

2019 Water Quality Committee Report

2019 Summary

Based on monitoring performed in 2019 by the Water Quality Committee, the water quality of Watchic Lake remains good and is substantially unchanged from data collected over the previous 3 years (2016-2018). As in recent years, a loss of oxygen in the lower depths of the lake was observed in 2019 as the summer progressed (low oxygen restricts viable fish species and may cause bound phosphorus release). In addition, specific observations for this year included a slightly lower average water clarity, a slight increase in the average pH with corresponding decrease in alkalinity and 3 large concentrations of metaphyton (loons need clear water to fish and we all want it for our lake activities). All of these observations will be monitored closely in 2020.

While water quality is good today, Watchic Lake remains at risk over the long term. Nutrient laden run-off from storms (especially mega-storms) can enter the watershed and lake causing negative changes in the lake's water quality. This could lead to significant algae blooms. In addition, while to-date no invasive plant or aquatic species have been identified in Watchic Lake, it only takes a little carelessness to create a big problem. Homeowners must be diligent on both counts: stop storm run-off entering the lake and always remove plant and other organic material from boats and fishing gear.

The Watchic Lake Watershed Protection Plan sponsored by the Watchic Lake Association (WLA) is being reviewed by the Environmental Protection Agency and will be finalized soon. This report will provide more specifics on how property owners and the Town of Standish can help protect our lake.

Table of Contents

2019 Summary	1
Scope of Report	2
Background and Methodology	2
Weather	3
Water sampling/monitoring	4
Lake Monitoring at Deep Spot - WLA Buoy.....	5
Page Brook Monitoring	6
Metaphyton Monitoring	6
Data Gaps	6
Results	6
Weather	6

Water Sampling - Lake	8
Temperature and Dissolved Oxygen.....	8
Trophic State indicators	11
Chemical Parameters	13
Metaphyton	13
Water Sampling - Tributaries	14
Conclusions and Recommendations	15
Recommendations for Continued Water Monitoring.....	15
General Recommendations for Lake Users to maintain and improve Water Quality	16
Recommendations for Lake Users to avoid the spread of Invasive Plants and other Species	16
GLOSSARY OF KEY TERMS	16

Scope of Report

This report summarizes data collected on Watchic Lake and its tributaries from 29-Oct-18 to 19-Oct-19. The data is compared to historical data (mostly 2016-2018, but also older data when appropriate) to look for trends or variations which could suggest a change in lake water quality or health. This analysis is used to direct further monitoring efforts and if necessary, specific actions.

Background and Methodology

This report documents the results of water quality monitoring conducted at Watchic Lake by the WLA Water Quality Committee volunteers in 2019. This work leverages that directed by FB Environmental (FBE) from 2016-2018 and represents the commitment of WLA volunteers to fully manage the monitoring going forward. Monitoring was conducted at the Deep spot of the Lake (see Figure 1), Page Brook, North of Kiwanis Beach and mouth of both Paine and Page Brooks.

Figure 1: Watchic Lake Monitoring sites



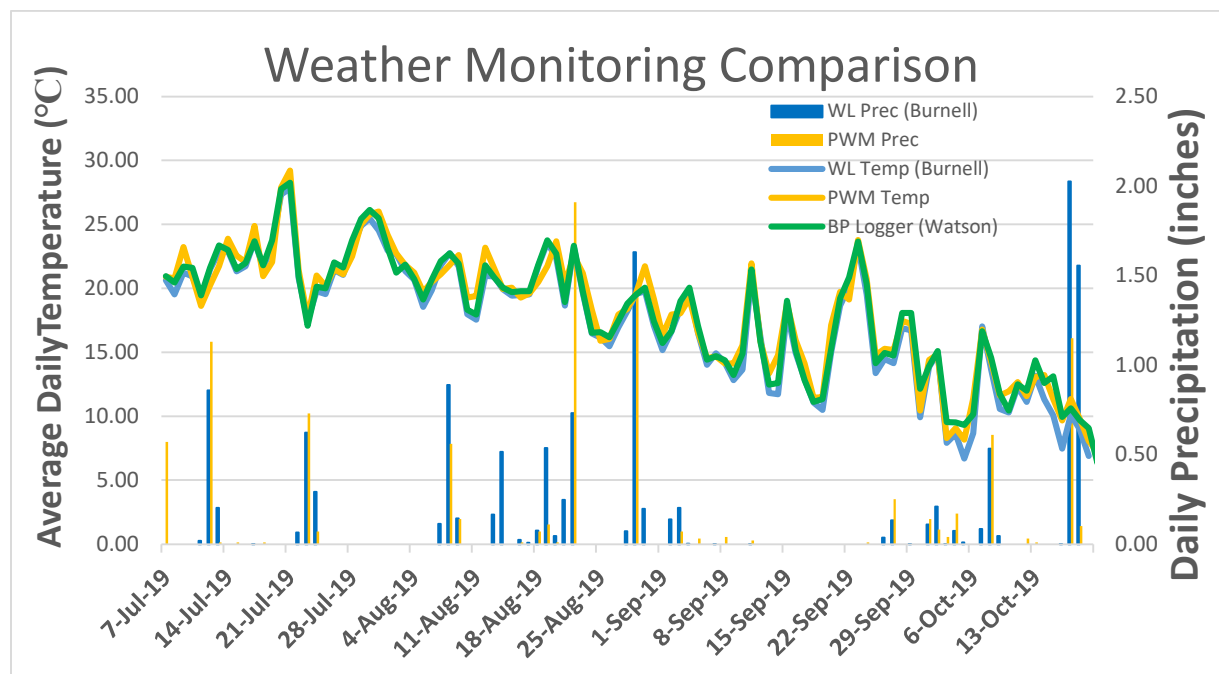
Weather

In 2016-2018, air temperature and barometric pressure was collected using an Onset HOBO® barometric pressure logger deployed on the east side of the lake (Bradbury dock). For 2019, the logger was deployed on the north end of the lake (Watson dock).

Precipitation data was obtained from the Portland Jetport

(<https://www.wunderground.com/history/monthly/us/me/south-portland/KPWM/date/2019-4>). This year a personal weather station was installed on the lake (Burnell dock) starting on 7-Jul-2019 (<https://dashboard.ambientweather.net/devices/public/07ab0e16e084b686213a92cd64264c2e>). This station measures outdoor temperature, precipitation, wind direction/speed and other parameters. A comparison of the data obtained from all 3 sources from 7-Jul to 19-Oct is presented in Figure 2.

Figure 2: Air Temperature and Precipitation Comparison



The comparison of the average daily temperature suggests fairly consistent temperatures between the 3 sites, with an average difference of -0.6 to 0.1°C (range 2.2 to -3.1°C). However, the daily precipitation values differed considerably between the Jetport (PWM) and the Watchic Lake (Burnell) sites. For example, during the storm on 17-Oct, 2.0 inches of rain were recorded at Watchic Lake, while only 1.1 inches were recorded at the Jetport. Conversely on 22-Aug, 1.9 inches of rain were recorded at the Jetport, while only 0.7 inches were recorded at Watchic Lake. These large differences in rainfall could have a major impact on our interpretation of lake data. For this reason, going forward, we will attempt to use local precipitation data if available.

Ice-in and Ice-out dates are taken from the Dam logbook and from the Lake Stewards of Maine (resident reported).

Water sampling/monitoring

All water sampling and monitoring was conducted in accordance with standard methods and procedures for lake monitoring established by the Maine Department of Environmental Protection (Maine DEP), the US Environmental Protection Agency (USEPA), and Lake Stewards of Maine (LSM- formerly the Maine Volunteer Lake Monitoring Program (VLMP)). Water Quality Committee volunteers (Cathy Watson and David and Eileen Burnell) received formal training and certification in these methods from Lake Stewards of Maine. Table 1 lists the dates monitoring was performed and the procedures carried out.

Table 1: 2019 Monitoring Schedule

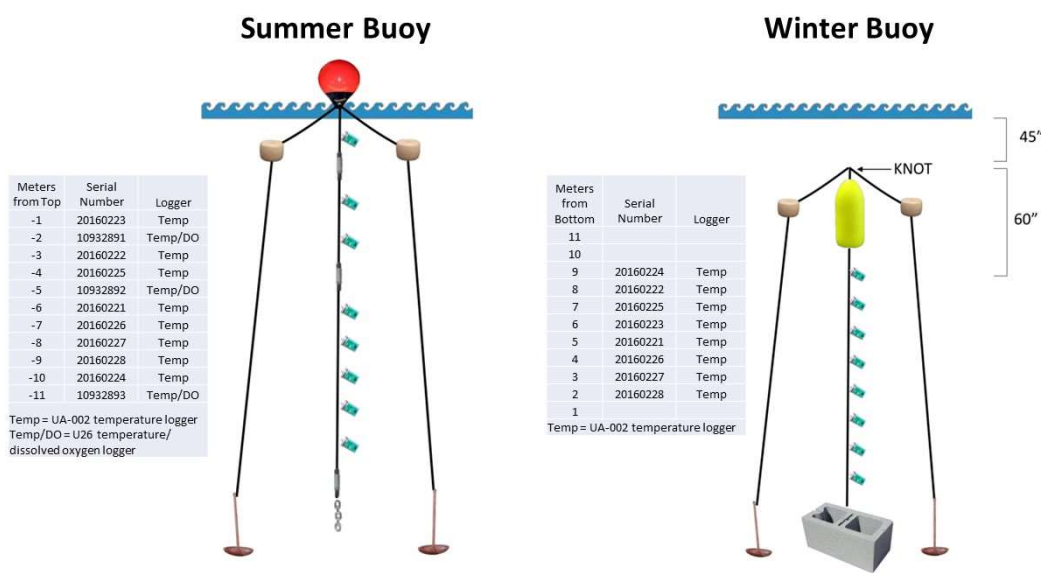
Date	Volunteer(s)	Secchi	Temp/DO	Meter	Logger reading	Water Samples	Metaphyt on survey	Comments
29-Apr-19	Cathy Watson, David Burnell	✓	✓	ProODO	✓*			Buoy Reconfigured (3 DO loggers re-deployed for summer). *Attempted logger reading - unsuccessful due to low battery in shuttle
04-May-19	Eileen and David Burnell	✓	✓	YSI-550A				
19-May-19	Eileen and David Burnell	✓	✓	YSI-550A				
05-Jun-19	Eileen and David Burnell	✓	✓	YSI-550A				
12-Jun-19	Eileen and David Burnell	✓	✓	YSI-550A	✓	✓ Core		
28-Jun-19	Eileen and David Burnell						✓	Mouth of Page Brook and north of Kiwanis Beach
01-Jul-19	Eileen and David Burnell	✓	✓	YSI-550A				
08-Jul-19	Cathy Watson	✓	✓	ProODO	✓			
12-Jul-19	Eileen and David Burnell	✓	✓	YSI-550A				
15-Jul-19	Cathy Watson	✓	✓	YSI-550A	✓	✓ Core		
28-Jul-19	Eileen and David Burnell	✓	✓	ProODO				
02-Aug-19	Eileen and David Burnell						✓	Mouth of Page and Paine Brooks and north of Kiwanis Beach
11-Aug-19	Eileen and David Burnell	✓	✓	ProODO				
12-Aug-19	Cathy Watson, Paul Baptiste	✓	✓	ProODO	✓	✓ Core, Bottom Grab, Page Brook		
25-Aug-19	Eileen and David Burnell	✓	✓	ProODO				
08-Sep-19	Eileen and David Burnell	✓	✓	ProODO				
21-Sep-19	Eileen and David Burnell	✓	✓	ProODO				
22-Sep-19	Eileen and David Burnell						✓	Mouths of Page and Paine Brooks and north of Kiwanis Beach
25-Sep-19	Cathy Watson	✓	✓	ProODO	✓	✓ Core, Bottom		

Date	Volunteer(s)	Secchi	Temp/DO	Meter	Logger reading	Water Samples	Metaphyt on survey	Comments
						Grab, Page Brook		
06-Oct-19	Eileen and David Burnell	✓	✓	ProSOLO				
18-Oct-19	Cathy Watson, Owen Smith	✓	✓	ProODO	✓			Buoy Reconfigured (all DO loggers removed for winter)

Lake Monitoring at Deep Spot - WLA Buoy

WLA Water Quality volunteers maintained a series of Onset HOB0® continuous logging devices at the WLA Buoy. The winter buoy consists of 8 Onset HOB0® UA-002 temperature loggers at 1-meter intervals starting at 2 meters from the bottom of the lake (Figure 3). The winter buoy was deployed on 29-Oct-2018 and remained in place over the 2018/2019 winter. An attempt to recover the data from these loggers was made on 29-Apr-2019. Unfortunately, the battery on the transfer shuttle was low and a complete transfer was not achieved, except for the 10m temperature logger (serial #20160224, located 9m from bottom on the winter buoy). The winter buoy was reconfigured to the summer buoy (Figure 3) and redeployed on 29-Apr-2019. The reconfiguration included adding 3 Onset HOB0® U26 temperature/dissolved oxygen loggers at 2, 5 and 11 meters below the water surface (these depths equate to critical layers in the water column, which becomes thermally-stratified in summer) and redistributing the temperature loggers at 1-meter intervals (Figure 3). The winter logger data, including any not retrieved on 29-Apr-19 was retrieved on 8-Jul-2019. The loggers were cleaned and downloaded during each monthly sampling event. The summer buoy was reconfigured back to the winter buoy (removal of U26 temperature/dissolved oxygen loggers and redistribution of the UA-002 temperature loggers) and redeployed on 19-Oct-2019. All loggers are set to read every 15 minutes while deployed.

Figure 3: Buoy and HOB0® Logger configurations for Summer and Winter



WLA volunteers collected manual temperature and dissolved oxygen profiles (using YSI DO meters) and Secchi disk transparency readings bi-weekly from May – October (Table 1).

In addition to the above measurements, integrated epilimnetic cores (a column of water taken from the surface of the lake, through the epilimnion (biologically active area) to the upper part of the thermocline (where the water temperature changes rapidly) were extracted monthly during the 2019 season (see Table 1 for dates). The thermocline was determined based on the Secchi disk, temperature and dissolved oxygen readings on the day of sampling. These core samples represent an average of lake water quality and were analyzed for trophic state indicators (total phosphorus and chlorophyll-a) and chemical parameters (total alkalinity, pH, and color). All samples were analyzed at the Health and Environmental Testing Laboratory (HETL) in Augusta, ME.

This year, volunteers resumed taking water samples from the bottom of the lake in August. These bottom grab samples were taken using a Kemmerer Bottle (1.2 L PVC, Silicone) sampler on 2 dates (Table 1 above) and analyzed for total phosphorus at HETL.

Page Brook Monitoring

Page Brook was monitored at the sampling station just downstream from the Route 113 bridge near the Outpost Restaurant. This sampling stations is located far enough upstream from the brook's outlet to the lake in order to minimize the impact of any mixing with lake water. The brook was monitored for dissolved oxygen and temperature and total phosphorus (analyzed at HETL) on 2 days this year (Table 1 above).

Metaphyton Monitoring

A large area of metaphyton was reported just north of Kiwanis beach. Arial pictures of the area were obtained using a drone from Firefly Aerial Solutions on 9-Jul-19. Two other areas (at the mouth of Paine and Page Brooks) were later reported to have similar concentrations of metaphyton, though on a smaller scale. All 3 areas were monitored regularly by WLA volunteers Eileen and David Burnell using a protocol developed by Lake Stewards of Maine (LSM).

Data Gaps

The following is a list of data gaps in the 2019 continuous logger dataset and the reason for the missing data.

- Temperature data from 15-Jul-19 from to 12-Aug-19 at 1 meter; error in data download.
- Temperature data from 29-Apr-19 to 8-Jul-19 at 3 meters; error in data down.
- Temperature and dissolved oxygen data from 8-Jul-19 to 15-Jul-19 at 5 meters; error in data download

Results

Weather

Weather can have a major effect on the water quality of a lake. A summary of the weather conditions from Oct-2018 to Oct-2019 is given below.

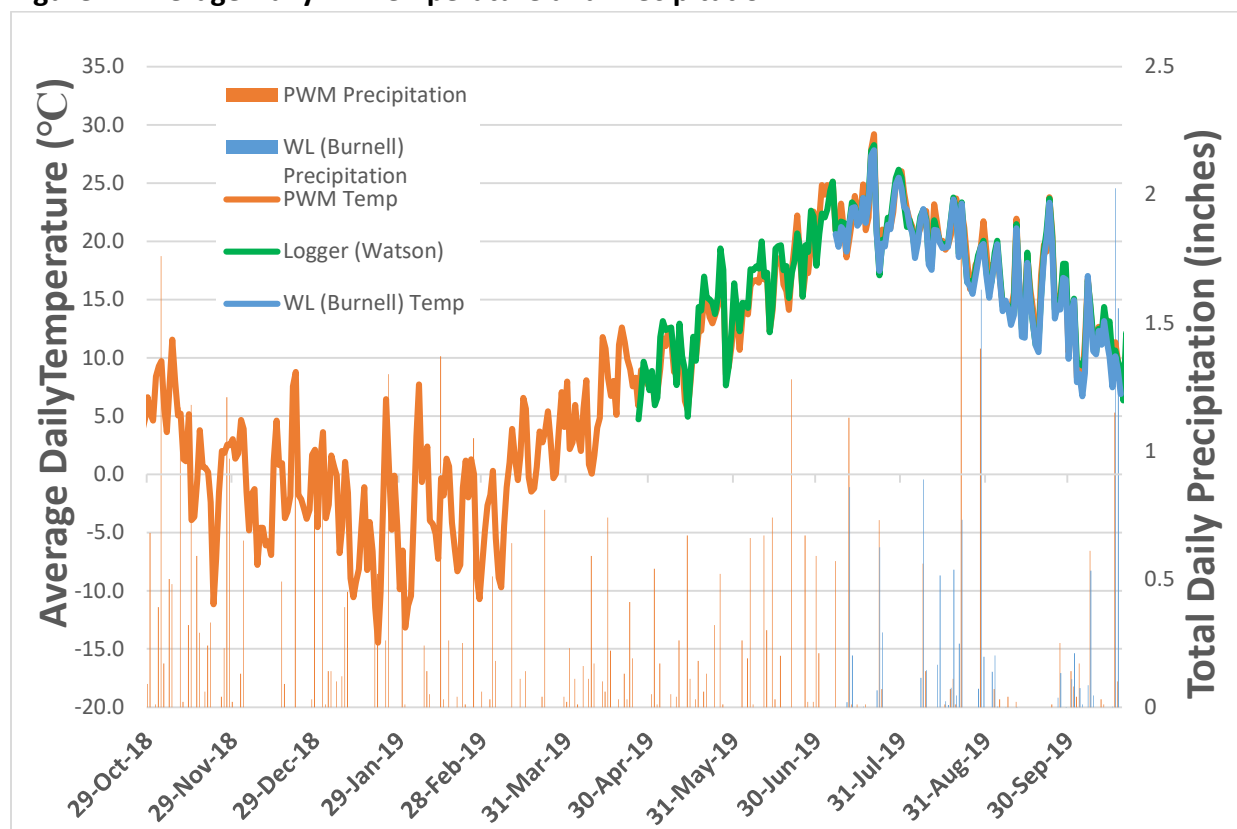
Ice-in and Ice-out time can affect water quality by increasing/decreasing the growing season for algae. Dates for the last 4 years are shown in Table 2. Other than the early ice-out in 2016, dates are remarkably similar from 2017-2019. The earliest ice-out recorded in recent years was 09-Mar-2010.

Table 2: Ice-in/Ice-Out Dates

YEAR	ICE-OUT	ICE-IN
2016	13-Mar-16	Not Recorded
2017	15-Apr-17	15-Dec-17
2018	22-Apr-18	13-Dec-18
2019	16-Apr-19	17-Dec-19

The average daily air temperature and precipitation at Portland Jetport (Oct-18 to 31-Oct-19) and at the lake (Burnell dock from 7-Jul-19 to 19-Oct-19) and the temperature at the lake (logger at Watson dock – 26-Apr-19 to 31-Oct-19) are shown in Figure 4.

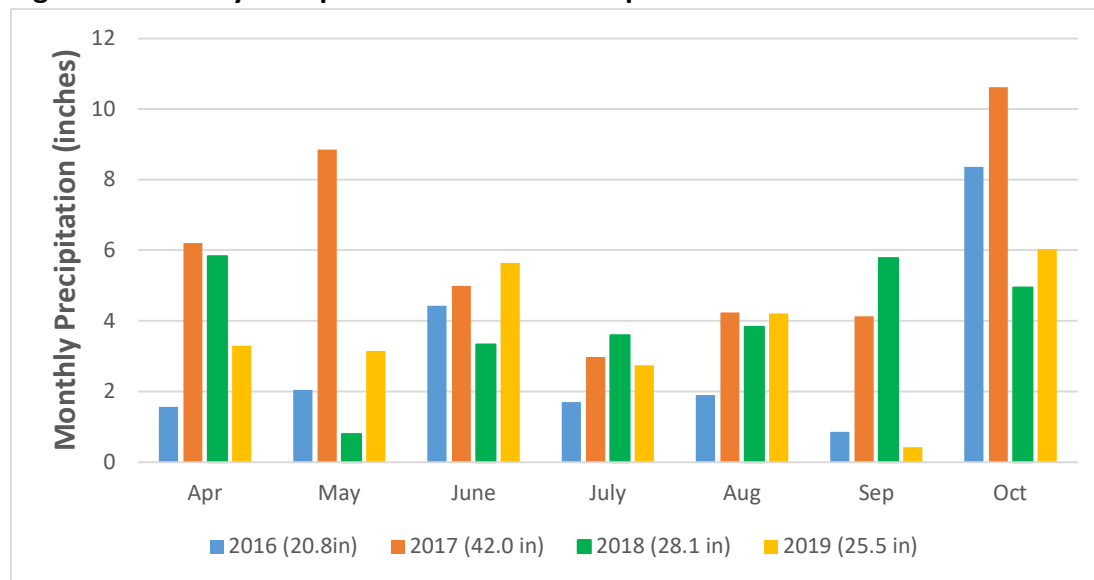
Figure 4: Average Daily Air Temperature and Precipitation



The total monthly precipitation recorded at the Portland Jetport for the last 4 lake seasons (May-Oct) are presented in Figure 5. Insufficient data was collected at the Burnell's dock to do analysis this year. Based on the data from the Jetport, 2019 was similar to 2018 in terms of

total rain (25.5 vs 28.1 inches), and could be described as a moderate year for total rain (25.5in vs. 42in in 2017 and 20.8in in 2016). Figure 4 and 5 suggest that with the exception of the month of September, which was relatively dry (only 0.4 in rain), rainfall was constant during the rest of the year.

Figure 5: Monthly Precipitation at Portland Jetport



Water Sampling - Lake

Temperature and Dissolved Oxygen

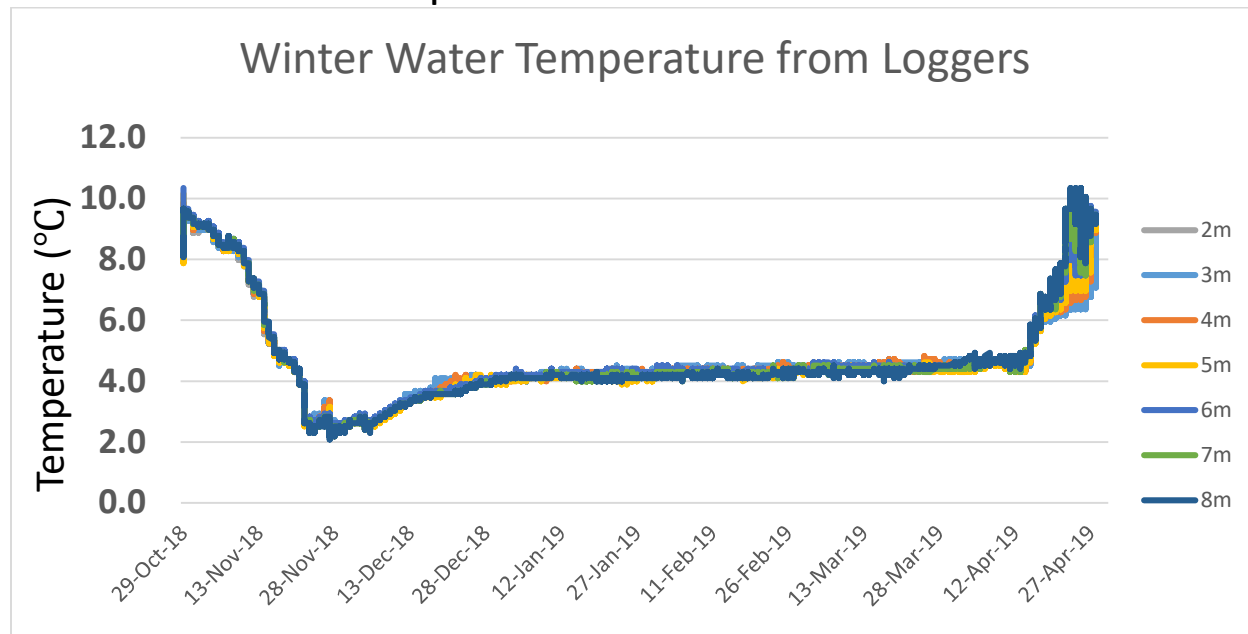
Temperature and Dissolved Oxygen (Temp/DO) were measured using continuous Onset HOB0® loggers attached to the WLA buoy (see Figure 3), and bi-weekly during the summer using DO/Temp YSI meters. Figure 6A shows the water temperature at 1-meter intervals during the Winter buoy configuration from 29-Oct-2018 to 29-Apr-2019. In this configuration, depths are measured from the bottom of the lake upwards, with higher numbers representing locations closer to the surface of the lake (e.g. 8m). Given that fall turnover occurred on 14-Oct-18, the temperature of the lake was uniform throughout this time period, starting at ~9-10°C in the fall and dropping to ~2°C in November, then settling in at ~4°C for the winter. The lake started to warm up in April (ice-out was 14-Apr-19) and began to stratify on 17-Apr-19.

Figure 6, Panel B show the water temperature at 1-meter intervals during the Summer buoy configuration from 29-Apr-2019 to 19-Oct-2019. In this configuration, depths are measured from the top of the lake downward, with larger negative numbers representing locations closer to the bottom of the lake (e.g. -11m). As expected, the bottom of the lake remained constant at ~9-10°C while the top of that lake warmed up during the season. Lake temperatures reached a maximum of 28°C at the surface over the July 4th weekend while lower depths continued to warm though August. Lake temperatures remained fairly constant through September then began to decrease again through October. On the last date of data collection for the season (19-Oct-19), the lake had a uniform temperature (Figure 7) and dissolved oxygen (Figure 8) reading to a depth of 10m, suggesting the lake was approaching fall turnover, but had not quite

completed it. Data collected bi-weekly using the YSI meters (Figures 7 and 8) are consistent with those from the continuous loggers (Figures 6B and 9).

Figure 6: Water Temperature from HOBO® Loggers

A: Winter - 29-Oct-2018 to 29-Apr-2019



B: Summer - 29-Apr-2019 to 19-Oct-2019

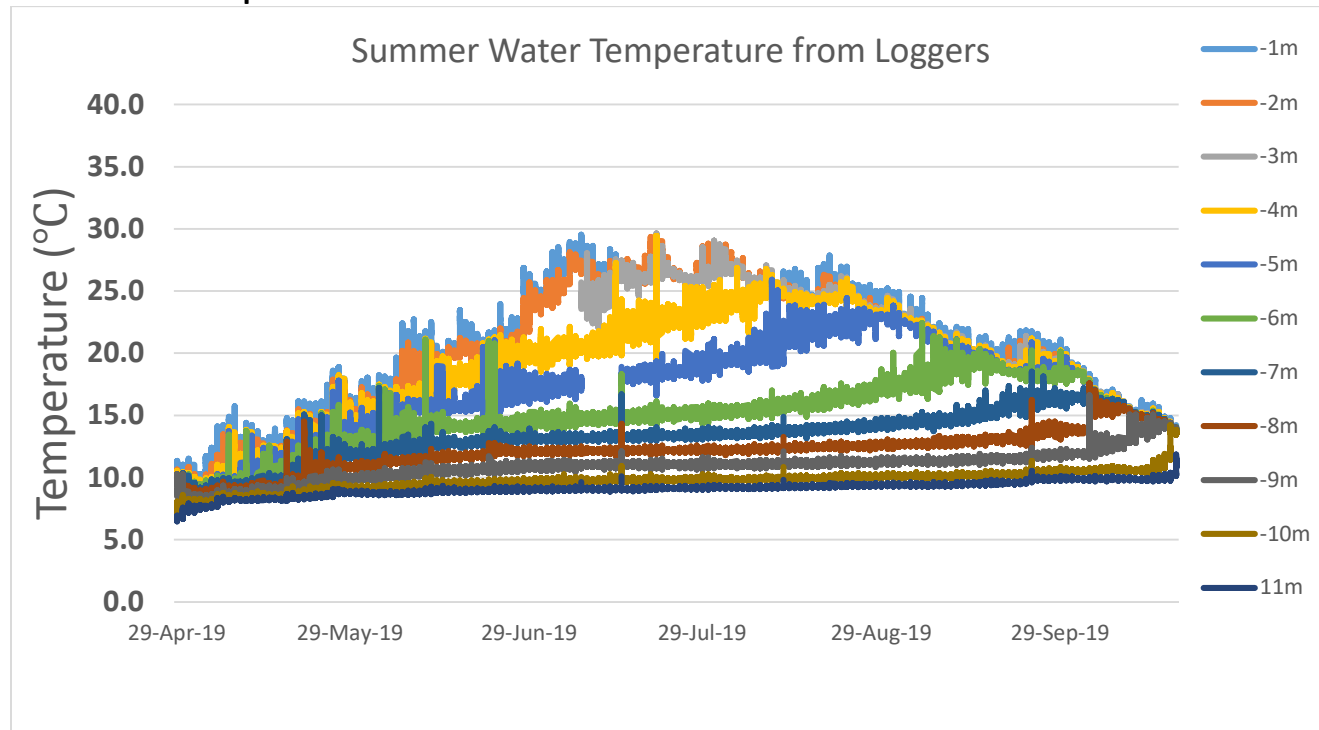
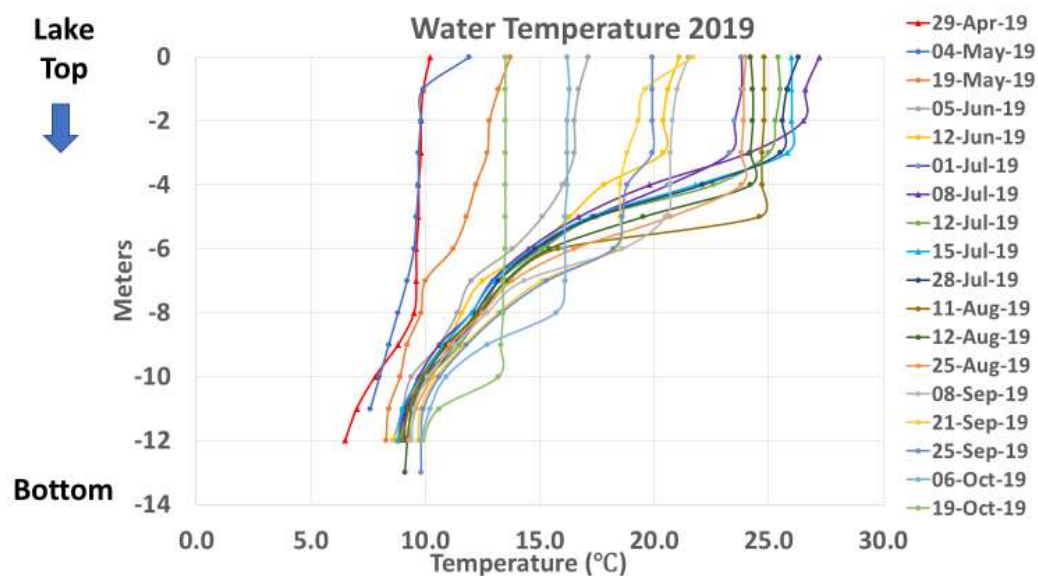


Figure 7: Water Temperature from YSI Meters



The dissolved oxygen (DO) pattern observed this season is similar what has been seen in recent years. Oxygen levels are high, and fairly uniform throughout the water column in May (Figures 8 and 9), but the deeper water becomes oxygen depleted as the season progresses. By 1-Jul, depths of $\geq 11\text{m}$ are below 2mg/dL of oxygen. This depletion extends to $\geq 9\text{m}$ by the end of July and to $\geq 7\text{m}$ by the end of September. The lack of oxygen at the bottom of the lake is known to restrict fish species that require colder water to survive, but may also cause phosphorus bound at the bottom of the lake to be released into the water column. This phosphorus can fuel further algae growth.

Figure 8: Dissolved Oxygen from YSI Meters

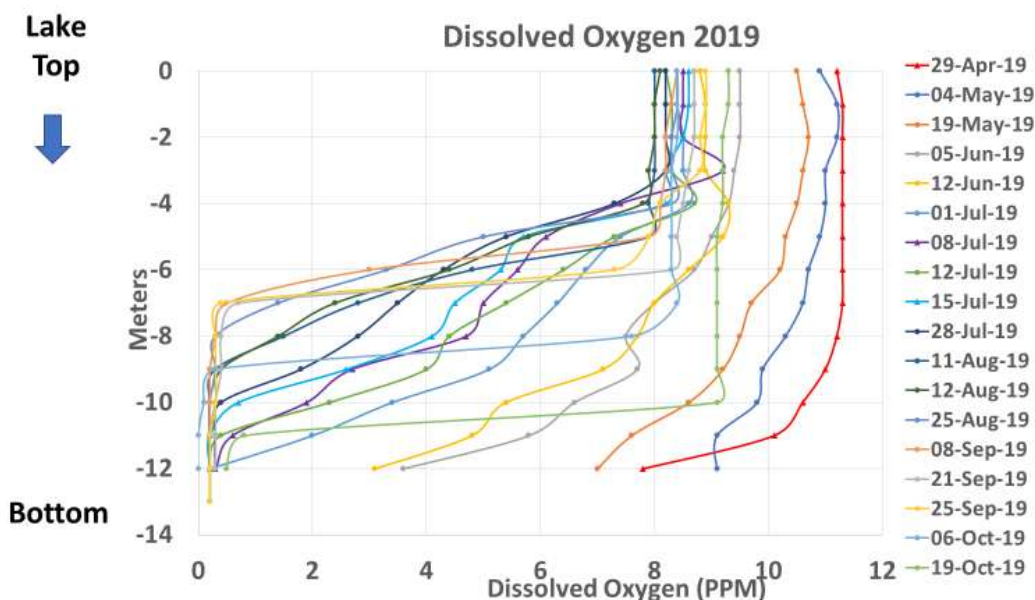
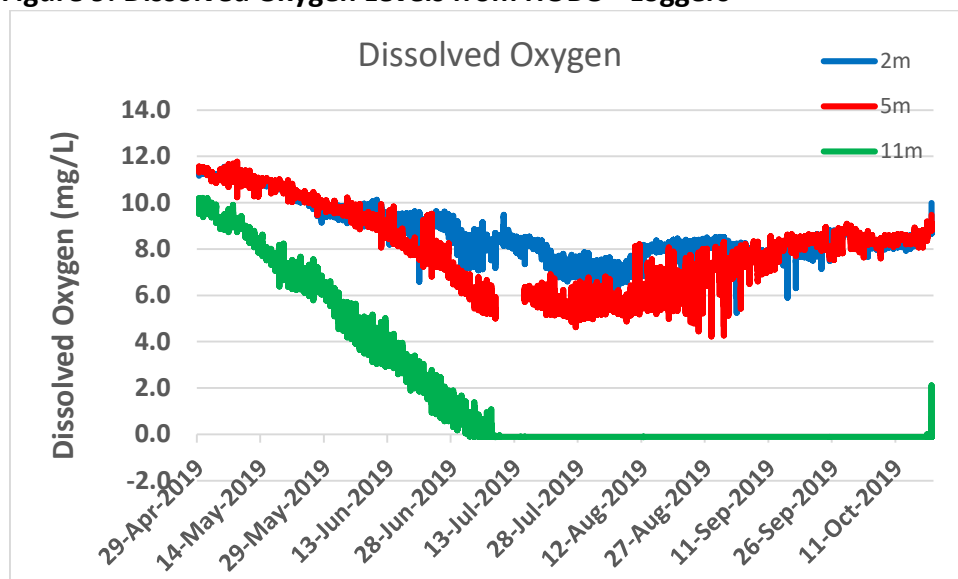


Figure 9: Dissolved Oxygen Levels from HOBO® Loggers



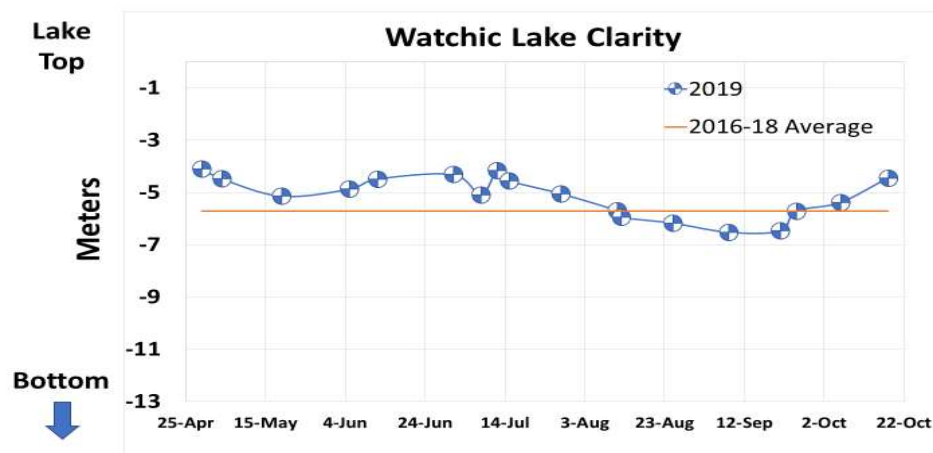
Trophic State indicators

Trophic state indicators (water clarity, total phosphorus, and chlorophyll-a) reflect the biological productivity (e.g. algae growth) of lakes.

Water Clarity

Water clarity (how far you can see down into the water) is measured using a Secchi disk. Figure 10 shows the readings this year and the historical average for 2016-2018 (-5.7m). In 2019, the Secchi disk readings ranged from -4.10m on 29-April to -6.53m on 8-Sep. These values are within the DEP Mesotrophic Water Clarity Acceptable Range of 4-8m. The average of all Secchi disk reading for 2019 was -5.1m, which is slightly lower than the 3-year average. While this may be due to a number of reasons, one big influencer could be the relatively wet spring in 2019, which likely resulted in an increase in nutrients (especially phosphorus) to wash into the lake.

Figure 10: Watchic Lake Secchi Disk Readings



Phosphorus and Chlorophyll-A

Phosphorus is the key nutrient for algae growth in lakes, while chlorophyll-A is a direct measurement of the amount of plant material, mostly algae, in the water.

An epicore sample (a column of water collected from the surface through the epilimnion or top layer of the lake where most of the algae growth occurs) was obtained each month at the deepest spot of the lake (WLA buoy). The results represent the average biological and chemical conditions in Watchic Lake.

The 2019 total phosphorus (TP) and chlorophyll-A (Chl-A) results are presented in Table 4 and are consistent with the patterns observed in previous years. Values tend to be higher in the Spring/early-Summer and decrease as the summer continues, suggesting a decrease in nutrients (phosphorus) and resulting algae (chlorophyll-A). Average TP and Chl-A values for 2019 are similar to those obtained in 2016-18 (Table 5) and individual values are within the min/max values recorded between 2016-2018.

Table 4: 2019 Water sampling results

Station	Date Sampled	Core Depth (m)	pH	Color (PCU)	Chl-A (ppb)	Alk. (ppm)	TP (ppb)
WATC-5040-01	12-Jun-19	5	7.1	26	5	6	9
WATC-5040-01	15-Jul-19	5	7.0	24	4	7	7
WATC-5040-01	12-Aug-19	5	7.0	19	3	7	7
WATC-5040-01*	25-Sep-19	6	7.0	15	3	6	6.5
Average	2019	5.3	7.0	21.0	3.8	6.5	7.4

*average of duplicates

ppb-parts per billion, ppm-parts per million, PCU-platinum-cobalt units

Table 5: Average Water sampling results for 2016-2019

Year	Core Depth (m)	pH*	Color (PCU)	Chl-A (ppb)	Alk (ppm)	Total Phos (ppb)
2016	6.8	6.5	12.8	2.9	7.3	7.9
2017	5.8	6.5	22.1	4.1	6.8	8.1
2018	5.3	6.8	14.6	3.3	7.0	7.3
2019	5.3	7.0	21.0	3.8	6.5	7.4
Average 2016-18	5.9	6.5	16.5	3.4	7.0	7.8
Max 2016-18	8.0	7.1	26.5	6.2	8.0	11.0
Min 2016-18	5.0	5.9	10.0	1.8	6.0	5.0

*Median values are reported

ppb-parts per billion, ppm-parts per million, PCU-platinum-cobalt units

In addition to the epicore samples, starting in August 2019, a sample from the bottom of the lake and analyzed for TP (Table 6). Results suggest that there is considerably more total phosphorus at the bottom of the lake than at the top (thermocline). There are historical

bottom grab TP results dating back to 1978, with the most comprehensive data coming from between 1998-2001. Most sample taken at this time were obtained from a 10m depth and had an average TP value of 18.3ppb and a range of 7-31ppb.

This additional phosphorus at the bottom of the lake could be coming from decaying organic material at the bottom of the lake or from bound phosphorus that is released due to the oxygen depletion observed (see Figures 8 and 9 above). In coming years, we will explore this observation further by continuing bottom grab samples throughout the year and potentially examining phosphorus levels at other depths.

Table 6: 2019 Bottom Grab Total Phosphorus Samples

Station	Date Sampled	Depth (m)	TP (ppb)
WATC-5040-01	12-Aug-19	13	63
WATC-5040-01*	25-Sep-19	12.5	30
WATC-5040-01*	25-Sep-19	12.5	30

* **duplicates**

ppb-parts per billion

Chemical Parameters

In addition to TP and Chl-A, pH, alkalinity and color were measured in the monthly core water samples (Table 5 above). Similar to TP and Chl-A, color was higher in June and July then decreased in August and September. Alkalinity and pH were similar throughout the season. When compared to previous results, color this year was higher than the average value from 2016-18, but within historic values. A trend toward higher pH and lower alkalinity values is suggested, although no single value is outside the min/max values recorded between 2016-18. Photosynthesis uses up dissolved carbon dioxide, which acts like carbonic acid (H_2CO_3) in water. CO_2 removal, in effect, reduces the acidity of the water and so pH increases. For example, a change in pH may increase the solubility of phosphorus, making it more available for plant growth and resulting in a greater long-term demand for dissolved oxygen. This observation should be explored further.

Metaphyton

Metaphyton is cotton candy-like algae that usually floats near the top of the shallow water, but can get stuck in lake vegetation and accumulate. This spring large accumulations of Metaphyton were reported just north of the Kiwanis Beach and in the mouth of Page Brook (see Figures 11 and 12). Another area near the mouth of Paine Brook was reported in late July. These areas were monitored regularly by WLA volunteers Eileen and David Burnell. The metaphyton found at the site near the mouth of Page Brook dissipated by September, though it remained visible at the other 2 sites.

Metaphyton, like most other algae, are fueled by extra nutrient entering the lake. This nutrient most likely comes from storm run-off or septic tank issues, but it is extremely hard to pinpoint the exact cause. We will continue to monitor the lake for large rafts of metaphyton. Home

owners can do their part by reducing storm runoff from their properties and maintaining their septic systems.

Figure 11: 2019 Metaphyton Surveys

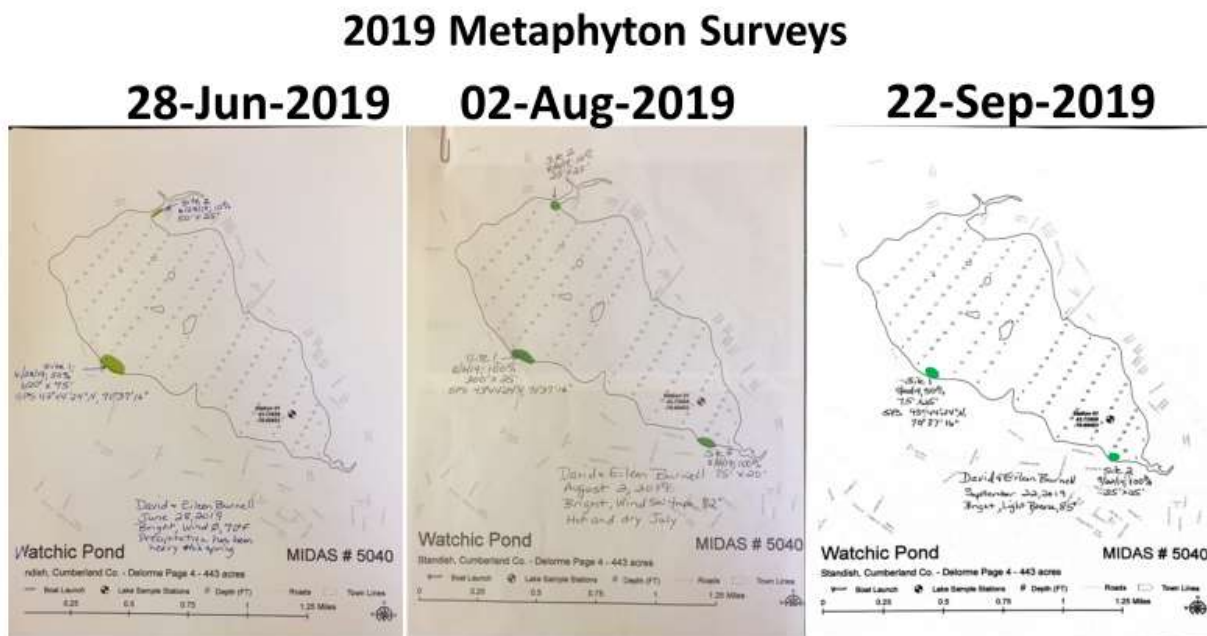
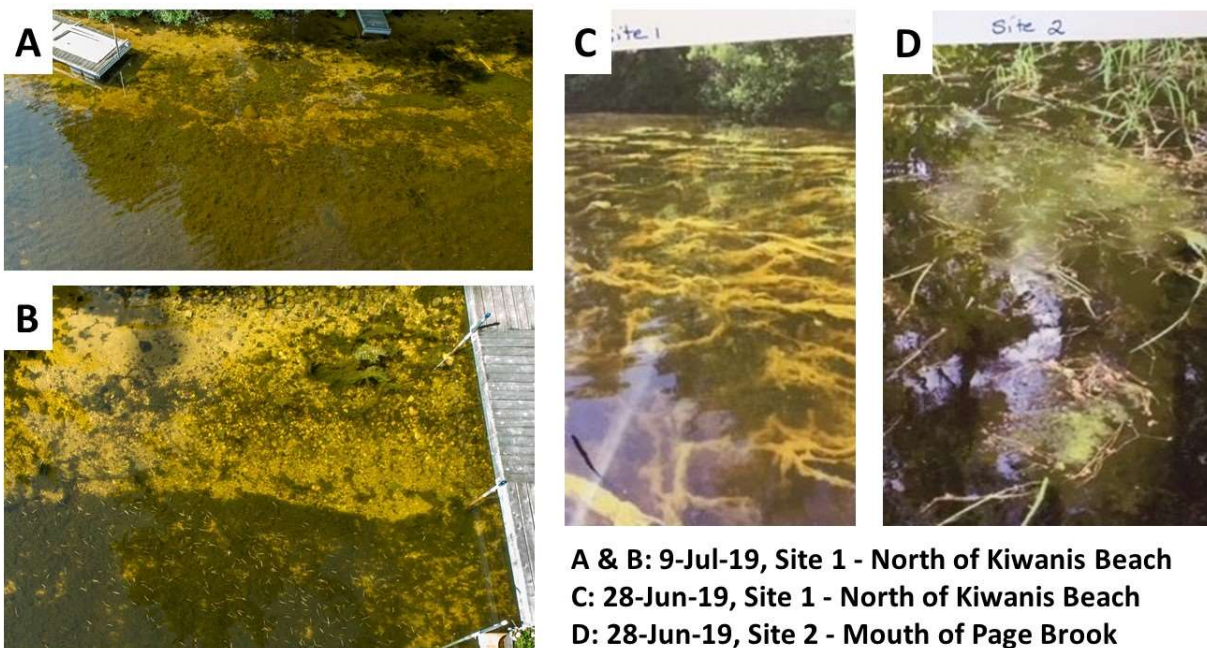


Figure 12: Metaphyton Photographs



Water Sampling - Tributaries

Temperature, dissolved oxygen and total phosphorus were measured in Page Brook in August and September. The results are shown in Table 7:

Table 7: 2019 Monitoring of Page Brook

Station	Date Sampled	Temp (°C)	DO (ppm)	DO Sat. (%)	TP (ppb)
Page Brook-01	12-Aug-19	17	5.03	52.2	38
Page Brook-01*	25-Sep-19	15	4.4	44	42
Page Brook-01*	25-Sep-19	-	-	-	28
Yearly Average	2016	16.9	5.6	58.0	32.0
	2017	17.0	6.0	61.0	29.1
	2018	17.0	5.5	57.4	26.3
	2019	16.0	4.7	48.1	36.5

* duplicates

ppb-parts per billion, ppm-parts per million

Conclusions and Recommendations

Based on monitoring performed by the Watchic Lake Water Quality Volunteers in 2019, the water quality of Watchic Lake remains good and is substantially unchanged from data collected over the previous 3 years. However, like all lakes, Watchic Lake is in a delicate balance where both nature and human influences could tip the balance against it. Nutrient laden run-off from storms (especially mega-storms) can wash into the watershed and lake causing negative changes in the lake's water quality. This could lead to significant algae blooms. In addition, while to-date no invasive plant or aquatic species have been identified in Watchic Lake, it only takes a little carelessness to create a big problem.

With these considerations in mind, the water committee has the following recommendations:

Recommendations for Continued Water Monitoring

Based on observations this year and 2016-2019, the following efforts should be continued and/or intensified:

Observation	Recommendation
Loss of oxygen in the lower depths	Expand bottom grab TP sampling to 4 monthly samples
	Consider TP grab samples at various depths
	Collaborate with researchers to look at composition of soil at bottom of lake for potential of phosphorus recycling
Slightly lower average water clarity	Continue to monitor and try to correlate with rainfall at lake
Slight increase pH/ decrease alkalinity	Continue monitoring. Check into possible method changes
3 large concentrations of metaphyton	Continue to monitor as needed
	See General Recommendations below
Page Brook Bridge repair scheduled for Summer 2020	Re-establish monthly monitoring for TP and nitrogen until October

General Recommendations for Lake Users to maintain and improve Water Quality

- Become LakeSmart by controlling phosphorus-laden sediment in runoff with best management practices (BMPs).
- Avoid using fertilizers, herbicides, and pesticides within 150 feet of lake, ponds, and streams.
- Leave duff and grass clippings; minimize lawn area and cut grass to 3 inches.
- Pump septic system every 3-5 years and keep leach field clear of trees. Inspect systems more than 20 years old.
- Reduce household chemical and Phosphorus-based product use.
- Wash car and boat in area where runoff is absorbed into the ground.
- Use oil-absorbing pillow or 'bilge snakes' to prevent pollutants from entering the lake via inboard motors.
- Store gas and oil in approved secondary containers and dispose at local repair shops. Clean fluid leaks with cat litter.
- Remove fishing line from water and use lead-free lures.
- Dispose of pet waste in trash or toilet.

Recommendations for Lake Users to avoid the spread of Invasive Plants and other Species

Follow the CLEAN, DRAIN, DRY procedures to prevent the spread of Invasive Species

- **Clean** off visible aquatic plants, animals, and mud from all equipment before leaving a body of water.
- Rinse equipment, boat hulls (with high pressure, when possible), interior compartments and flush motor. Use hot water (120F) when possible.
- **Drain** motor, bilge, livewell, and other water containing devices before leaving water access.
- **Dry** everything for at least 5 days OR wipe with a towel to dry before reuse.
- **Dispose** of any unwanted bait, worms and fish parts in the TRASH.
- If CLEAN, DRAIN, DRY was not done prior to leaving a body of water, ensure that it is done BEFORE entering a new body of water. Be sure to perform the CLEAN and DRAIN activities well away from any body of water.

GLOSSARY OF KEY TERMS

Chlorophyll-a (Chl-A): A measurement of the green pigment found in plants, including microscopic plants like algae. It is used as an estimate of algae biomass; higher Chl-A equates to greater concentration of algae in the lake.

Color: A measure of the influence of suspended and dissolved particles in water from weathered geologic material, vegetation cover, and land use activity. Colored lakes (>25 platinum-cobalt units -PCU) can have reduced water clarity and increased phosphorus concentrations.

Dissolved Oxygen (DO): The concentration of oxygen dissolved in water. Adequate oxygen is critical to the healthy metabolism of many creatures that reside in the water. DO levels in lake water are influenced by a number of factors, including water temperature, amount of algae and other plants in the water, and the amount of nutrients and organic matter that flow into the waterbody from the watershed. DO concentrations may change dramatically with lake depth. Oxygen is produced in the top portion of a lake (where sunlight drives photosynthesis), and oxygen is consumed near the bottom of a lake (where organic matter accumulates and decomposes).

Epilimnion: The top layer of lake water that is directly affected by seasonal air temperature and wind. This layer is well oxygenated by wind and wave action during summer. It extends to 5-7 meters below the surface in Watchic Lake.

Escherichia coli (E. coli): An indicator of harmful pathogens from fecal contamination that can derive from a number of mammalian sources, including human, canine, and wildlife.

Eutrophication: Process by which lakes become more productive over time. Lakes with high productivity have high levels of phosphorus and chlorophyll-a, low water clarity, and abundant biomass with significant accumulation of organic matter on lake bottom. Eutrophic lakes are susceptible to algae blooms and severe oxygen depletion in the hypolimnion. Lakes naturally become more productive or “age” over thousands of years. In recent geologic time, however, humans have enhanced the rate of enrichment and lake productivity, speeding up this natural process to tens or hundreds of years.

Fall Turnover: the process of complete lake mixing when cooling surface waters become denser and sink, forcing lighter, less-dense water to the surface. This process is critical for the natural exchange of oxygen and nutrients between surface and bottom layers in the lake.

Hypolimnion: the bottom-most layer of the lake. It experiences periods of low oxygen during stratification and is devoid of sunlight for photosynthesis. Watchic Lake experiences low oxygen in summer from 7 meters to the bottom at 12 meters.

Integrated Epilimnetic Core: A water sample that is taken with a long tube to determine average nutrient concentration from the lake surface to the top of the thermocline.

pH: The standard measure of the acidity or alkalinity of a solution on a scale of 0-14. Most aquatic species require a pH between 6.5 and 8. As the pH of a lake declines, particularly below 6, the reproductive capacity of fish populations can be greatly impacted as the availability of nutrients and metals changes. pH is influenced by bedrock, acid rain or snow deposition, wastewater discharge, and natural carbon dioxide fluctuations.

Secchi Disk Transparency (SDT) or Water Clarity: A vertical measure of water transparency (ability of light to penetrate water) obtained by lowering a black and white disk into the water until it is no longer visible. Measuring water clarity is one of the most useful ways to show whether a lake is changing from year to year. Changes in water clarity may be due to increased or decreased algae growth or the amount of dissolved or particulate materials in a lake, resulting from human disturbance or other impacts.

Spring Turnover: the process of complete lake mixing following ice-out when surface waters are exposed to wind action, bringing oxygen to the bottom and nutrients to the top of the water column.

Summer Stratification: the development of a thermal barrier that separates warm surface waters from dense, cool bottom waters. Without oxygen replenishment from the surface, bottom-dwelling organisms rapidly consume oxygen throughout the summer and early fall.

Thermocline: the markedly cooler, dynamic middle layer of rapidly changing water temperature. The top of this layer is distinguished by at least a degree Celsius drop per meter of depth.

Total Alkalinity: A measure of the buffering capacity of a lake (i.e., the capacity of water to neutralize acids). The buffering capacity or the concentration of bicarbonate, carbonate, and hydroxide ions in water, is largely determined by the geology of soils and rocks surrounding the lake. Total alkalinity above 20 ppm buffers against drastic changes in pH that could impact aquatic plants and animals.

Total Phosphorus (TP): The total concentration of phosphorus found in water, including organic and inorganic forms. Phosphorus is one of the limiting nutrients needed for plant growth; as phosphorus increases, the amount of algae generally increases. Humans can add excess phosphorus to a lake through stormwater runoff, lawn or garden fertilizers, and leaky or poorly-maintained septic systems.

Trophic State Indicators: Are indicators of biological productivity in lake ecosystems, including water clarity, total phosphorus, and chlorophyll-a. The combination of these parameters helps determine the extent and effect of eutrophication in lakes, and helps signal changes in lake water quality over time.

Watershed: An area of land that drains water to the outlet of a stream, river, or lake.

Winter Stratification: the development of a physical ice barrier and snowpack layer that limit the exchange of oxygen and nutrients between surface and bottom waters. A layer of ice forms at the lake surface, protecting waters below from frigid temperatures and wind storms. Cold winters with significant snowpack can block sunlight and limit photosynthesis that would otherwise replenish the lake