# Detailed Report 2023: Water Team Activities

## Background

In 2017 water team members, advised by Dr Sue Watson, a prominent Harmful Algal Bloom Specialist, Hedy Kling, an Algal Taxonomist, and assisted by Dr Mark Verschoor, carried out extensive sampling on our lake to investigate algal abundance and diversity, water chemistry, and possible links to algal blooms. The resulting report- Watson and Kling, 2017 https://www.leonardlake.net/water-quality-studies -provides a good basis for further studies which our water team has been pursuing for the past 6 years. In 2022 Mark Verschoor prepared a follow up report, also posted on the Leonard lake website.

Dr Verschoor's report, supplemented by advice from Dr Norman Yan, indicated 3 areas of focus:

1. We should continue focussing on South Bay, that that is likely the "nursery" (nutrient source) for the cyanobacteria; and also need to determine the extent of the South Bay which experiences anoxia.
2. That we should determine the water currents in the lake, specifically the ones potentially bringing material out of the South Bay to the areas where blooms frequently occur. Bill has fashioned the devices to carry out this test, and we intend to complete it in 2024.
3. Try to focus more on obtaining information that would complement and validate data obtained in 2022, and focus less on testing that does not appear to enhance our objectives.

## Sampling Sites

Past reports have noted the importance of maintaining well referenced, long term sampling sites in order to understand historical changes in the lake. Three types of sampling sites, all GPS referenced, are used by the water team: (See Figure 1 below)

**Deep sites**: The Mid-lake Site corresponds with the DMM site 3 which the District has used for their historical spring turnover sampling in Leonard lake; the NDH Site ( North Deep Hole ), the deepest spot in the lake, corresponds with the site that Dorset Environmental Science Centre has used in their historic 1979-2025 report; while the Site 2 South Bay site was also established by DMM several decades ago, but seldom used in their sampling. In 2017, sampling (Watson and Kling) revealed high levels of anoxia in mid-August at this site, and possible internal nutrient loading.

**Shoreline sites:** Four shoreline sites, located near docks, just a meter or two offshore, are located in areas where algae blooms have been reported in the past, and form part of our regular sampling program. In particular, these sites are sampled using taxonomy and fluorometry for evidence of elevated cyanobacteria when algae blooms are reported on the lake.

**Runoff sites**: During the spring freshet of 2022, a survey of runoff points into the lake, carried out by Bill Heatlie, resulted in 12 sites identified as runoff points for sampling within a meter or 2 of the water entering the lake. Results are reported below.

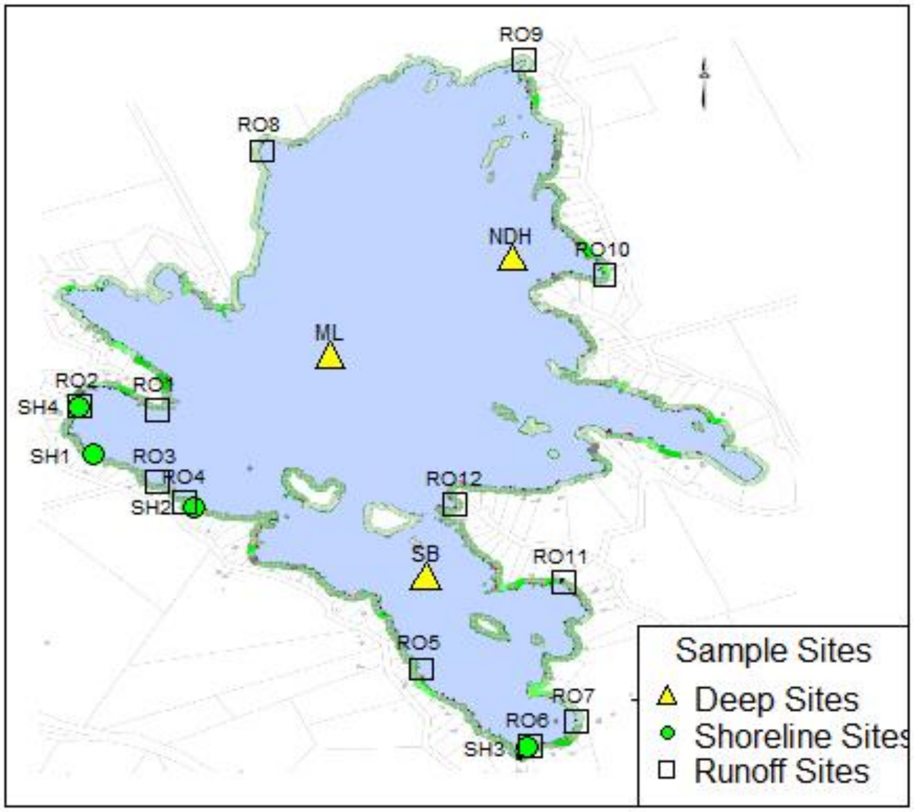


*Figure 1 Leonard Lake map of sampling points: deep sites marked with buoys, shoreline sampling points, and runoff sampling points. Further explanation of sites found in the text above.*

## Runoff Studies - Total Phosphorus

Elevated levels of phosphorus from streams and runoff into the lake can be a nutrient source for algae blooms and impact food webs. In 2022, with permission from each property owner, we identified 12 sites along the shoreline where intermittent runoff occurs. (RO 1-12). These Runoff sampling points are shown in figure 1. Sampling for Total Phosphorus and chlorophyll was carried out on 4 occasions; twice yearly (spring and fall) in both 2022 and 2023. Not all points were sampled in each season or year. Total phosphorus in runoff samples are shown in Figure 2.

An analysis of these data indicated significant variation between sites, between seasons, and between years. Site 7 (located closest to Hwy 118) was found to have the highest mean Total Phosphorus. Average total phosphorus across all runoff points and seasons was 22.7 ug/l, about 4 times higher than the long term mean total phosphorus measured at mid-lake, indicating that runoff is a significant source of nutrients into the lake . This study did not differentiate between human-produced and natural sources.

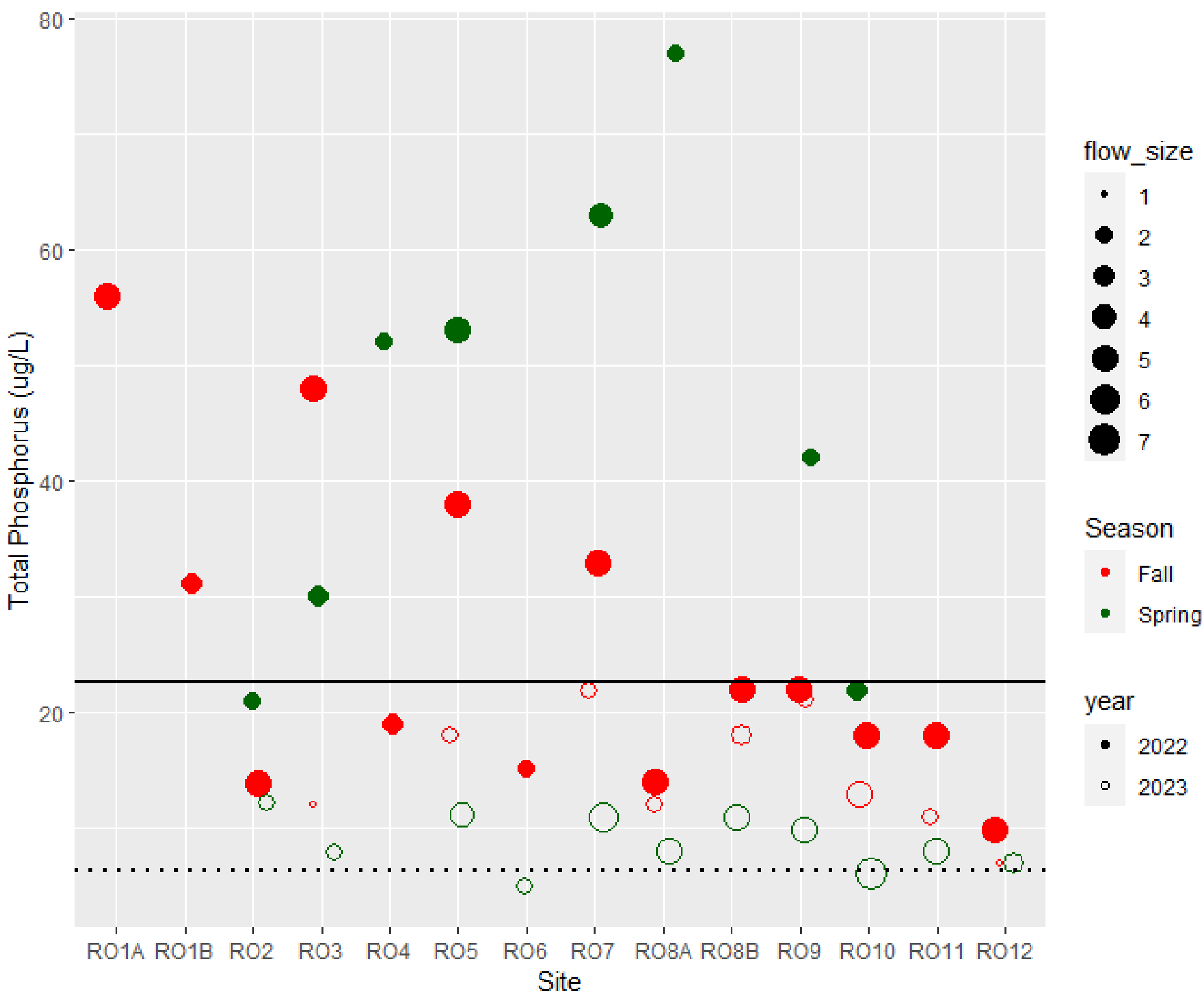


*Figure2: Total Phosphorus plotted against the Runoff sites for 2022 and 2023 samplings. Spring (05-2022 and 04-2023) and Fall (10-2022 and 11-2023) are denoted by colors green and red, respectively. Years are denoted by full points (2022) and empty points (2023). The size of the points represents the magnitude of flow where 1 is "Very low", and 7 is "very high". Dotted horizontal line represents the mean mid-lake phosphorus concentration, and the solid horizontal line at 22.7 ug/l represents the mean runoff phosphorus in the runoff samples. See Figure 1 for location of the runoff points.*

## Road Salt study - Chloride.

Lakes and streams can be negatively impacted by road salt draining from nearby roads and highways. In 2023 fall and spring, runoff samples were used to assess chloride levels, which is a component of road salt**.** Results are shown in Figure 3. Chloride levels at all but 3 sites were found to be similar to or lower than 5g/l which is the recent mid-lake mean in Leonard Lake, but also the level found to be toxic to sensitive Daphnia species. Samples from the 3 sites closest to Hwy 118 contained elevated levels, up to 15 times the lake chloride level. This is a strong indication that the salt used to de-ice Hwy 118 is finding its way into Leonard Lake. Both chloride and phosphorus levels in runoff into the lake need to be further monitored.

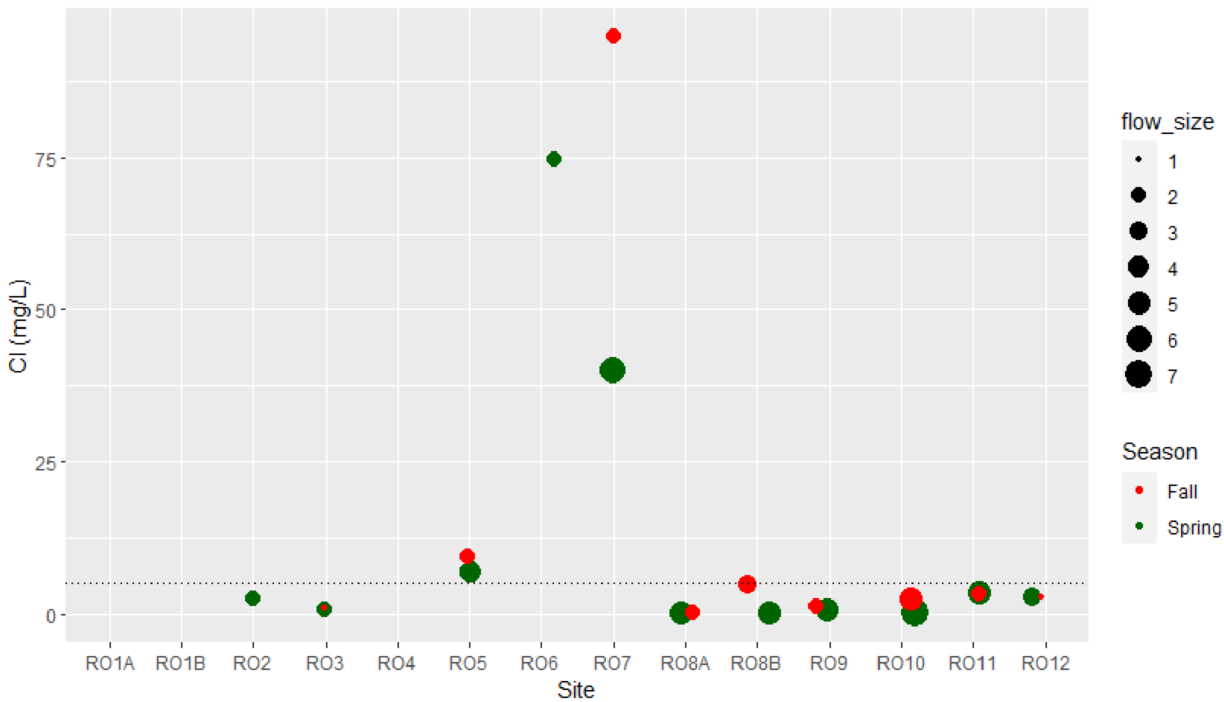


*Figure 3: Chloride levels (mg/l) plotted across runoff sampling sites in 2023. Size of circles are flow size (i.e. flow rate) from very low (1) to very high (7). The Horizontal dotted line represents a Chloride level of 5mg/l, the Leonard Lake mid-lake Chloride mean. The 5mg/l chloride level is considered potentially toxic to some Daphnia species. Locations of the runoff (RO) sites are found in Figure1*

## Eyes on the Lake and Algae Blooms in 2023

Pre-blooms (transitory, with mild to moderate elevation of phycocyanin), as well as identification of Dolichospermum lemmermannii were found on a few occasions. They were small and transient, often disappearing within 1 or 2 days, with phycocyanin levels quickly returning to baseline, and often accompanied by murky water rather than a surface scum.

The LLSA water team responds and samples at any sites in response to alerts from lake residents. Reports are often followed up by repeat sampling and testing on subsequent days.

In 2023, three reports were filed. Only the first 2 involved Cyanobacteria. Dolichospermum lemmermannii was identified microscopically by Rohan in Algae 1 (June 2 and June 5), and in Algae 2 (Aug 14 and Aug 16)). Both were transient. The MECP was notified in June, but did not see anything and did not take samples.

**Comments:**

1. Whereas the boat launch was part of both Algae 1 and Algae 2 reports, we also noted the incidence of Bloom Forming Colonies at that site on 3 other occasions (end of July to end of Sep).
2. Whenever small pre-blooms were seen, there tended to be similar evidence in other areas of the lake around the same time.
3. Fortunately none of the Pre-blooms developed into more extensive blooms or were widespread.
4. One factor that could be relevant is the lower water temperature recorded during the month of August, compared to previous years. Other factors may well have been involved.
5. A decrease in “dwell time” of lake water could also be a factor; discussed later.

## LLSA Water sampling – deep sites and shoreline sites:

Three Deep sites (marked by buoys) and 4 shoreline sites were monitored and sampled by the water team, usually biweekly, from May 23-Oct 24. See **Site Map. Figure 1)**

In addition to the mandated testing and protocols required for several agencies (discussed later), further testing and sampling was done at various depths at the 3 deep sites.

Samples were tested for algal pigments (chlorophyll and phycocyanin), as well as various components of water chemistry. Some samples were also submitted for algal taxonomy. When discrete samples were obtained at specific depths, water temperature was recorded. For analytes such as reduced phosphorus and reduced iron, samples were collected and filtered under anaerobic conditions. As this was the first season since 2017 that no blooms were reported, we looked specifically at factors that might help explain why blooms did not occur this season. Some findings are summarized below.

1. **Taxonomy**

   Samples for taxonomy were taken from near the sediment in South Bay on 4 occasions: July 31, Aug 14, Sep 12, Sep 25, and sent to Hedy Kling, an Algal Taxonomist. She reported NO evidence of Dolichospermum lemmermannii (the Bloom - forming species seen in previous shoreline blooms, and also documented near the sediment in South Bay in mid Sep 2022) in any of the samples; so we were unable to duplicate this specific finding from 2022. She did report a few Planktolynbya in each sample, as well as a high concentration of iron sulphur bacteria and organic detritus. Could the absence of the bloom -forming species during the 2023 season at the bottom of the South Bay site be a factor in the absence of shoreline Blooms in 2023?

**2. Water Temperature**

See Water Temperature Graph 2017-2023 below, Figure 4. The solid blue line in the graph corresponds to the results from 2023. Note the red vertical lines delineating the month of August. It is clear that the water temperatures in August 2023 tended to be lower than in previous years. Would this lower temperature in 2023 help to explain why no confirmed blooms were recorded in 2023?

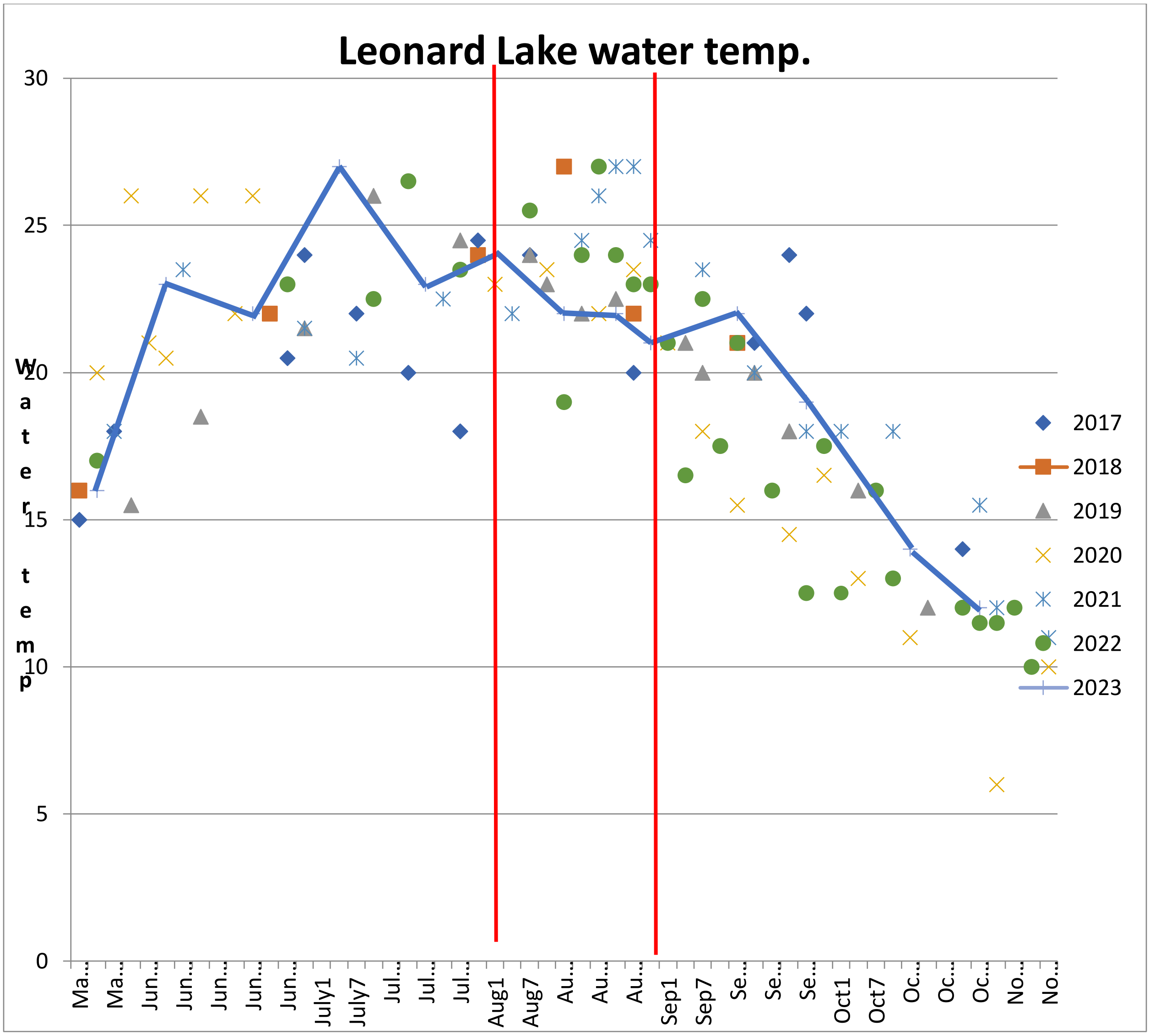


*Figure 4: see text above for explanation*

**3. Iron**

Release of ferrous (also known as reduced or dissolved) iron from anoxic sediments (internal loading) can be an important source of nutrient for algae blooms. Samples were taken for both total Iron and ferrous Iron from the **South Bay site,** both from the surface and near the sediment, on June 5, Aug 28, and Sep 25; samples were also taken from the NDH on Sep 25 for comparison purposes.

Watson reported sampling for total iron in 2017. In 2022, the water team had sampled for ferrous iron, and only near the sediment. The objective, in 2023, was to compare iron results from 2017 to current results in order to determine the trajectory of iron levels over the entire season, and to observe the changes in oxidized and reduced iron as a function (proxy) of variations in Dissolved Oxygen (DO) levels throughout the season. (The ability to measure DO levels directly was only available in late September on one occasion).
Results are reported below and in table 1.

1. **South Bay**: On **June 5,** 2023, the **total iron** at the sediment in South Bay was already 3-4 times higher than the surface level, and approximately 1/3 of the iron at the sediment was reduced (ferrous).
2. By the end of **Aug** 2023, the **total iron** at the sediment had increased to 3746 ug/l , and 93% of that was in the ferrous state. This value is almost 3 times higher than the total iron measured at this site in 2017.
3. By **Sep 25**, the **total iron** measurement had risen to 8512 ug/l , with 96% of that iron in the ferrous state.
4. In contrast, at the **NDH site** on Sep 25, 2023, the B-1 (near the sediment) total iron was 1252 ug/l (compared to 8512 ug/l in South Bay), and only 1/3 of that was ferrous iron.

**We can conclude that:**

1. Internal loading of iron at the sediment in South Bay has been demonstrated in consecutive years, and is already evident in early June.

2. Between early June and the end of September the total iron **near the sediment** had increased 30 times, and was 167 times higher than the iron level at the surface; in addition, the proportion of reduced iron at the sediment in South Bay, had increased to over 90% of the total iron.

3. Iron levels at the NDH (deepest spot on the lake) appear similar between 2022 and 2023, and are in stark contrast to those found in the South Bay; at the end of September reduced iron near the sediment in South Bay was 20 times higher than at the NDH site.

4. Phosphorus: Whereas the surface total phosphorus (TP) levels are consistently less than 10 (6-8 ug/l), the TP levels near the sediment in South Bay are about 4 times higher, with approximately half of the phosphorus in the reduced state.

*Table 1 Measurements of Total (Tfe) and Dissolved (Dfe) Iron at South Bay and NDH sites: 2017-2023*

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IRON AND PHOSPHORUS comparison** | | | | | | | | | | Total Iron | | Dissolved Iron (ferrous) | | | | | | |
| **2017-2023** | | | | | | | | | | Total Tfe, | | Dissolved Dfe (ferrous) | | | | | | |
| **SOUTH BAY** | | | | | | | | | | | | | | | | | | |
| 2017 | June | Tota l | Dfe | July | Total | Dfe | Total | Diss. | August | Total | Dfe | Total | Diss. | Sept | Total | Dfe | Total | Diss. |
| | | Tfe | ferr. | | Tfe | ferr. | Phos | Phos. | 3rd week | Tfe | ferr. | Phos | Phos. | | Tfe | ferr. | Phos | Phos. |
| | | ug/L | ug/L | | ug/L | ug/L | ug/L | ug/L | | ug/L | ug/L | ug/L | ug/L | | ug/L | ug/L | ug/L | ug/L |
| | Depth | | | Depth | | | | | Depth | | | | | Depth | | | | |
| | 1m | | | 1m | | | | | 1m | 23 | | | | 1m | | | | |
| | | | | | | | | | 3.5 m | 28 | | | | | | | | |
| | B-1 | | | B-1 | | | | | B-1 (7m) | 1291 | | | | B-1 | | | | |
| 2022 | June | | | July 26 | | | | | Aug 23 | | | | | Sep 13 | | | | |
| | Depth | | | Depth | | | | | Depth | | | | | Depth | | | | |
| | 1m | | | 1m | | <50 | 8 | <3 | 1m | | <50 | 6 | 3 | 1m | | <50 | 6 | <3 |
| | B-1 (7m) | | | B-1 (7.5m) | | 1660 | 16 | <3 | B-1 (7.5m) | | 2150 | 12 | 7 | B-1 (8m) | | 5450 | 22 | 6 |
| 2023 | June 5 | | | July 26 | | | | | Aug 28 | | | | | Sep 25 | | | | |
| | Depth | | | Depth | | | | | Depth | | | | | Depth | | | | |
| | 1m | 76 | | 1m | | | | | 1m | <10 | | | | 1m | 51 | | 7 | |
| | | | | | | | | | | | | | | | | | | |
| | B-1 (8m) | 287 | 91 | B-1 | | | | | B-1 (8.5m) | 3746 | 3497 | | | B-1 (8.5m) | 8512 | 8127 | 28 | 13 |
| **NDH** | June | | | July | | | | | Aug | | | | | Sep | | | | |
| 2017 | | | | | | | | | 3rd week | | | | | | | | | |
| | | | | | | | | | Depth | | | | | | | | | |
| | | | | | | | | | 1m | 21 | | | | | | | | |
| | | | | | | | | | 3.5 m | 17 | | | | | | | | |
| | | | | | | | | | B-1 | 318 | | | | | | | | |
| 2022 | June | | | July 26 | | | | | Aug 24 | | | | | Sep 13 | | | | |
| | | | | | | | | | | | | | | | | | | |
| | Depth | | | Depth | | | | | Depth | | | | | Depth | | | | |
| | 1m | | | 1m | | <50 | | | 1m | | <50 | 6 | <3 | 1m | | <50 | 5 | <3 |
| | B-1 | | | B-1 (14m) | | 75 | | | B-1 (14m) | | 165 | 6 | 4 | B-1 (15.5m) | | 610 | 14 | 5 |
| 2023 | | | | | | | | | | | | | | Sep 25 | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | Depth | | | | |
| | | | | | | | | | | | | | | 1m | | | | |
| | | | | | | | | | | | | | | B-1 (15m) | 1252 | 407 | | |

**Internal Loading** of nutrients from the sediment under anoxic conditions is also supported by changes in **conductivity** measurements. Sonde data from South Bay in 2022 showed rising conductivity levels near anoxic sediments, and the extent of this increase generally correlated with rising levels of ferrous iron measured at the same depth; whereas at the NDH site, where anoxia occurred only at the end of the season, release of ferrous iron was much lower, and the increase in conductivity was minimal. See Figure 5.

**2022 Sonde: Conductivity and Ferrous (dissolved) Iron**

| South Bay | Dfe ug/l | Conduc.y |
|---|---|---|
| | ug/L | uS/cm |
| | 50 | 36.9 |
| | 1660 | 52 |
| | 2150 | 60.9 |
| | 5450 | 76.7 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | Dfe | Conduc.y |
| NDH | 50 | 36.9 |
| | 75 | 37 |
| | 165 | 37.8 |
| | 610 | 42.4 |
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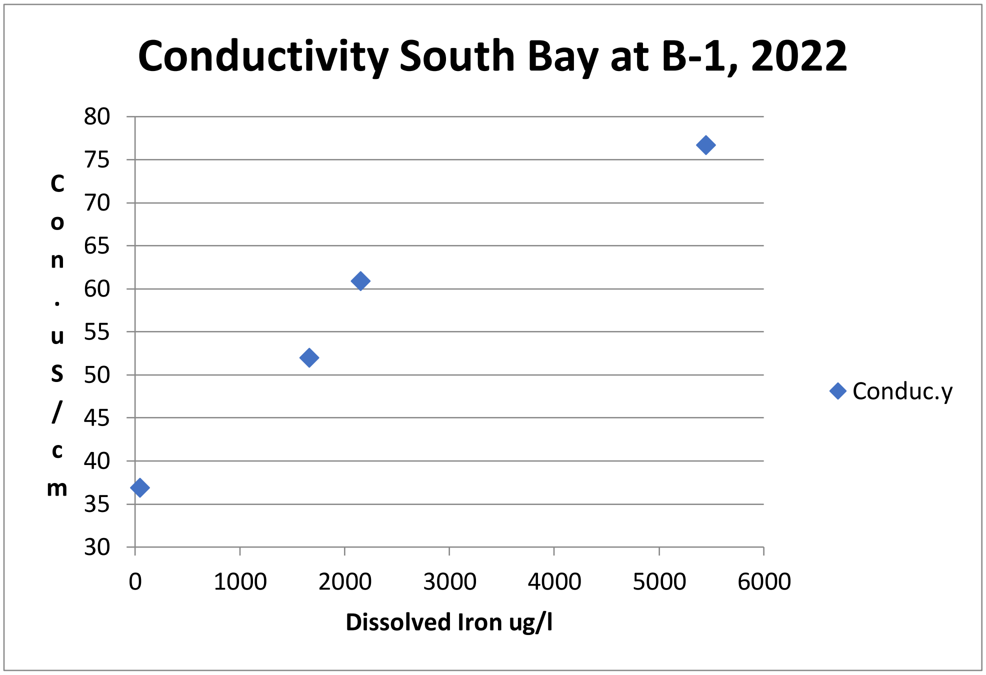


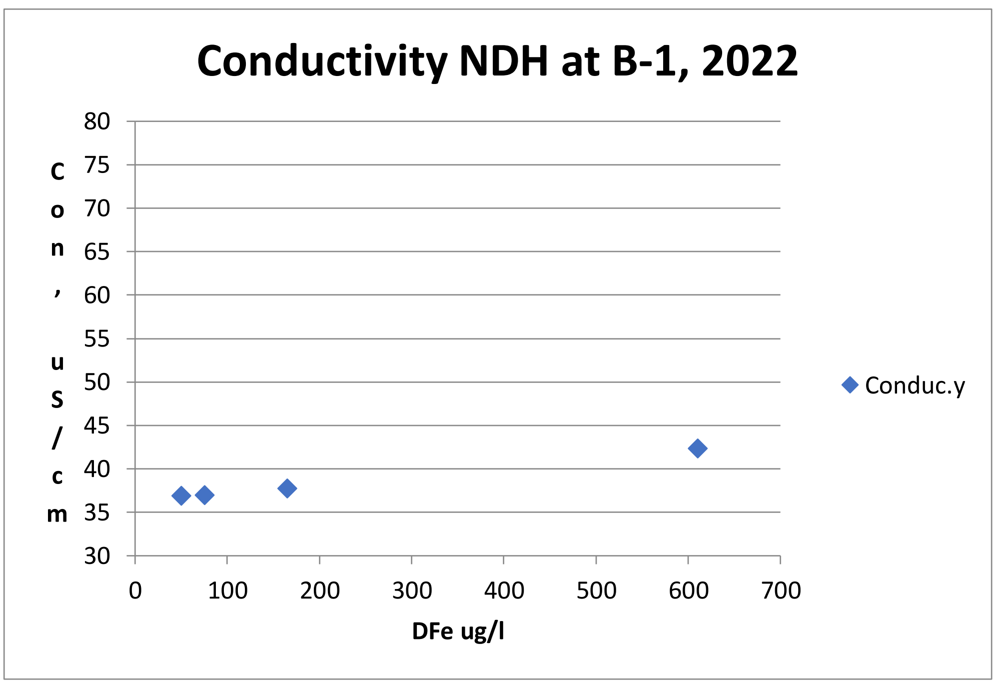


*Figure 5*

**Observations on Conductivity Changes Near the Sediment at the Deep Sites:**

1. Conductivity at 1 m depth at all 3 sites on all occasions (July 25, Aug 14, Sep 14) was very consistent: 36.7-37.0 uS/cm.

2. A rise in conductivity was only noted at those depths where the dissolved oxygen had sharply decreased.

3. Samples for dissolved iron (ferrous), collected under anaerobic conditions with the Van Dorn sampler, were obtained at 1m depth, then also at B-1 depth (1 meter above the sediment).

4. Ferrous levels at 1m depth were consistently less than 50 ug/l at all sites, and on all 3 sampling occasions. For the purpose of graphing, they have been set at 50 ug/ l.

5. Only the South Bay was anoxic in July. As the season progressed, the other sites also became anoxic, and the extent of anoxia increased over time. (Anoxia defined as Dissolved Oxygen levels less than 1 mg/l).

6. An increase in ferrous concentration at B-1 paralleled the increase in anoxia.

7. And rising levels of ferrous iron were also associated with increased conductivity readings.

8. There is generally a positive correlation between levels of ferrous iron and conductivity. This is stronger in the South Bay where ferrous iron levels steadily increased throughout the season and reached very significant levels. At other sites where ferrous iron levels were much lower, the increase in conductivity was small.

9. It is likely that the internal loading of iron from the sediment under anoxic conditions is accompanied by the release of other compounds that can also contribute to increased conductivity. This aspect will be further studied in 2024.

## Extent of Anoxia in South Bay:

South Bay has been identified as the probable nutrient source of the cyanobacteria that are found in almost all of the shoreline algae blooms in recent years. This has also been the site where anoxia and internal loading have been documented.

Figure 6 (below) portrays the "**South Bay Anoxia Area**". According to the bathymetric map of Leonard Lake, the "deeper area" in South Bay resembles a "footprint" which is approximate 550 m long, and about 200 m wide near the North end where the buoy is situated. The edge of this basin is 6 m deep; the deepest areas (8-9m) are north, south, and east of the buoy, as well as a much smaller area in the very south end.

To further understand the extent of the anoxia at this site, we were able to use a Sonde on Sep 27, 2023 to test a number of sites around the buoy to determine both depth and the incidence of anoxia. Time constraints limited the number of sites that could be tested for Dissolved Oxygen, therefore these are preliminary findings for **South Bay**: (Total depth 8.5-9 m).

**Preliminary results**

1. Whereas, in both August and September in **2022**, the metalimnion in South Bay was between 4 and 5.5m, and anoxia was found at about 5 meters (Dissolved Oxygen (DO) less than 1 mg/L), the findings were different in 2023. On Sep 27 **2023** the anoxic layer was consistently found at 7 m.
2. It is has been shown (Patterson) that Dissolved Oxygen (DO) profiles at the NDH varied considerably from year to year.
3. Watson,( in the latter part of Aug 2017), documented DO levels of 2 mg/L at 4.5 meters, and 1 mg/L at 5 m at the South Bay site.
4. Results from **2022** also indicated that DO profiles can change as the season progresses – between the end of July and mid Sep.
5. Because we have only 1 data point in 2023 (Sep 27), we cannot determine whether the difference between Sep 13, **2022** and Sep 27, **2023** in the anoxic depth at South Bay, is due to annual variation, and that the level of anoxia was generally less in 2023; or whether a significant change in profile usually occurs between mid and the end of Sep due to normal Fall turnover.
6. For comparison purposes, the Sonde was also used (on Sep 27, 2023) at the Mid-Lake buoy site; the total depth there is approximately 14-14.5 m, and a DO level of 1.0 was found at 13.5 m. It would appear that (in 2023) by the end of Sep., there was only a very thin layer of anoxia (1-2 m) at Mid Lake as well as in South Bay. See also Temperature profiles below.
7. If the level of anoxia in South Bay was less in 2023 than in the previous year, would this have contributed to the lower incidence or lower severity of algal blooms in 2023?

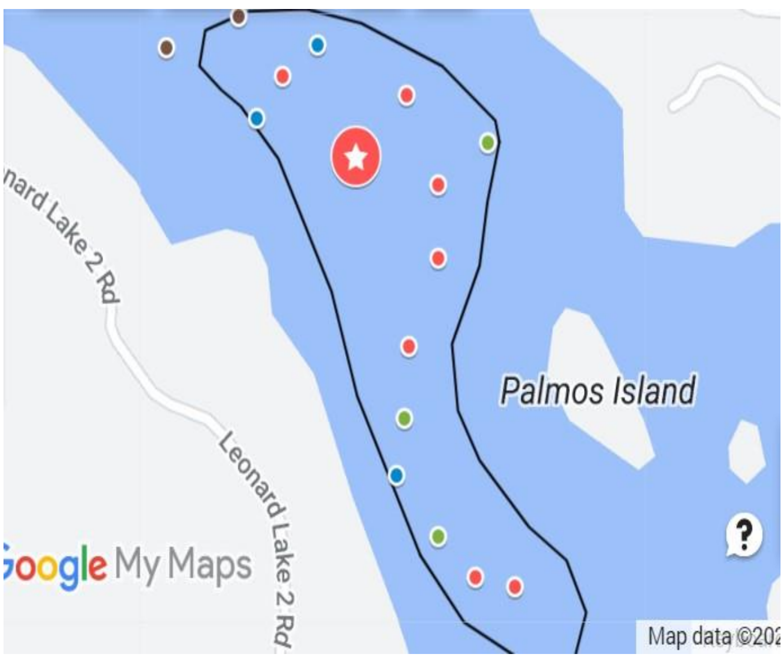


*Figure 6: Area of posssible anoxia ( footprint shape) around Site 2 ( represented by the star) in South Bay. Areas >8 m deep are marked in red; 7-8 m green, 6-7 m blue.*

## Residence time of lake water

A small outflow on the western shore is the only exit point for water from Leonard Lake. The exit flow usually ceases during the summer which leads to an increase in stagnation, and a longer turnover rate of the water in the lake.

In 2023, it was noted that the exit flow of water was continuous throughout the season. Was the decreased residence time and replenishment of fresh water into the lake, a factor in the lower incidence of algal blooms? This will be more closely monitored in 2024.

## Changes in water temperature stratification

Temperature stratification precedes stratification of Dissolved Oxygen and the incidence of anoxia in bottom layers. Water temperatures at different depths were recorded at all 3 deep sites throughout the season. The temperature profiles are plotted at the lake surface, at 6-7 m depths where the DCM are located, and near the sediment (B-1) specific to each location. The results (below) may also clarify the time and process of "turnover" in the Fall. See Figures 7a,7b,7c

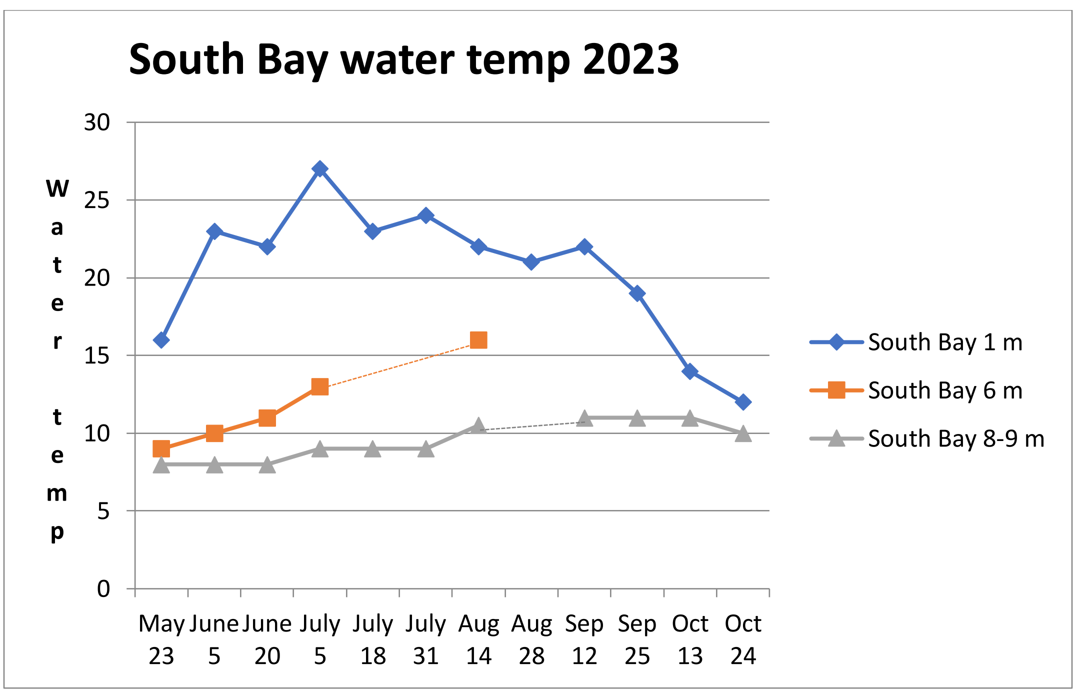


*Figure 7a*

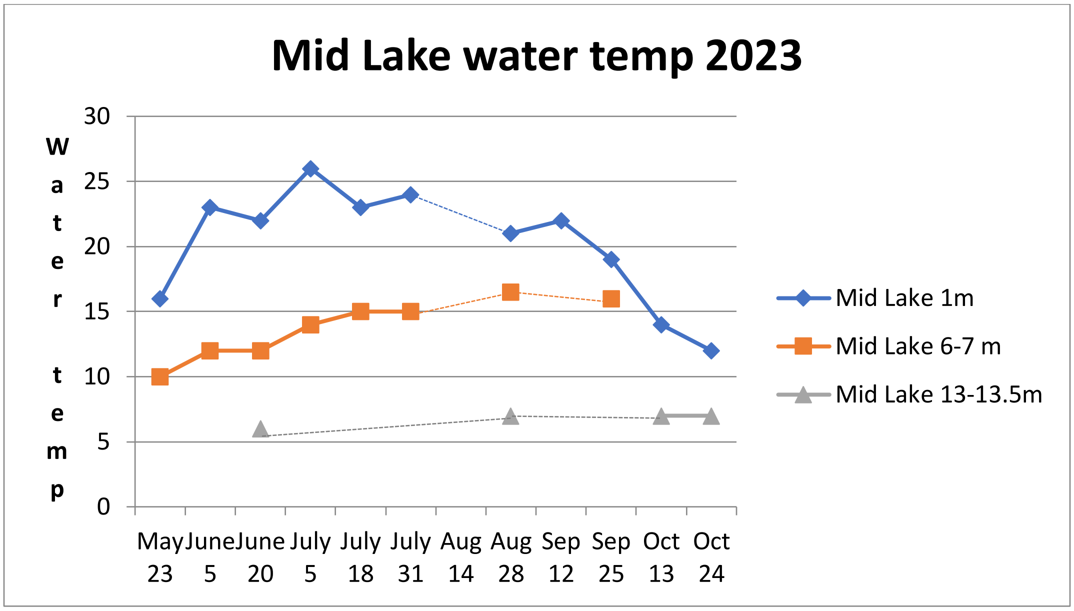


*Figure 7b*

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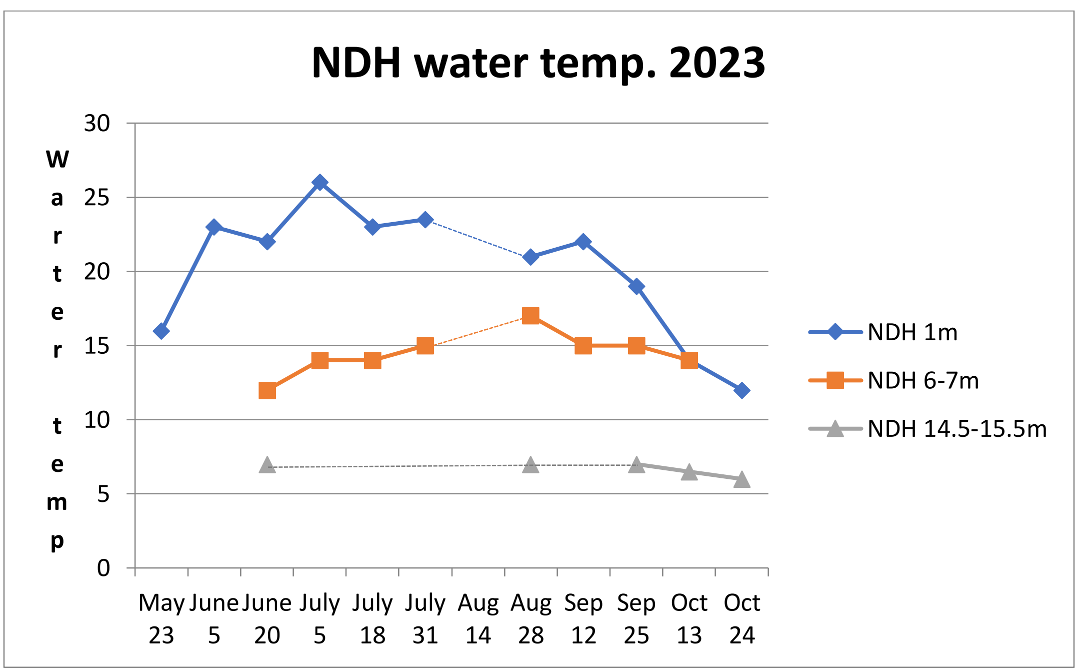


*Figure 7c*

*Figures 7 a,b,c: Temperature profiles between surface and sediment at the 3 deep sites in Leonard Lake in 2023*

# Further Details Of Collaborative work with other Organizations

**LPP:**

The Lake Partner Programme (LPP )is a province- wide, volunteer-based, water-quality monitoring program. Hundreds of volunteers collect water samples from many lakes, usually near the end of May during spring-turnover; these results provide long-term data for Total Phosphorus, Chloride, Calcium, and water clarity.

**Testing**:

1. All 3 deep sites had Water Temperature, Secchi depth, and weather conditions documented monthly between May 23 and Oct 13.
2. All 3 deep sites were also sampled on May 23 for total phosphorus (TP), calcium, and chloride at 1x Secchi depth.
3. South Bay was additionally sampled monthly for TP and other chemistry at 1xSecchi Depth. This additional sampling at South Bay throughout the season is outside standard protocol, and was done because South Bay requires additional monitoring because of a suspected link to algae blooms.

**Results**: Not yet available for 2023

**MWC Algae Project**

The Muskoka Watershed Council initiated a pilot **Algae Project** in 2019 with 5 lakes, including Leonard Lake; we have participated each year since, and in 2023 the group included over 20 lakes. Water samples are obtained biweekly from 2 sites at 2times Secchi depth, between May and October. These samples are analyzed for 2 pigments - phycocyanin and chlorophyll; the chlorophyll readings provide a measure of the total algae present, and the phycocyanin concentrations approximate the biomass of Cyanobacteria (CB, aka “Bluegreen algae).

**Testing**:

1. Two sites (Nearshore -- in 2 meters of water; and Farshore –Mid Lake buoy) were sampled at 2times Secchi Depth from May 23 to Oct 24.
2. Samples were analyzed for Phycocyanin and Chlorophyll levels using a Fluorometer, and results submitted.

**Results**: No report yet from MWC.

**Benthic Testing- District of Muskoka :**

Monitoring bottom-dwelling aquatic invertebrate communities has been part of the District Municipality of Muskoka's Lake System Health Biological Monitoring Program since 2003. In biological monitoring, composition of the aquatic-invertebrate community, the pattern of abundances of different species collected, indicates the health of the ecosystem. Different species have different sensitivities to environmental changes such as pollution or habitat alteration. Benthic testing (See map Fig 8)was done at 3 sites on Aug 20, with the assistance of a technician, Maggie Dechert, from the District and volunteers from Leonard Lake: Site 1, and 2 new ones: Site 3 and Site 4. (Site 2 was discontinued.)

**Conclusions:** Maggie Dechert commented that "there has been a decline in lake health, and that is the overall trend I am seeing for the average lake in Muskoka."

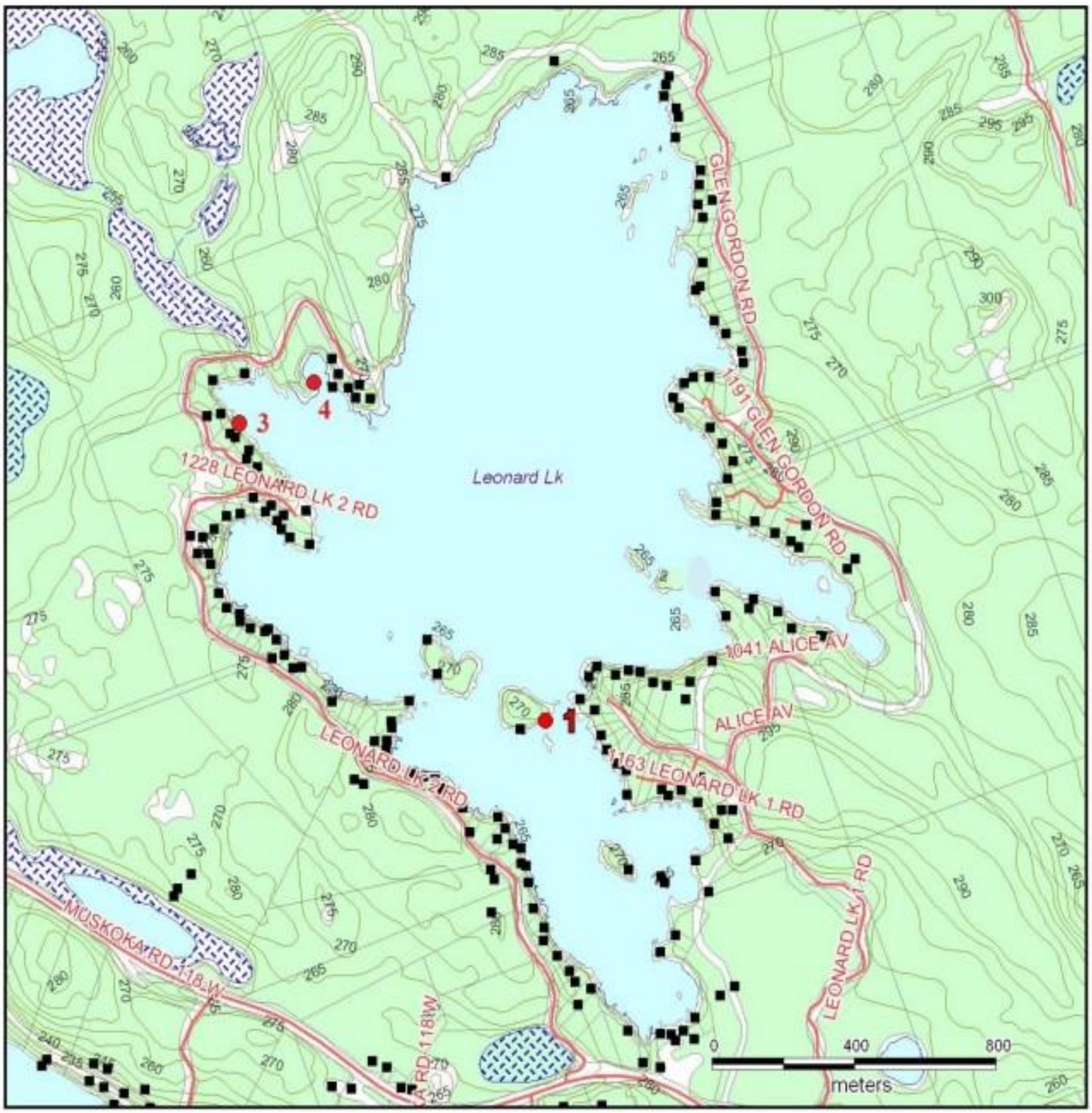


*Figure 8: Benthic sites sampled in 2023, marked with solid red circles*

### Support for PhD Student

Rebecca Gasman, PhD student from York University, conducted testing primarily in South Bay. Her research is focused on the role of climate change on algal bloom formations in low nutrient lakes. This research has four specific objectives: 1) determine if anaerobic sediments are associated with blooms in the study lakes, 2) identify nursery areas for bloom formation, 3) assess the extent to which blooms in the Canadian subarctic are dominated by cyanobacteria species and evaluate the extent of historical change over time, and 4) collect and integrate local Indigenous Knowledge (IK) and local management expertise with existing and new scientific knowledge to create a more holistic picture of the issue. The research will use a combination of techniques: modern-day sampling, paleolimnological methods, and semi-structured interviews. Shallow near-shore bays in (predominantly) oligotrophic lakes will be monitored for thermal stability, oxygen depletion, internal loading of nutrients (P) and trace metals ($Fe2+$), and intensity of bloom formation during the ice-free period using high frequency data loggers, modern-day sampling techniques, and cyanobacteria traps. This included buoys with attached equipment, also core samples which were obtained in the Fall and Winter. She was given support by the community, especially Bill Heatlie. The results will be part of her thesis.

## Conclusion : Focussing our work for maximum impact in supporting Lake Health

This report, (and the accompanying Summary Document), have highlighted some important results that can help focus our work . This report is not comprehensive. Rather, it contains information that can help stakeholders and others to understand the investigations and findings of the water team during 2023.

**Possible areas of focus:**

- Continued monitoring of internal loading (nutrients and anoxia) around South Bay looking at seasonal and annual effects.
- Weather, wave and water current effects on near-shore blooms.
- Impacts of shoreline runoff on the health of our lake
- Long term sampling and database storage at the established deep and near-shore sites.
- Our capacity is limited – we must reach out to others, (experts, government, NGOs and other lake associations.
- We know that Zooplankton grazers like Daphnia, which can keep harmful algal blooms from proliferating, may be at risk from salt, pyrethroid sprays used to control mosquitoes, or other changes in the lake. We wish to initiate Zooplankton studies, but the lack of baseline data and difficult sampling protocols will make this study challenging. If possible, initiate studies to determine if there is a decline in zooplankton grazers, specifically Daphnia species.
- Continue to inform stakeholders about the important contributions they can make to safeguard our lake and to prevent further decline of water quality. Residents/users can:
    - urge authorities to reduce the use of road salt;
    - use alternate methods for mosquito and tick control, particularly avoiding the use of the commonly-used Pyrethroid pesticides which are extremely toxic to Benthos creatures;
    - ensure that gasoline or other petroleum products do not enter the lake;
    - ensure that invasive species are kept out;
    - avoid erosion, and keep/restore naturalized shorelines to minimize negative effects from run-off.