91
6	6.1	9.60	11.9	10.86	16.4	7.20
7	5.2	6.68	8.7	8.34	12.0	4.96
8	4.8	4.70	7.1	5.64	9.2	3.06
9	4.6	4.03	5.9	2.45	7.4	1.44
10	4.5	2.82	5.2	0.94	6.5	1.12
11	4.3	2.46	4.9	0.83	5.6	1.02
12	4.3	1.53	4.8	0.75	5.2	0.85
13	4.2	0.62	4.7	0.67	5.0	0.73
14	4.2	0.59	4.5	0.62	4.9	0.69
15	4.2	0.56	4.4	0.60	4.7	0.67
16			4.4	0.58	4.7	0.64
17			4.4	0.56		

South Basin

MLSB	11-May-23		20-Jul-23		13-Sep-23	
Depth (m)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)	Temp (°C)	D.O. (mg/L)
0.1	14.3	12.03	24.4	8.40	21.4	8.87
1	13.9	12.10	24.3	8.41	21.4	8.85
2	13.3	12.30	24.2	8.49	21.4	8.84
3	12.5	12.65	24.0	8.40	21.5	8.81
4	10.4	13.34	23.6	8.38	21.5	8.79
5	9.1	13.16	19.5	9.99	21.1	8.81
6	7.7	12.45	14.9	10.29	19.8	8.72
7	6.8	11.75	10.9	10.55	15.0	8.88
8	6.2	11.39	8.8	8.80	11.7	7.45
9	5.8	11.00	7.9	9.26	9.8	7.56
10	5.6	10.57	7.0	9.07	8.5	7.80
11	5.3	10.41	6.4	8.33	7.3	6.70
12	5.1	10.21	5.8	7.64	6.6	6.77
13	4.9	10.05	5.5	7.60	6.0	6.71
14	4.7	9.92	5.2	7.22	5.5	6.46
15	4.6	9.72	4.9	6.89	5.2	5.83
16	4.6	9.47	4.7	6.55	4.9	5.59
17	4.5	9.39	4.5	6.44	4.7	5.28
18	4.4	9.12	4.4	6.11	4.6	5.05
19	4.3	8.85	4.3	5.88	4.5	4.85
20	4.3	8.87	4.3	4.66	4.4	4.63
21	4.2	8.64	4.2	5.41	4.3	4.26
22	4.2	8.51	4.1	5.16	4.3	4.50
23	4.2	8.21	4.1	4.75	4.2	3.66
24	4.1	8.02	4.1	4.23	4.2	2.96
25	4.1	7.87	4.1	3.34	4.2	2.24
26	4.1	7.43	4.1	2.51	4.2	1.55
27	4.1	7.13	4.2	2.05	4.2	1.12
28	4.1	6.84	4.1	1.64	4.2	0.85
29	4.1	6.02	5.2	0.58	4.2	0.72

North Basin

MLNB	11-May-23		20-Jul-23		13-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	14.8	12.12	25.2	8.38	21.3	8.92
1	14.5	12.17	24.8	8.40	21.5	8.88
2	13.5	12.30	24.7	8.37	21.5	8.86
3	12.5	12.70	24.6	8.37	21.5	8.84
4	10.0	13.55	24.3	8.35	21.5	8.80
5	9.4	13.42	20.3	10.18	21.5	8.78
6	8.8	13.18	16.2	10.01	20.5	8.67
7	8.1	12.04	12.6	9.76	16.4	9.27
8	6.8	10.73	10.0	8.89	12.6	8.56
9	6.3	10.16	8.2	7.43	10.3	6.82
10	6.0	9.69	7.1	6.98	8.5	5.82
11	5.7	9.30	6.5	6.33	7.3	4.35
12	5.4	9.10	6.1	5.56	6.6	3.03
13	5.2	8.51	5.8	5.82	6.1	3.09
14	5.1	8.28	5.7	4.62	5.8	2.38
15			5.5	4.63	5.6	2.82
16			54.0	4.45	5.5	2.82
17			5.3	4.11	5.3	1.63
18			5.1	3.42	5.2	0.79

Shabomeka Lake

Main Basin

SLMB	29-May-23		12-Jul-23		28-Sep-23	
Depth (m)	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**	**Temp (°C)**	**D.O. (mg/L)**
0.1	19.7	9.28	25.4	8.26	18.5	9.69
1	19.5	9.28	24.9	8.29	18.4	9.71
2	18.3	9.49	24.8	8.28	18.2	9.71
3	18.1	9.52	24.7	8.26	18.2	9.69
4	15.4	10.00	21.3	9.58	18.2	9.67
5	12.6	10.56	16.5	10.05	18.1	9.64
6	8.6	10.84	12.9	10.65	18.0	9.62
7	7.5	10.55	10.1	10.63	13.7	11.87
8	6.8	10.20	7.7	9.96	9.6	9.78
9	6.4	9.92	6.7	9.34	8.5	8.72
10	6.1	9.81	6.1	9.19	7.0	8.06
11	5.9	9.72	5.9	9.04	6.6	7.79
12	5.6	9.59	5.7	8.88	6.1	7.70
13	5.5	9.49	5.5	8.86	5.9	7.74
14	5.4	9.37	5.4	8.90	5.8	7.63
15	5.3	9.39	5.3	8.51	5.6	7.48
16	5.2	9.36	5.2	8.77	5.5	7.28
17	5.1	9.30	5.2	8.71	5.4	7.19
18	5.0	9.25	5.1	8.70	5.3	7.06
19	5.0	9.18	5.1	8.63	5.3	6.40
20	4.9	9.06	5.0	8.04	5.2	6.03
21	4.9	8.94	4.9	7.94	5.1	5.78
22	4.8	8.90	4.9	7.89	5.0	5.35
23	4.8	8.84	4.8	7.84	5.0	4.99
24	4.8	8.76	4.8	7.84	4.9	4.80
25	4.8	8.64	4.8	7.56	4.8	4.61
26	4.7	8.51	4.8	7.47	4.8	3.93
27	4.7	8.45	4.7	7.37	4.8	3.39
28	4.7	8.37	4.7	7.11	4.8	3.11
29	4.7	8.28	4.7	6.42	4.7	2.78
30	4.7	7.67	4.7	5.14	4.7	2.34
31	4.6	7.49	4.6	3.54	4.7	2.18

Appendix B: Lake Results Summary

Lake Name	Max Depth (m)	Thermal Status	# Years Sampled	2023 Avg. Total Phosphorus (µg/L)	2023 Avg. Secchi Depth (m)	Trophic Status		Trophic Trend	
						Total Phosphorus	Secchi Depth	Total Phosphorus	Secchi Depth
Ardoch	17.4	Warm	8	10.3	6.3	Mesotrophic	Oligotrophic	Stable	Stable
Big Gull	26.0	Cold	5	12.7	3.7	Mesotrophic	Mesotrophic	Stable	Stable
Dalhousie	11.0	Warm	11	7.5	4.7	Oligotrophic	Mesotrophic	Stable	Stable
Kashwakamak	22.0	Warm	7	6.8	3.6	Oligotrophic	Mesotrophic	Stable	Stable
Kishkebus	32.9	Cold	5	6.7	3.3	Oligotrophic	Mesotrophic	Stable	Stable
Malcolm^	4.6	Warm	5	12.7	4.0	Mesotrophic	Mesotrophic	Stable	Stable
Marble	18.3	Warm	5	7.0	4.5	Oligotrophic	Mesotrophic	Stable	Stable
Mazinaw*	145.0	Cold	8	8.2	4.4	Oligotrophic	Mesotrophic	Stable	Stable
Mississippi	10.0	Warm	19	10.8	3.5	Mesotrophic	Mesotrophic	Stable	Stable
Mosque	34.0	Cold	6	5.0	4.7	Oligotrophic	Mesotrophic	Stable	Stable
Shabomeka	32.0	Cold	5	9.7	4.0	Oligotrophic	Mesotrophic	Stable	Stable

^Malcolm is not >5m deep therefore can't get an oligotrophic Secchi depth rating.

*Mazinaw South Basin outlier removed.