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MUNICIPALITY OF NORTH COWICHAN SERVICE
AGREEMENT WITH THE SOMENOS MARSH WILDLIFE
SOCIETY ANNUAL WATER QUALITY REPORT 2024

Prepared for: Municipality of North Cowichan

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2 WATER QUALITY MONITORING PROGRAM

2.1 EXECUTIVE SUMMARY

The Somenos Marsh Wildlife Society undertook extensive water quality monitoring in 2024 under the Municipality of North Cowichan Service Agreement, focusing on various physical, chemical, and biological parameters across multiple water bodies, including Somenos Lake and its tributaries. The monitoring involved regular assessments of critical indicators such as temperature, dissolved oxygen (DO), pH, specific conductivity, total dissolved solids (TDS), and nutrient levels, including total phosphate, ammonia, nitrate, nitrite, and total nitrogen.

Key findings revealed that Somenos Lake is hyper-eutrophic, exhibiting significant fluctuations in nutrient levels, particularly during the summer months. Dissolved oxygen levels were alarmingly low, especially below 3 meters, leading to anoxic conditions detrimental to salmonids.

Temperature stratification was variable in spring and may have had a multiple turnover events. Mid-summer stratification created conditions of extremely high surface temperatures correlating with low oxygen levels at depth, creating inhospitable conditions for aquatic life. Additionally, the presence of blue-green algae raised concerns regarding potential toxins that could impact both wildlife and human health. Monitoring the algae community resulted in findings that the likely cause of the fish kill that occurred this year was due to a sudden die-off of blue-green algae mid-summer, and a rapid decline of dissolved oxygen throughout the lake. Another nutrient to focus on is the exceeded ammonia throughout the lake and tributaries. Further analysis is needed to discover what the toxicity relationship of ammonia is to the temperature and pH conditions in the lake and tributaries.

Overall, seasonal trends highlighted a pattern of intermittent lake stratification and turnover, with summer elevated temperatures and anoxic conditions posing risks to aquatic ecosystems. Monitoring of tributaries indicated varying water quality, with Somenos Creek and Richards Creek at Herd Road displaying notably lower dissolved oxygen levels, which hinder salmon migration to spawning sites. These findings emphasize the necessity for ongoing assessments and proactive management strategies to maintain the ecological balance of the Somenos Watershed.

2.2 THE S'AMUNU | SOMENOS WATERSHED

The S'amunu | Somenos Watershed (the Watershed) covers 71 km² within unceded Cowichan Tribes Territory and is mostly located within the Municipality of North Cowichan (MNC). Portions of the Watershed encompass Cowichan Tribes land, land within the City of Duncan, and the Cowichan Valley Regional District (CVRD). The watershed includes tributaries that flow from Mt. Prevost and Mt. Richards at Crofton Lake. The major tributaries are Richards, Averill, and Bings Creeks which flow into Somenos Lake, and exit into Somenos Creek. The end of the watershed study area is where Somenos Creek meets the Cowichan River. The Society has conducted water quality monitoring in Somenos Lake for the MNC since 2014 and, beginning in 2020, added monitoring of the four major tributaries: Richards, Averill, Bings, and Somenos Creeks (Figure 1).

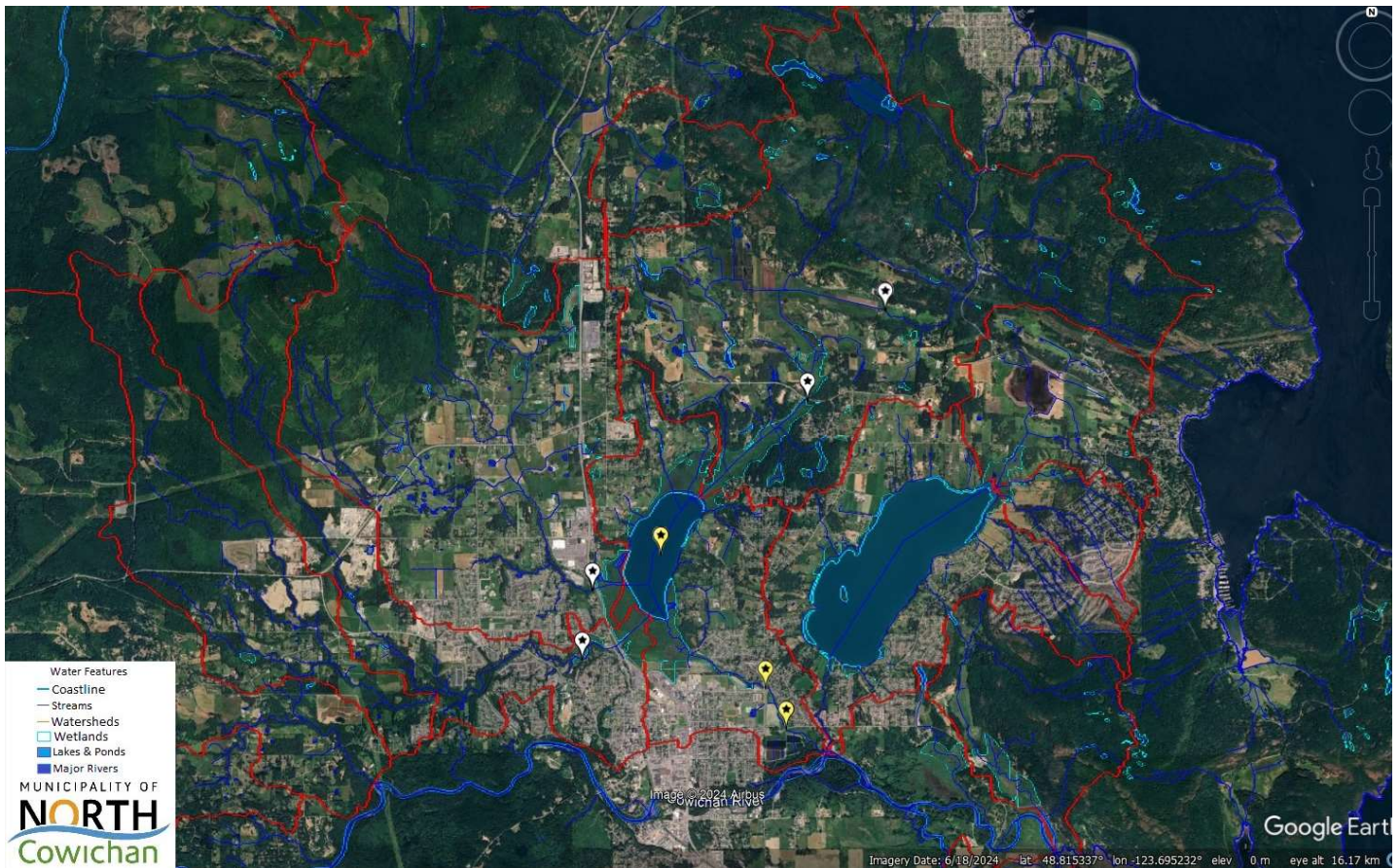


Figure 1: Somenos Watershed Water Quality 2024 YSI Weekly/Monthly Testing Locations. Yellow sites have data loggers recording hourly dissolved oxygen and temperature

2.3 PURPOSE OF THE WATER QUALITY MONITORING PROGRAM

The Somenos Watershed is being impacted by agriculture, development, and a growing demand for more housing developments and supporting infrastructure. Runoff and airborne precipitation from these impacts can discharge into the watershed and may contain compounds that can harm the watershed’s aquatic ecology. Monitoring water quality allows us to understand the current state of Somenos Lake and the watershed’s health allowing us to identify impacts over time as well as the location of anthropogenic sources from land-water connections. The monitoring results allow the Society to provide recommendations of future monitoring requirements, additional sampling parameters, and land use mitigations to the MNC and appropriate governing bodies. The waterways of the Somenos watershed are important natural assets that aid in the reduction of flood risk, the removal of stormwater and the treatment of pollutants. Water quality monitoring will facilitate the adoption and management of Somenos waterways into the Municipality’s developing natural assets management program.

2.4 WATER QUALITY PARAMETERS COLLECTED

Under the Municipality of North Cowichan Service Agreement for 2023, the Somenos Marsh Wildlife Society Water Quality Monitoring physical, chemical and biological parameters include:

- **Tributaries:**
 - Bings Creek (Somenos Conservation Area and Mary St.), Averill Creek, Richards Creek (Herd Road and Richards Trail)

- Monthly (Winter: Oct 01 – Apr 30) and Weekly (Summer: May 01- Sep 30):
 - YSI testing for T (temperature), DO (dissolved oxygen), pH (acid balance), SPC (specific conductivity) and TDS (total dissolved solids) at
 - Nutrients: total phosphate, ammonia, nitrate, nitrite, total nitrogen at Bings Creek (Somenos Conservation Area), Averill Creek, Richards Creek (Herd Road and Richards Trail), Somenos Creek at Somenos Lake (surface and 6m)
- **Somenos Lake**
 - Monthly (Winter: Oct 01 – Apr 30) and Weekly (Summer: May 01- Sep 30):
 - YSI testing for T (temperature), DO (dissolved oxygen), pH (acid balance), SPC (specific conductivity) and TDS (total dissolved solids):
 - Nutrients: total phosphate, ammonia, nitrate, nitrite, total nitrogen: Monthly in winter, weekly in Summer
 - Lake elevation
 - Secchi depth measurement
 - Bi-monthly (May1-October30) and Monthly (November 1- April 30):
 - Phytoplankton community composite samples taken at depths 0-3m
 - Hourly Data Loggers: T + DO (depths T: 0 - 6m; DO: 1m and 5m)
- **Somenos Creek**
 - Monthly (Winter: Oct 01 – Apr 30) and Weekly (Summer: May 01- Sep 30):
 - YSI testing for T (temperature), DO (dissolved oxygen), pH (acid balance), SPC (specific conductivity) and TDS (total dissolved solids):
 - Nutrients: total phosphate, ammonia, nitrate, nitrite, total nitrogen: Monthly in winter, weekly in Summer
 - Hourly Data Loggers: T + DO (2 sites: Lakes Road, Tzouhalem Road)
 - Additional fall weekly testing for anomalies that may prevent salmon migration (October 1-Dec 31): YSI testing: T + DO
- **Beverly Wetland Monitoring:** 10 weeks (August to November)

2.5 METHOD OF WATER QUALITY DATA COLLECTION

In the fall, weekly testing of temperature and dissolved oxygen was included to determine when the tributaries were within the accepted range of values for salmon spawning migration. The dissolved oxygen (DO) and temperature (T) probe installed in 2022 continued to record fluctuations throughout 2024 every 10 minutes at the Lakes Road bridge on Somenos Creek. Another DO and T probe was installed in 2024 at Tzouhalem Road and was frequently checked as well.

The equipment used for collecting temperature, pH, dissolved oxygen, turbidity, and specific conductivity data was a YSI Professional Series Multi-meter. In spring to fall the probe was used twice a week in the lakes and creeks, and once a month in winter. The meter was calibrated once a month, to ensure accurate readings the dissolved oxygen membrane was replaced every 2 months.

Nutrient samples and parameters for total phosphate, ammonia, nitrate, and nitrite are tested year-round in the lake and creeks and are respectively shown in Appendix A and B. In 2024, a Van-dorn bottle was used in the lake to collect the nutrient water samples at the surface and bottom of the lake, and a grab mid-channel in the creeks. When sampling the lake, the Van Dorn is rinsed and sent down to the desired depth (surface and 6m). Sample jars are cleaned with the

water from the Van Dorn three times, then filled. This is repeated for both depths. Water is then analyzed using a YSI 9300 Photometer to test each parameter. Preservatives are not required if samples are tested the same day. Reagents specific to each nutrient being tested are added to a 10ml glass sample vial and left to react with the water for 10 minutes. The vial is then placed in the Photometer to obtain a result. A control vial without a reagent is also tested to obtain a background result for each site. Testing is done in-house using the YSI 9300 and are sent to CARO Laboratories once a year to check the quality of the results.

Due to concerns of cyanobacteria (blue-green algae) toxic outbreaks, phytoplankton (algae) community monitoring was included in the water quality program starting in 2023 into 2024 in Somenos Lake. Field and lab methods were completed the same as the Municipality of North Cowichan on Quamichan Lake. This will enable the two lakes to be compared over time. The sampling device is made of three meters of plastic tubing, with a 10-pound weight attached with hose clamps to one end. The weight is meant to keep the tubing vertical in the water column to obtain a sample a composite between 0-3m of the algal community in the photic zone of the lake. The tubing was lowered into the water column to the desired depth of 3m. The top end at the surface was sealed by hand to capture the composite sample. This trapped the water sample within the tube, which was pulled to the surface, and emptied into a clean mixing bucket. A 250ml bottle was filled with the sample water and 25 drops (25%) of lugol's solution was added to preserve it for shipping. These samples were sent to Biologica Environmental Services Ltd. for analysis.

Beverly Wetland Monitoring started in 2022 and continued to 2024. A location map is included in Appendix E, Figure 30. The purpose is to test the successful functioning of the wetland. Water samples are tested for total metals, phosphorus, and turbidity at MB Laboratories Ltd. SMWS collected water samples at two upstream locations (BWQ1US, BWQ2US) where storm water runs into the wetland off Beverly Street, and one downstream site (BWQ1DS) where the water flows out of the wetland through the dike to Somenos Creek. Samples were collected during the dry season for five weeks, and wet season for another five weeks. Samples were frozen and shipped to MB Laboratories after the 10-week sampling period was completed.

2.6 WATER QUALITY DATA AND CHARTS

Refer to the appendices to review the results of the water quality data collection program.

2.7 WATER QUALITY TEST RESULTS

The results of this year's annual water quality monitoring program show us a glimpse of what is happening in the Somenos Watershed regarding water quality health and what the potential impacts are on aquatic life. observations made during the Somenos Lake water quality sampling season in 2024 are:

- Somenos Lake thermal stratification occurred briefly in March, then more consistently from May to late September when turnover occurred (Figure 2). There may have been a few instances where the lake turned over mid-summer as well.
- Dissolved oxygen oxycline in the lake occurred in March; but dropped dramatically throughout the lake after the algal community collapse on August 7/8th. Dissolved oxygen in the lake oxycline returned after it recovered by late August, then followed temperature in late November when oxygen levels throughout the lake mixed and began to drop.
- Over the last four years spring thermal stratification occurred in March 2021, May 2022 and April 2023, and May 2024. Fall turnover in all four years was in September.
- Somenos lake dissolved oxygen at the bottom (6m depth) was anoxic (<2mg/L) from June 18 to October 22 (120 days).

- There was a fish kill of Coho salmon (*Oncorhynchus kisutch*) smolts, Pumpkinseed sunfish (*Lepomis gibbosus*), and a few Brown bullheads (*Ameiurus nebulosus*) observed in the morning of August 11 by residents of the lake. Dissolved oxygen levels dropped dramatically starting on August 8th, and by 1:30 pm levels were at lethal levels on the surface (<6mg/L) for Coho, and remained <1mg/L for several days which would have been lethal for the remaining fish species in the lake. Observations for the next few weeks while oxygen remained low were of pumpkinseeds jumping throughout the entire lake. This behavior is assumed to be because of low oxygen levels.
- The Somenos Lake algae was observed on the surface of the lake starting as green flecks in June. The surface of the lake fluctuated between 'brown' and 'green' with regular periods of a propane, sulfurous odour from June to October. Late September clumps of blue-green algae were observed on the lily pads near the public Drinkwater boat launch. By December The lake was clear of visible algae. Further algae analysis shows the phytoplankton community each month. Microcystis species were present in the lake year-round except in months March to May. The blue-green algae community peaked and dominated the algae community just before the time of the fish kill. By August 13th the blue-green algae collapsed to very low levels. Data tables and figures of 2024 results are in Appendix A.
- Dissolved oxygen data loggers used for monitoring on Somenos Creek was valuable in determining when salmon migrate upstream to spawn. In 2024, SMWS observed that the salmon migration up Somenos Creek to the upper tributaries of Averill, Bings creek was delayed until late November, and December for Richard's Creek. This has become an annual occurrence, and similar in previous years. This is due to unfavorable dissolved oxygen conditions in Somenos Creek until November 18, and lower Richard's creek (at Herd Road) until December 20 when more rain events created higher flows, improving conditions.
- Somenos Lake figures and data tables of 2024 results are in Appendix A and C, respectively.
- Tributary figures and data tables of 2024 results are in Appendix B and D, respectively.
- Beverly wetland data tables of 2024 results are in Appendix E.

3 APPENDIX A – WATER QUALITY RESULTS FOR SOMENOS LAKE

The weekly, monthly measurements of dissolved oxygen (DO), temperature, and conductivity profiles are represented in Figures 2 to 4. The monthly nutrient sampling of total phosphate, ammonia (and pH), nitrate, nitrite, total nitrogen is shown in Figures 5-12. Lake depths and hourly temperature data logger recordings are shown in Figures 13-14.

TEMPERATURE AND DISSOLVED OXYGEN IN SOMENOS LAKE

Dissolved oxygen levels and temperatures are important to monitor as an indicator of biological activities, lake stratification and fish habitat. Thus, looking at these two parameters will help us understand the biological activity in the lake and if fish are able to inhabit the lake at certain times of the year.

In 2024, dissolved oxygen and temperature were measured weekly at every meter of the lake. This indicated that a thermo-stratification occurred a few times in spring. Briefly in March, then it turned over in April, until it stratified again in May (Figure 2), finally turning over in September creating homogenous temperatures at all depths.

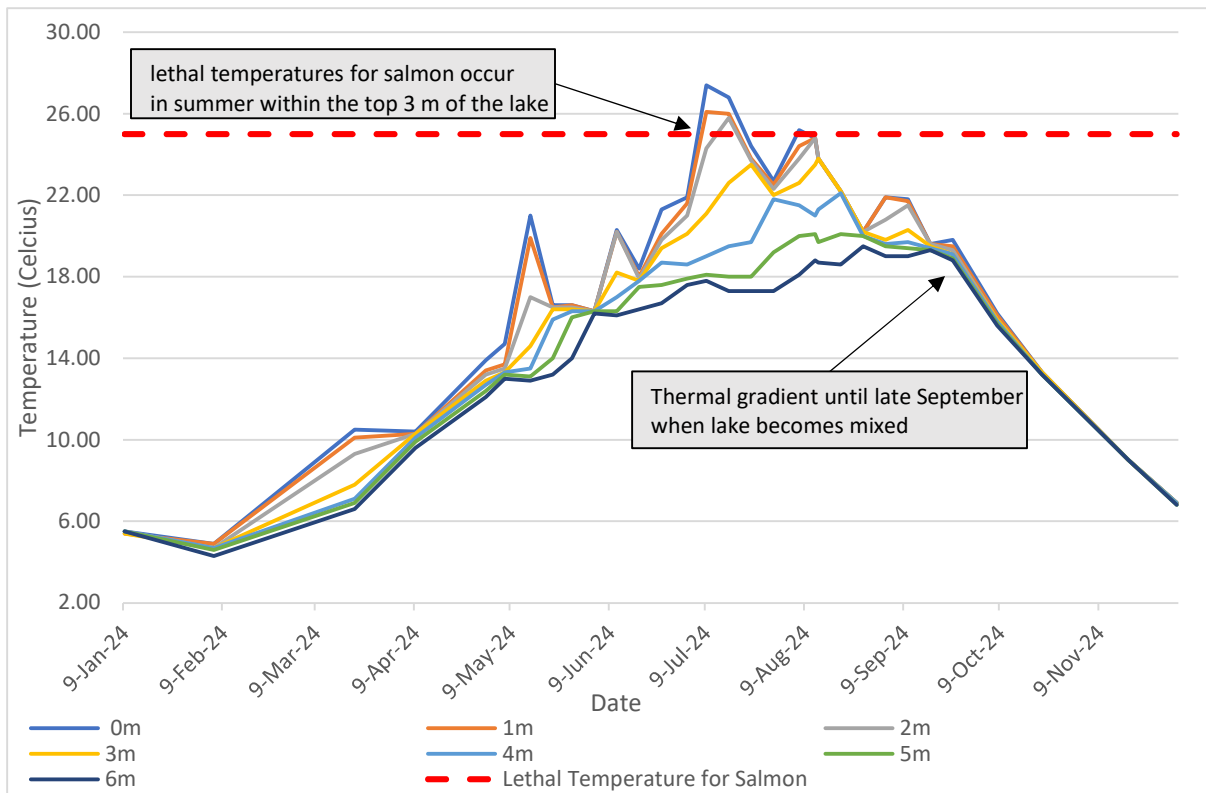


Figure 2 Somenos Lake Temperature YSI Depth Profile of Surface to 6 m, 2024.

One main importance of thermal gradient observations is to determine where pockets of adequate temperature and dissolved oxygen levels exist in the lake, allowing fish to survive. Salmonids are known to use Somenos Lake as a migratory pathway and a refuge; however, fish kills have occurred in the past due to summer anoxic conditions. Their dissolved oxygen anoxia conditions are 0-4 mg/L (Davis 1975) so below this is lethal for salmonids. Generally, salmonids consistently avoid concentrations below 6mg/L (Carter 2005).

Dissolved oxygen levels in Somenos Lake were lower in the summer (except the top 1-3 meters). Specifically, dissolved oxygen was anoxic-hypoxic below 3 m depth starting late May just after stratification, with some variability of oxygen at 4m throughout the summer (Figure 3). Unfortunately, where oxygen levels were high in the lake, the temperatures at 1-3m were frequently >25C, lethal to salmonids (Carter 2005; BCMOE 2001), and regularly above 20C except in the anoxic depths of the lake. So when oxygen was good for salmonids (near the surface) the temperatures were too high, and where temperatures were tolerable deeper in the lake (cooler), the oxygen was too low (Chart 2). This makes the lake uninhabitable in the summer for salmonids.

In addition, by August 9 the entire water column dropped < 4mg/L, which was the likely cause of this summer's fish kill, where a few hundred coho smolts, thousands of pumpkinseeds, and a few brown bullheads were observed floating on the lake by residents. It is assumed that overnight on August 8, there was enough of a reduction of algae photosynthesis to reduce oxygen to cause a fish kill. That in addition to warm temperatures around that time (>25C) during the day, and shallow depths, the fish may not have been able to escape this anoxic and thermal zone. After the August fish kill, the oxygen levels in the lake recovered above 2mg in early September to >6mg/L, likely due to the recovering algae community.

Interestingly, in late September when thermal mixing occurred, dissolved oxygen dropped again throughout the lake (Figure 3). This likely occurred during turnover when the anoxic conditions at the bottom of the lake mixed with the top layers and created low oxygen environment throughout. By late November all layers of the lake had similar dissolved oxygen levels, indicating cooler conditions slowed biological activity, which also caused the oxygen to drop.

Overall, the data over the years indicate a consistent pattern of spring stratification and fall turnover, with varying durations of low oxygen events. Elevated temperatures and anoxic conditions during summer months continue to pose significant risks to the aquatic life in Somenos Lake, emphasizing the need for continuous monitoring and mitigation efforts to preserve the lake's ecological balance.

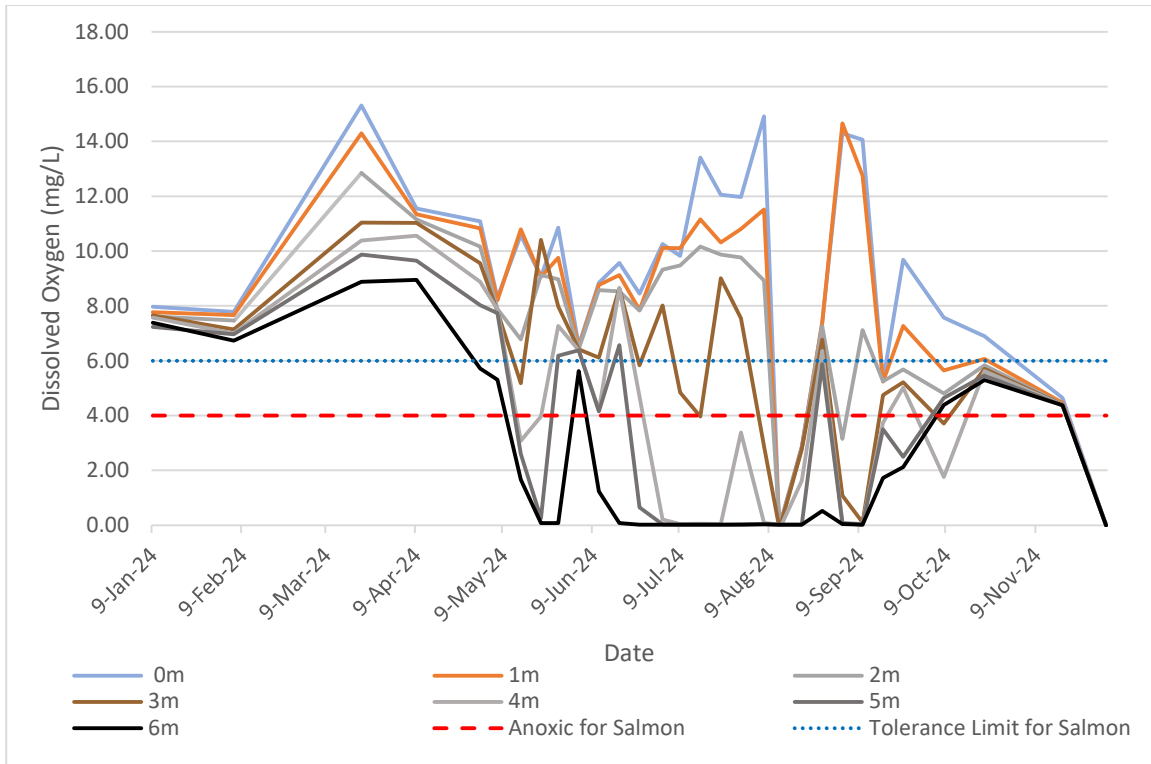


Figure 3: Somenos Lake Water Quality Profile of Dissolved Oxygen, 2024

CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN SOMENOS LAKE

Conductivity and total dissolved solids (TDS) have a direct relationship with temperature changes in the lake. (EMS 2019). As such, an increase in temperature can dissolve minerals (also creating more total dissolved solids) mobilize ions and increase conductivity (EMS 2019). This could explain in warmer months when temperatures within the water column heat up, minerals from the sediment at the bottom of the lake have the highest amount of TDS and conductivity (dotted line). Figure 4 shows similar results of these two parameters.

The first spike in TDS and conductivity occurred on May 28th following a spike in temperature on the first few meters of the lake, causing a brief stratification on May 15th. On June 4th a mixing of the thermal layers occurred again, and the TDS and conductivity levels both dropped. This pattern of increased lake temperatures, followed by increased ion mobilization, particularly near the bottom occurred up until July 9th when thermal layers stabilized.

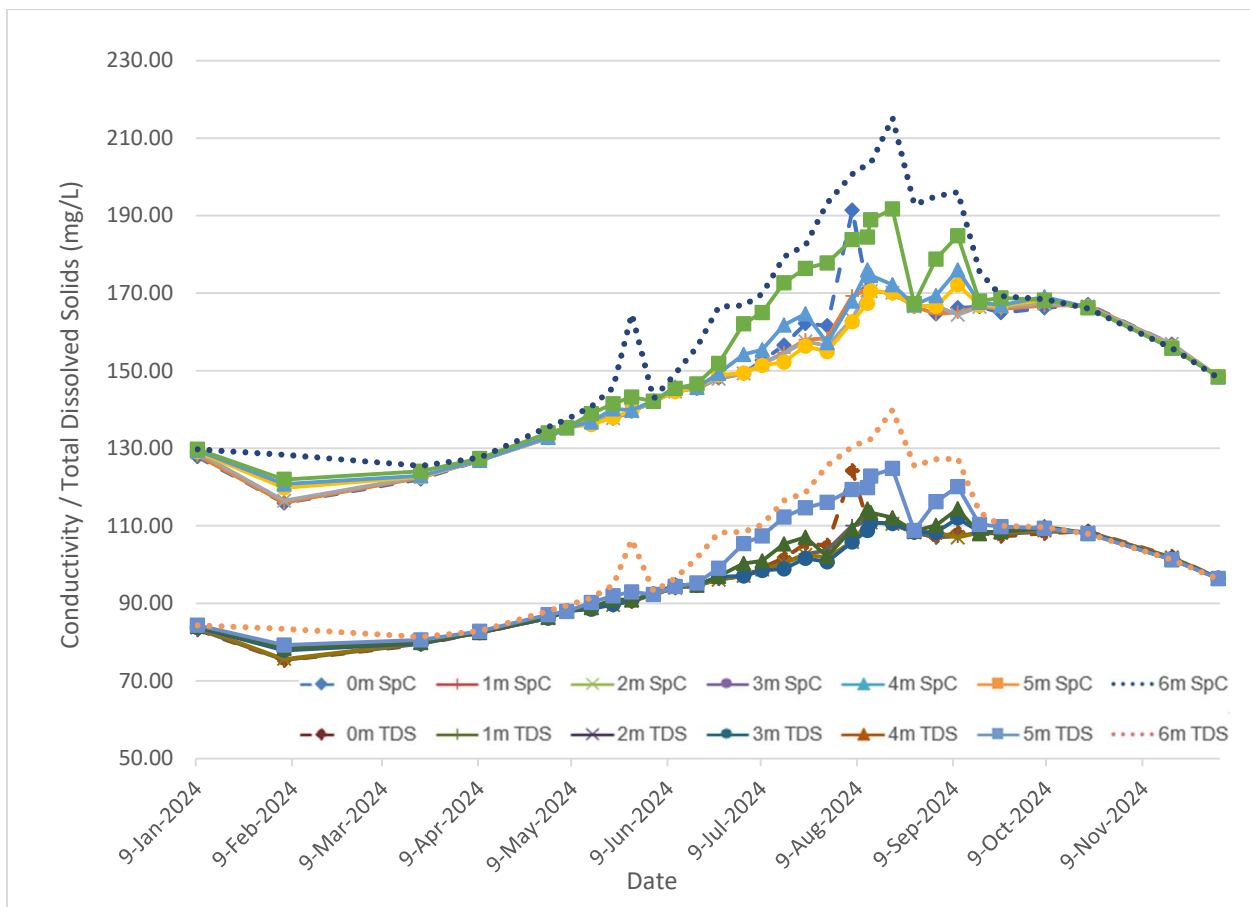


Figure 4 Somenos Lake Monthly Specific Conductivity and Total Dissolved Solids Depth Profiles, 2024

NUTRIENTS IN SOMENOS LAKE

Somenos Lake is a hyper-eutrophic lake, therefore, part of the monitoring program the nutrients studied were nitrate, ammonia, nitrite, and phosphate. These nutrients accumulate in the lake and have the potential to increase growth of aquatic plants and algae, which can deplete oxygen levels.

NITRATE IN SOMENOS LAKE

Nitrate levels from 2021 to 2024 have not exceeded BCMOE (2024) guidelines for aquatic life at the top or bottom of the lake for acute (32.8 mg/L as NH₃-N) or chronic exposures (3 mg/L as NH₃-N, or 9.9 mg/L as NH₃) (Figure 5).

In 2021 to 2024, Nitrate levels are the lowest until after the peak summer temperatures on the surface, showing it was likely consumed first by algae and other microbes, and is not used during those colder months when microbes are less active.

It is good to consider that farming best practices for fall fertilizer loading on fields are to have a manure application on before the end of September. After this time, the rain begins and cause runoff of nitrogen rich material to occur. This can also be attributed to any increase in nitrogen in fall.

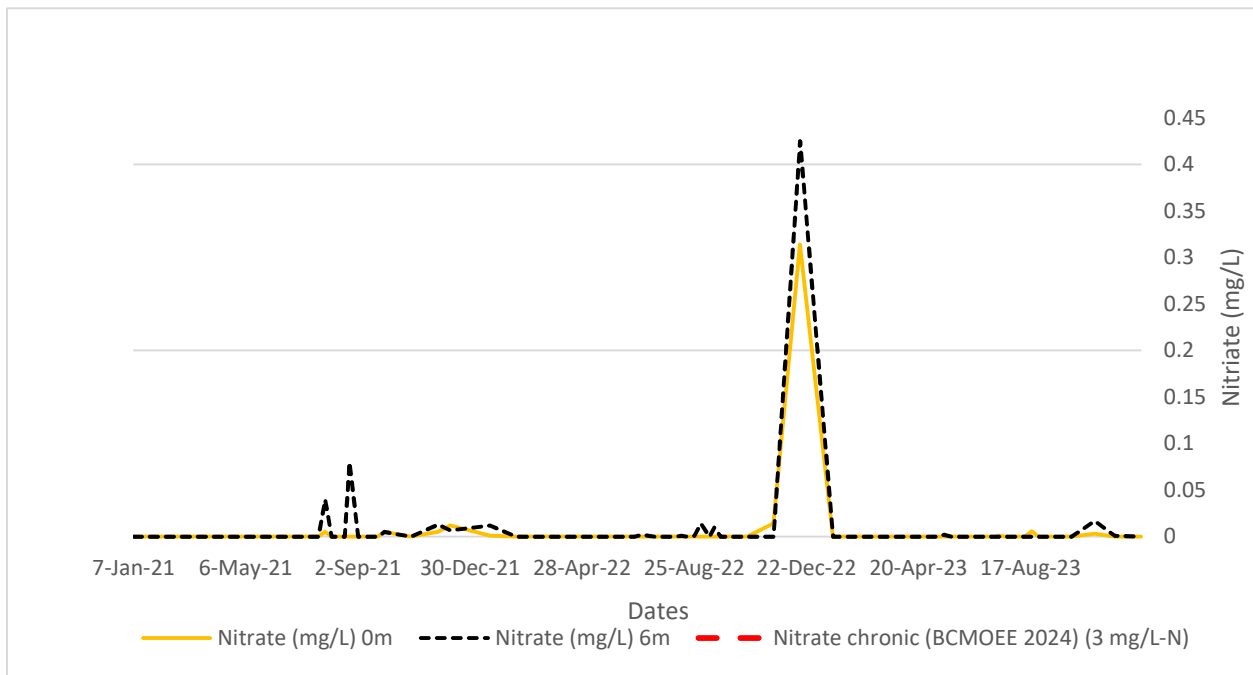


Figure 5: Somenos Lake Nitrate (NO₃) and Temperature Levels at the surface and bottom, 2021-2024. Although levels of Nitrate were note above recommended guidelines, the spike in 2023 is not concerning.

NITRITE IN SOMENOS LAKE

Nitrite levels at acute limit exposure of 0.06 mg/L as N (or as results are shown as 0.264 mg/L NO₂) was not exceeded over the 4 years above or at the bottom of the lake (Figure 6).

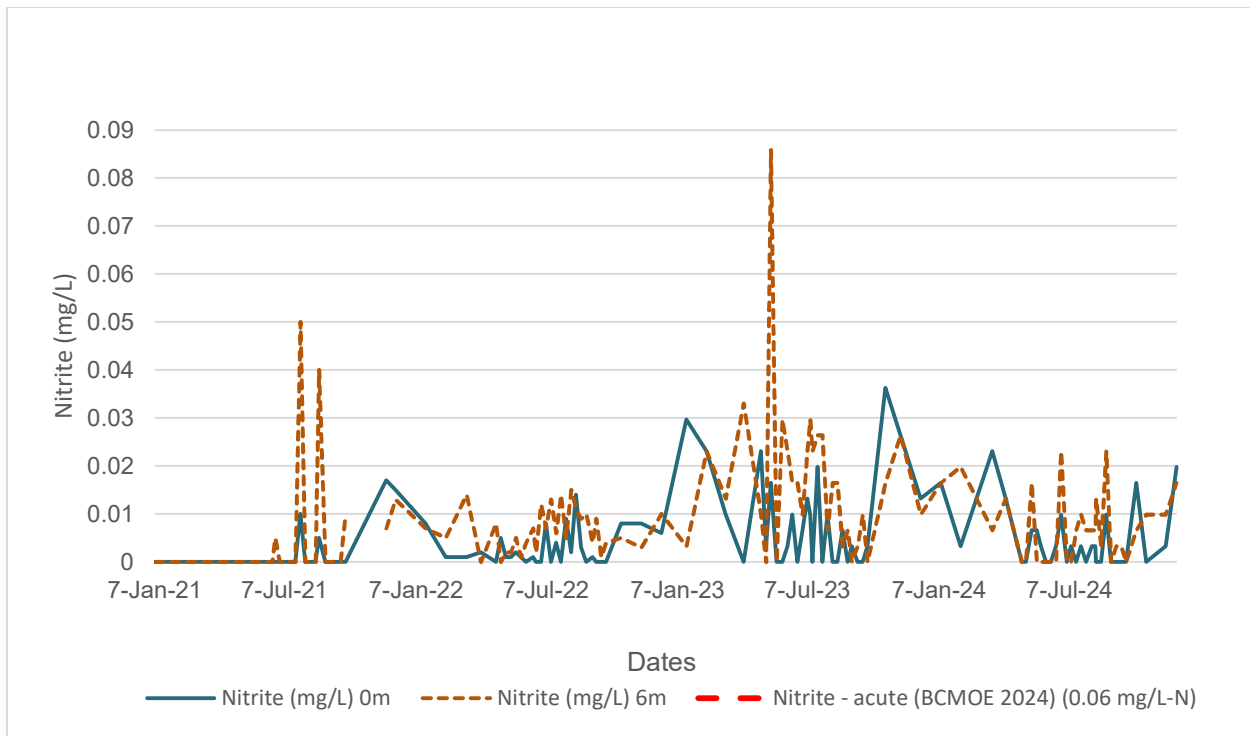


Figure 6: Somenos Lake Nitrite (NO₂) and Temperature at the Surface and Bottom, 2021-2024

AMMONIA IN SOMENOS LAKE

Ammonia is highly soluble and comprises much of the available nitrogen that is naturally found in the environment and is metabolized by microorganisms changing it to nitrite, then nitrate in an aerobic environment (CCME 2010). Depending on environmental conditions, such as temperature and pH, ammonia's form can change between ionized (NH₄⁺) and unionized (NH₃) (CCME 2010) potentially making it toxic to aquatic organisms (Figure 7). Ammonia is an important compound to measure because it is principally used in the production of nitrogenous fertilizers (CCME 2010), and the Somenos watershed is abundant in agriculture activities.

Ammonia concentrations tend to be higher at the bottom of the lake than at the surface. It is likely due to the anaerobic environment at the bottom of the lake during warmer months. Ammonia-oxidizing bacteria (AOB) will not be present to change ammonia into nitrite or nitrate and so there are less microorganisms there to metabolize it. In some years, ammonia at the bottom get close to the maximum recommendation, unlike at the surface where the algae and other AOB's use ammonia for energy. Luckily pH is low at the bottom which keeps the ammonia bound in a less toxic form (ionized ammonia or ammonium). It would be more of a concern if ammonia was high at the surface when pH is significantly higher during algae blooms. This could create a toxic form of ammonia (un-ionized NH₃-N). On a positive note, the high oxygen environment on the surface of the lake produced by algae activity converts un-ionized ammonia into nitrite, which rapidly converts to nitrate (MOECC 2025), reducing the concern of ammonia toxicity. For the purposes of this report the ammonia guidelines followed were based on the Canadian Council of Ministers of the Environment for a general overview of results (0.02 mg/L-N; CCME, 2010).

Key observations in 2024:

- Weekly data show ammonia was consistent at the surface up to August 7th, and acidity was high (>9) until the next testing date of August 12th (Figure 7; Appendix C).
- A large spike of ammonia was recorded on August 12th at the surface and pH dropped down to neutral. Because of a gap in the week between August 7 and 12, ammonia concentrations and toxicity on the surface of the lake are unknown. Ammonia remained high from August 12th (>>1mg/L) to September 3rd when it dropped down to 0.07 mg/L.
- Similar results on the surface show dates August 12-20th coincided with a drop in pH to neutral (pH 9-7), dissolved oxygen (~0-3mg/L) and a drop in total algae on July 30 to August 13th from 80 µL/L to 0.2 µL/L. Algae recovered its community by August 27th, following with an increase in pH (~9) and dissolved oxygen (14.3 mg/L) by September 3rd.
- During the period of July 23 to September 10, when ammonia fluxuations were recorded on the surface, ammonia remained high (~1mg/L) at the bottom of the lake with a few peaks on June 4th and December 3rd likely due to anoxic conditions at the bottom.

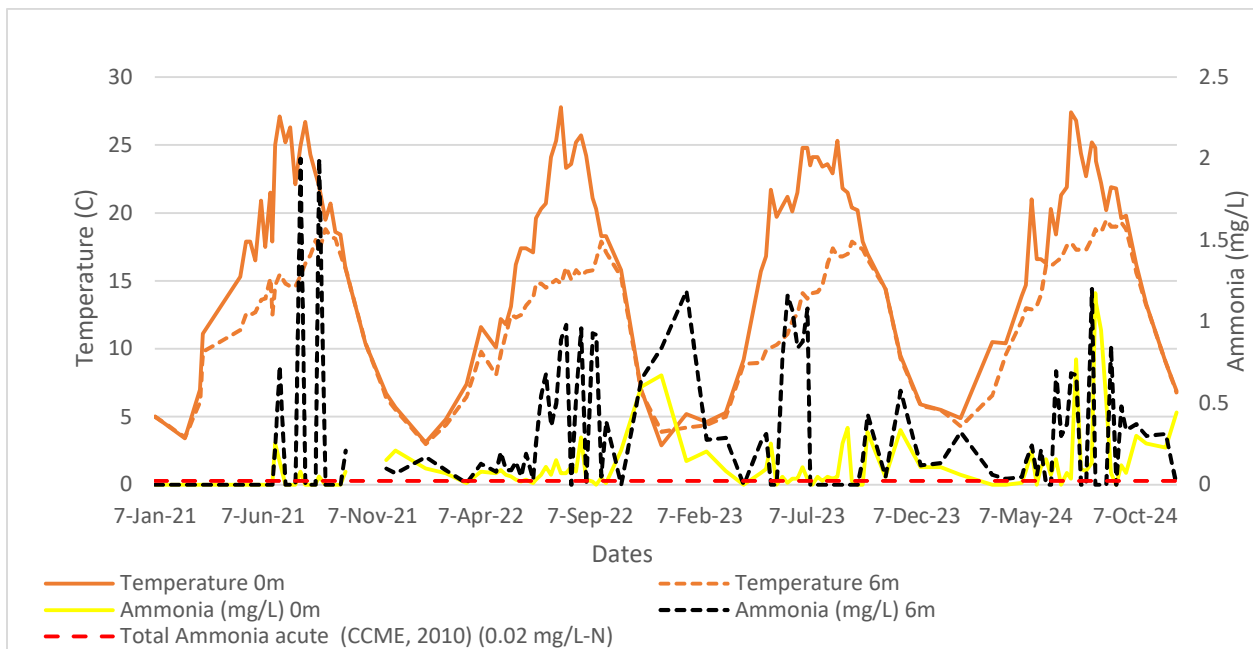


Figure 7: Somenos Lake Ammonia Levels with Temperature at the Lake Surface and Bottom, 2021-2024

PH IN SOMENOS LAKE

The 2024 pH depth profile in Somenos Lake is shown in Figure 8 below, and over 4 years in Figure 9.

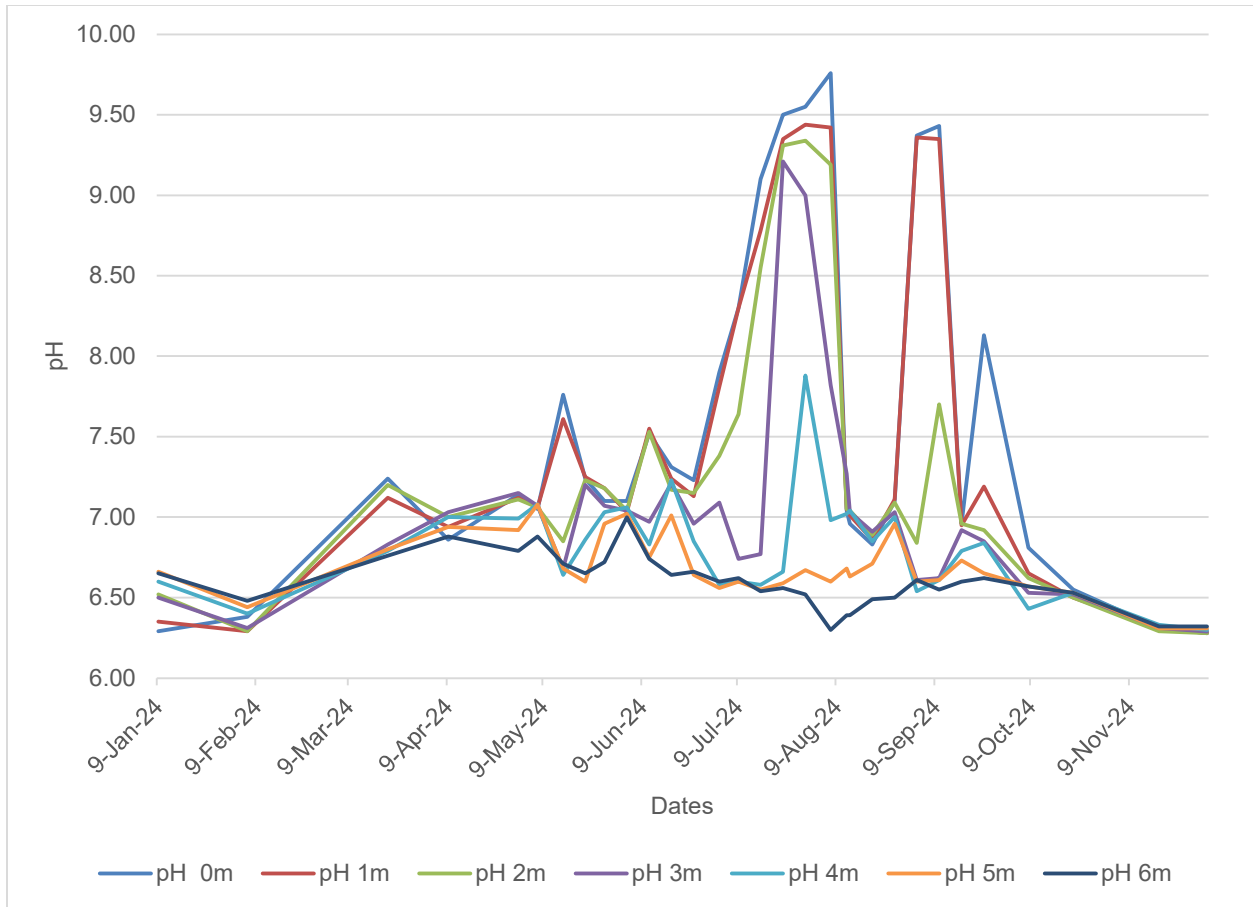


Figure 8: Somenos Lake pH Levels (0-6m depth profile), 2024

Similar pH results observed in 2021 to 2024 show a consistently high alkalinity at the surface in summer. Excluding 2024, there was a trend of increased acidification in the lower depths of the lake (Figure 9).

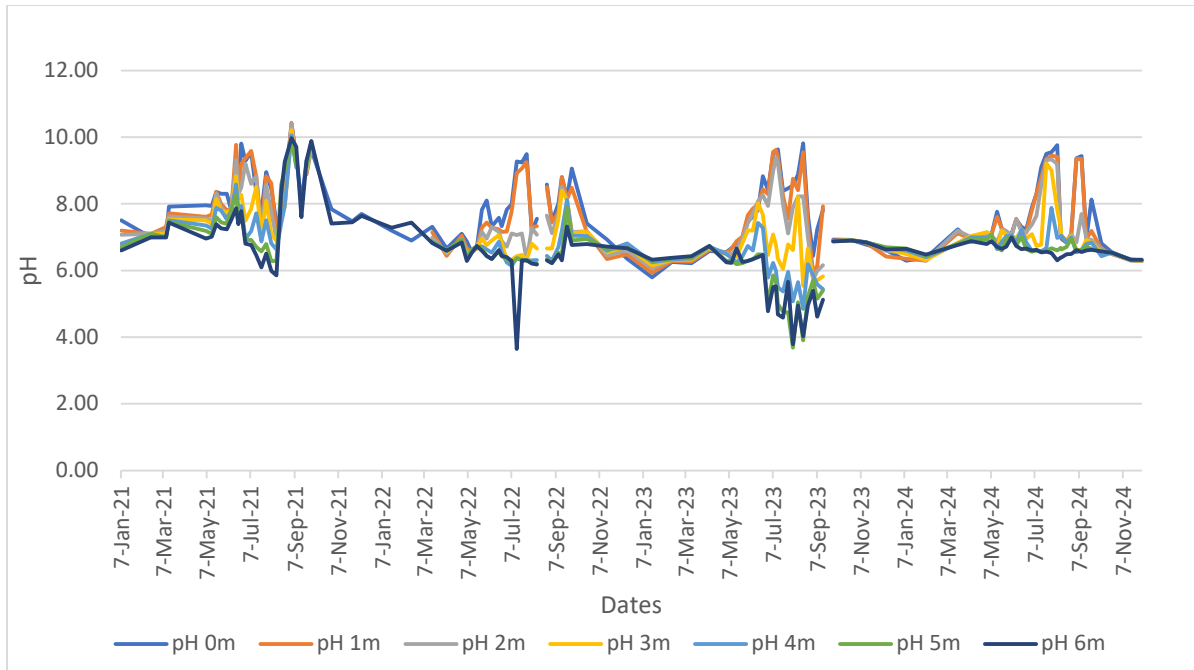


Figure 9: Somenos Lake pH YSI Profile Levels, 2021-2024

A major factor to consider when monitoring pH is that ammonia toxicity increases with more alkaline water, which occurs on the surface in summer. In the summer at the lake surface, when pH was between 8-10, ammonia levels regularly exceeded guidelines (0.02 mg/L NH₃-N, or 0.024mg/L NH₃ BCMOE, 2024) (Figure 10). When alkalinity is high at the surface, there is a relationship of high algae activity (blooms) in the epilimnion in summer as well. With higher oxygen, the ammonia on the surface is expected to be converted to nitrite then nitrate. However, there are still exceedances recorded and require further investigation on the toxicity effects of pH and temperature on ammonia levels.

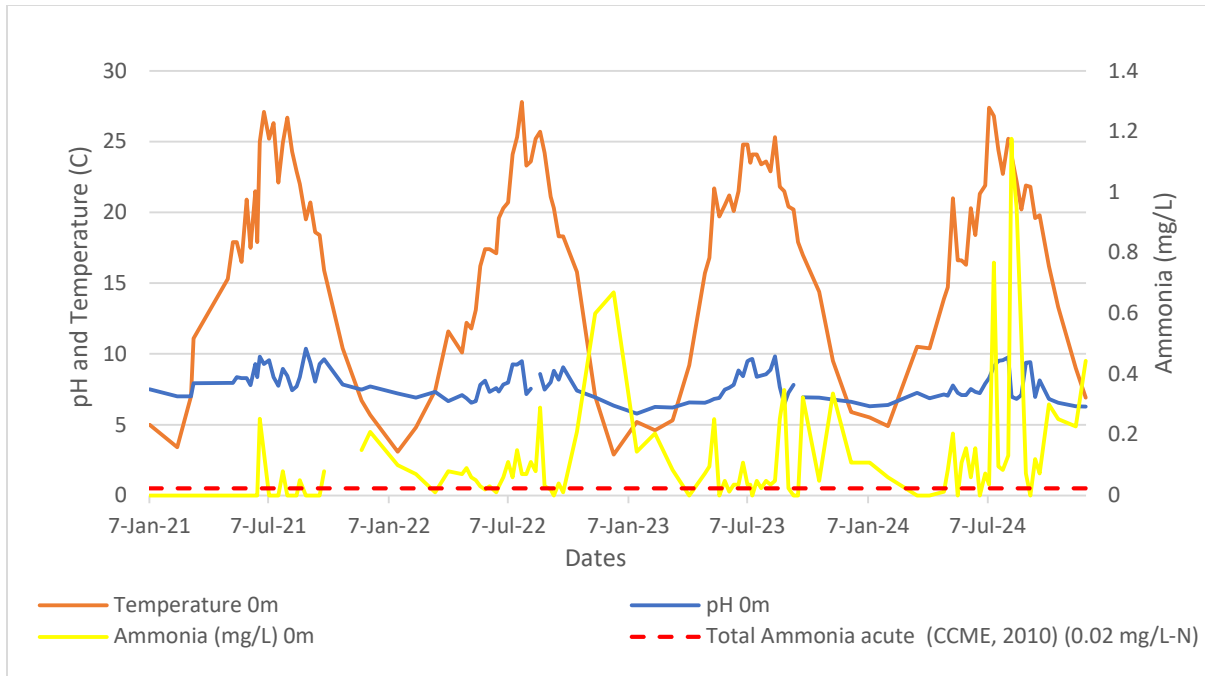


Figure 10: Somenos Lake pH, Temperature (C), and Ammonia Surface Levels, 2021-2024

Conversely, at the lake bottom the pH is low (more acidic), which can reduce ammonia’s toxicity (Figure 11). The baseline guideline shows regular exceedances therefore a more site-specific look at the relationship pH and temperature effects the toxicity of ammonia is also required. Toxicity to fish at the deepest part of the lake mid-summer is unlikely due to the consistent low oxygen levels; however, this may still affect other aquatic life and the trophic cascade.

The bottom pH was observed as declining over the past 3 years (Figure 11) in summer to an average of 6-6.5. The anomaly of this occurred in 2021, when the lake bottom had a high alkalinity spike in late summer with an ammonia exceedance. Reasons for this are unknown; however, in 2025 a continuous pH data logger will be installed in the lake with the hopes of monitoring future toxicity conditions to provide further insight.

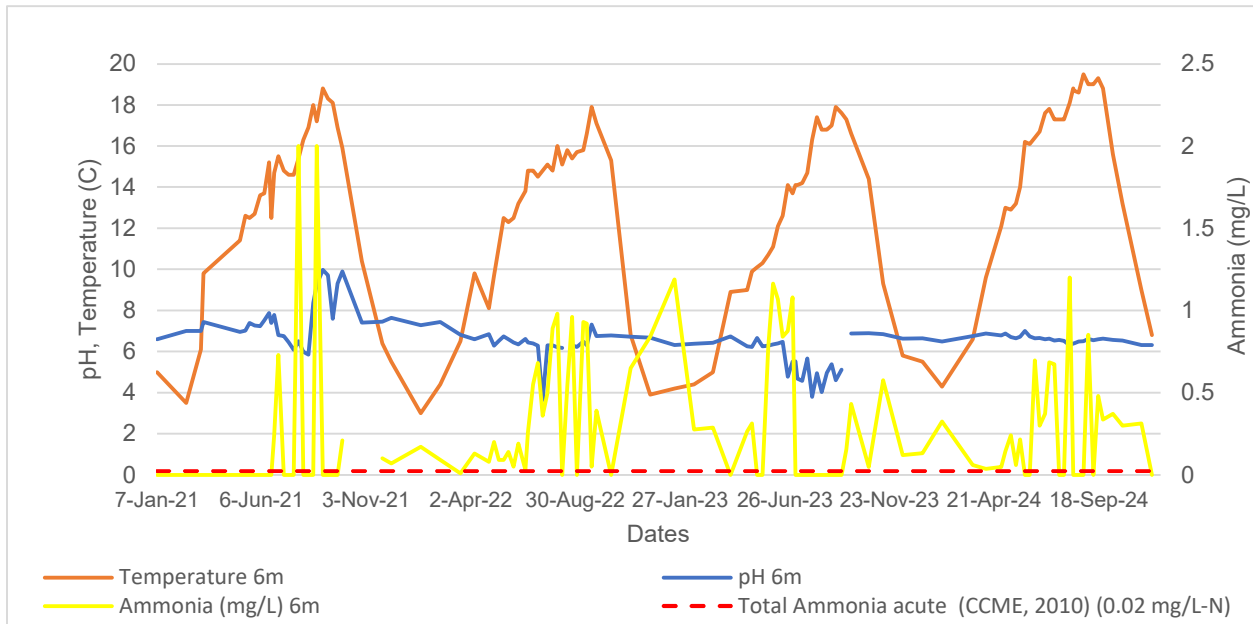


Figure 11: Somenos Lake pH, Temperature (C), and Ammonia Bottom (6m) Levels, 2021-2024

PHOSPHATE IN SOMENOS LAKE

Phosphate is an important nutrient in the growth of aquatic plants and organisms. However, excessive levels of phosphate can cause further degradation of conditions in eutrophic lakes (CCME 2004). Figures 12-13 show the phosphate levels from 2021- 2024 at the bottom and surface of the lake, respectively, and its relationship with temperature and dissolved oxygen levels. It is observed that phosphate is released from the bottom of the lake as summer approaches when temperatures rise, and dissolved oxygen declines. As the bottom of the lake becomes anoxic in summer, a release of phosphate from the sediment is initiated (Jones and Smol 2024), feeding algae growth on the surface, and microbial activity. When excessive organic matter from algal blooms sinks to the bottom, it is decomposed by microbes, creating an anoxic environment at the bottom, which is why we see a decline in dissolved oxygen. In the fall lake turnover occurs mixing lake water, allowing dissolved oxygen to recover.

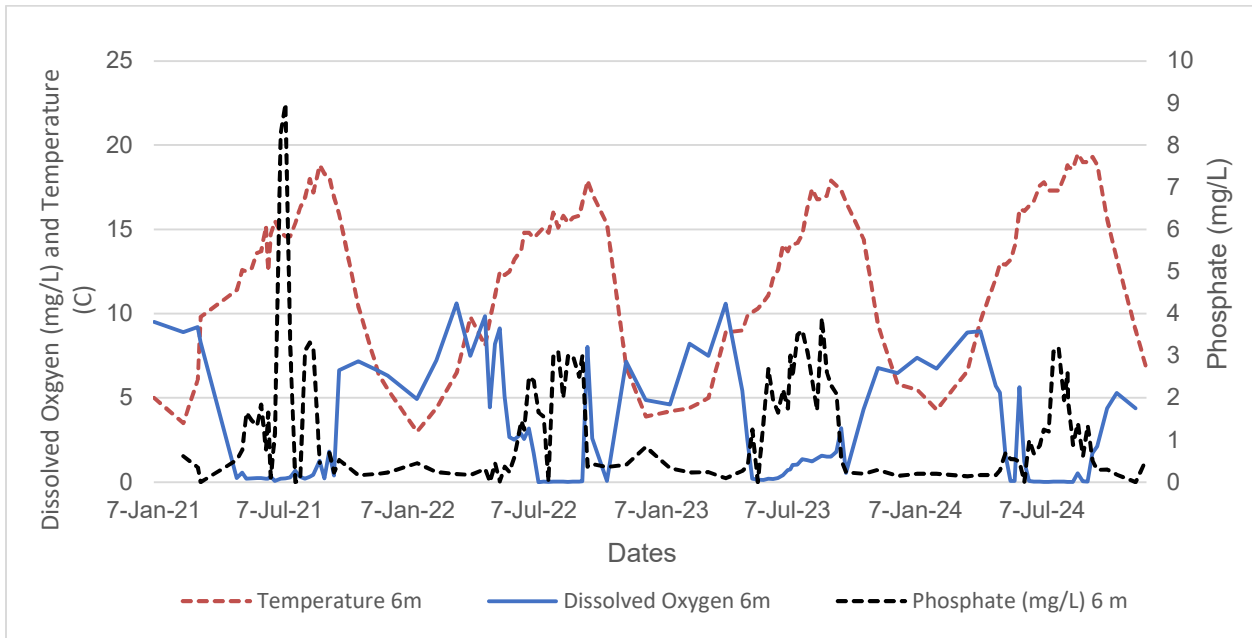


Figure 12: Somenos Lake total phosphate, temperature and dissolved oxygen at the bottom from 2021-2024

In Figure 13, in summer when the lake is stratified, phosphate is low at the surface because it is consumed by algae blooms during the growing season. At this time, algae will then produce more oxygen at the surface. Note: there are a few mid-summer crashes of dissolved oxygen on the surface which indicate possible fish kills that may have occurred in the past as they did in 2024.

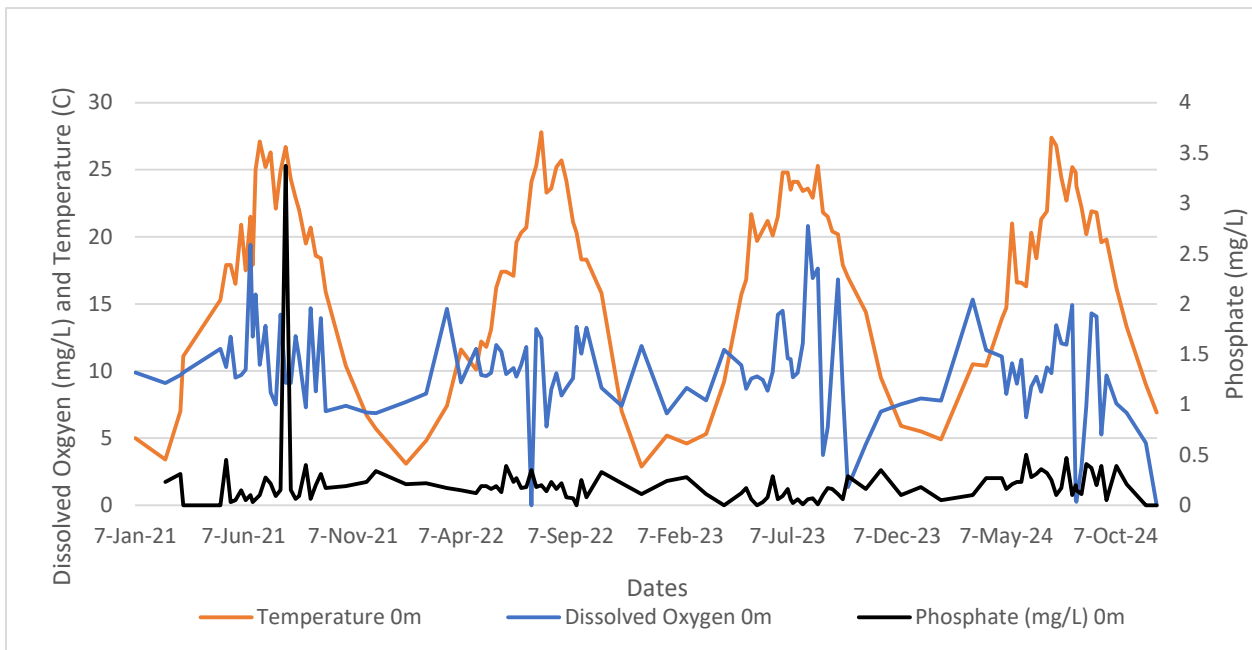


Figure 13: Somenos Lake total phosphate, temperature, and dissolved oxygen at the surface, 2021-2024

SOMENOS LAKE PHYTOPLANKTON COMMUNITY

The phytoplankton community sampling in the summer of 2024 revealed a high amount of blue-green algae present in Somenos Lake (Table 1, Figure 14). When we look closer at when these communities thrived, blue- green algae is the dominate phytoplankton community but peaks in summer. Especially on July 30th when the blue-green algae dominated the community prior to the fish kill that occurred after August 7th. This corresponds with field observations of strong odorous lake water, and green blooms on the surface in July and August. The date range of March 21 to May 1 were the only months without blue-green algae blooms.

Table 1: Somenos Lake Annual Total Phytoplankton Community Abundance (µL/L) by Taxon, 2024

<i>Date</i>	Total Diatoms	Total Green Algae	Total Golden Algae	Total Cryptomonads	Total Euglenoids	Total Blue-green Algae	Total Dinoflagellates	Total Other (Flagellated)	Total
Jan 09	2.3551	0.0332	0.0091	0.7256	0.0481	0.0191	0.0318	0.0000	3.222
Feb 06	0.0062	0.1003	0.0950	0.5152	0.0266	0.0007	0.0191	0.0000	0.763
Mar 21	1.8368	0.2616	3.3717	2.6481	0.0385	0.0000	0.1689	0.0000	8.326
Apr 09	1.3374	0.0685	2.3000	1.2073	0.0218	0.0000	0.0000	0.0000	4.935
May 01	0.0000	0.0076	4.9988	0.2389	0.0000	0.0000	0.0000	0.0000	5.245
May 15	2.8003	0.1557	0.1509	1.1126	0.0453	0.0022	0.0000	0.0000	4.267
Jun 11	0.0000	0.3118	0.0562	0.0066	0.4475	1.3918	0.1705	0.0000	2.385
Jun 25	1.6771	0.4184	0.0278	0.0438	0.1801	0.4342	0.0000	0.0000	2.781
Jul 09	0.0009	3.9657	0.4327	0.0185	0.3742	0.1270	0.0031	0.0000	4.922
Jul 30	0.0000	0.0036	0.0055	0.0018	0.0791	79.9755	0.7636	0.0000	80.829
Aug 13	0.0006	0.0304	0.0011	0.0151	0.0021	0.0453	0.1090	0.0004	0.204
Aug 27	0.0000	5.0576	0.0594	8.8312	0.0000	0.4550	10.0600	0.0000	24.463
Sep 03	0.1499	1.7766	0.0891	2.7507	0.0000	2.4552	0.0000	0.0000	7.222
Sep 24	2.0595	2.2773	0.0019	4.2600	0.2021	4.4560	1.3833	0.0000	14.640
Oct 08	2.8603	2.0228	0.0000	2.3357	0.3849	1.3099	0.0000	0.0000	8.914
Oct 22	2.2677	1.4314	0.0019	1.1734	0.0405	0.4314	0.0000	0.0000	5.346
Nov 18	0.1894	0.0707	0.0002	0.0165	0.0172	0.1330	0.0000	0.0000	0.427
Dec 03	0.1159	0.0132	0.0027	0.0212	0.0038	0.0216	0.0000	0.0000	0.178

After the blue-green peak in summer, there was a period in early August (13), 2024 where there was an overall reduction of all species in the phytoplankton community (Table 1). This was noticed to occur after as the fish kill that occurred on Somenos Lake (August 11). By the next sampling date of August (27), Dinoflagellates(briefly) dominated the phytoplankton community profile, followed by Cryptomonads and Green algae (Table 1, Figure 14).

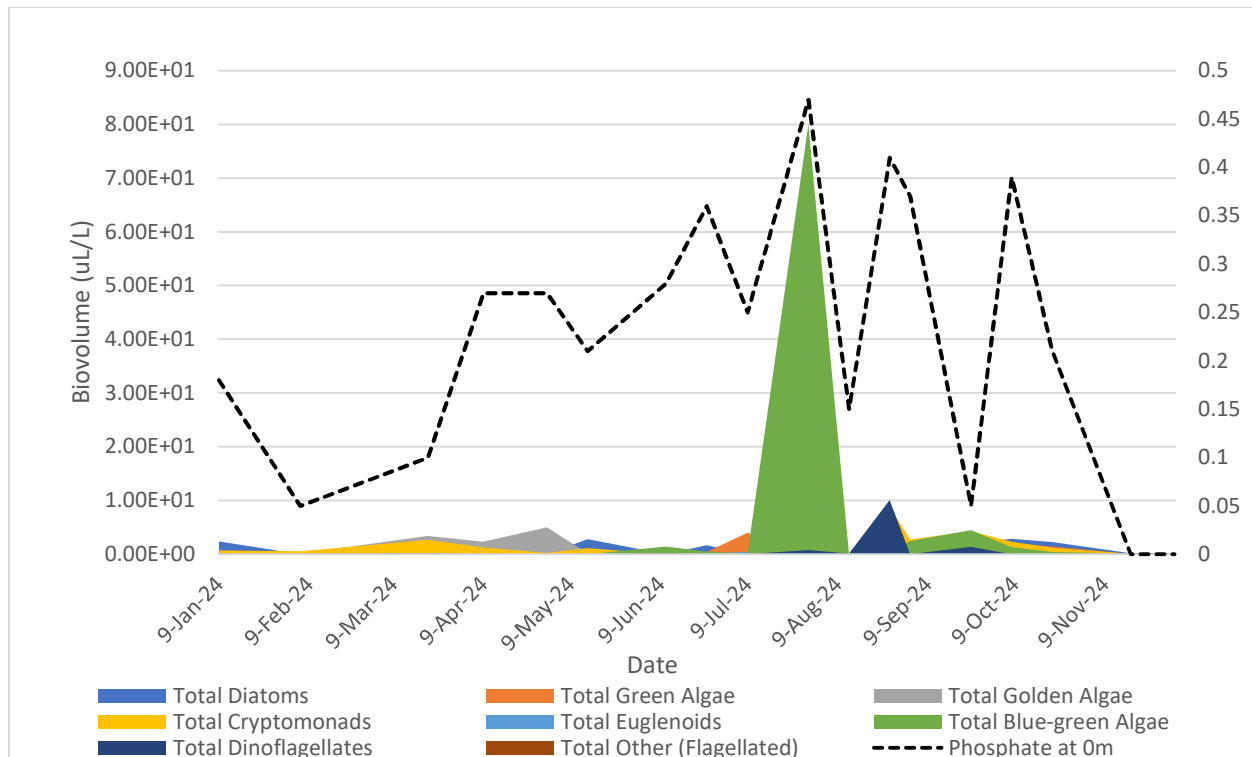


Figure 14: Somenos Lake Phytoplankton Community Bi-Monthly Abundance with surface Phosphate, 2024

The high blue-green algae in summer are a concern due to the recreational use of the area and many of these species produce toxins that can kill wildlife and may be harmful to humans. In summer, the blue-green algae community peaked followed by a smaller bloom in fall.

Microcystis and Dolichospermum are among the most toxic cyanobacterial genera (Chia et. al., 2018) and both blooms were predominately Dolichospermum (formally Anabaena), followed by Microcystis, with smaller amounts of other species (Pseudanabaena, Woroncichinia, *Chroococcus*, *Aphanothece*). *Synechococcus sp.* was only present in fall and *Aphanocapsa* was present in small amounts in all seasons.

The fall bloom had a similar blue-green algae community profile as in summer but was missing *Aphanothece* and *Chroococcus spp.* (Table 2, Figure 15).

Table 2: Somenos Lake Blue-Green Algae Bi-Monthly Species Abundance, 2024

Date	<i>Aphanothece</i> sp.	<i>Chroococcus</i> sp.	<i>Microcystis</i> sp.	<i>Dolichospermum</i> sp.	<i>Pseudanabaena</i> sp.	<i>Woronichinia</i> sp.	<i>Aphanocapsa</i> sp.	<i>Synechococcus</i> sp.	TOTAL
Jan 09			0.0188		0.0002				0.0191
Feb 06			0.0003				0.0003		0.0007
Mar 21									0.0000
Apr 09									0.0000
May 01									0.0000
May 15							0.0022		0.0022
Jun 11			0.0829	1.3065	0.0024				1.3918
Jun 25			0.0083	0.4229	0.0030				0.4342
Jul 09	0.0017		0.1132	0.0109	0.0005	0.0007			0.1270
Jul 30		0.0039	0.3337	79.5626	0.0019	0.0734			79.9755
Aug 13			0.0435	0.0013	0.0002	0.0001	0.0002		0.0453
Aug 27			0.4546		0.0004				0.4550
Sep 03			1.1277	1.3118	0.0145			0.0012	2.4552
Sep 24			0.4772	3.9789					4.4560
Oct 08			0.1800	1.1294	0.0005				1.3099
Oct 22			0.3583	0.0050		0.0532	0.0146	0.0002	0.4314
Nov 18			0.1322		0.0005			0.0003	0.1330
Dec 03			0.0209		0.0006			0.0001	0.0216
	0.0017	0.0039	3.3517	87.7292	0.0249	0.1274	0.0174	0.0019	

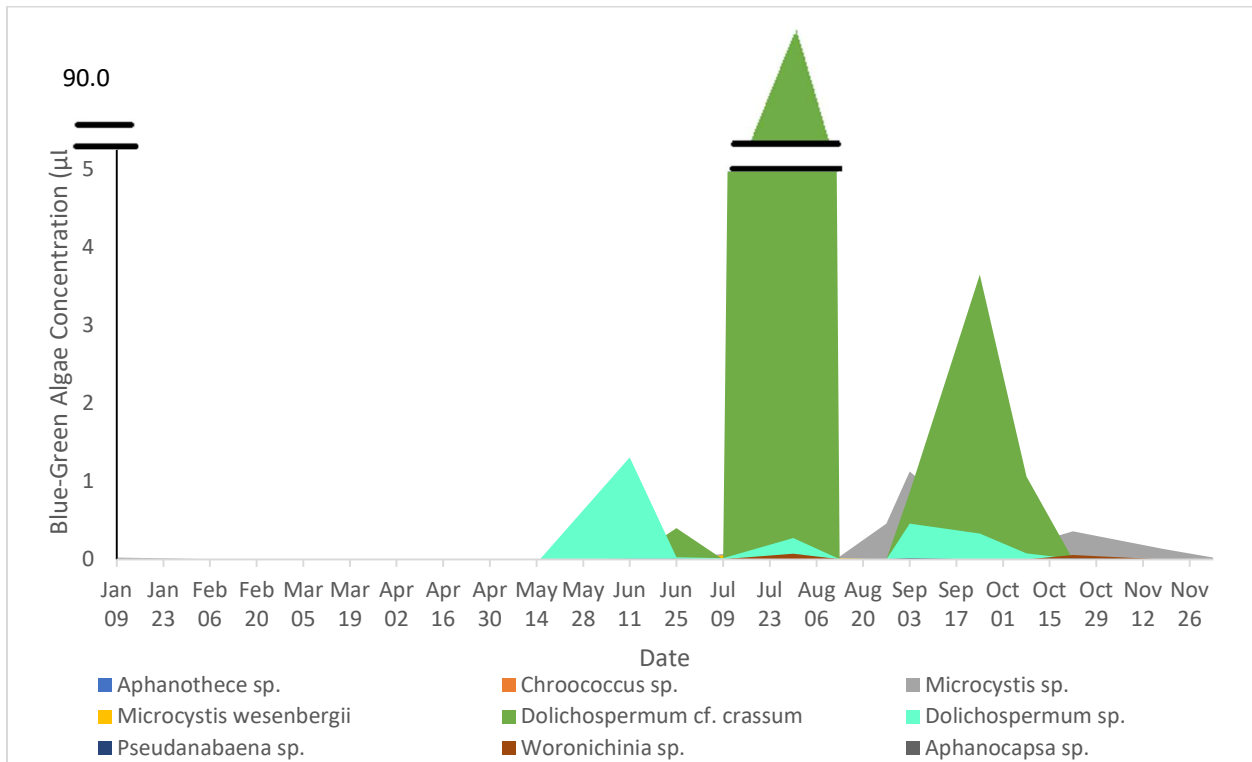


Figure 15: Somenos Lake Blue-Green Algae Bi-Monthly Species Abundance, 2024

SOMENOS LAKE LEVEL ANNUAL TRENDS

A review of Somenos Lake depths from 2017 to 2024 was completed to see any changes over time. The results are presented in Figure 16 below.

If we remove the flood year of 2021, there appears to be a reduction in maximum water levels in the lake from 2017 and 2024 (7.06 to 6.05m). There was a slight decline observed in the minimum water levels between 2017 and 2020 (4.98 to 4.44m), however it appears to have stabilized at an average of 4.6m between 2020 and now with no further declines. Two new beaver dams were observed in 2021 at the mouth of Somenos Creek which could have raised the minimum elevation during this time. Factors influencing the lake level parameters will continue to be monitored over the next few years to see if trends occur.

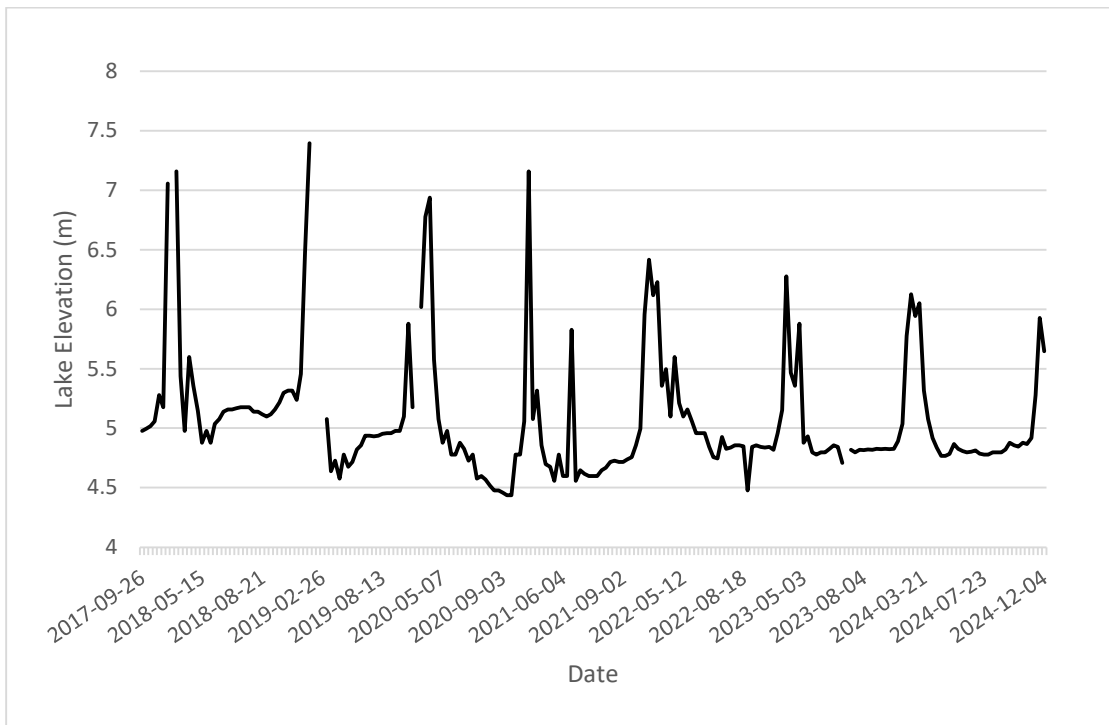


Figure 16: Somenos Lake Monthly Lake Level Measurements, 2017-2024

HOURLY DATA LOGGERS IN SOMENOS LAKE

Somenos Marsh Wildlife Society has multiple years of recorded temperature data at all depths of Somenos Lake (Figure 17). Temperatures mostly have been consistent over the years, other than a slight increase in surface and bottom temperatures since 2021 which will be monitored closely over the next few years.

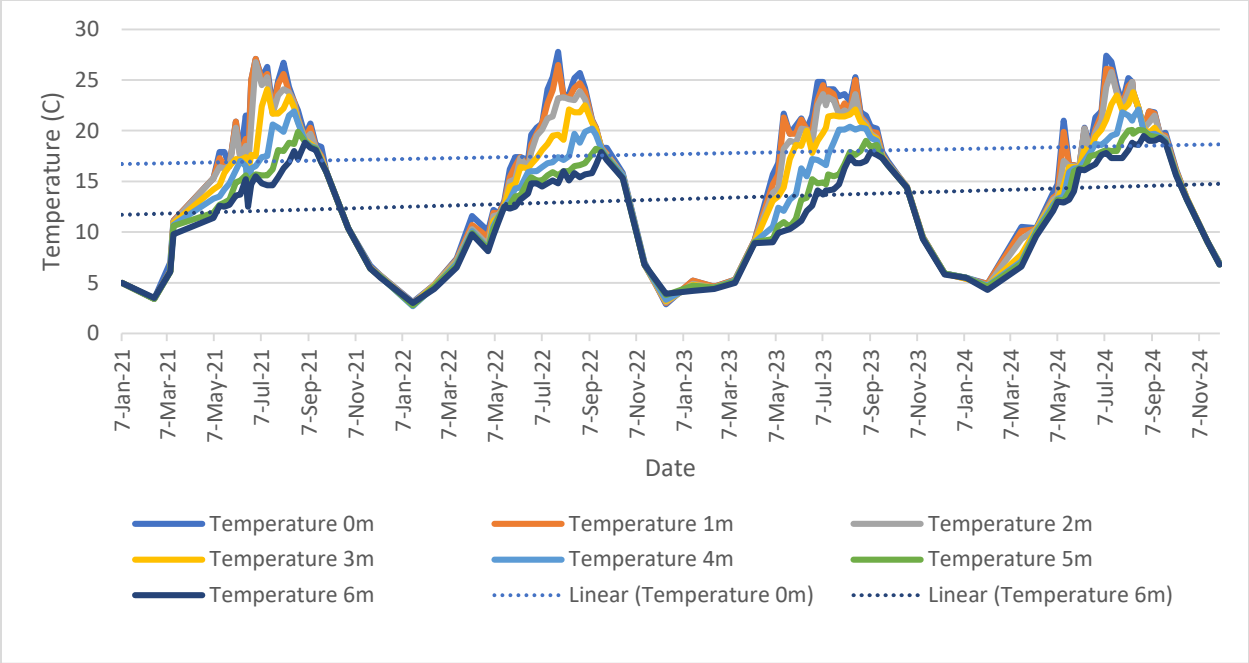


Figure 17: Mean Somenos Lake Temperature Recorded at Surface to Bottom (0-6m), 2021-2024

In 2024, data loggers (Onset Hobo MX2202, U22 and U26 models) were deployed in Somenos Lake to measure hourly temperatures, every meter, from the surface to 6m depths (Figure 18). Consistent data was recorded from early May to late November. During the warmer months from spring to early fall Somenos Lake is intermittently stratified, when the surface temperature (0m) is warmer than the bottom (6m). Data gaps from logger malfunctions earlier in the year prevent us from observing when exactly stratification occurred in spring. When turnover occurred in fall you can clearly see when temperatures at multiple layers mix and become similar, creating a sharp decline in temperature at all depths. There seem to be a few turnover events that also occur in early June and again at the end of August, followed by re-stratification. This is a common occurrence in shallow lakes, however the reasons for this in Somenos Lake are yet unknown. Some potential influences are from winds, phytoplankton community changes, groundwater or other cool water influxes (Jones and Smol, 2024).

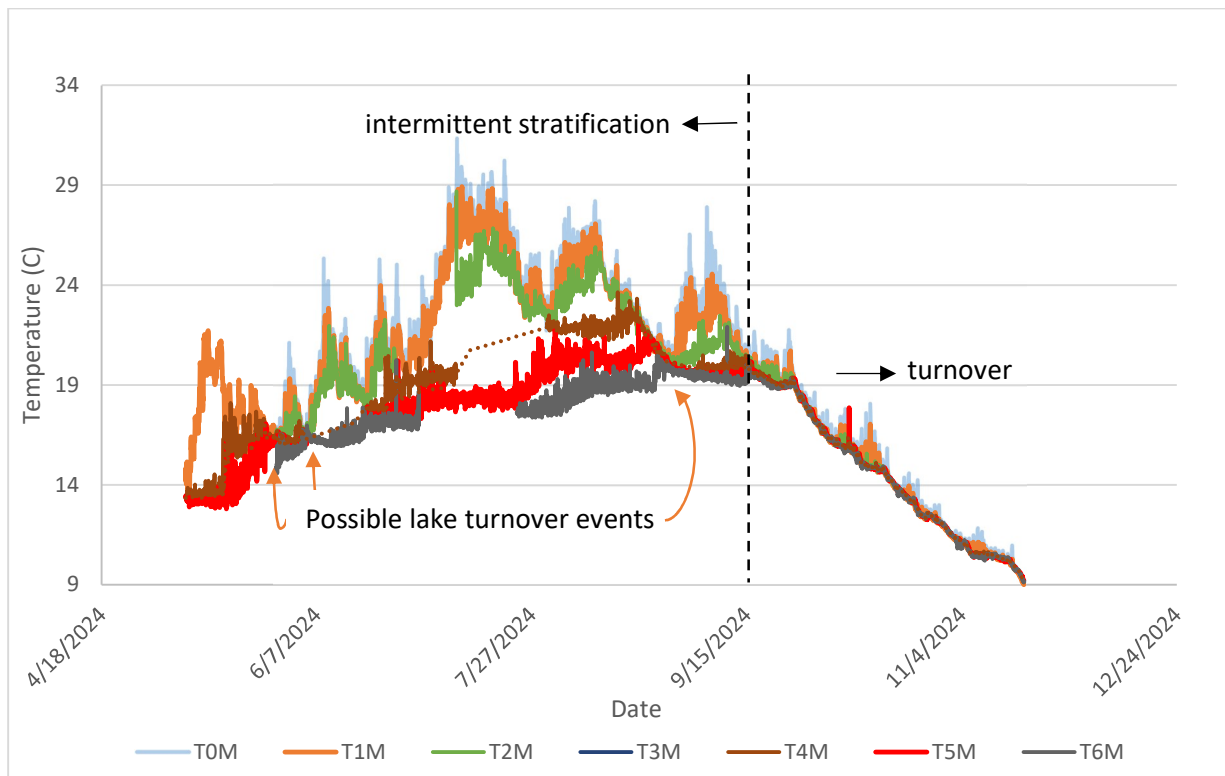


Figure 18: Somenos Lake Temperature Probes recorded in 1m intervals, surface to bottom, May to November 2024.

Data loggers (U26 models) also measured hourly dissolved oxygen and were placed at 1m and 5m depths in 2024 (Figure 19). This showed us the surface dissolved oxygen was higher than the lower bottom dissolved oxygen levels. However, the elevated surface dissolved oxygen fluctuated throughout the spring-summer and was observed to increase when algae blooms occurred. An algae die off likely attributed to the drop in oxygen on August 8th, which attributed to the fish mortality observed throughout

the lake that week.

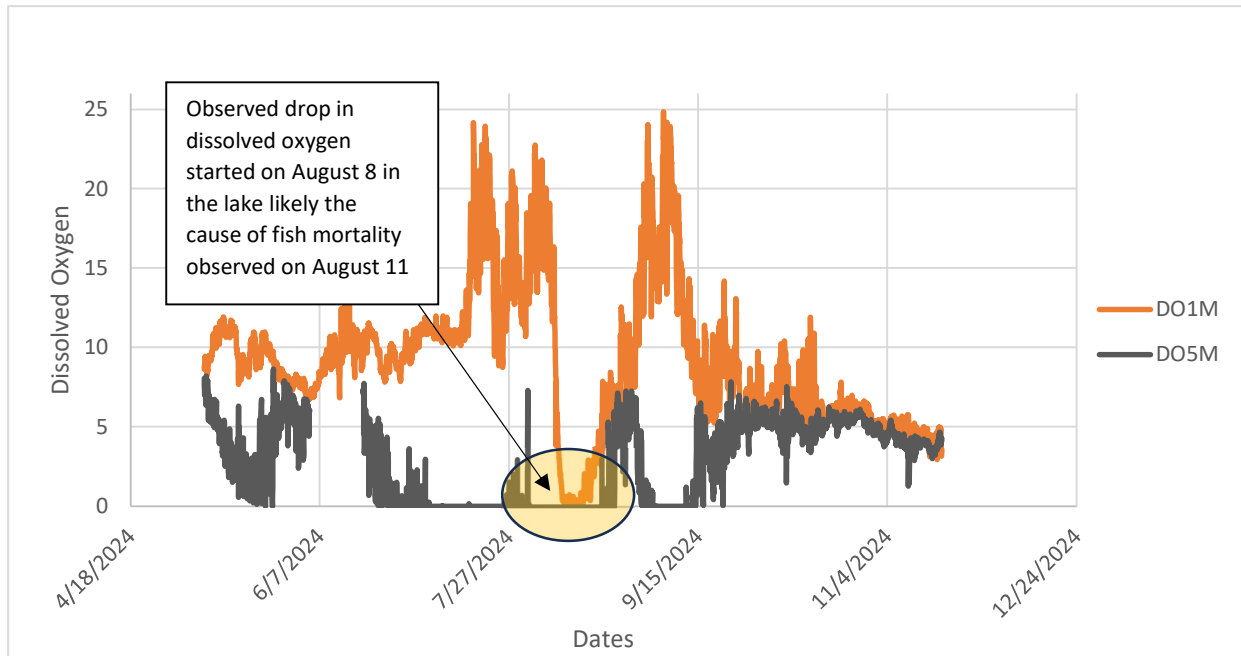


Figure 19: Somenos Lake Dissolved Oxygen Probes recorded in 1m intervals, May to November 2024

SOMENOS CREEK

A U26 Data Logger was installed at Somenos Creek Lakes and Tzouhalem road bridges to measure dissolved oxygen and temperature. Results can be seen in Figure 20, where the two sites had similar trends with Lakes road having significantly higher average daily temperatures. The chart shows temperature remained consistent through the spring and summer, and dissolved oxygen varied but on average dropped slowly to anoxic levels until fall. By October 10, oxygen spiked briefly to above 5mg/L however it was short lived and dropped again to below tolerant levels for migrating salmon. Temperatures slowly dropped in fall and dissolved oxygen only recovered to consistent levels above 5-6mg/L by December 20th after a few rain storms. This level of oxygen is considered low, but observations of spawning salmon in upper Richards Creek at this time confirmed it was possible by migrating salmon upstream to spawn in the upper tributaries.

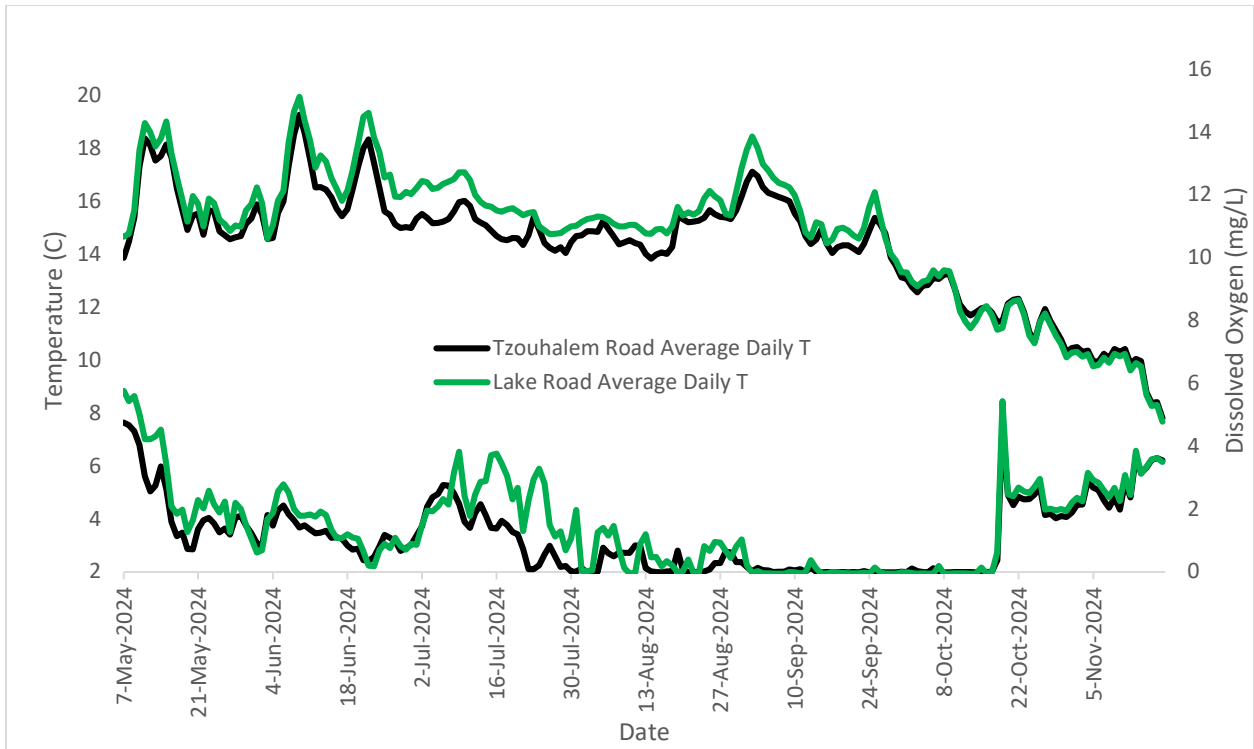


Figure 20: Somenos Creek Daily Average Temperature and Dissolved Oxygen at Two Locations, 2024

4 Appendix B - Water Quality Results for the Somenos Watershed Tributaries

The main tributaries in the Somenos Watershed are Somenos Creek, Bings Creek (Mary/Phillips Street and Reach 1), Richards Creek (Richards Trail and Herd Road), and Averill Creek. They were all monitored for various water chemistry parameters to determine patterns and potential changes over time. These parameters were temperature, dissolved oxygen, pH, specific conductivity, and dissolved oxygen, measured weekly in summer and monthly the rest of the year. Monthly parameters measured were total phosphate, ammonia, nitrate, and nitrite. The charts below show the results of testing in 2023.

TOTAL DISSOLVED SOLIDS AND SPECIFIC CONDUCTIVITY IN THE SOMENOS TRIBUTARIES

The more TDS the more conductivity of materials (mineral salts dissolved in water that are conductive) in the water column. Elevated total dissolved solids and conductivity coincided with water temperatures in summer. This makes sense since warmer temperatures can release some minerals into the creek.

The tributary total dissolved solids (TDS) and specific conductivity levels in Figures 21 and 22 match very closely, except for an event on July 19th where there was a large spike in TDS in Bings Creek downstream of the highway in Reach 1. It is possible an ionic compound that does not have conductivity entered the system from the highway run-off.

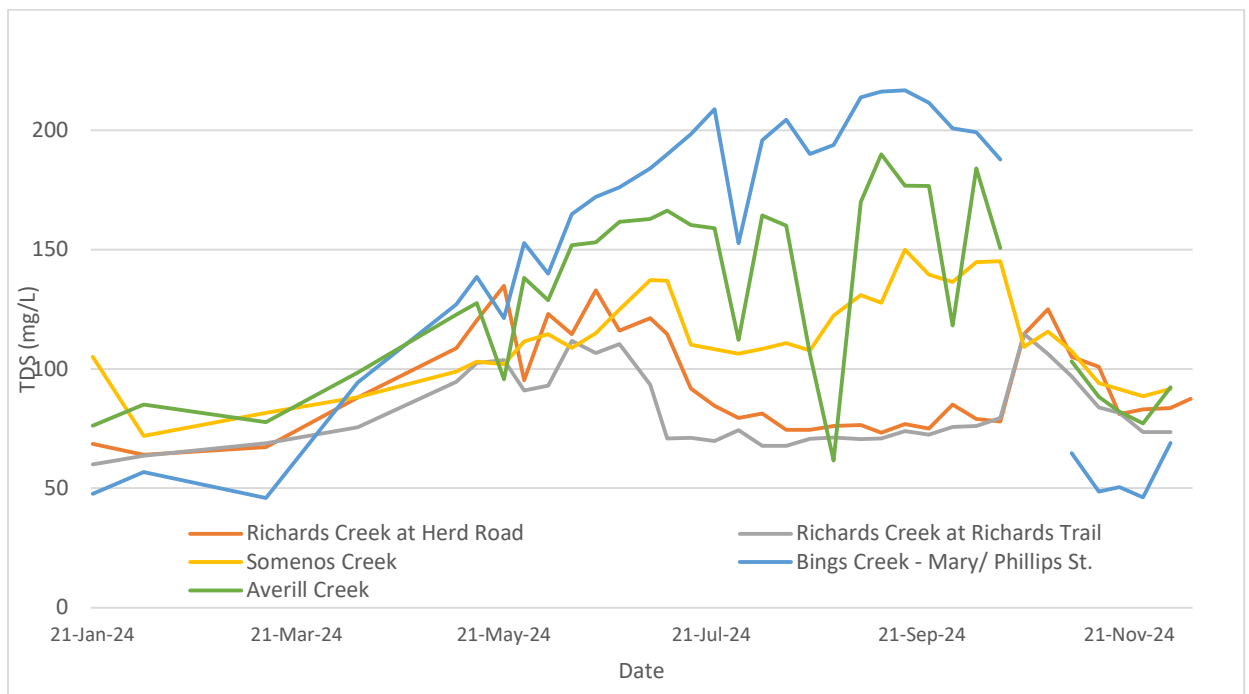


Figure 21 Somenos Watershed Tributary Total Dissolved Solids, 2024

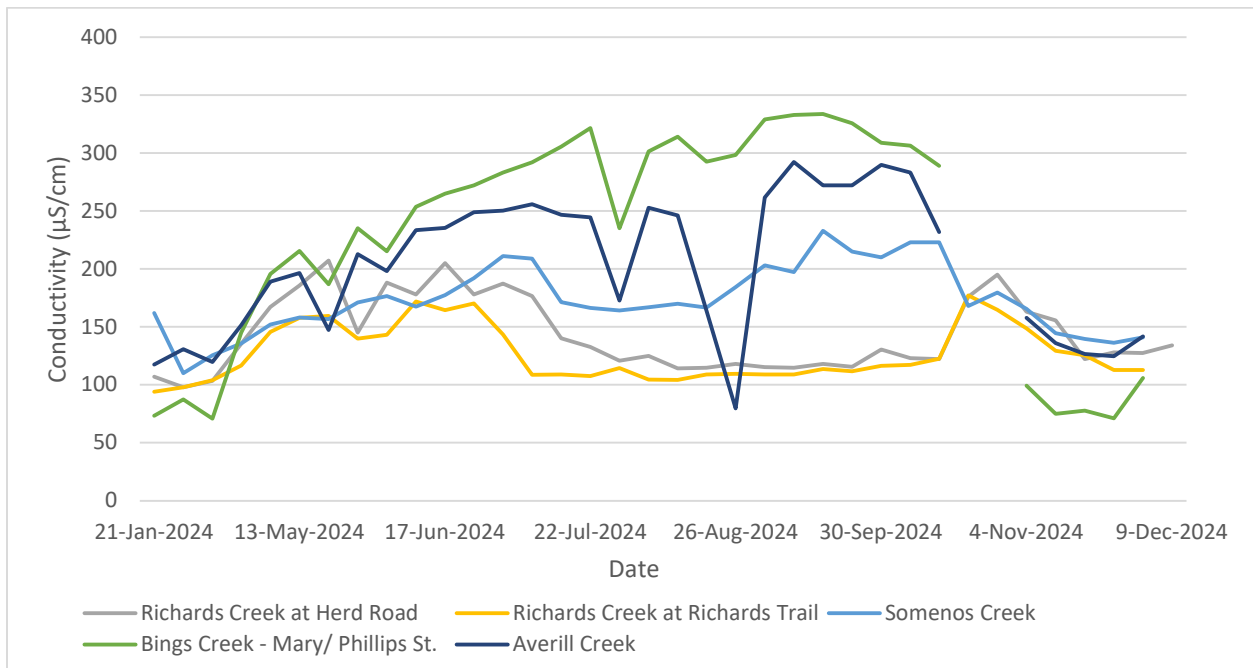


Figure 22: Somenos Watershed Tributary Specific Conductivity Levels, 2024

DISSOLVED OXYGEN IN THE SOMENOS TRIBUTARIES

In 2024, dissolved oxygen was measured at a 1 m depth in Richard’s creek at Herd road and Somenos Creek. All other locations were shallow and sampled just below surface.

Weekly dissolved oxygen levels were similar between the spawning creeks: Bings, Averill, and upper Richards Creek (Richards Trail) (Figure 23). All three creeks remained between sub-optimal to optimal range for the entire year. The highest dissolved oxygen was 14.77 mg/L in January and lowest was 7.36 mg/L in July 2024.

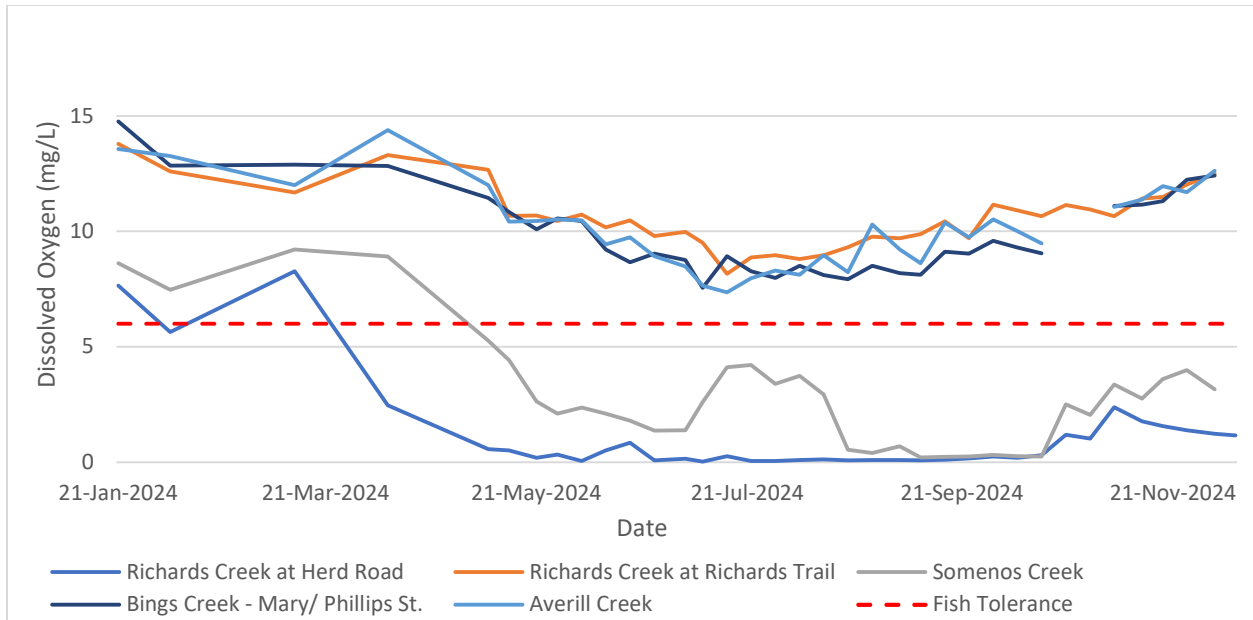


Figure 23: Somenos Watershed Tributary Dissolved Oxygen Levels, 2024

On the other hand, if we are looking at weekly testing, Richards Creek at Herd Road and Somenos Creek are much lower than the other locations. Somenos Creek had low dissolved oxygen conditions for salmonids from May until December that varied between 0.21 – 6.0 mg/L. Only by the week of December 16, when seasonal rains began, did oxygen levels recover to sub-optimal levels above 7 mg/L. This would allow salmon to migrate up to the tributaries to spawn.

Weekly Richards Creek at Herd Road had anoxic conditions for salmonids (trout and salmon) from early April until the week of December 16th.

According to these weekly results, salmon that have been waiting until mid-December for dissolved oxygen levels to rise to be able to migrate upstream to their annual spawning grounds. It is important to note these were weekly field measurements and hourly loggers recorded some intermittent changes that were not observed on the weekly testing day. A salmon survey confirmed the December run for Coho Salmon occurred on Richards Creek, however, an earlier fluctuation in oxygen on October 19 5.43mg/L in a 24 hr period likely allowed Coho Salmon to access Bings and Averill Creek earlier than Richards creek. This observation can be seen in the previous section in Figure 20.

TEMPERATURE IN THE SOMENOS TRIBUTARIES

Richards Creek at Richards Trail, Averill Creek and Bings Creek weekly results show similar temperatures over the year (Figure 24). Somenos Creek had the highest temperature value of 19.5°C on June 10 compared to the other creeks and was the first to warm up in early May. Bings, Richards at Richards Trail, and Averill ranged between 15-19°C in the summer. Bings Creek’s peak temperature was reached in July, while Averill and Richards (Richards Trail) temperatures peaked in August. Interestingly, Richards’ creek at Herd road remained the coolest with temperatures reaching a maximum of 17.9°C. It is suspected it could be influenced by groundwater keeping it at cooler temperatures. All creek temperatures gradually declined at a similar rate as they approach fall and winter.

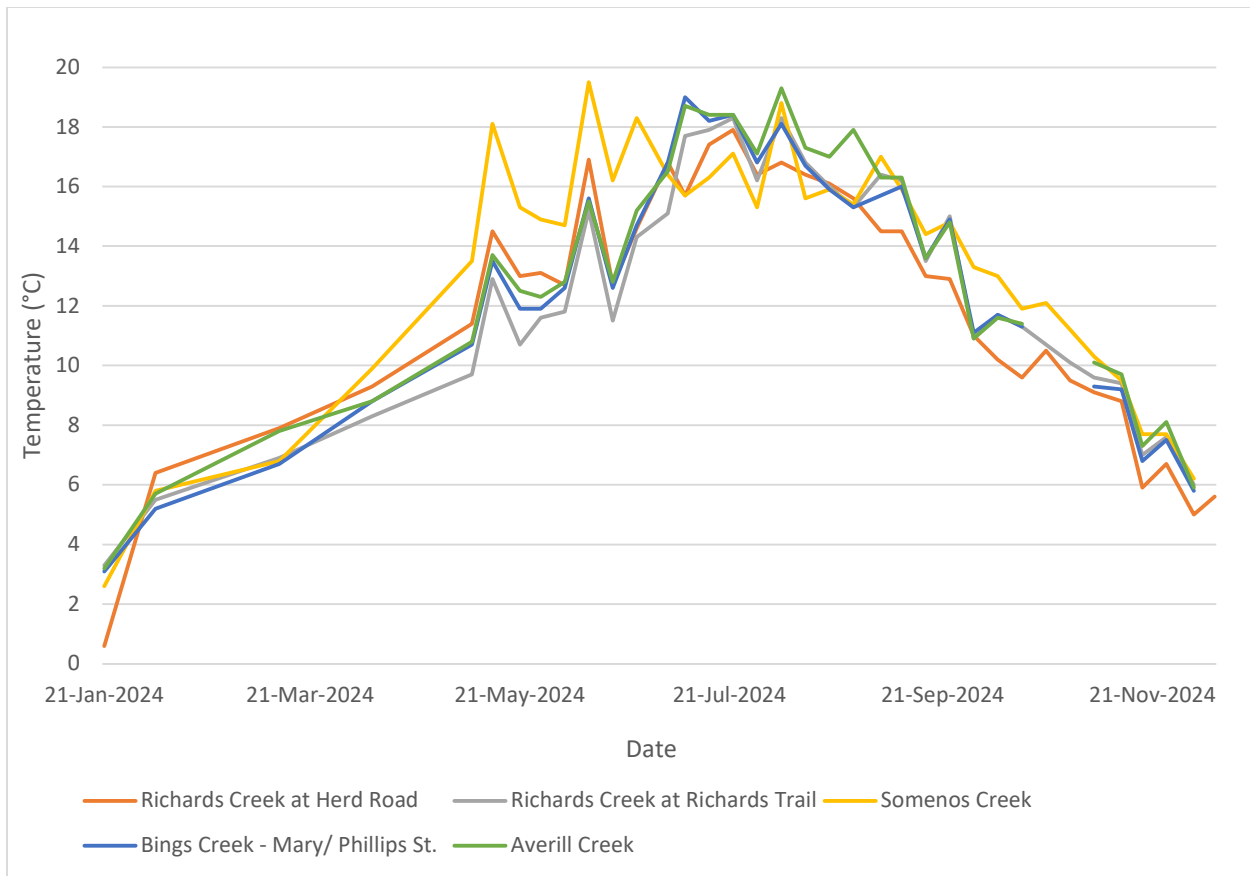


Figure 24: Somenos Watershed Tributary Temperature Levels, 2024

ACIDITY IN THE SOMENOS TRIBUTARIES

The biggest observation is the difference in acidity between Somenos Creek and Richards Creek (at Herd Road) with the other tributary locations (Figure 25). Over the year, these two creeks were more acidic and ranged between 5.76- 6.83, with a mean of 6.29. Averill, Bings and Richards creek (at Richards Trail) were generally higher - acidic to neutral - and ranged between 6.69-7.91, with a mean of 7.17.

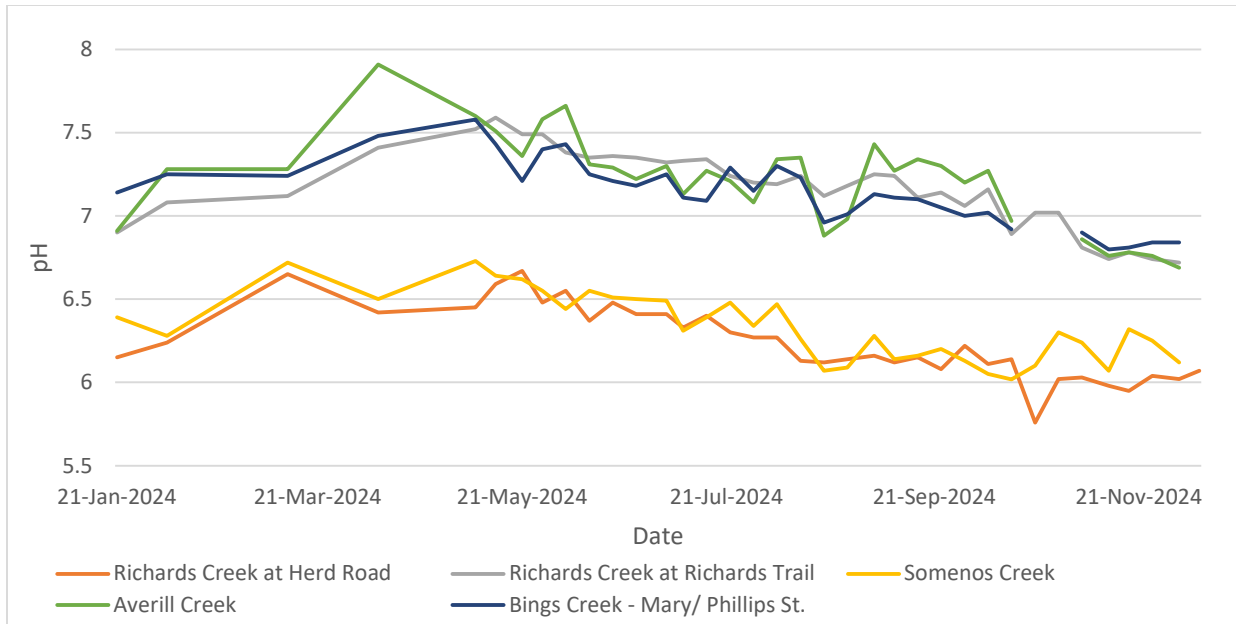


Figure 25: Somenos Watershed Tributary Monthly pH Levels, 2024

AMMONIA IN THE SOMENOS TRIBUTARIES

As mentioned, when temperatures and pH increase (alkaline), ammonia toxicity concentration guidelines decrease becoming more stringent. Since the pH levels were acidic to neutral for all creeks, and temperatures below 19.5°C, the general CCME 2010 guideline of < 0.02mg/L of NH₃ as N (or 0.024 mg/L as NH₃) was followed however it was regularly exceeded (Figure 26). Since a low pH creates a less toxic ammonia, further investigation into the relationship between low pH and toxicity to aquatic life is needed.

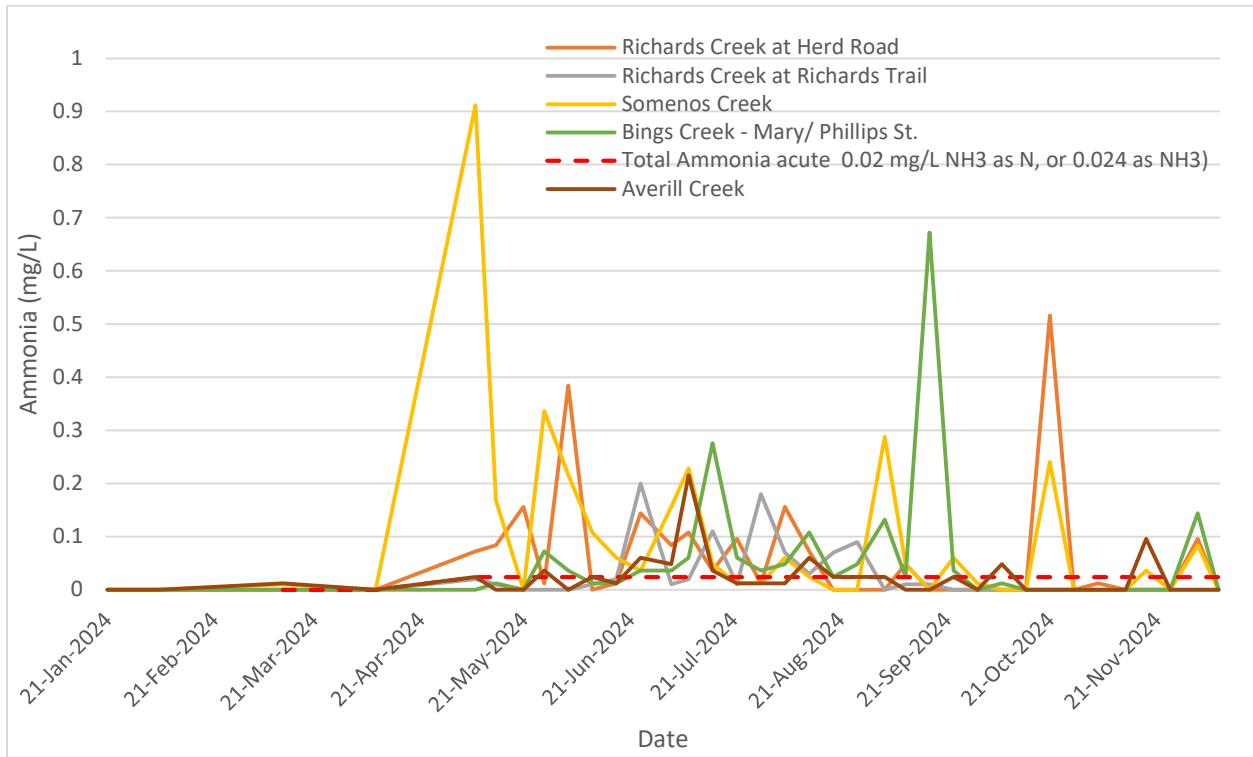


Figure 26: Somenos Watershed Tributary Monthly Ammonia Levels, 2024

NITRITE AND NITRATE IN THE SOMENOS TRIBUTARIES

The results for Nitrate (as N) in the tributaries were well below the BCMOE 2024 guidelines for acute (32.8 mg/L) and chronic exposures (3.0 mg/L) were too high to show on Figure 27.

The Nitrite (as N) chronic exposures (0.02 mg/L) and acute (0.06 mg/L) BCMOE 2024 guidelines were exceeded in 2024 and shown in Figure 28. The chronic exposures were not long enough to be considered an issue (e.g. less than 5 samples in 30days). So acute exposures were focused on. The only acute exceedance spikes in Nitrite occurred in December at Richards Creek at Herd Road. This could account for runoff or anthropogenic sources, such as sewer water, into the creek during rain events. Future investigations of runoff access to this site should be investigated.

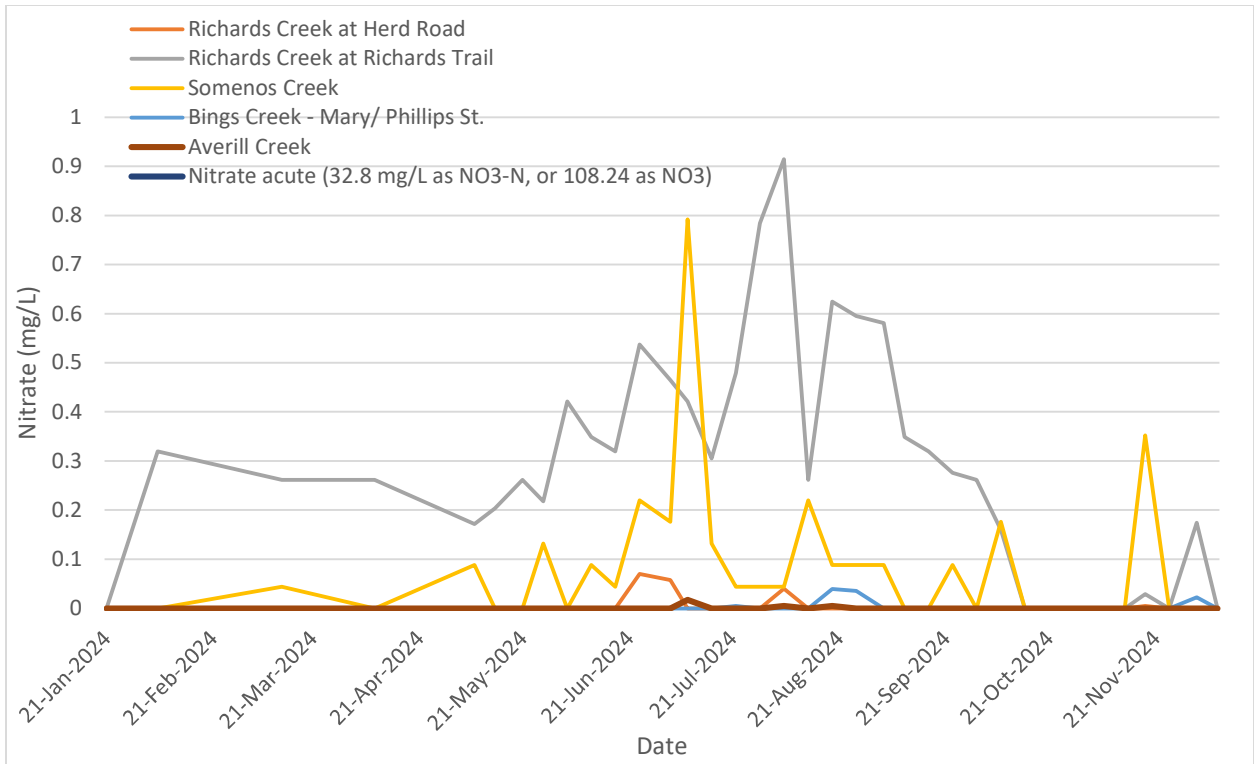


Figure 27: Somenos Watershed Tributary Monthly Nitrate Levels, 2024

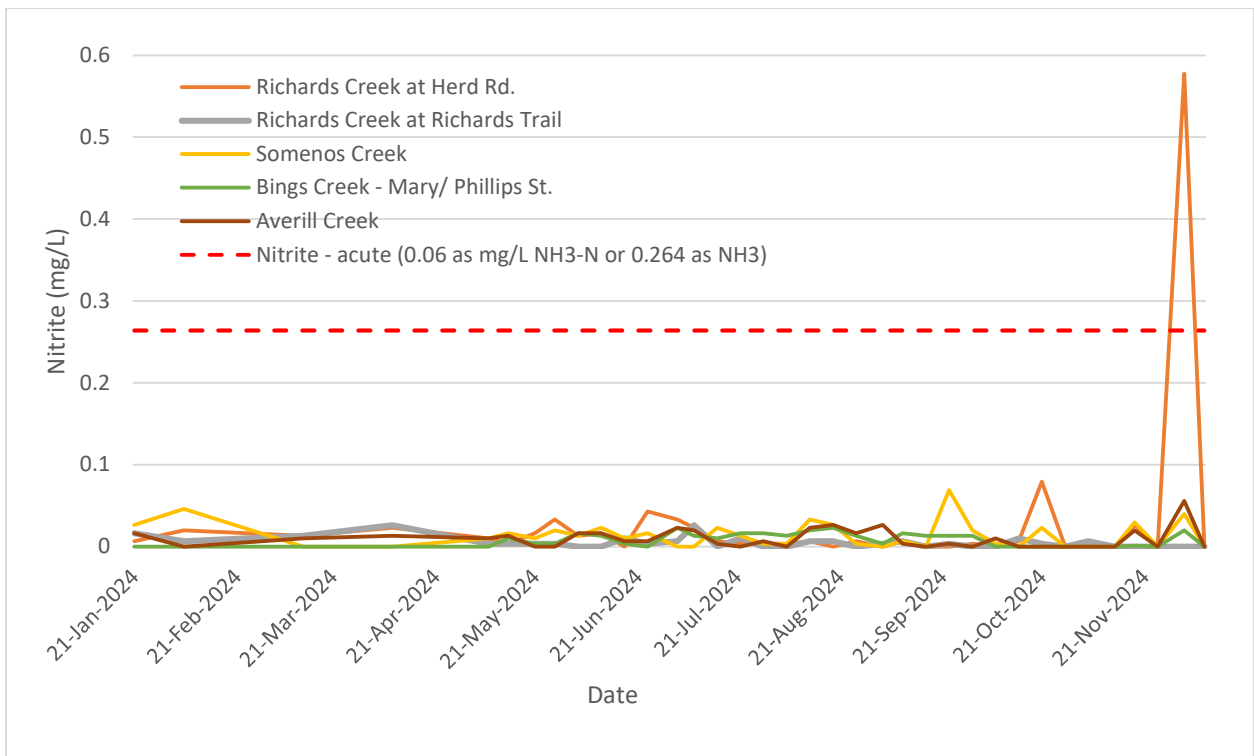


Figure 28: Somenos Watershed Tributary Monthly Nitrite Levels, 2024

PHOSPHATE IN THE SOMENOS TRIBUTARIES

In Figure 29, all the tributaries had an increase in phosphate from spring into fall. This is likely due to warming temperatures and potentially spikes when fertilizing occurs in the upstream farming fields in spring and fall. This can be easily seen in Richards Creek at Herd Road, and Somenos Creek located immediately below and adjacent to farmland, as phosphate spikes in May, September and October.

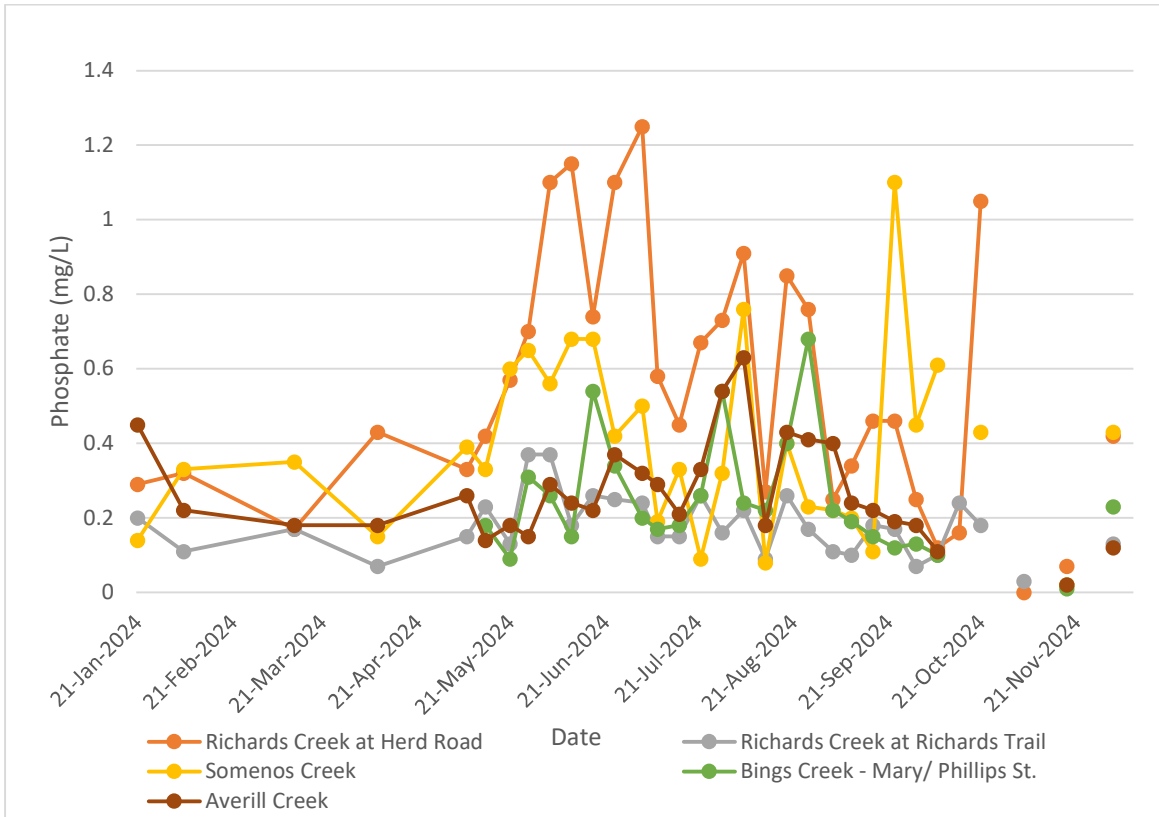


Figure 29: Tributary Phosphate Levels, 2024

5 APPENDIX C - DATA TABULATIONS FOR SOMENOS LAKE DATA

Month	Temperature (°C)						
	0m	1m	2m	3m	4m	5m	6m
9-Jan-24	5.50	5.40	5.50	5.40	5.50	5.50	5.50
6-Feb-24	4.90	4.90	4.70	4.70	4.70	4.60	4.30
21-Mar-24	10.50	10.10	9.30	7.80	7.10	6.90	6.60
9-Apr-24	10.40	10.30	10.30	10.30	10.10	9.90	9.60
1-May-24	13.90	13.40	13.20	12.90	12.70	12.40	12.10
7-May-24	14.70	13.70	13.50	13.30	13.30	13.20	13.00
15-May-24	21.00	19.90	17.00	14.60	13.50	13.10	12.90
22-May-24	16.60	16.50	16.50	16.40	15.90	14.00	13.20
28-May-24	16.60	16.60	16.50	16.40	16.30	16.00	14.00
4-Jun-24	16.30	16.30	16.30	16.30	16.30	16.30	16.20
11-Jun-24	20.30	20.20	20.20	18.20	17.00	16.30	16.10
18-Jun-24	18.40	18.00	17.90	17.80	17.80	17.50	16.40
25-Jun-24	21.30	20.10	19.80	19.40	18.70	17.60	16.70
3-Jul-24	21.90	21.60	21.00	20.10	18.60	17.90	17.60
9-Jul-24	27.40	26.10	24.30	21.10	19.00	18.10	17.80
16-Jul-24	26.80	26.00	25.80	22.60	19.50	18.00	17.30
23-Jul-24	24.40	23.80	23.70	23.50	19.70	18.00	17.30
30-Jul-24	22.70	22.50	22.30	22.00	21.80	19.20	17.30
7-Aug-24	25.20	24.40	23.80	22.60	21.50	20.00	18.10
12-Aug-24	24.80	24.80	24.80	23.50	21.00	20.10	18.80
13-Aug-24	23.80	23.80	23.80	23.80	21.30	19.70	18.70
20-Aug-24	22.20	22.20	22.20	22.20	22.10	20.10	18.60
27-Aug-24	20.20	20.20	20.20	20.20	20.00	20.00	19.50
3-Sep-24	21.90	21.90	20.80	19.80	19.60	19.50	19.00
10-Sep-24	21.80	21.70	21.50	20.30	19.70	19.40	19.00
17-Sep-24	19.60	19.60	19.60	19.50	19.40	19.30	19.30
24-Sep-24	19.80	19.50	19.30	19.10	19.10	18.90	18.80
8-Oct-24	16.20	16.10	15.90	15.90	15.80	15.70	15.60
22-Oct-24	13.30	13.30	13.30	13.30	13.20	13.20	13.20
18-Nov-24	9.00	9.00	9.00	9.00	9.00	9.00	9.00
3-Dec-24	6.90	6.90	6.90	6.90	6.90	6.80	6.80

Month	Dissolved Oxygen (mg/L)						
	0m	1m	2m	3m	4m	5m	6m
9-Jan-24	7.97	7.77	7.62	7.65	7.57	7.23	7.38
6-Feb-24	7.78	7.66	7.46	7.14	7.00	6.96	6.73
21-Mar-24	15.32	14.30	12.86	11.05	10.38	9.88	8.88
9-Apr-24	11.55	11.34	11.16	11.03	10.57	9.65	8.95
1-May-24	11.09	10.83	10.16	9.56	8.88	8.03	5.71
7-May-24	8.30	8.20	7.89	7.79	7.87	7.73	5.30
15-May-24	10.58	10.79	6.78	5.18	3.08	2.60	1.66
22-May-24	9.05	9.07	9.12	10.41	3.96	0.25	0.07
28-May-24	10.85	9.75	8.97	7.98	7.27	6.18	0.07
4-Jun-24	6.55	6.48	6.43	6.42	6.38	6.38	5.62
11-Jun-24	8.84	8.76	8.58	6.11	4.20	4.15	1.23
18-Jun-24	9.57	9.12	8.53	8.65	8.65	6.57	0.07
25-Jun-24	8.45	7.85	7.83	5.83	4.69	0.64	0.02
3-Jul-24	10.26	10.12	9.32	8.01	0.20	0.03	0.02
9-Jul-24	9.83	10.11	9.47	4.84	0.04	0.02	0.01
16-Jul-24	13.41	11.16	10.16	3.96	0.05	0.02	0.01
23-Jul-24	12.05	10.31	9.87	9.01	0.04	0.02	0.02
30-Jul-24	11.97	10.80	9.77	7.55	3.38	0.03	0.02
7-Aug-24	14.92	11.52	8.93	2.89	0.08	0.04	0.03
12-Aug-24	0.42	0.37	0.38	0.02	0.02	0.01	0.01
13-Aug-24	0.25	0.19	0.17	0.13	0.02	0.01	0.01
20-Aug-24	2.87	2.82	2.80	2.76	1.62	0.02	0.01
27-Aug-24	7.41	7.37	7.26	6.77	6.36	5.88	0.52
3-Sep-24	14.30	14.66	3.15	1.08	0.08	0.06	0.04
10-Sep-24	14.06	12.76	7.12	0.10	0.04	0.02	0.02
17-Sep-24	5.26	5.23	5.25	4.74	3.74	3.50	1.72
24-Sep-24	9.68	7.27	5.68	5.21	5.01	2.49	2.12
8-Oct-24	7.57	5.64	4.80	3.71	1.75	4.64	4.38
22-Oct-24	6.89	6.06	5.83	5.70	5.62	5.46	5.29
18-Nov-24	4.64	4.46	4.41	4.40	4.38	4.37	4.37
3-Dec-24	-	-	-	-	-	-	-

Month	pH						
	0m	1m	2m	3m	4m	5m	6m
9-Jan-24	6.29	6.35	6.52	6.50	6.60	6.66	6.65
6-Feb-24	6.38	6.29	6.29	6.31	6.40	6.44	6.48
21-Mar-24	7.24	7.12	7.20	6.83	6.79	6.80	6.76
9-Apr-24	6.86	6.94	7.00	7.03	7.00	6.94	6.88
1-May-24	7.14	7.12	7.11	7.15	6.99	6.92	6.79
7-May-24	7.05	7.06	7.06	7.07	7.08	7.08	6.88
15-May-24	7.76	7.61	6.85	6.68	6.64	6.68	6.71
22-May-24	7.24	7.25	7.23	7.20	6.86	6.60	6.65
28-May-24	7.10	7.18	7.18	7.07	7.03	6.96	6.72
4-Jun-24	7.10	7.03	7.04	7.04	7.06	7.02	7.00
11-Jun-24	7.52	7.55	7.53	6.97	6.83	6.75	6.74
18-Jun-24	7.31	7.24	7.17	7.21	7.23	7.01	6.64
25-Jun-24	7.23	7.13	7.15	6.96	6.85	6.64	6.66
3-Jul-24	7.90	7.81	7.38	7.09	6.58	6.56	6.60
9-Jul-24	8.30	8.30	7.64	6.74	6.60	6.60	6.62
16-Jul-24	9.10	8.78	8.55	6.77	6.58	6.55	6.54
23-Jul-24	9.50	9.35	9.31	9.21	6.66	6.59	6.56
30-Jul-24	9.55	9.44	9.34	9.00	7.88	6.67	6.52
7-Aug-24	9.76	9.42	9.19	7.82	6.98	6.60	6.30
12-Aug-24	7.04	7.05	7.05	7.27	7.02	6.68	6.39
13-Aug-24	6.96	7.01	7.04	7.03	7.04	6.63	6.39
20-Aug-24	6.83	6.86	6.89	6.91	6.85	6.71	6.49
27-Aug-24	7.10	7.11	7.09	7.03	7.00	6.96	6.50
3-Sep-24	9.37	9.36	6.84	6.61	6.54	6.60	6.61
10-Sep-24	9.43	9.35	7.70	6.62	6.61	6.61	6.55
17-Sep-24	6.96	6.95	6.96	6.92	6.79	6.73	6.60
24-Sep-24	8.13	7.19	6.92	6.85	6.84	6.65	6.62
8-Oct-24	6.81	6.65	6.62	6.53	6.43	6.57	6.57
22-Oct-24	6.55	6.50	6.50	6.52	6.53	6.53	6.53
18-Nov-24	6.31	6.31	6.29	6.31	6.33	6.31	6.32
3-Dec-24	6.28	6.28	6.28	6.29	6.30	6.31	6.32

Month	Conductivity ($\mu\text{S}/\text{cm}$)						
	0m	1m	2m	3m	4m	5m	6m
9-Jan-24	127.90	128.20	128.90	129.10	129.40	129.80	129.80
6-Feb-24	115.90	116.00	116.50	119.80	120.80	122.00	128.40
21-Mar-24	122.10	122.40	122.70	122.70	122.90	124.10	125.50
9-Apr-24	126.90	126.90	126.90	126.90	126.90	127.40	127.60
1-May-24	132.80	132.60	132.70	132.70	132.80	134.00	135.50
7-May-24	135.40	135.50	135.30	135.40	135.30	135.30	137.50
15-May-24	138.40	137.80	137.50	136.10	136.80	138.90	140.80
22-May-24	137.80	137.80	137.80	137.90	140.20	141.50	145.70
28-May-24	139.60	139.30	139.50	139.70	139.80	143.20	164.70
4-Jun-24	142.10	142.10	142.00	142.10	142.10	142.10	142.80
11-Jun-24	144.60	144.60	144.60	144.60	145.80	145.40	149.30
18-Jun-24	145.40	145.40	145.80	145.60	145.70	146.60	156.20
25-Jun-24	148.20	148.00	147.90	148.90	149.30	151.90	166.60
3-Jul-24	149.30	149.20	149.30	149.40	154.20	162.10	166.90
9-Jul-24	152.70	151.90	151.80	151.40	155.40	165.00	169.90
16-Jul-24	156.60	154.60	154.40	152.20	161.80	172.70	179.40
23-Jul-24	162.20	158.00	157.60	156.30	164.70	176.40	182.40
30-Jul-24	161.60	158.40	156.40	154.90	157.20	177.80	193.30
7-Aug-24	191.40	169.30	163.30	162.60	168.00	183.80	200.70
12-Aug-24	170.90	170.90	170.80	167.40	176.00	184.50	203.30
13-Aug-24	170.60	170.50	170.50	170.50	174.60	188.90	203.60
20-Aug-24	170.00	170.10	170.10	170.10	172.20	191.70	215.20
27-Aug-24	166.60	166.60	166.60	166.70	167.00	167.30	192.80
3-Sep-24	164.70	164.70	166.70	166.60	169.40	178.80	195.00
10-Sep-24	166.20	165.10	164.40	172.20	176.00	184.80	196.10
17-Sep-24	166.60	166.60	166.50	166.90	167.60	168.00	175.60
24-Sep-24	165.00	165.90	166.50	166.70	166.90	168.80	169.30
8-Oct-24	166.20	166.80	167.30	168.30	169.00	168.20	168.50
22-Oct-24	167.10	166.90	166.60	166.40	166.30	166.20	166.10
18-Nov-24	156.80	156.60	156.90	156.10	155.80	155.80	155.80
3-Dec-24	148.50	148.50	148.50	148.50	148.40	148.40	148.20

Month	Total Dissolved Solids (mg/L)						
	0m	1m	2m	3m	4m	5m	6m
9-Jan-24	83.20	83.40	83.80	83.80	84.10	84.40	84.40
6-Feb-24	75.30	75.40	75.70	77.90	78.40	79.30	83.50
21-Mar-24	79.40	79.60	79.80	79.70	79.90	80.60	81.40
9-Apr-24	82.50	82.50	82.50	82.50	82.50	82.80	82.90
1-May-24	86.30	86.20	86.20	86.20	86.40	87.10	88.10
7-May-24	88.00	88.10	88.00	88.00	88.00	87.90	89.50
15-May-24	90.00	89.60	89.40	88.50	88.90	90.20	91.50
22-May-24	89.60	89.60	89.60	89.70	91.10	92.00	94.80
28-May-24	90.50	90.60	90.70	90.80	90.90	93.00	106.50
4-Jun-24	92.40	92.40	92.30	92.40	92.40	92.30	93.10
11-Jun-24	94.00	94.00	94.00	94.50	94.80	94.40	96.50
18-Jun-24	94.60	94.50	94.80	94.70	94.70	95.30	101.80
25-Jun-24	96.40	96.20	96.10	96.80	97.00	99.10	108.30
3-Jul-24	97.10	97.00	97.10	97.10	100.30	105.40	108.50
9-Jul-24	99.20	98.70	98.70	98.50	101.00	107.40	110.40
16-Jul-24	101.80	100.50	100.30	98.90	105.30	112.30	116.60
23-Jul-24	105.40	102.70	102.50	101.60	107.10	114.70	118.60
30-Jul-24	105.00	103.70	101.90	100.70	102.10	116.10	125.60
7-Aug-24	124.20	110.00	105.80	105.80	109.10	119.40	130.40
12-Aug-24	111.10	111.10	111.00	108.80	114.30	119.90	132.20
13-Aug-24	110.90	110.90	110.90	110.90	113.40	122.80	132.40
20-Aug-24	110.50	110.50	110.50	110.60	112.10	124.80	139.90
27-Aug-24	108.30	108.30	108.30	108.40	108.60	108.80	125.50
3-Sep-24	107.10	107.00	108.40	108.30	110.10	116.20	127.20
10-Sep-24	108.30	107.30	107.00	112.00	114.40	120.10	127.40
17-Sep-24	108.30	108.30	108.20	108.50	108.00	110.40	113.50
24-Sep-24	107.30	107.90	108.20	108.40	108.50	109.80	110.00
8-Oct-24	108.10	108.50	108.80	109.40	109.80	109.40	109.70
22-Oct-24	108.60	108.50	108.30	108.20	108.10	108.00	108.00
18-Nov-24	102.10	101.80	101.90	101.50	101.30	101.30	101.30
3-Dec-24	96.50	96.50	96.50	96.50	96.40	96.40	96.30

Date	Nutrients at Somenos Lake surface and the bottom							
	Phosphate (mg/L)		Ammonia (mg/L)		Nitrite (mg/L)		Nitrate (mg/L)	
	0-1m	6 m	0m	6m	0m	6m	0m	6m
9-Jan-24	0.180	0.200	0.108	0.132	0.017	0.017	<<	<<
6-Feb-24	0.050	0.200	0.060	0.324	0.003	0.020	<<	<<
21-Mar-24	0.100	0.140	0.000	0.060	0.023	0.007	<<	<<
9-Apr-24	0.270	0.170	<<	0.036	0.013	0.013	<<	<<
1-May-24	0.270	0.170	0.012	0.048	0.000	0.000	<<	<<
7-May-24	0.160	0.280	0.084	0.144	0.000	0.000	<<	<<
15-May-24	0.210	0.700	0.204	0.240	0.007	0.017	<<	<<
22-May-24	0.230	0.550	<<	0.060	0.007	0.000	<<	<<
28-May-24	0.230	0.540	0.108	0.216	0.003	0.000	<<	<<
4-Jun-24	0.500	0.480	0.156	>>1	0.000	0.000	0.000	<<
11-Jun-24	0.280	NA	0.060	-	0.000	-	<<	NA
18-Jun-24	0.310	1.000	0.156	0.696	0.003	0.000	<<	<<
25-Jun-24	0.360	0.680	>>1	0.300	0.010	0.023	<<	<<
3-Jul-24	0.320	0.870	0.072	0.372	0.000	0.000	<<	<<
9-Jul-24	0.250	1.250	0.036	0.684	0.003	0.000	<<	<<
16-Jul-24	0.100	1.200	0.768	0.672	0.000	0.007	<<	<<
23-Jul-24	0.170	3.100	0.096	>>1	0.003	0.010	<<	<<
30-Jul-24	0.470	3.200	0.084	>>1	0.000	0.007	0.013	0.004
7-Aug-24	0.100	1.950	0.132	1.200	0.003	0.007	0.070	0.013
12-Aug-24	0.200	2.600	1.176	>>1	0.003	0.007	<<	<<
13-Aug-24	0.150	1.900	1.116	>>1	0.000	0.013	<<	<<
20-Aug-24	0.110	0.880	0.948	>>1	0.000	0.003	<<	<<
27-Aug-24	0.410	1.400	0.516	>>1	0.010	0.023	<<	0.013
3-Sep-24	0.370	0.620	0.072	0.852	0.000	0.000	<<	0.000
10-Sep-24	0.200	1.350	0.000	>>1	0.000	0.003	<<	<<
17-Sep-24	0.390	0.510	0.120	0.480	0.000	0.003	<<	<<
24-Sep-24	0.050	0.290	0.072	0.336	0.000	0.000	<<	<<
8-Oct-24	0.390	0.300	0.300	0.372	0.0165	0.007	<<	<<
22-Oct-24	0.210	0.180	0.252	0.300	0.000	0.010	<<	<<
18-Nov-24	<<	<<	0.228	0.312	0.003	0.010	<<	0.013
3-Dec-24	0.000	0.540	0.444	>>1	0.020	0.017	<<	<<

<< = less than 0.001 mg/L

6 Appendix D - Data Tabulations for Somenos Tributaries

Date	Dissolved Oxygen (mg/L)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	7.64	13.8	8.61	14.77	13.53	13.56
Monday, February 5, 2024	-	5.64	12.6	7.47	12.84	12.84	13.26
Tuesday, March 12, 2024	-	8.28	11.68	9.22	12.89	12.22	12
Monday, April 8, 2024	-	2.46	13.3	8.9	12.83	12.03	14.39
Tuesday, May 7, 2024	-	0.56	12.67	5.26	11.45	11.52	12
Monday, May 13, 2024	-	0.5	10.67	4.42	10.84	-	10.42
Tuesday, May 21, 2024	-	0.18	10.68	2.62	10.08	-	10.45
Monday, May 27, 2024	-	0.33	10.45	2.1	10.56	-	10.52
Monday, June 3, 2024	-	0.04	10.72	2.36	10.44	-	10.47
Monday, June 10, 2024	-	0.5	10.17	2.1	9.21	-	9.43
Monday, June 17, 2024	-	0.84	10.47	1.8	8.66	-	9.74
Monday, June 24, 2024	-	0.07	9.79	1.36	9.03	-	8.92
Wednesday, July 3, 2024	-	0.14	9.98	1.38	8.75	-	8.47
Monday, July 8, 2024	-	0.03	9.5	2.6	7.56	-	7.65
Monday, July 15, 2024	-	0.26	8.17	4.11	8.92	-	7.36
Monday, July 22, 2024	-	0.04	8.87	4.2	8.27	-	7.96
Monday, July 29, 2024	-	0.04	8.96	3.39	7.98	-	8.3
Monday, August 5, 2024	-	0.09	8.8	3.74	8.51	-	8.12
Monday, August 12, 2024	-	0.12	8.96	2.93	8.1	-	8.96
Monday, August 19, 2024	-	0.07	9.31	0.53	7.92	-	8.23
Monday, August 26, 2024	-	0.09	9.77	0.39	8.5	-	10.3
Tuesday, September 3, 2024	-	0.09	9.7	0.68	8.18	-	9.21
Monday, September 9, 2024	-	0.07	9.88	0.21	8.12	-	8.62
Monday, September 16, 2024	-	0.1	10.43	0.23	9.11	-	10.37
Monday, September 23, 2024	-	0.16	9.7	0.24	9.03	-	9.74
Monday, September 30, 2024	-	0.24	11.15	0.31	9.58	-	10.52
Monday, October 7, 2024	-	0.19	10.9	0.26	9.3	-	10
Monday, October 14, 2024	-	0.3	10.65	0.24	9.04	-	9.47
Monday, October 21, 2024	-	1.18	11.14	2.5	-	-	-
Monday, October 28, 2024	-	1.02	10.95	2.04	-	-	-
Monday, November 4, 2024	5.86	2.38	10.66	3.36	11.1	-	11.05
Tuesday, November 12, 2024	-	1.76	11.42	2.75	11.15	-	11.37
Monday, November 18, 2024	-	1.56	11.49	3.6	11.3	-	11.96
Monday, November 25, 2024	-	1.38	12.02	3.98	12.23	-	11.69
Tuesday, December 3, 2024	-	1.23	12.48	3.15	12.41	-	12.62
Monday, December 9, 2024	6.45	1.15	-	-	-	-	-

Date	Temperature °C						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	0.6	3.3	2.6	3.1	1.3	3.2
Monday, February 5, 2024	-	6.4	5.5	5.8	5.2	5.3	5.7
Tuesday, March 12, 2024	-	7.9	6.9	6.8	6.7	7	7.8
Monday, April 8, 2024	-	9.3	8.3	9.9	8.8	8.9	8.8
Tuesday, May 7, 2024	-	11.4	9.7	13.5	10.7	10.6	10.8
Monday, May 13, 2024	-	14.5	12.9	18.1	13.5	-	13.7
Tuesday, May 21, 2024	-	13	10.7	15.3	11.9	-	12.5
Monday, May 27, 2024	-	13.1	11.6	14.9	11.9	-	12.3
Monday, June 3, 2024	-	12.7	11.8	14.7	12.6	-	12.8
Monday, June 10, 2024	-	16.9	15.2	19.5	15.6	-	15.5
Monday, June 17, 2024	-	12.7	11.5	16.2	12.6	-	12.8
Monday, June 24, 2024	-	14.6	14.3	18.3	14.7	-	15.2
Wednesday, July 3, 2024	-	16.8	15.1	16.4	16.8	-	16.5
Monday, July 8, 2024	-	15.7	17.7	15.7	19	-	18.7
Monday, July 15, 2024	-	17.4	17.9	16.3	18.2	-	18.4
Monday, July 22, 2024	-	17.9	18.3	17.1	18.4	-	18.4
Monday, July 29, 2024	-	16.4	16.2	15.3	16.8	-	17.1
Monday, August 5, 2024	-	16.8	18.3	18.8	18.1	-	19.3
Monday, August 12, 2024	-	16.4	16.8	15.6	16.7	-	17.3
Monday, August 19, 2024	-	16.1	16	15.9	15.9	-	17
Monday, August 26, 2024	-	15.6	15.3	15.4	15.3	-	17.9
Tuesday, September 3, 2024	-	14.5	16.4	17	15.7	-	16.3
Monday, September 9, 2024	-	14.5	16.2	15.9	16	-	16.3
Monday, September 16, 2024	-	13	13.5	14.4	13.6	-	13.6
Monday, September 23, 2024	-	12.9	15	14.8	14.9	-	14.8
Monday, September 30, 2024	-	11	10.9	13.3	11.1	-	10.9
Monday, October 7, 2024	-	10.2	11.7	13	11.7	-	11.6
Monday, October 14, 2024	-	9.6	11.3	11.9	11.3	-	11.4
Monday, October 21, 2024	-	10.5	10.7	12.1	-	-	-
Monday, October 28, 2024	-	9.5	10.1	11.2	-	-	-
Monday, November 4, 2024	-	9.1	9.6	10.3	9.3	-	10.1
Tuesday, November 12, 2024	-	8.8	9.4	9.5	9.2	-	9.7
Monday, November 18, 2024	-	5.9	7	7.7	6.8	-	7.3
Monday, November 25, 2024	-	6.7	7.6	7.7	7.5	-	8.1
Tuesday, December 3, 2024	-	5	6	6.2	5.8	-	5.9
Monday, December 9, 2024	6.6	5.6	-	-	-	-	-

Date	pH						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	6.15	6.9	6.39	7.14	6.96	6.91
Monday, February 5, 2024	-	6.24	7.08	6.28	7.25	7.1	7.28
Tuesday, March 12, 2024	-	6.65	7.12	6.72	7.24	7.01	7.28
Monday, April 8, 2024	-	6.42	7.41	6.5	7.48	7.16	7.91
Tuesday, May 7, 2024	-	6.45	7.52	6.73	7.58	7.28	7.6
Monday, May 13, 2024	-	6.59	7.59	6.64	7.43	-	7.51
Tuesday, May 21, 2024	-	6.67	7.49	6.62	7.21	-	7.36
Monday, May 27, 2024	-	6.48	7.49	6.55	7.4	-	7.58
Monday, June 3, 2024	-	6.55	7.38	6.44	7.43	-	7.66
Monday, June 10, 2024	-	6.37	7.35	6.55	7.25	-	7.31
Monday, June 17, 2024	-	6.48	7.36	6.51	7.21	-	7.29
Monday, June 24, 2024	-	6.41	7.35	6.5	7.18	-	7.22
Wednesday, July 3, 2024	-	6.41	7.32	6.49	7.25	-	7.3
Monday, July 8, 2024	-	6.33	7.33	6.31	7.11	-	7.13
Monday, July 15, 2024	-	6.4	7.34	6.39	7.09	-	7.27
Monday, July 22, 2024	-	6.3	7.24	6.48	7.29	-	7.21
Monday, July 29, 2024	-	6.27	7.2	6.34	7.15	-	7.08
Monday, August 5, 2024	-	6.27	7.19	6.47	7.3	-	7.34
Monday, August 12, 2024	-	6.13	7.24	6.26	7.23	-	7.35
Monday, August 19, 2024	-	6.12	7.12	6.07	6.96	-	6.88
Monday, August 26, 2024	-	6.14	7.18	6.09	7.01	-	6.98
Tuesday, September 3, 2024	-	6.16	7.25	6.28	7.13	-	7.43
Monday, September 9, 2024	-	6.12	7.24	6.14	7.11	-	7.27
Monday, September 16, 2024	-	6.15	7.11	6.16	7.1	-	7.34
Monday, September 23, 2024	-	6.08	7.14	6.2	7.05	-	7.3
Monday, September 30, 2024	-	6.22	7.06	6.13	7	-	7.2
Monday, October 7, 2024	-	6.11	7.16	6.05	7.02	-	7.27
Monday, October 14, 2024	-	6.14	6.89	6.02	6.92	-	6.97
Monday, October 21, 2024	-	5.76	7.02	6.1	-	-	-
Monday, October 28, 2024	-	6.02	7.02	6.3	-	-	-
Monday, November 4, 2024	-	6.03	6.81	6.24	6.9	-	6.86
Tuesday, November 12, 2024	-	5.98	6.74	6.07	6.8	-	6.76
Monday, November 18, 2024	-	5.95	6.78	6.32	6.81	-	6.78
Monday, November 25, 2024	-	6.04	6.74	6.25	6.84	-	6.76
Tuesday, December 3, 2024	-	6.02	6.72	6.12	6.84	-	6.69
Monday, December 9, 2024	6.37	6.07	-	-	-	-	-

Date	Specific Conductivity ($\mu\text{S}/\text{cm}$)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	106.8	94	162	73.2	85.3	117.3
Monday, February 5, 2024	-	98	97.9	110	87.3	97.7	130.7
Tuesday, March 12, 2024	-	103.4	103.9	125.3	70.8	77.6	119.6
Monday, April 8, 2024	-	135.4	116.5	135.6	145.1	156.5	151.5
Tuesday, May 7, 2024	-	167.1	145.5	151.9	195.6	198.3	188.8
Monday, May 13, 2024	-	185.6	157.6	157.9	215.3	-	196.3
Tuesday, May 21, 2024	-	207.2	159.5	156.6	186.8	-	147.1
Monday, May 27, 2024	-	145	139.9	171	235.1	-	212.6
Monday, June 3, 2024	-	188	143	176.5	215.2	-	198.1
Monday, June 10, 2024	-	178	171.8	167.5	253.6	-	233.5
Monday, June 17, 2024	-	204.9	164.4	177.3	264.8	-	235.4
Monday, June 24, 2024	-	178	170.2	192	272.1	-	248.7
Wednesday, July 3, 2024	-	187.4	143.4	211	283	-	250.2
Monday, July 8, 2024	-	176.5	108.7	208.8	292	-	255.8
Monday, July 15, 2024	-	140	108.9	171.2	305.3	-	246.6
Monday, July 22, 2024	-	132.5	107.4	166.3	321.4	-	244.5
Monday, July 29, 2024	-	120.8	114.5	164.2	235	-	172.6
Monday, August 5, 2024	-	125	104.5	166.8	301.3	-	252.7
Monday, August 12, 2024	-	114.2	104.1	169.9	314	-	246.1
Monday, August 19, 2024	-	114.7	108.8	166.5	292.5	-	163.9
Monday, August 26, 2024	-	118	109.5	184.1	298.2	-	79.6
Tuesday, September 3, 2024	-	115.2	108.9	203.1	328.9	-	261.5
Monday, September 9, 2024	-	114.6	108.8	197.3	332.8	-	292.2
Monday, September 16, 2024	-	118	113.5	233	333.6	-	272
Monday, September 23, 2024	-	115.5	111.5	214.9	325.6	-	272
Monday, September 30, 2024	-	130.5	116.3	210	308.8	-	289.6
Monday, October 7, 2024	-	123	117.2	222.8	306.4	-	283.1
Monday, October 14, 2024	-	122	122.3	222.9	288.9	-	231.7
Monday, October 21, 2024	-	176	177.3	168	-	-	-
Monday, October 28, 2024	-	195	164.5	179.5	-	-	-
Monday, November 4, 2024	-	163	148.5	165.5	99.3	-	157.7
Tuesday, November 12, 2024	-	155.5	129.2	144.5	74.8	-	135.8
Monday, November 18, 2024	-	122	125.5	139.6	77.6	-	126.4
Monday, November 25, 2024	-	128	112.8	136.1	71	-	124.7
Tuesday, December 3, 2024	-	127.3	112.8	140.8	105.7	-	141.7
Monday, December 9, 2024	142.3	133.9	-	-	-	-	-

Date	Total Dissolved Solids (mg/L)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	68.5	60	105	47.6	55.4	76.2
Monday, February 5, 2024	-	64	63.6	72	56.7	63.5	85
Tuesday, March 12, 2024	-	67.2	68.8	81.5	46	50.4	77.7
Monday, April 8, 2024	-	88	75.5	88.1	94.3	101.7	98.5
Tuesday, May 7, 2024	-	108.6	94.6	98.9	127.1	128.9	122.7
Monday, May 13, 2024	-	120.3	102.5	103	138.6	-	127.6
Tuesday, May 21, 2024	-	134.9	103.7	102	121.2	-	95.6
Monday, May 27, 2024	-	95.2	90.9	111.5	152.8	-	138.2
Monday, June 3, 2024	-	123	92.9	114.5	139.9	-	128.8
Monday, June 10, 2024	-	114.5	111.7	108.8	164.8	-	151.8
Monday, June 17, 2024	-	133	106.7	114.9	172.1	-	153
Monday, June 24, 2024	-	116	110.4	124.9	176.1	-	161.6
Wednesday, July 3, 2024	-	121.3	93.4	137.2	184	-	162.8
Monday, July 8, 2024	-	114.5	70.8	136.9	189.9	-	166.3
Monday, July 15, 2024	-	91.7	71.1	110.2	198.4	-	160.3
Monday, July 22, 2024	-	84.5	69.8	108.3	208.9	-	159
Monday, July 29, 2024	-	79.4	74.3	106.4	152.7	-	112.2
Monday, August 5, 2024	-	81.3	67.7	108.4	195.8	-	164.3
Monday, August 12, 2024	-	74.5	67.7	110.8	204.4	-	160
Monday, August 19, 2024	-	74.5	70.7	107.7	190.1	-	106.3
Monday, August 26, 2024	-	76	71.3	122.4	193.8	-	61.7
Tuesday, September 3, 2024	-	76.5	70.6	130.9	213.8	-	170
Monday, September 9, 2024	-	73.3	70.8	127.7	216.3	-	190
Monday, September 16, 2024	-	76.9	73.9	150	216.8	-	176.8
Monday, September 23, 2024	-	75	72.4	139.5	211.6	-	176.6
Monday, September 30, 2024	-	85	75.7	136.4	200.8	-	118.2
Monday, October 7, 2024	-	79	76.1	144.7	199.2	-	184
Monday, October 14, 2024	-	78	79.4	145.1	187.8	-	150.6
Monday, October 21, 2024	-	114.5	114.7	109.2	-	-	-
Monday, October 28, 2024	-	125	106.3	115.7	-	-	-
Monday, November 4, 2024	-	105	96.8	107.5	64.6	-	103.2
Tuesday, November 12, 2024	-	100.9	83.9	94.1	48.6	-	88.3
Monday, November 18, 2024	-	81	81.5	91.5	50.4	-	82.1
Monday, November 25, 2024	-	83	73.5	88.6	46.1	-	77.1
Tuesday, December 3, 2024	-	83.55	73.45	91.65	68.9	-	92.3
Monday, December 9, 2024	92.3	87.5	-	-	-	-	-

Date	Phosphate (mg/L)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	0.29	0.2	0.14	-	0.09	0.45
Monday, February 5, 2024	-	0.32	0.11	0.33	-	0.21	0.22
Tuesday, March 12, 2024	-	0.17	0.17	0.35	-	0.16	0.18
Monday, April 8, 2024	-	0.43	0.07	0.15	-	0.19	0.18
Tuesday, May 7, 2024	-	0.33	0.15	0.39	-	0.23	0.26
Monday, May 13, 2024	-	0.42	0.23	0.33	0.18	-	0.14
Tuesday, May 21, 2024	-	0.57	0.13	0.6	0.09	-	0.18
Monday, May 27, 2024	-	0.7	0.37	0.65	0.31	-	0.15
Monday, June 3, 2024	-	1.1	0.37	0.56	0.26	-	0.29
Monday, June 10, 2024	-	1.15	0.18	0.68	0.15	-	0.24
Monday, June 17, 2024	-	0.74	0.26	0.68	0.54	-	0.22
Monday, June 24, 2024	-	1.1	0.25	0.42	0.34	-	0.37
Wednesday, July 3, 2024	-	1.25	0.24	0.5	0.2	-	0.32
Monday, July 8, 2024	-	0.58	0.15	0.19	0.17	-	0.29
Monday, July 15, 2024	-	0.45	0.15	0.33	0.18	-	0.21
Monday, July 22, 2024	-	0.67	0.26	0.09	0.26	-	0.33
Monday, July 29, 2024	-	0.73	0.16	0.32	0.54	-	0.54
Monday, August 5, 2024	-	0.91	0.22	0.76	0.24	-	0.63
Monday, August 12, 2024	-	0.27	0.09	0.08	0.22	-	0.18
Monday, August 19, 2024	-	0.85	0.26	0.4	0.4	-	0.43
Monday, August 26, 2024	-	0.76	0.17	0.23	0.68	-	0.41
Tuesday, September 3, 2024	-	0.25	0.11	0.22	0.22	-	0.4
Monday, September 9, 2024	-	0.34	0.1	0.2	0.19	-	0.24
Monday, September 16, 2024	-	0.46	0.18	0.11	0.15	-	0.22
Monday, September 23, 2024	-	0.46	0.17	1.1	0.12	-	0.19
Monday, September 30, 2024	-	0.25	0.07	0.45	0.13	-	0.18
Monday, October 7, 2024	-	0.12	0.1	0.61	0.1	-	0.11
Monday, October 14, 2024	-	0.16	0.24	-	-	-	-
Monday, October 21, 2024	-	1.05	0.18	0.43	-	-	-
Monday, October 28, 2024	-	-	-	-	-	-	-
Monday, November 4, 2024	-	<<	0.03	-	-	-	-
Tuesday, November 12, 2024	-	-	-	-	-	-	-
Monday, November 18, 2024	-	0.07	0.02	0.02	0.01	-	0.02
Monday, November 25, 2024	-	-	-	-	-	-	-
Tuesday, December 3, 2024	-	0.42	0.13	0.43	0.23	-	0.12
Monday, December 9, 2024	-	-	-	-	-	-	-

Date	Ammonia (mg/L)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	<<	<<	<<	-	-	<<
Monday, February 5, 2024	-	0.000	<<	<<	-	<<	<<
Tuesday, March 12, 2024	-	<<	<<	0.012	-	<<	0.012
Monday, April 8, 2024	-	0.000	<<	<<	-	<<	<<
Tuesday, May 7, 2024	-	0.072	0.024	0.912	-	0.012	0.024
Monday, May 13, 2024	-	0.084	0.012	0.168	0.012	-	<<
Tuesday, May 21, 2024	-	0.156	<<	<<	<<	-	<<
Monday, May 27, 2024	-	0.012	0.000	0.336	0.072	-	0.036
Monday, June 3, 2024	-	0.384	<<	0.216	0.036	-	<<
Monday, June 10, 2024	-	<<	0.012	0.108	0.012	-	0.024
Monday, June 17, 2024	-	0.012	0.024	0.06	0.012	-	0.012
Monday, June 24, 2024	-	0.144	0.24	0.036	0.036	-	0.06
Wednesday, July 3, 2024	-	0.084	0.012	0.156	0.036	-	0.048
Monday, July 8, 2024	-	0.108	0.024	0.228	0.06	-	0.216
Monday, July 15, 2024	-	0.036	0.132	0.048	0.276	-	0.036
Monday, July 22, 2024	-	0.096	0.012	0.012	0.06	-	0.012
Monday, July 29, 2024	-	0.012	0.216	0.012	0.036	-	0.012
Monday, August 5, 2024	-	0.156	0.084	0.06	0.048	-	0.012
Monday, August 12, 2024	-	0.072	0.036	0.024	0.108	-	0.06
Monday, August 19, 2024	-	0.000	0.084	0.000	0.024	-	0.024
Monday, August 26, 2024	-	0.000	0.108	<<	0.048	-	0.024
Tuesday, September 3, 2024	-	<<	0.000	0.288	0.132	-	0.024
Monday, September 9, 2024	-	0.048	0.012	0.048	0.024	-	0.000
Monday, September 16, 2024	-	0.000	0.012	<<	0.672	-	<<
Monday, September 23, 2024	-	<<	<<	0.06	0.036	-	0.024
Monday, September 30, 2024	-	<<	<<	0.012	<<	-	<<
Monday, October 7, 2024	-	<<	<<	<<	0.012	-	0.048
Monday, October 14, 2024	-	<<	<<	-	-	-	-
Monday, October 21, 2024	-	0.516	<<	0.240	-	-	-
Monday, October 28, 2024	-	-	-	-	-	-	-
Monday, November 4, 2024	-	0.012	<<	-	-	-	-
Tuesday, November 12, 2024	-	-	-	-	-	-	-
Monday, November 18, 2024	-	0.000	<<	0.036	<<	-	0.096
Monday, November 25, 2024	-	-	-	-	-	-	-
Tuesday, December 3, 2024	-	0.096	<<	0.084	0.144	-	<<
Monday, December 9, 2024	-	-	-	-	-	-	-

Date	Nitrite (mg/L)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	0.0066	0.0165	0.0264	-	0.0099	0.0165
Monday, February 5, 2024	-	0.0198	0.0066	0.0462	-	0.000	0.000
Tuesday, March 12, 2024	-	0.0132	0.0132	0.0231	-	0.0099	0.0099
Monday, April 8, 2024	-	0.0231	0.0264	0.000	-	0.0132	0.0132
Tuesday, May 7, 2024	-	0.0099	0.0033	0.0099	-	0.000	0.0099
Monday, May 13, 2024	-	0.0033	0.0033	0.0165	0.0099	-	0.0132
Tuesday, May 21, 2024	-	0.0165	0.0033	0.0099	0.001	-	0.000
Monday, May 27, 2024	-	0.033	0.0033	0.0198	0.001	-	0.000
Monday, June 3, 2024	-	0.0132	0.000	0.0132	0.005	-	0.0165
Monday, June 10, 2024	-	0.0165	0.000	0.0231	0.004	-	0.0165
Monday, June 17, 2024	-	0.000	0.0099	0.0099	0.001	-	0.0066
Monday, June 24, 2024	-	0.0429	0.0033	0.0165	<<	-	0.0066
Wednesday, July 3, 2024	-	0.033	0.0066	0.000	0.007	-	0.0231
Monday, July 8, 2024	-	0.0231	0.0264	0.000	0.004	-	0.0198
Monday, July 15, 2024	-	0.0066	0.000	0.0231	0.003	-	0.0033
Monday, July 22, 2024	-	0.0033	0.0099	0.0132	0.005	-	0.000
Monday, July 29, 2024	-	0.0033	0.000	0.0033	0.005	-	0.0066
Monday, August 5, 2024	-	0.0033	0.000	0.0033	0.004	-	0.000
Monday, August 12, 2024	-	0.0066	0.0066	0.033	0.006	-	0.0231
Monday, August 19, 2024	-	0.000	0.0066	0.0264	0.007	-	0.0264
Monday, August 26, 2024	-	0.0066	0.000	0.0033	0.004	-	0.0165
Tuesday, September 3, 2024	-	0.000	0.0033	0.000	0.001	-	0.0264
Monday, September 9, 2024	-	0.0066	0.0066	0.0066	0.005	-	0.0033
Monday, September 16, 2024	-	0.000	0.000	<<	0.004	-	0.000
Monday, September 23, 2024	-	0.000	0.0033	0.0693	0.004	-	0.0033
Monday, September 30, 2024	-	0.0033	0.000	0.0198	0.004	-	0.000
Monday, October 7, 2024	-	0.000	0.000	0.0033	0.000	-	0.0099
Monday, October 14, 2024	-	0.0066	0.0099	-	-	-	-
Monday, October 21, 2024	-	0.0792	0.0033	0.0231	-	-	-
Monday, October 28, 2024	-	-	-	-	-	-	-
Monday, November 4, 2024	-	0.001	0.0066	-	-	-	-
Tuesday, November 12, 2024	-	-	-	-	-	-	-
Monday, November 18, 2024	-	0.0264	0.000	0.0297	0.001	-	0.0198
Monday, November 25, 2024	-	-	-	-	-	-	-
Tuesday, December 3, 2024	-	0.578	0.000	0.040	0.006	-	0.056
Monday, December 9, 2024	-	-	-	-	-	-	-

Date	Nitrate (mg/L)						
	Somenos Lake Dock	Richards Creek at Herd Road	Richards Creek at Richards Trail	Somenos Creek	Bings Creek, Mary-Phillips St.	Bings Creek, Reach 1	Averill Creek
Sunday, January 21, 2024	-	<<	<<	<<	-	<<	<<
Monday, February 5, 2024	-	<<	<<	0	-	<<	<<
Tuesday, March 12, 2024	-	<<	<<	<<	-	<<	<<
Monday, April 8, 2024	-	<<	<<	<<	-	<<	<<
Tuesday, May 7, 2024	-	<<	<<	<<	-	0	<<
Monday, May 13, 2024	-	<<	<<	<<	<<	-	<<
Tuesday, May 21, 2024	-	<<	<<	<<	<<	-	<<
Monday, May 27, 2024	-	<<	<<	<<	<<	-	0
Monday, June 3, 2024	-	<<	<<	<<	<<	-	<<
Monday, June 10, 2024	-	<<	<<	<<	<<	-	<<
Monday, June 17, 2024	-	<<	0	<<	<<	-	<<
Monday, June 24, 2024	-	0.0704	0.0044	0.0088	<<	-	<<
Wednesday, July 3, 2024	-	0.0572	0.0352	<<	<<	-	<<
Monday, July 8, 2024	-	<<	<<	<<	<<	-	0.0176
Monday, July 15, 2024	-	<<	<<	<<	<<	-	<<
Monday, July 22, 2024	-	<<	0.066	0.0132	0.001	-	<<
Monday, July 29, 2024	-	<<	0.0044	<<	<<	-	0
Monday, August 5, 2024	-	0.0396	0.0132	0.0572	<<	-	0.0044
Monday, August 12, 2024	-	<<	<<	<<	<<	-	<<
Monday, August 19, 2024	-	<<	0.0088	0.0176	0.009	-	0.0044
Monday, August 26, 2024	-	<<	<<	<<	0.008	-	<<
Tuesday, September 3, 2024	-	<<	0.0132	<<	<<	-	<<
Monday, September 9, 2024	-	<<	<<	<<	<<	-	<<
Monday, September 16, 2024	-	<<	0	<<	<<	-	<<
Monday, September 23, 2024	-	<<	0.0088	<<	<<	-	<<
Monday, September 30, 2024	-	<<	<<	<<	<<	-	<<
Monday, October 7, 2024	-	<<	<<	0.017	0	-	0
Monday, October 14, 2024	-	<<	0	-	-	-	-
Monday, October 21, 2024	-	<<	<<	<<	-	-	-
Monday, October 28, 2024	-	-	-	-	-	-	-
Monday, November 4, 2024	-	<<	<<	-	-	-	-
Tuesday, November 12, 2024	-	-	-	-	-	-	-
Monday, November 18, 2024	-	0.0044	<<	<<	0	-	0
Monday, November 25, 2024	-	-	-	-	-	-	-
Tuesday, December 3, 2024	-	<<	0.0044	0	0.022	-	<<
Monday, December 9, 2024	-	-	-	-	-	-	-

7 APPENDIX E – BEVERLY WETLAND WATER QUALITY RESULTS

sample location sample name time sampled	Dry Season															units	Max.for Aquatic Life
	27-Aug-24			4-Sep-24			11-Sep-24			18-Sep-24			27-Sep-23				
	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	N/A	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2		
	BWQ1DS.1	BWQ1US.1	BWQ2US.1	BWQ1DS.2	BWQ1US.2	BWQ2US.2	BWQ1DS.3	BWQ1US.3	BWQ2US.3	BWQ1DS.4	BWQ1US.4	BWQ2US.4	BWQ1DS.5	BWQ1US.5	BWQ2US.5		
12:36	12:58	12:50	13:45	14:06	14:01	13:24	13:41	13:34	13:16	13:35	-	13:20	13:32	13:28			
Elements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Freshwater		
1) Aluminium	0.031	0.228	0.445	0.015	0.122	0.500	0.041	1.000	0.735	0.053	0.031	-	0.043	0.186	0.245	mg/L	n/a
2) Antimony	<0.500	<0.500	0.83	<0.500	<0.500	1.08	<0.500	1.82	0.66	<0.500	<0.500	-	<0.500	1.05	1.34	ug/L	n/a
3) Arsenic	0.883	1.690	1.530	0.793	2.280	3.750	0.844	3.120	3.180	2.770	2.260	-	<0.500	<0.500	<0.500	ug/L	5
4) Barium	0.027	0.050	0.049	0.046	0.085	0.072	0.039	0.055	0.065	0.041	0.077	-	0.017	<0.009	0.015	mg/L	n/a
5) Beryllium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	2.630	<0.003	<0.003	<0.003	-	<0.003	<0.003	<0.003	mg/L	0.01
6) Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	mg/L	n/a
7) Cadmium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	ug/L	1.05-2.11
8) Calcium	17.500	21.600	27.200	0.760	0.650	0.190	0.270	12.400	0.660	1.580	0.660	-	11.100	1.790	4.350	mg/L	n/a
9) Chromium	<0.003	<0.003	0.004	<0.003	<0.003	0.005	<0.003	0.004	<0.003	<0.003	<0.003	-	<0.003	<0.003	0.004	mg/L	0.1
10) Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	89.000	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	mg/L	1.32
11) copper	<0.008	<0.008	0.008	<0.008	<0.008	0.028	<0.008	0.033	0.015	<0.008	<0.008	-	<0.008	<0.008	0.010	mg/L	0.030-0.127
12) Gold	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	-	<0.040	<0.040	<0.040	mg/L	n/a
13) Iron	3.490	0.430	2.790	0.350	1.560	1.150	1.240	1.190	2.030	0.970	0.850	-	0.580	0.497	0.475	mg/L	1
14) Lanthanum	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-	<0.020	<0.020	<0.020	mq/L	n/a
15) Lead	0.630	1.330	3.730	<0.500	<0.500	10.500	<0.500	4.580	5.120	<0.500	<0.500	-	<0.500	0.931	1.450	uq/L	30
16) Magnesium	3.300	4.020	4.680	5.680	6.940	5.850	5.780	2.110	5.590	6.060	7.320	-	2.260	0.270	0.460	mg/L	n/a
17) Manganese	0.052	0.362	0.143	0.164	0.705	0.409	0.031	0.257	0.579	0.212	0.561	-	0.030	0.022	0.016	mg/L	n/a
18) Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	ug/L	2
19) Molybdenum	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	-	<0.005	<0.005	0.005	mg/L	n/a
20) Nickel	<0.004	<0.004	<0.004	<0.004	<0.004	0.005	<0.004	<0.004	0.004	<0.004	<0.004	-	<0.004	<0.004	<0.004	mg/L	n/a
21) Phosphorus	0.120	0.176	0.161	0.061	0.170	0.378	0.133	0.539	0.282	0.802	0.123	-	0.077	0.056	0.100	mg/L	n/a
22) Potassium	0.900	1.320	1.050	0.700	2.150	1.740	1.490	0.890	1.970	0.380	2.200	-	1.410	0.170	0.650	mg/L	n/a
23) Scandium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	mg/L	n/a
24) Selenium	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	-	<0.500	<0.500	<0.500	ug/L	10
25) Silicon	2.180	4.830	3.130	2.670	5.730	4.000	5.920	4.030	3.250	6.510	7.760	-	1.420	0.513	0.729	mg/L	n/a
26) Silver	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	mg/L	0.01
27) Sodium	14.200	30.200	23.300	28.600	69.900	35.600	27.900	14.000	33.500	22.900	59.500	-	8.710	1.340	2.880	mg/L	n/a
28) Strontium	0.080	0.090	0.110	0.130	0.170	0.140	0.140	0.050	0.140	0.140	0.160	-	0.050	0.010	0.010	mg/L	75
29) Tin	<0.020	<0.020	<0.020	93.800	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	100.000	-	100.000	<0.020	<0.020	mg/L	n/a
30) Titanium	100.000	<0.010	0.016	96.100	<0.010	0.049	<0.010	0.042	0.024	<0.010	<0.010	-	<0.010	<0.010	<0.010	mg/L	n/a
31) Tungsten	<0.050	<0.050	<0.050	62.300	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	mg/L	n/a
32) Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	mg/L	n/a
33) Zinc	0.021	0.050	0.150	0.024	0.037	0.138	0.018	0.171	0.101	0.008	0.032	-	0.016	0.059	0.124	mg/L	0.490-1.35
Hardness mg/L (CaCO3)	57.300	70.500	87.200	25.300	30.200	24.600	24.500	39.700	24.700	28.900	31.800	-	37.000	5.580	12.800	mg/L	0-75 mg/L = soft
pH	6.850	6.560	6.650	6.320	6.090	6.980	6.860	6.19	6.44	7.390	6.680	-	6.350	6.670	6.370	[H+]	6.5-9.0
Turbidity (NTU)	5.120	15.800	18.400	3.530	76.700	45.400	7.650	34.300	33.500	53.500	49.800	-	5.600	15.000	19.700	NTU	

sample location sample name time sampled Elements	Wet Season															units	Max. for Aquatic Life
	23-Oct-24			30-Oct-24			6-Nov-24			13-Nov-23			20-Nov-24				
	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2	DOWNSTREAM	UPSTREAM1	UPSTREAM2		
	BWQ1DS.6	BWQ1US.6	BWQ2US.6	BWQ1DS.7	BWQ1US.7	BWQ2US.7	BWQ1DS.8	BWQ1US.8	BWQ2US.8	BWQ1DS.9	BWQ1US.9	BWQ2US.9	BWQ1DS.10	BWQ1US.10	BWQ2US.10		
	14:39	14:33	14:25	13:51	14:11	14:04	13:47	14:04	13:57	13:51	14:06	13:59	14:11	14:23	14:18		Freshwater
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		
1) Aluminium	0.011	0.059	<0.010	0.013	0.542	0.898	0.010	0.043	0.522	0.049	0.128	0.564	0.071	0.204	0.282	mg/L	n/a
2) Antimony	<0.500	<0.500	<0.500	<0.500	1.03	1.34	<0.500	0.57	<0.500	<0.500	0.74	1.63	<0.500	<0.500	0.95	ug/L	n/a
3) Arsenic	1.28	<0.500	<0.500	<0.500	0.697	0.613	<0.500	1.660	<0.500	<0.500	<0.500	<0.500	<0.500	1.180	<0.500	ug/L	5
4) Barium	0.059	0.032	0.027	0.032	0.023	0.029	0.033	0.045	0.035	0.019	0.009	0.020	0.025	0.038	0.016	mg/L	n/a
5) Beryllium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	1.170	<0.003	<0.003	mg/L	0.01
6) Boron	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	mg/L	n/a
7) Cadmium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	ug/L	1.05-2.11
8) Calcium	0.78	26.900	23.700	27.400	9.320	5.410	1.320	0.140	0.280	15.700	4.720	2.680	22.100	24.600	3.520	mg/L	n/a
9) Chromium	<0.003	100.000	<0.003	<0.003	0.004	<0.003	0.009	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	mg/L	0.1
10) Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	100.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/L	1.32
11) copper	<0.008	<0.008	<0.008	<0.008	<0.008	0.012	<0.008	<0.008	<0.008	<0.008	<0.008	0.009	<0.008	0.009	<0.008	mg/L	0.030-0.127
12) Gold	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	mg/L	n/a
13) Iron	0.91	0.292	0.064	0.759	1.250	0.390	0.095	2.860	5.380	0.278	0.979	11.900	0.185	1.320	0.766	mg/L	1
14) Lanthanum	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	mg/L	n/a
15) Lead	<0.500	0.525	<0.500	<0.500	1.070	2.020	<0.500	<0.500	2.030	<0.500	0.670	2.480	<0.500	<0.500	1.340	ug/L	30
16) Magnesium	5.82	5.010	4.390	4.970	1.730	0.890	5.360	6.550	5.310	2.740	0.750	0.770	3.840	4.410	0.460	mg/L	n/a
17) Manganese	0.579	0.019	0.005	0.010	0.118	0.058	0.006	0.385	0.042	0.012	0.044	0.033	0.009	0.228	0.028	mg/L	n/a
18) Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	ug/L	2
19) Molybdenum	<0.005	<0.005	<0.005	0.005	0.007	<0.005	0.030	0.011	0.008	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	mg/L	n/a
20) Nickel	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	mg/L	n/a
21) Phosphorus	0.086	0.045	<0.010	0.038	0.058	0.082	<0.010	0.139	0.063	0.017	0.045	0.096	0.018	0.068	0.043	mg/L	n/a
22) Potassium	1.35	1.360	1.140	1.270	0.570	0.580	1.380	1.550	1.450	0.800	0.350	0.380	1.160	3.280	0.350	mg/L	n/a
23) Scandium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	mg/L	n/a
24) Selenium	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	ug/L	10
25) Silicon	4.79	6.980	6.560	5.480	2.320	2.050	8.070	7.640	8.650	3.590	0.794	1.130	6.000	4.250	0.764	mg/L	n/a
26) Silver	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	mg/L	0.01
27) Sodium	42.7	21.800	20.000	21.700	9.720	3.150	24.200	30.800	24.000	11.100	3.920	1.080	19.900	24.400	6.370	mg/L	n/a
28) Strontium	0.13	0.120	0.100	0.120	0.040	0.020	0.130	0.120	0.130	0.070	0.020	0.010	0.090	0.090	0.010	mg/L	75
29) Tin	<0.020	<0.020	<0.020	<0.020	<0.020	100.000	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	mg/L	n/a
30) Titanium	12	<0.010	11.800	22.800	0.019	0.031	<0.010	<0.010	<0.010	<0.010	<0.010	0.021	<0.010	<0.010	<0.010	mg/L	n/a
31) Tungsten	24.7	<0.050	46.200	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	mg/L	n/a
32) Vanadium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	mg/L	n/a
33) Zinc	0.045	0.015	0.011	0.036	0.092	0.198	0.032	0.017	0.052	0.038	0.032	0.086	0.023	0.048	0.096	mg/L	0.490-1.35
Hardness mg/L (CaCO3)	25.9	87.800	77.300	88.900	30.400	17.200	25.400	27.300	22.600	50.500	14.900	9.860	71.000	79.600	10.700	mg/L	0-75 mg/L = soft
pH	6.41	7.040	6.900	6.790	6.710	6.860	6.750	6.920	6.980	6.770	6.640	6.710	6.870	6.540	6.710	[H+]	6.5-9.0
Turbidity	28.9	6.38	0.67	1.4	21.1	31.4	0.72	23.1	11.9	3.5	8.82	34.5	2.7	21.7	9.05	NTU	

Table 3: Field Notes of Observations and Activities of concern that may affect results

Site ID	Date/Week	Season	Activity of concern	Comments
BWQ1DS.1	Week 1	dry season	Pumping filtered groundwater into the wetland from adjacent construction site, just above this downstream site, thus it could be affected.	iron oxidizing bacteria observed at DS site
BWQ1US.1			Pumping filtered groundwater into wetland from adjacent construction site. Location is just below this site. Effect unknown	Oil spill sheen in water
BWQ2US.1			-	-
BWQ1DS.2	Week 2	dry season	Pumping water	iron oxidizing bacteria observed at DS site
BWQ1US.2				
BWQ2US.2				
BWQ1DS.3	Week 3	dry season	Pumping water	iron oxidizing bacteria observed at DS site
BWQ1US.3				
BWQ2US.3				
BWQ1DS.4	Week 4	dry season	Not pumping water that day	
BWQ1US.4				
BWQ2US.4				Very little water thus could not obtain an BWQ2US.4 grab
BWQ1DS.5	Week 5	dry season	Pumping water	Conditions were semi wet due to rains
BWQ1US.5				
BWQ2US.5				
BWQ1DS.6	Week 6	wet season	Pumping water	
BWQ1US.6				Iron oxide bacteria at culvert
BWQ2US.6				
BWQ1DS.7	Week 7	wet season	Pumping water	
BWQ1US.7				At this upstream site, water is flowing directly out through the dike from the Beverly round about culvert, and not filtering through the wetland. See Figure 31
BWQ2US.7				

Notes:

- Regularly, most weeks iron oxidizing bacteria was observed at the BWQ1US site at the Beverly round-about.
- The water that flows from the Beverly round-about at BWQ1US, was observed flowing directly out the dike (Figure 30-31) every week. This has never been observed to flow through the wetland for treatment.

- Construction crews were pumping filtered groundwater into the wetland immediately downstream of the BWQ2US site during testing for all weeks except the 4th week. Therefore, it is likely that the downstream results will be more diluted which will impact results for 2024.



Figure 30: Site locations of Beverly Wetland. US = Upstream sites where storm water enters the wetland. DS = Downstream site where filtered storm water exits the wetland.



Figure 31: On a regular basis, site BWQ1US water flows directly from the Beverly Street culvert and adjacent Beverly street ditch (flows east toward round about), through this dike culvert, and does not flow through the wetland

8 APPENDIX H - REFERENCES

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