2021 Annual Report

Summerside Lake Environmental Services

Prepared for:

Summerside Residents Association

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2021 Annual Report

Summerside Lake Environmental Services
Signature Page

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1 Introduction

The community of Summerside Lake was constructed in the early 2000s and surrounds a 32-acre man-made lake. The lake provides opportunities for recreation, including swimming, fishing and boating in the summer, and ice fishing and skating in the winter. The lake is managed and maintained by the Summerside Residents Association (SSRA). Since its creation, SSRA has been contracting environmental services for lake and fisheries management to assess the health of the lake, identify aquatic ecosystem trends, and provide recommendations for management. A new contractor was hired in 2021 with a new focus on lake management and scope that included lake treatment.

2 Objectives

The SSRA identified three main goals for lake management in 2021 which included maintaining safe water quality for recreation, clear water for aesthetics, and improved angling opportunities. The primary objective of the 2021 program was to move from basic lake monitoring and towards a robust lake management framework to meet those goals. To achieve the goals, the following activities were undertaken in 2021:

- Water quality monitoring (winter, summer and fall)
- Sediment analysis (including supplemental water quality)
- Yellow perch removal
- Cyanobacterial treatments (for blue green algae)
- Research into P-binding chemicals
- Communication to the SSRA and messaging for residents

The following describes the methods used to complete these studies, the results of the programs, and recommendations to further achieve the goals of Summerside.

In addition to the activities listed above led by Aquality, SSRA also completed the following programs:

- Placing gravel around community docks and the boat launch area to reduce plant growth and bind some available phosphorus
- Weekly beach monitoring during the summer for coliforms
- Documented cases of Swimmer's Itch, and
- Harvesting of aquatic vegetation using machinery (Truxor) and by hand (with volunteer divers).

3 Methods

Generally, the methods employed during the 2021 field surveys were conducted in similar locations and times as in previous monitoring. Many of the same limnological parameters were measured throughout the year; however, our methods were improved (i.e., equipment, depth in water column) to better understand the nutrient interaction between the water and the substrate. Where possible, results from the current studies below were compared to the results from previous studies conducted by EnviroMak Inc. (EnviroMak).

3.1 Water Quality

Water quality parameters were measured at two predetermined locations in Summerside Lake throughout the year (Figure 1). Table 1 outlines the reoccurring methods of the Summerside Water Quality Monitoring Program.

Water quality results were compared to the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta, 2018) and the Water Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 1999.)

Table 1. Water quality parameters measured as part of the Summerside Lake Water Quality Program, 2021

Parameter	January	March	August	November
Water temperature (°C) and dissolved oxygen (mg/L and percent saturation [%])	X	X	X	X
Nutrients	X	X [1]	X	
Routine and Metals	X [2]		X	
Zooplankton			X	
Chlorophyll *a*			X	
Sediment		X		

[1] Phosphorus collected only
[2] Conductivity and pH also collected during dissolved oxygen profile

3.1.1 Dissolved Oxygen and Temperature

Dissolved oxygen (DO) and water temperature profiles were conducted throughout the year to document changes and as supplemental information for other parameters:

- under ice to assess the available oxygen over winter to supplement the sediment sampling to determine potential phosphorus release
- in open water to assess the available oxygen during summer conditions, and
- immediately following shutdown of the lake aeration system.

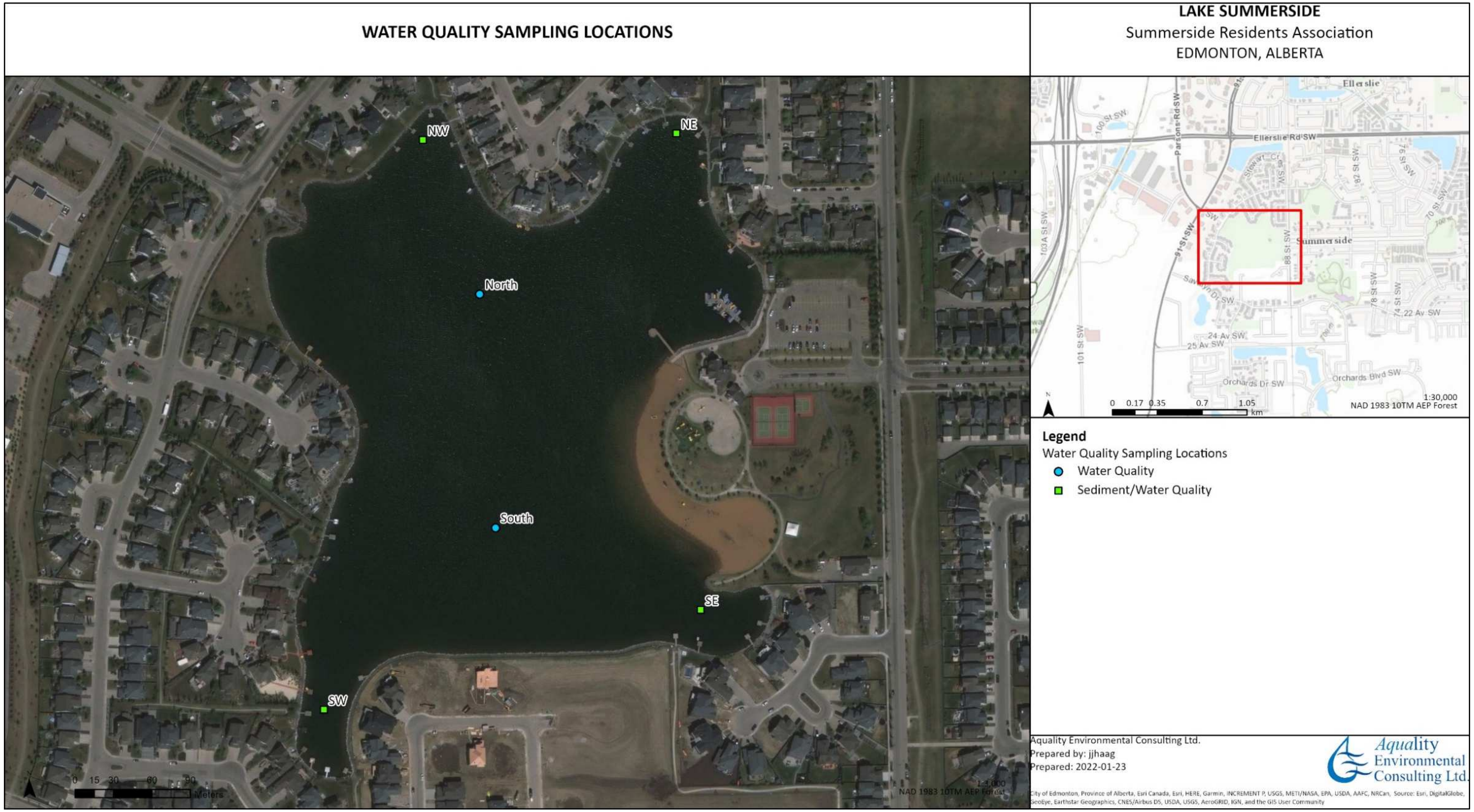

Figure 1. Water quality monitoring and sediment sampling locations at Summerside Lake, 2021.

The profiles were generally measured at the two deepest locations (north and south sites) in Summerside Lake (Figure 1) for year over year comparison, but four additional sites (northeast, southeast, southwest, northwest) were also measured to supplement the sediment sampling program (March 2021). DO measurements were measured using an optical dissolved oxygen probe (e.g., YSI ProODO or YSI ProDSS), and a membrane-style probe (YSI 556) was used during the winter event.

Measurements for water temperature (°C) and dissolved oxygen (mg/L and percent saturation [%]) were recorded at 0.5 m depth intervals along a vertical profile. Measurements were recorded on the way down and were additionally recorded on the way back up for comparison.

3.1.2 Nutrients

The water quality results were analyzed to determine potential nutrient sources that may contribute to growth of phytoplankton, algae and submergent vegetation (Table 2).

Table 2. Nutrient parameters analyzed in Summerside Lake, 2021.

Category	Parameters
Nutrients	Total nitrogen, total Kjeldahl nitrogen, nitrate, nitrite, ammonia, total phosphorus, total dissolved phosphate, orthophosphate

During the winter sampling event, discrete water samples were collected at 1 m intervals using a vertical Kemmerer bottle. Water samples were preserved and submitted to Element Materials Technology (Element) in Edmonton for dissolved phosphorus, total phosphorus and orthophosphate analysis. One additional water sample was collected at the deepest location at the north and south sites for nutrient analysis, which included the parameters of Ammonium-N, Total and Kjeldahl nitrogen, nitrate, and nitrite.

Each of the sampling container bottles was labelled with the date, time, and sampling location, placed in a cooler, and immediately transported to Element for analysis.

Sampling for nutrients during the remainder of the year focused on collecting water closer to the water-substrate interface. This was achieved by using a horizontal Beta sampler. Lower detection analyses for total and dissolved phosphorus were also completed. Nitrogen analysis was excluded during the sediment sampling program.

3.1.3 Routine Parameters and Metals

Routine water chemistry and metals were measured during the summer of 2021 from the north and south water quality sites (Table 3).

Table 3. Routine water chemistry and metal parameters measured in Summerside Lake in 2021.

Category	Parameters
Routine Water Chemistry	pH, Conductivity (EC), Calcium, Magnesium, Sodium, Potassium, Iron, Sulphate, Chloride, Manganese, carbonate, bicarbonate, nitrate, nitrite, alkalinity, hardness, total dissolved solids, colour, turbidity, total suspended solids
Metals (total and dissolved)	Aluminum (Al), Antimony (Sb), Arsenic (Ar), Barium (Ba), Beryllium (Be), Bismuth (Bi), Boron (B), Cadmium (Cd), Calcium (Ca), Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Lead (Pb), Lithium (Li), Magnesium (Mg), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Potassium (K), Selenium (Se), Silicon (Si), Silver (Ag), Sodium (Na), Strontium (Sr), Sulphur (S), Thallium (Tl), Titanium (Ti), Uranium (U), Vanadium (V), Zinc (Zn)

A sampling tube fitted with a one-way foot valve was used to collect a full column composite water sample. The tube was decanted into a clean bucket to obtain sufficient sample volume. The composite sample was then transferred to the appropriate sample containers and preservatives were added as needed. Field filtering of water samples was not conducted. Each of the sampling container bottles was labelled with the date, time, and sampling location, placed in a cooler, and transported to Element for analysis.

Conductivity and pH were also recorded in the winter as part of the dissolved oxygen profile measurements. EnviroMak Inc. had previously recommended monitoring the pH levels due to potential leaching from large rip rap placed around the perimeter of the lake (D. Marchuk, pers comm.), and the higher pH values reported in previous studies.

Odour sampling measuring Threshold Odour Number (TON) was not conducted in 2021 as there were no concerns raised by residents.

3.1.4 Zooplankton

Zooplankton were sampled from the north and south sites during the summer event. Samples were collected with a Wisconsin net (20 cm mouth opening, approximately 70 cm long, with 63 µm mesh). A vertical haul was used to obtain an integrated depth sample through the fill column depth. Each haul was condensed as a single sample and decanted into a 1 L bottle, and the volume further reduced to a single 250 mL bottle per site. Each sample was labelled and then preserved with 100 mL of isopropyl alcohol. The samples were submitted to Invert Solutions for analysis including zooplankton counts and identification of major taxa.

3.1.5 Chlorophyll *a*

Chlorophyll *a* samples were collected from the north and south sites during the summer event. The water clarity was measured using a Secchi disk and the distance visible was used to approximate the euphotic zone (area of sufficient light for photosynthesis to occur). It is within this zone that water samples were collected chlorophyll *a*.

The water sample was collected using the sampling tube fitted with the one-way foot valve. The tube was decanted into a clean bucket to obtain sufficient sample volume. All samples were submitted Element for analysis. Repeat sampling for chlorophyll *a* was required on September 9 as the first samples were not analyzed within the hold times due to a courier issue.

3.2 Sediment

Sediment cores were collected from four locations in Summerside Lake (Figure 1) on March 10, 2021, to determine the releasable phosphorus content. Two sediment cores were taken from each location using a hand corer through a hole drilled in the ice. The corer was fitted with tubes and core catchers and attached to a 4.57 m (15’) extender pole. The corer was pushed into the bottom sediments and the sample retrieved. The cores were capped on both ends, labelled, and returned to the office for processing. The cores were stored in a refrigerator until processing.

The samples were extruded from the core tubes into 5 cm sub-samples. Each sub-sample was placed in a glass jar and labelled with the site identifier and sample number. Select samples were packaged and shipped to Wageningen University in the Netherlands for sequential phosphorus extractions to determine the releasable phosphorus fraction.

Water samples were collected for phosphorus analysis, and dissolved oxygen profiles were measured.

3.3 Yellow Perch Eradication

The removal of Yellow Perch has been conducted annually, primarily using gill nets. Minnow traps have also been used. Recently, some Yellow Perch eggs have been removed using spruce boughs. In 2021, gill nets and minnow traps were the only sampling methods used.

Yellow perch removal was conducted between April 27 and 29, 2021 under Alberta Environment and Parks (AEP) Fish Research License (FRL) #21-3805. Each net consisted of one panel of 19.1 mm (¾”) mesh and one panel of 25.4 mm (1”) mesh. Each panel was 2.4 m (8’) high and 15.2 m (50’) long. Gill nets were bottom set at four locations around the lake parallel to the shoreline across each embayment (Figure 2). The nets were initially checked between approximately 2.5 and 4.5 h and then fished overnight.

Ten minnow traps were baited with dry cat food and set at various locations around the lake (Figure 2). Individual traps were not left for more than 24 hours at a time.

Upon equipment retrieval, captured Yellow Perch were removed. The site and the gill net mesh size (as applicable) were documented. The fish were then placed into buckets and euthanized using a clove oil solution.

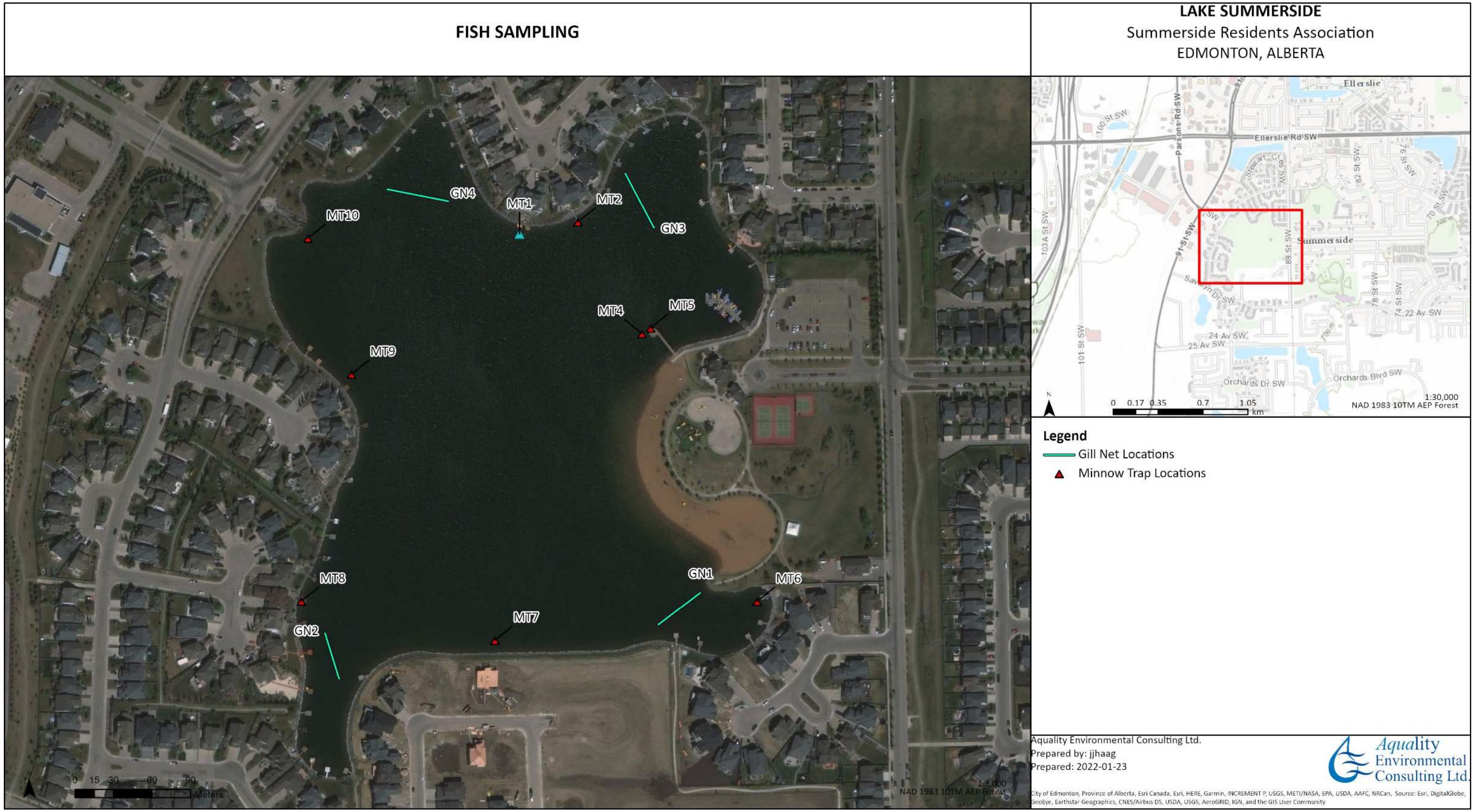

Figure 2. Fish sampling locations at Summerside Lake, 2021.

Representative Yellow Perch were retained, and fork length, weight, sex, and spawning status were recorded. Fin and otolith structures were also retained for aging purposes.

All Yellow Perch removed from Summerside Lake were tabulated and the data were submitted to AEP per conditions of the FRL.

3.4 Cyanobacteria Control

To combat the growth of undesirable cyanobacteria, Lake Summerside was treated with granular hydrogen peroxide (sodium percarbonate) on July 21 and again September 24, 2021 following the emergence of visible blooms. During each treatment, two applicators dispersed the granules using handheld Chapin fertilizer spreaders from the stern of a boat that navigated around the perimeter of the lake at a constant speed.

Seven hundred kilograms (14 X 50 kg bags) of sodium percarbonate were applied in July, and 500 kg were applied in September. Baseline measurements of hydrogen peroxide concentration (ppm) were measured using Bartovation Low Level residual test strips. Peroxide residual measurements were taken at ten locations prior to initial treatment in July, and for the next two days July 22 and 23, 2021 to protect recreational users. Peroxide residual measurements were taken at these same ten locations during and post-treatment on September 24.

4 Results

4.1 Water Quality

4.1.1 Dissolved Oxygen and Temperature

4.1.1.1 January 2021

Dissolved oxygen (DO) and temperature profiles were conducted in late winter to understand the overwintering conditions for fish survival. DO typically decreases with depth and water temperature typically is warmer closer to the bottom. Different fish species are more tolerant of decreased DO and can survive at lower depths where the temperatures are lower.

As expected, the lowest water temperatures were less than 0.0°C at the ice-water interface, and the highest at the bottom, measuring 3.4°C (Appendix A, Table A1-A2, Figure 3). The rate of temperature increase was highest within the first 2.0 to 2.5 m (thermocline), and then the rate declined.

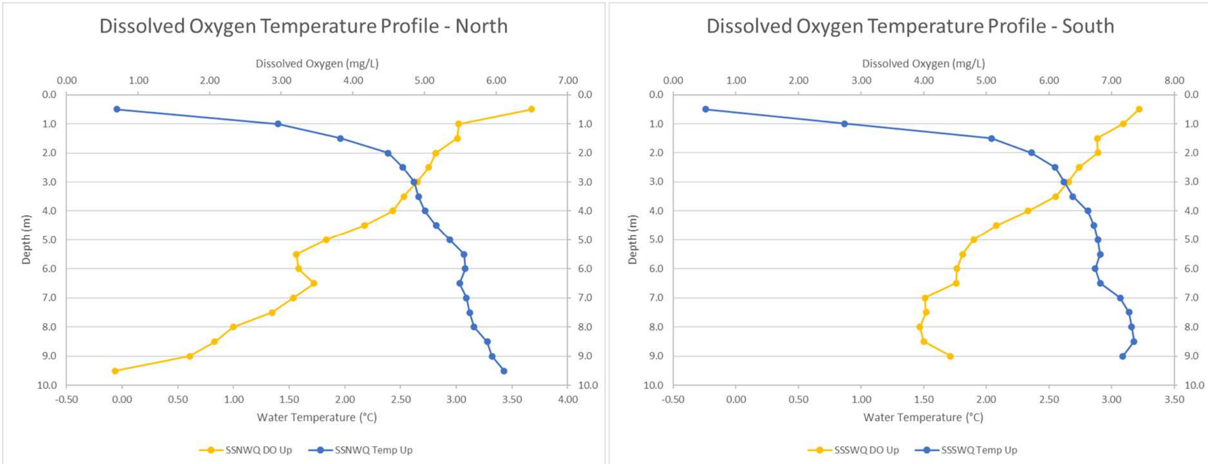

Figure 3. Dissolved oxygen and temperature profile for Summerside Lake at the north and south sites, January 29, 2021.

The DO generally declined with depth. When comparing measurements made when descending versus ascending, DO concentrations descending were more variable (Appendix A, Table A1-A2). It is possible the meter became more stable as it acclimatized to the changes between air temperature and water temperature. The slower acclimatization is one of the differences between a DO meter with a membrane and a meter that uses an optical sensor. Therefore, profiles were generated based on measurements ascending.

At the north site, the DO was 6.5 mg/L at the surface, was below 5.0 mg/L at a depth of approximately 3 m, and was below 1.0 mg/L at a depth of 9.5 m (Figure 3). At the south site, the DO was 7.4 mg/L near the surface, was below 5.0 mg/L at a depth of approximately 5 m and remained at approximately 4.0 mg/L near the bottom at 9.0 m. The short-term (acute) DO guideline for the protection of freshwater aquatic life is 5.0 mg/L (EQGASW 2018). For certain times of the year and some invertebrates, 8.3 mg/L is considered a long-term guideline (or chronic guideline).

DO concentrations measured from the upper 3 m of the water column in January 2021 were similar to those measured by EnviroMak in January 2020 (EnviroMak 2020).

Yellow perch were observed using an AquaVu® 715c underwater camera at both sites with more fish observed at the south site. No other fish species were observed, but the camera was stationed near the bottom where the DO concentrations were lower and less suitable for trout.

4.1.1.2 March 2021

The sites were selected based on depth to accommodate sampling the sediments using the corer and were typically less than 4 m. The lowest temperature at these sites was 0.1°C (near the surface), and the highest was 3.1 °C (near the bottom), representative of under ice conditions (Appendix A, Tables A3-A6; Figure 4). The DO generally declined with depth, similar to those concentrations observed in January (Appendix A, Tables A3-A4).

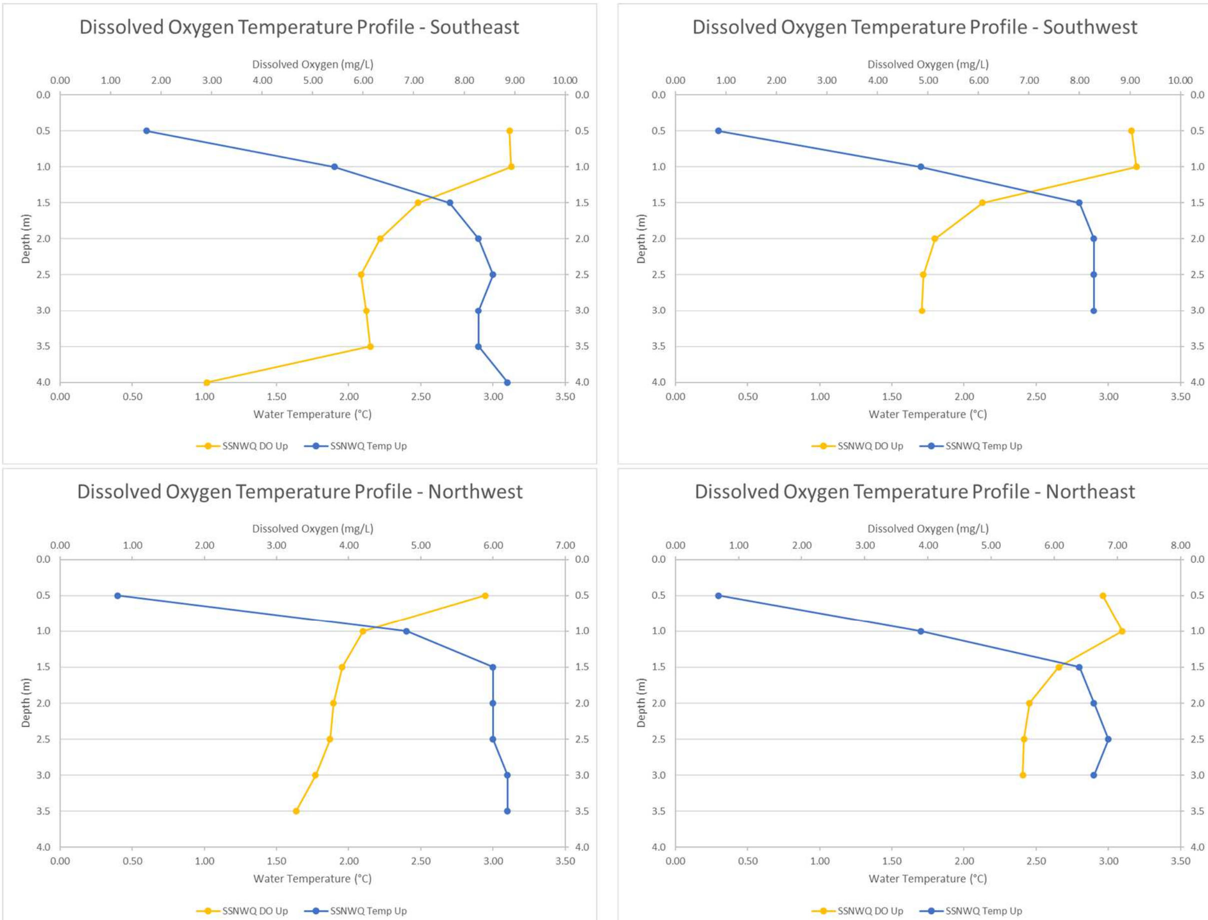

Figure 4. Dissolved oxygen and temperature profile for Summerside Lake at the southeast, southwest, northwest, and northeast sites, March 10, 2021.

The lowest DO concentration was measured at the southeast site (2.91 mg/L) near the bottom of the lakebed at 4.0 m (Appendix A, Table A3; Figure 4). The highest DO concentration measured was at the southwest site (9.70 mg/L) at 0.5 m, but have been elevated from augering the hole through the ice as concentrations were typically approximately 9.0 mg/L at the south sites (Appendix A, Table A4; Figure 4). Overall, the northwest corner of the lake had the lowest DO.

4.1.1.3 Summer DO

The temperatures at both sites decreased with depth in contrast to measurement collected during ice conditions. The coldest location at the north site was at a depth of 9 m and was 9.5°C (Appendix A, Table A7; Figure 5). The coldest location at the south site was at a depth of 8 m and was 11.5°C (Appendix A, Table A8). The maximum surface temperature measured was 17.1 °C measured near the surface (Appendix A, Table A7-A8). The thermocline was located between 6.0 and 6.5 m.

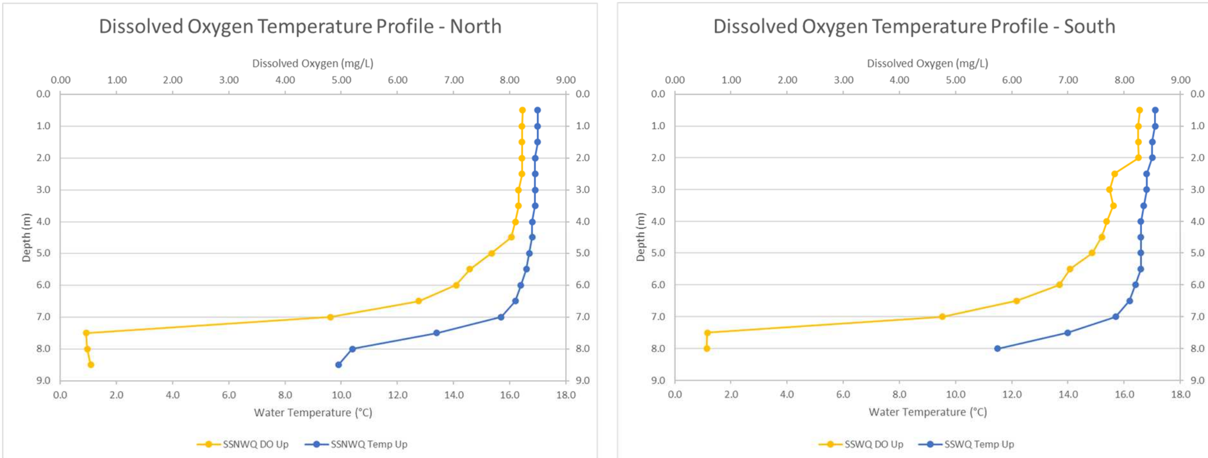

Figure 5. Dissolved oxygen and temperature profile for Summerside Lake at the north and south sites, August 26, 2021.

The DO again declined with depth, like the under-ice conditions. The highest DO concentrations were above 8.0 mg/L, due to wind and wave action (Appendix A, Tables A7-A8; Figure 5). The lowest concentrations were measured at 9 m depth (near bottom) at the north site (0.48 mg/L) and 8 m depth in the south (0.57 mg/L). DO concentrations also decreased at a higher rate below 6.0 and 6.5 m, but were below 5.0 mg/L at a depth of 7.0 m.

DO concentrations measured from the upper 3 m of the water column in August 2021 were similar to those measured by EnviroMak in August 2020 (EnviroMak 2020).

4.1.1.4 Fall DO

The temperatures at both sites remained consistent with depth. The temperature at the north site ranged from 4.0°C-4.1°C and 4.1-4.2°C at the south site (Appendix A, Table A9-A10). The straight lines in the temperature and DO profiles for both sites (Figure 6) indicate the lake was well mixed due to fall turnover and aeration. The DO concentrations ranged between 11.49 mg/L and 11.60 mg/L at the north site and between 11.46 mg/L and 11.58 mg/L at the south site (Appendix A, Table A9-A10; Figure 6). Compared to the DO profiles measured earlier in 2021, November had the most consistent measurements throughout the water column.

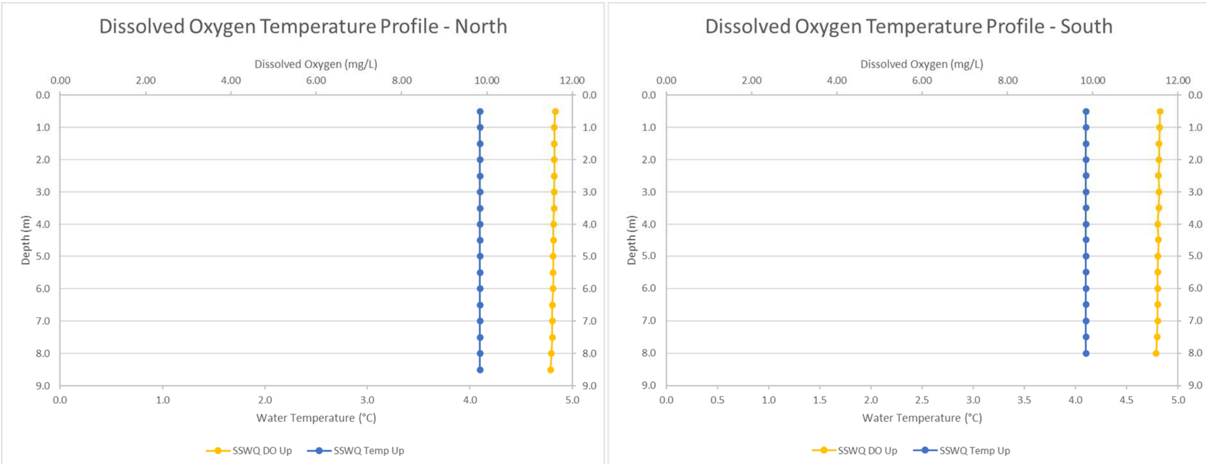

Figure 6. Dissolved oxygen and temperature profile for Summerside Lake at north and south sites, November 3, 2021.

4.1.2 Nutrients

4.1.2.1 January 2021

Nutrient concentrations measured during the winter event were similar between the north and south sites and largely below detection.

At the north site, all the dissolved phosphorus and most of the total phosphorus concentrations were below detection (<0.05 mg/L) (Appendix B, Table B1). Total phosphorus was detected in samples collected at depths of one and five meters. The detection at 5 m depth corresponded to a small drop in DO. Orthophosphate was detected throughout the water column, with higher values recorded at a depth of one meter and depths at six meters and beyond. It is this orthophosphate that is biologically available to be taken up by growing plants.

At the south site, all the dissolved and total phosphorus concentrations were below detection (Appendix B, Table B2). Orthophosphate was detected throughout the water column, with higher values recorded at depths of eight and nine meters.

All the nitrogen-based parameters were above the detection limits for both sites (Appendix B, Table B1-B2).

4.1.2.2 March 2021

Water samples were collected for phosphorus nutrient analysis to supplement the sediment sampling; nitrogen parameters were not analyzed. The dissolved and total phosphorus concentrations were below detection (<0.05 mg/L) at all four sites (Appendix B, Table B3). However, when the low-detection (D.L. of 0.005 mg/L) analysis was run, total phosphorus was detected at all four sites (0.027 mg/L in the northeast, 0.020 mg/L in the northwest, 0.019 mg/L in the southwest, and 0.018 mg/L in the southeast (Appendix B, Table B3). In addition, the southeast site had a measurable concentration of 0.008 mg/L for dissolved phosphorus (D.L. of 0.005 mg/L). Orthophosphate was also below detection at all four sites (<0.01 mg/L). All phosphorus parameters were within guidelines.

4.1.2.3 August 2021

During the summer sampling event, the phosphorus concentrations at both sites were considerably elevated. The total phosphorus concentrations in the north and south sites were 0.476 mg/L and 0.282 mg/L, respectively (Appendix B, Table B4). The dissolved phosphorus concentrations in the north and south sites were 0.048 mg/L and 0.016 mg/L, respectively. The orthophosphate concentration was 0.04 mg/L in the north, while the south was below detection (<0.01 mg/L).

The *Environmental Quality Guidelines for Alberta Surface Waters* (EQGASW) (Government of Alberta, 2018) includes site-specific objectives for nutrients (i.e., nitrogen and phosphorus), which have not yet been determined for Summerside Lake. The previous iteration of the guidelines for Alberta, *Alberta Surface Water Quality Guidelines for the Protection of Freshwater Aquatic Life* (ASWQG-FAL) (Alberta Environment, 1999) included a total phosphorus guideline value of 0.05 mg/L. Using the 1999 guidance document the total phosphorus values measured in August were considered exceedances. Phosphorus is likely becoming more bioavailable due to the near anoxic conditions measured near the substrate.

The nitrogen-based parameters for both sites were within guidelines (Appendix B, Table B4).

4.1.3 Routine Parameters and Metals

Routine parameters were analyzed during the summer sampling event in August 20201. The results were similar between the north and south sample sites (Appendix B) and were comparable to those reported in August 2020 by EnviroMak (EnviroMak 2020). Though water pH was 8.81 in August 2020 (EnviroMak 2020), the highest pH measured in January 2021 was 8.12 and in August was 7.84. These lower values in 2021 may either be due to sampling location within the water column, or the equipment/analysis used to measure pH.

Most of the dissolved and total metals analyzed were either below detection or were within the guidelines for the protection of aquatic life. Generally, the concentrations were similar between the north and south sites. Total and dissolved silicon and total manganese were higher in the north site, but were below guidelines (Appendix B, Table B6). Total copper and total zinc were higher in the south site and were in exceedance of the guidelines for the protection of aquatic life (Appendix B, Table B6). Total copper, manganese, and zinc concentrations were higher in 2021 than reported in 2020 (EnviroMak 2020), but these differences may be the result of the different collection methods.

4.1.4 Zooplankton

Zooplankton abundance and biomass analysis were conducted on samples from the north and south sites. Zooplankton were identified as either subphylum Crustacea or phylum Rotifera and then further classified to species (Appendix E).

Crustacea zooplankton were more abundant than Rotifera zooplankton, and due to the size difference, Crustacea zooplankton provided more biomass (Appendix E, Tables E1 and E2). Abundance and biomass of zooplankton was similar between both the north and south sites.

Polyarthra sp. and *Ascomorpha sp.* were the dominant rotifer species encountered (Appendix E, Figure E1). Of the crustaceans, Nauplii (copepods) were more abundant in both the north and south sides, followed by *Ceriodaphnia sp*. (Appendix E, Figure E2); however, *Ceriodaphnia sp.* contributed the most to overall biomass (Appendix E, Figures E3 and E4, Table E3). Zooplankton results from 2021 could not be directly compared to results from previous years due to changes in sampling methods.

4.1.5 Chlorophyll a

Chlorophyll *a* is a green pigment found in plants and algae that is responsible for photosynthesis. Water samples submitted for chlorophyll *a* also included phaeophytin, one of the breakdown products of chlorophyll. In 2021, the chlorophyll *a* and the phaeophytin concentrations were similar between sites (Appendix B) and were within the range reported previously by EnviroMak (EnviroMak 2020).

4.2 Sediment

The measured phosphorus concentrations in the sediment indicate that the lake is at least mesotrophic (LSI Limnological Solutions International, 2021). According to the LSI Limnological Solutions International report (Appendix C), it is estimated that the total phosphorus load in Summerside Lake is 16.2 kg. In the unlikely event that all phosphorus would be released at once, the application of Phoslock would immobilize the phosphorus and prevent algal growth. An application of 35.8 tonnes of Phoslock would be required to bind to 358 kg of phosphorus (LSI Limnological Solutions International, 2021).

4.3 Yellow Perch Eradication

A total of 9,690 Yellow Perch were removed from Summerside Lake between April 27 and 29. Minnow traps captured 78 Yellow Perch over a combined effort of 280.6 trap-h (Appendix D). These fish had fork lengths that ranged from 75 mm to 111 mm (average of 95.0 mm) and weighed between 4.1 g and 104 g (average of 14.2 g). Gill nets were the more efficient capture technique, with 9,612 Yellow Perch caught. Most (*n*=7,643) of the Yellow Perch were captured in the 25.4 mm (1”) mesh versus the smaller 19.1 mm (3/4”) mesh.

Fish length (fork) and weight data were collected from representative fish (Table 4). The fork lengths ranged from 75 mm to 134 mm and the weights ranged from 4.1 g to 104 g.

Table 4. Summary of fork length and weight data from representative Yellow Perch captured from Summerside Lake between April 27 and 29, 2021.

Sample Method	*n*	Fork Length (mm)			Weight (g)		
		Min.	Max.	Ave.	Min.	Max.	Ave.
Minnow Trap	78	75	111	95.0	4.1	104.0	14.2
Gill Net (19.1 mm)	118	75	134	91.3	5.8	30.5	8.8
Gill Net (25.4 mm)	113	84	113	93.5	7.2	17.5	9.8

There was no by-catch of stocked trout species or other fishes.

4.4 Cyanobacteria Control

Visible blue green algal blooms (cyanobacteria) prompted two treatments using food grade granular hydrogen peroxide (sodium perchlorate). The goal was to dose blue green algae with approximately 30 ppm of peroxide, which kills the cyanobacteria immediately. During both treatments, visible cyanobacterial masses were seen rising from the bottom of the lake to the top. Baseline peroxide measurements in Lake Summerside were 3 ppm. During treatment on July 21, 2021, residual hydrogen peroxide measurements rose to 10 ppm in seven of the monitoring locations (Table 5). Application was completed at approximately 15:15, and it took approximately three hours for the sites measuring 10 ppm to decline to 3 ppm. On July 22, after approximately 18 hours post-treatment, all the hydrogen peroxide concentrations were 3 ppm or less. Treatment results were immediately effective, with residuals decaying to background levels within 24 hours. An unintended yet positive consequence was improved water clarity observed for a period of weeks following treatment.

Table 5. Hydrogen peroxide concentrations (ppm) in Lake Summerside before and after treatment, July 21 to 23, 2021.

Sample Location	21-Jul-21								22-Jul-21		23-Jul-21	
	Time	Reading	Time	Reading	Time	Reading	Time	Reading	Time	Reading	Time	Reading
DOCK 1	10:14	3	15:36	3	18:38	3	21:38	3	9:00	2	8:53	2
DOCK 2	10:10	3	15:41	10	18:32	3	21:32	3	9:02	2	8:55	2
ENTRY	10:05	3	15:38	3	18:29	6	21:26	5	9:04	3	8:57	2
DOCK 3	9:56	3	15:26	3	18:22	6	21:21	5	9:06	2	8:58	2
DOCK 4	9:48	3	15:30	10	18:17	3	21:16	3	9:07	2	8:59	2
DOCK 5	9:40	3	15:20	10	18:13	3	21:11	3	9:08	1	9:01	3
DOCK 6	9:32	3	15:15	10	18:10	3	21:06	3	9:11	2	9:03	2
BEACH	10:34	3	15:52	10	18:44	3	21:45	3	9:20	1	9:09	2
BOAT DOCK	10:35	3	15:56	10	18:46	3	21:47	3	9:15	1	9:06	1
BOAT LAUNCH	10:31	3	15:58	10	18:48	3	21:49	3	9:16	2	9:07	2

NOTE: treatment started after baseline readings on July 21st 10:35 and was completed before the next readings started at 15:15 the same day.

During treatment on September 24, 2021, residual hydrogen peroxide measurements rose to 10 ppm in nine of the monitoring locations (Table 6). It took approximately four hours for the sites measuring 10 ppm to decline to 3 ppm (Table 6).

Table 6. Hydrogen peroxide concentrations (ppm) in Lake Summerside before and after treatment, September 24, 2021.

Sample Location	24 September 2021						
	09:00	11:00	13:00	15:00	17:00	19:00	21:00
BOAT DOCK	3	10	6	3	3	3	3
DOCK 1	10	10	6	3	3	3	3
DOCK 2	10	10	3	3	3	1	1
ENTRY PARK	3	10	3	3	3	1	1
DOCK 3	3	10	6	3	3	3	1
DOCK 4	10	10	6	3	3	3	3
DOCK 5	10	10	3	3	3	3	3
DOCK 6	10	10	3	3	3	1	1
MIDDLE OF LAKE	10	10	6	3	3	3	1
BEACH	5	5	6	3	3	3	3
FISHING DOCK	10	10	6	6	3	3	3

4.5 SSRA Activities

There were no concerns with the gravel that were placed around the community docks and boat launch area.

Reports of Swimmer's Itch in 2021 were less than in 2020, but similar with typical years based on records maintained by SSRA. Options to reduce or prevent Swimmer's Itch in the swimming area are being further explored.

The Beach Pooch Patrol Program used to deter waterfowl from the swimming area was successful and coliforms were not an issue within the swimming area in 2021.

Aquatic vegetation harvesting continued in 2021 with good success. The Truxor harvester was used on June 24 and August 2.

5 Discussion and Conclusions

Summerside Lake health was very good overall. The water transparency was very clear and recreational users were frequently observed in and on the water during all times of the year. No advisories were issued by Alberta Health.

Most of the measured parameters met the surface water quality guidelines for the protection of aquatic life (Canadian Council of Ministers of the Environment, 1999). DO levels were recorded below 5.0 mg/L during all seasons except the November period when the aerators were fully operational. These depressed oxygen concentrations can create conditions when phosphorus can be released from the sediments. Reduced oxygen concentrations can also affect fish survival and location in the water body.

Under previous water quality guidelines for Alberta (Alberta Environment, 1999), the total phosphorus values of 0.06 mg/L and 0.07 mg/L recorded at the north site in January and 0.476 mg/L and 0.282 mg/L at the north and south sites in August would have been considered exceedances. These elevated concentrations of phosphorus may be correlated to the depressed oxygen concentrations measured near the water-substrate interface. However, given the wide range and the numerous factors influencing nutrient concentrations, it is impossible to determine a single value that would be protective or desirable for all Alberta waters. This numeric guideline of 0.05 mg/L had been removed in the most recent version of the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta, 2018).

Nitrogen levels were detected in January, August, and November but not exceed the guidelines. Nitrogen levels were not measured in March. Although nitrogen contributes to the growth of phytoplankton, algae, and aquatic macrophytes, phosphorus is not the limiting factor based on the Redfield Ratio[1]. Our calculated Redfield Ratio based on the summer data indicated a maximum 4:1 (N:P).

Orthophosphate is available to be taken up by growing plants. The highest orthophosphate levels were recorded in August, which coincided with a higher rate of plant growth.

Total copper and total zinc were higher in the south site and were in exceedance of the guidelines for the protection of aquatic life. It is not clear what the source of these elevated metals was. If related to sediment deposition from exposed soils on the south shoreline, other metal concentrations would also be expected to be higher. However, other metal concentrations were typically similar of ever higher at the north site.

The Yellow Perch eradication program successfully removed over 9,600 fish with no by-catch. It is possible the use of smaller mesh nets in 2021 contributed to the increased number of fish encountered compared to previous years. The site selection for the nets and the position in the water column may also have contributed to the increased catch rates.

The sediment coring program determined there is a narrow layer of sediment built up since construction of the lake. The results of the preliminary assessment suggest the application of Phoslock or other P-binding chemical would immobilize available phosphorus and reduce algal growth.

Hydrogen peroxide treatment was immediately effective in removing undesirable cyanobacteria.

[1] The optimal N/P ratio for phytoplankton growth, known as the Redfield Ratio, is 16:1 (based on molecular concentrations). Large differences from 16 at high N/P ratios can result in potential phosphorus limitation of the primary production of phytoplankton.

6 Recommendations

The following actions are recommended for Summerside Lake as part of the 2022 field season:

- Measure full column DO and temperature profiles monthly to assess timing of aeration during open-water conditions.
- Conduct aeration during summer to late fall to reduce summer oxygen declines and releases of bioavailable phosphorus from the sediments.
- Conduct annual perch eradication program using small mesh gill net panels (19.1 mm and 25.4 mm).
- Continue aquatic vegetation harvesting and exploring P-binding treatments (e.g., Alum or Phoslock treatment).
- Apply P-binding treatment during summer in water depths greater than 7 m to reduce potential release of phosphorus.
- Continue control of cyanobacteria using hydrogen peroxide treatments.
- Develop an exclusion system to deter Swimmer's Itch schistosomes from entering the beach area.
- Continue existing SSRA-lead initiatives to manage contributing factors to nutrient loading (e.g., duck and goose deterrent program).
- Investigate recent observations of crayfish and develop communications.

7 References

Alberta Environment. (1999). *Surface Water Quality Guidelines for Use in Alberta.* Edmonton AB: Alberta Environment, Government of Alberta.

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Environmental quality guidelines for Alberta surface waters. Retrieved from: https://open.alberta.ca/publications/9781460138731#summary

LSI Limnological Solutions International. 2021. *Summerside Lake: Short evaluation of water and sediment quality data and the potential use of Phoslock.*

Site Photographs

Photo 1	
Date: January 29, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Collecting under-ice water sample using a Kemmerer sampler	

Photo 2	
Date: August 26, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Collecting a water sample from the water-substrate interface using a 2.2 L beta bottle	

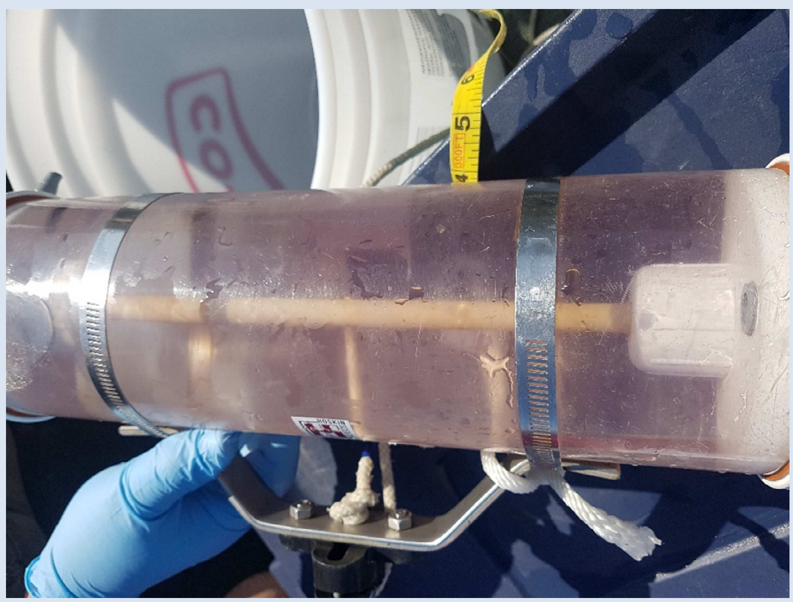


Photo 3	
Date: March 10, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Collecting sediment cores and water samples for water quality monitoring	

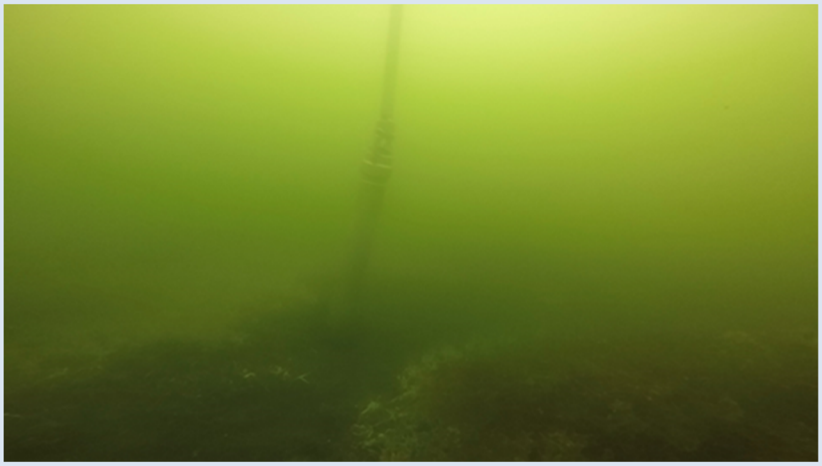
Photo 4	
Date: March 10, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Underwater view of sediment corer collecting a sample.	

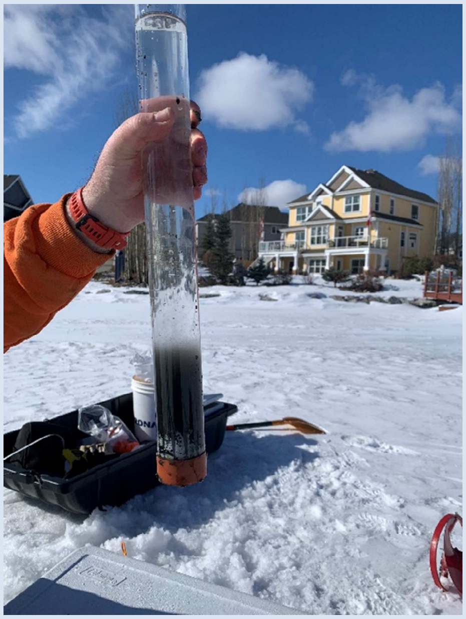
Photo 5	
Date: March 10, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Collected sediment core.	

Photo 6	
Date: March 11, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Sediment core being divided into 5 cm increments for phosphorus analysis.	

Photo 7	
Date: April 27, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Removal of Yellow Perch using gill nets	

Photo 8	
Date: April 28, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Processing representative Yellow Perch, including length, weight, sex, and ageing structure removal.	

Photo 9	
Date: July 21, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Treating Lake Summerside with hydrogen peroxide to combat undesirable algae growth	

Photo 10	
Date: September 24, 2021	
Location of Photo: Summerside Lake	
Photo Direction: N/A	
Description: Algal masses rising to the top after being treated by hydrogen peroxide	

Appendix A Dissolved Oxygen and Temperature Profiles

Table A1. Dissolved oxygen and temperature profile for Summerside Lake at the north site, January 29, 2021.

Project Number:	20-074		**Comments:**		
Project Location:	Lake Summerside		**DO meter cord not marked with depth**		
Samplers:	C. Stefura, J. White, J. McDonell				
Date:	29-Jan-21		**Took 10 minutes to stabilize**		
Time:	11:15		**Pine rental 27633 - YSI 556 MPS**		
Site ID:	SSNWQ				
Site Location:	**NAD83**	**Easting:**	335702	**Northing:**	5921641

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	-0.37	14.21	96.5	7.78	-
1.0	1.16	10.47	77.0	7.78	-
1.5	1.79	8.44	62.0	7.74	-
2.0	2.16	7.37	55.0	7.73	-
2.5	2.42	7.78	56.7	7.73	427
3.0	2.54	7.31	54.5	7.72	428
3.5	2.57	6.55	47.8	7.71	428
4.0	2.60	5.26	38.9	7.69	428
4.5	2.67	9.48	70.2	7.70	428
5.0	2.74	9.27	69.0	7.69	429
5.5	2.92	8.64	64.9	7.68	430
6.0	2.99	7.21	54.1	7.67	431
6.5	3.07	6.34	47.3	7.66	433
7.0	3.05	6.38	47.7	7.66	433
7.5	3.08	6.43	47.7	7.64	434
8.0	3.10	6.66	48.9	7.64	435
8.5	3.13	5.01	37.0	7.64	435
9.0	3.23	1.77	13.9	7.64	438
9.5	3.43	0.68	3.1	7.62	442
10.0	-	-	-	-	-
9.5	3.43	0.68	3.1	7.62	442
9.0	3.32	1.72	13.2	7.64	440
8.5	3.28	2.07	15.5	7.64	439
8.0	3.16	2.33	17.8	7.64	436
7.5	3.12	2.87	21.5	7.65	434
7.0	3.09	3.17	23.7	7.65	434
6.5	3.03	3.46	25.7	7.66	432
6.0	3.08	3.24	23.9	7.66	432
5.5	3.07	3.21	24.0	7.67	431
5.0	2.94	3.63	27.2	7.67	429
4.5	2.82	4.16	30.7	7.68	428
4.0	2.72	4.56	33.7	7.69	427
3.5	2.66	4.71	34.7	7.70	426
3.0	2.62	4.90	36.2	7.71	426
2.5	2.52	5.06	37.1	7.73	425
2.0	2.39	5.16	37.7	7.73	424
1.5	1.96	5.46	39.6	7.74	420
1.0	1.40	5.48	39.2	7.74	413
0.5	-0.05	6.50	39.7	7.74	399
Surface (0.0)					

Table A2. Dissolved oxygen and temperature profile for Summerside Lake at the south site, January 29, 2021.

Project Number:	20-074		**Comments:** Lots of perch on bottom. Weird measurements right under ice. Pine rental 27633 - YSI 556 MPS		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, J. McDonell				
Date:	29-Jan-21				
Time:	15:15				
Site ID:	SSSWQ				
Site Location:	**NAD83**	**Easting:**	335721	**Northing:**	5921454

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	-0.04	11.88	81.8	7.96	405
1.0	1.30	10.15	72.0	7.96	418
1.5	1.76	9.73	69.8	7.97	423
2.0	2.13	9.20	66.9	7.97	427
2.5	2.46	8.82	64.7	7.92	429
3.0	2.54	8.52	62.6	7.96	430
3.5	2.60	8.27	61.0	7.97	431
4.0	2.69	7.85	57.9	7.95	431
4.5	2.74	7.60	55.8	7.95	431
5.0	2.83	6.83	50.4	7.95	432
5.5	2.85	6.38	47.2	7.95	433
6.0	2.89	5.87	43.4	7.94	433
6.5	2.87	5.23	38.7	7.93	434
7.0	2.90	4.96	36.9	7.94	434
7.5	2.92	4.90	36.3	7.95	435
8.0	3.07	4.50	33.5	7.94	437
8.5	3.16	4.30	32.0	7.95	439
9.0	3.11	4.47	33.6	7.99	441
9.5	Hit bottom	-	-	-	-
9.0	3.09	4.43	32.9	7.98	441
8.5	3.18	4.00	30.0	7.98	440
8.0	3.16	3.94	29.4	7.99	439
7.5	3.14	4.04	30.7	7.98	438
7.0	3.07	4.02	29.9	7.98	437
6.5	2.91	4.52	33.6	7.99	434
6.0	2.87	4.53	33.8	8.06	433
5.5	2.91	4.62	34.4	7.99	432
5.0	2.89	4.80	35.6	8.01	432
4.5	2.86	5.16	38.2	8.03	431
4.0	2.81	5.67	42.0	8.03	430
3.5	2.69	6.11	45.2	8.06	429
3.0	2.62	6.31	46.6	8.05	428
2.5	2.55	6.48	47.7	8.07	428
2.0	2.36	6.78	49.0	8.07	426
1.5	2.04	6.77	49.0	8.08	423
1.0	0.87	7.19	50.6	8.12	411
0.5	-0.24	7.44	50.4	8.16	400
Surface (0.0)					

Table A3. Dissolved oxygen and temperature profile for Summerside Lake at the southeast site, March 10, 2021.

Project Number:	20-074		**Comments:** Southeast corner of lake by beach. WP221. Sediment cores (2) at 14:13.		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, E. Northcott				
Date:	10-Mar-21				
Time:	13:57				
Site ID:	SG-4				
Site Location:	**NAD83**	**Easting:**	335877	**Northing:**	5921388

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	0.30	9.19	63.4		
1.0	1.30	9.45	67.0		
1.5	2.30	7.97	58.1		
2.0	2.80	6.89	50.9		
2.5	2.90	6.36	47.2		
3.0	3.00	6.03	44.7		
3.5	2.90	6.36	47.2		
4.0	3.10	2.91	21.6		
3.5	2.90	6.14	45.5		
3.0	2.90	6.06	44.8		
2.5	3.00	5.96	44.3		
2.0	2.90	6.34	46.9		
1.5	2.70	7.09	52.2		
1.0	1.90	8.93	64.4		
0.5	0.60	8.90	61.9		
Surface (0.0)					

Table A4. Dissolved oxygen and temperature profile for Summerside Lake at the southwest site, March 10, 2021.

Project Number:	20-074		**Comments:**		
Project Location:	Lake Summerside		**Southwest corner of lake. WP220.**		
Samplers:	C. Stefura, J. White, E. Northcott				
Date:	10-Mar-21				
Time:	12:52				
Site ID:	SG-3				
Site Location:	**NAD83**	**Easting:**	335579	**Northing:**	5921327

Depth (m)	**Water Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**% Sat**	**pH**	**Conductivity (µS/cm)**
Surface (0.0)					
0.5	0.60	9.70	63.1		
1.0	1.10	9.23	65.2		
1.5	2.30	8.38	61.1		
2.0	2.80	5.68	42.1		
2.5	2.80	5.64	41.6		
3.0	2.90	4.88	36.1		
2.5	2.90	4.91	36.5		
2.0	2.90	5.14	38.1		
1.5	2.80	6.08	44.9		
1.0	1.70	9.13	65.3		
0.5	0.30	9.03	62.3		
Surface (0.0)					

Table A5. Dissolved oxygen and temperature profile for Summerside Lake at the northwest site, March 10, 2021.

Project Number:	20-074		**Comments:** Northwest corner of lake. WP219. Approximately 25 m from shore. WQ at 12:16.		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, E. Northcott				
Date:	10-Mar-21				
Time:	12:00				
Site ID:	SG-2				
Site Location:	**NAD83**	**Easting:**	335681	**Northing:**	5921767

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	% Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	0.70	6.31	44.0		
1.0	1.70	5.11	36.5		
1.5	2.40	4.63	33.7		
2.0	2.80	4.26	31.5		
2.5	2.90	3.98	29.5		
3.0	3.10	3.65	27.2		
3.5	3.10	3.27	24.4		
3.0	3.10	3.54	26.4		
2.5	3.00	3.74	27.8		
2.0	3.00	3.79	28.1		
1.5	3.00	3.91	29.1		
1.0	2.40	4.20	30.6		
0.5	0.40	5.89	40.7		
Surface (0.0)					

Table A6. Dissolved oxygen and temperature profile for Summerside Lake at the northeast site, March 10, 2021.

Project Number:	20-074		**Comments:** Northeast corner of lake in bay. WP218. WQ at 11:06 may have touched bottom as some particulate in sampler.		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, E. Northcott				
Date:	10-Mar-21				
Time:	10:44				
Site ID:	SG-1				
Site Location:	**NAD83**	**Easting:**	335879	**Northing:**	5921761

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	0.10	6.92	47.5		
1.0	0.70	7.34	51.5		
1.5	2.20	6.92	50.2		
2.0	2.70	6.16	45.2		
2.5	2.80	5.81	43.0		
3.0	2.90	5.50	40.8		
3.0	2.90	5.50	40.8		
2.5	3.00	5.52	41.0		
2.0	2.90	5.61	41.7		
1.5	2.80	6.07	44.9		
1.0	1.70	7.08	50.7		
0.5	0.30	6.77	46.7		
Surface (0.0)					

Table A7. Dissolved oxygen and temperature profile for Summerside Lake at the north site, August 26, 2021.

Project Number:	20-074		**Comments:** Depth 9.2 m 6.2 m is euphotic.		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, J. McDonell				
Date:	26-Aug-21				
Time:	10:00				
Site ID:	Summerside North WQ				
Site Location:	**NAD83**	**Easting:**	335730	**Northing:**	5921641

Depth (m)	**Water Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**% Sat**	**pH**	**Conductivity (µS/cm)**
Surface (0.0)					
0.5	16.9	8.18	84.5		
1.0	16.9	8.18	84.5		
1.5	16.9	8.18	84.4		
2.0	16.9	8.17	84.4		
2.5	16.9	8.16	84.2		
3.0	16.9	8.15	84.2		
3.5	16.9	8.15	84.1		
4.0	16.9	8.14	84.0		
4.5	16.8	7.91	81.5		
5.0	16.7	7.58	78.0		
5.5	16.7	7.37	75.9		
6.0	16.6	7.15	73.4		
6.5	16.5	6.76	69.2		
7.0	15.8	5.00	50.5		
7.5	13.5	0.62	6.1		
8.0	10.9	0.52	4.7		
8.5	9.9	0.51	4.5		
9.0	9.5	0.48	4.2		
8.5	9.9	0.54	4.8		
8.0	10.4	0.48	4.3		
7.5	13.4	0.46	4.4		
7.0	15.7	4.81	47.3		
6.5	16.2	6.38	64.8		
6.0	16.4	7.05	71.8		
5.5	16.6	7.29	74.7		
5.0	16.7	7.68	78.8		
4.5	16.8	8.03	82.7		
4.0	16.8	8.10	83.5		
3.5	16.9	8.16	84.3		
3.0	16.9	8.16	84.2		
2.5	16.9	8.22	84.7		
2.0	16.9	8.22	84.9		
1.5	17.0	8.22	85.0		
1.0	17.0	8.22	85.1		
0.5	17.0	8.23	85.2		
Surface (0.0)					

Table A8. Dissolved oxygen and temperature profile for Summerside Lake at the south site, August 26, 2021.

Project Number:	20-074		**Comments:**		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, J. McDonell				
Date:	26-Aug-21				
Time:	12:55		**South. Depth 8.4 m**		
Site ID:	South Summerside WQ				
Site Location:	**NAD83**	**Easting:**	335717	**Northing:**	5921457

Depth (m)	**Water Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**% Sat**	**pH**	**Conductivity (µS/cm)**
Surface (0.0)					
0.5	17.0	8.26	85.5		
1.0	17.0	8.24	85.2		
1.5	16.9	8.24	85.2		
2.0	16.9	8.23	85.0		
2.5	16.9	8.21	84.7		
3.0	16.8	8.10	83.4		
3.5	16.7	7.79	80.1		
4.0	16.7	7.87	80.9		
4.5	16.6	7.74	79.4		
5.0	16.6	7.64	78.3		
5.5	16.6	7.59	77.9		
6.0	16.4	6.80	69.5		
6.5	16.3	6.51	66.4		
7.0	15.7	4.59	46.3		
7.5	13.4	0.65	6.2		
8.0	11.5	0.57	5.2		
7.5	14.0	0.58	5.7		
7.0	15.7	4.76	48.0		
6.5	16.2	6.09	61.9		
6.0	16.4	6.85	70.1		
5.5	16.6	7.04	72.1		
5.0	16.6	7.43	76.2		
4.5	16.6	7.60	78.0		
4.0	16.6	7.69	78.9		
3.5	16.7	7.81	80.3		
3.0	16.8	7.74	79.7		
2.5	16.8	7.83	80.6		
2.0	17.0	8.26	85.4		
1.5	17.0	8.25	85.3		
1.0	17.1	8.25	85.5		
0.5	17.1	8.28	85.8		
Surface (0.0)					

Table A9. Dissolved oxygen and temperature profile for Summerside Lake at the north site, November 3, 2021.

Project Number:	20-074		**Comments:**		
Project Location:	Lake Summerside		**Wind gusting 20 from south**		
Samplers:	C. Stefura, J. White, J. McDonell		**-4°C air temp**		
Date:	03-Nov-21		**Turned off aeration for sampling (been on**		
Time:	09:46-10:40		**for 1 month)**		
Site ID:	Summerside North WQ		**YSI meter pro. 8.67 m bottom**		
Site Location:	**NAD83**	**Easting:**	335724	**Northing:**	5921649

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	4.0	11.57	88.6		
1.0	4.1	11.57	88.6		
1.5	4.0	11.57	88.6		
2.0	4.1	11.56	88.5		
2.5	4.1	11.55	88.5		
3.0	4.1	11.56	88.5		
3.5	4.1	11.56	88.5		
4.0	4.1	11.55	88.5		
4.5	4.1	11.55	88.5		
5.0	4.1	11.55	88.4		
5.5	4.1	11.53	88.4		
6.0	4.1	11.52	88.3		
6.5	4.1	11.51	88.2		
7.0	4.1	11.51	88.2		
7.5	4.1	11.50	88.2		
8.0	4.1	11.50	88.1		
8.5	4.1	11.50	88.1		
9.0	-	-	-		
8.5	4.1	11.49	88.1		
8.0	4.1	11.51	88.2		
7.5	4.1	11.53	88.3		
7.0	4.1	11.53	88.3		
6.5	4.1	11.53	88.4		
6.0	4.1	11.55	88.4		
5.5	4.1	11.55	88.4		
5.0	4.1	11.55	88.5		
4.5	4.1	11.56	88.5		
4.0	4.1	11.56	88.5		
3.5	4.1	11.57	88.6		
3.0	4.1	11.57	88.6		
2.5	4.1	11.58	88.7		
2.0	4.1	11.58	88.7		
1.5	4.1	11.58	88.7		
1.0	4.1	11.58	88.7		
0.5	4.1	11.60	88.8		
Surface (0.0)					

Table A10. Dissolved oxygen and temperature profile for Summerside Lake at the north site, November 3, 2021.

Project Number:	20-074		**Comments:**		
Project Location:	Lake Summerside				
Samplers:	C. Stefura, J. White, J. McDonell				
Date:	03-Nov-21				
Time:	10:45-11:40		**South. Depth 8.6 m**		
Site ID:	Summerside South WQ				
Site Location:	**NAD83**	**Easting:**	335724	**Northing:**	5921472

Depth (m)	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Sat	pH	Conductivity (µS/cm)
Surface (0.0)					
0.5	4.1	11.58	88.8		
1.0	4.1	11.56	88.7		
1.5	4.2	11.56	88.7		
2.0	4.1	11.55	88.6		
2.5	4.1	11.53	88.5		
3.0	4.1	11.54	88.5		
3.5	4.1	11.54	88.5		
4.0	4.1	11.53	88.5		
4.5	4.1	11.52	88.4		
5.0	4.1	11.53	88.5		
5.5	4.1	11.52	88.4		
6.0	4.1	11.53	88.4		
6.5	4.1	11.52	88.4		
7.0	4.1	11.52	88.4		
7.5	4.1	11.52	88.4		
8.0	4.1	11.49	88.2		
8.5	4.2	11.46	88.0		
8.0	4.1	11.49	88.2		
7.5	4.1	11.51	88.3		
7.0	4.1	11.52	88.3		
6.5	4.1	11.52	88.3		
6.0	4.1	11.52	88.3		
5.5	4.1	11.52	88.4		
5.0	4.1	11.53	88.5		
4.5	4.1	11.54	88.6		
4.0	4.1	11.52	88.3		
3.5	4.1	11.55	88.6		
3.0	4.1	11.56	88.6		
2.5	4.1	11.54	88.5		
2.0	4.1	11.56	88.5		
1.5	4.1	11.56	88.7		
1.0	4.1	11.57	88.8		
0.5	4.2	11.58	88.8		
Surface (0.0)					

Appendix B Element Lab Water Quality Results

Table B1. Nutrient water quality results for Summerside Lake at the north and south sites, January 29, 2021.

			Parameter Name	Phosphorus (Dissolved)	Phosphorus (Dissolved) Low Level	Phosphorus (Total)	Phosphorus (Total) Low Level	Orthophosphate -P (Dissolved)	Ammonium - N	Kjeldahl Nitrogen (Total)	Nitrate - N	Nitrite - N	Nitrate and Nitrite - N
			Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site Id	Sample Depth (m)	Sampled Date	*Detection Limit*	*0.05*	*0.005*	*0.05*	*0.005*	*0.01*	*0.025*	*0.07*	*0.01*	*0.005*	*0.01*
SSNWQ-1	1	2021-01-29		<0.05		0.06		0.02					
SSNWQ-2	2	2021-01-29		<0.05		<0.05		0.01					
SSNWQ-3	3	2021-01-29		<0.05		<0.05		0.01					
SSNWQ-4	4	2021-01-29		<0.05		<0.05		0.01					
SSNWQ-5	5	2021-01-29		<0.05		0.07		0.01					
SSNWQ-6	6	2021-01-29		<0.05		<0.05		0.02					
SSNWQ-7	7	2021-01-29		<0.05		<0.05		0.02					
SSNWQ-8	8	2021-01-29		<0.05		<0.05		0.02					
SSNWQ-9	9	2021-01-29		<0.05	0.016	<0.05	0.026	0.02	0.108	0.5	0.25	0.011	0.27
SSSWQ-1	1	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-2	2	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-3	3	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-4	4	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-5	5	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-6	6	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-7	7	2021-01-29		<0.05		<0.05		0.01					
SSSWQ-8	8	2021-01-29		<0.05		<0.05		0.02					
SSSWQ-9	9	2021-01-29		<0.05	0.023	<0.05	0.024	0.02	0.075	0.48	0.27	0.012	0.28

Table B2. Nutrient water quality results for Summerside Lake at the northeast, northwest, southwest, and southeast sediment sampling sites, March 10, 2021.

				Parameter Name	Phosphorus (Dissolved)	Phosphorus (Dissolved) Low Level	Phosphorus (Total)	Phosphorus (Total) Low Level	Orthophosphate-P (Dissolved)
				Unit	mg/L	mg/L	mg/L	mg/L	mg/L
Site Id	**Sample Description**	**Sampled Date**	**Sampled Time**	***Detection Limit***	***0.05***	***0.005***	***0.05***	***0.005***	***0.01***
SG-1	NE bay; near bottom	2021-03-10	11:06:00		<0.05	0.005	<0.05	0.027	<0.01
SG-2	NW bay; near bottom	2021-03-10	12:16:00		<0.05	0.005	<0.05	0.02	<0.01
SG-3	SW bay; near bottom	2021-03-10	13:14:00		<0.05	0.005	<0.05	0.019	<0.01
SG-4	SE bay; near bottom	2021-03-10	14:17:00		<0.05	0.008	<0.05	0.018	<0.01

Table B3. Nutrient water quality results for Summerside Lake at the north and south sites, August. 26, 2021.

		Parameter Name	Phosphorus (Dissolved) Low Level	Phosphorus (Total) Low Level	Orthophosphate-P (Dissolved)	Ammonium - N	Kjeldahl Nitrogen (Total)	Nitrate - N	Nitrite - N	Nitrate and Nitrite - N
		Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site Id	**Sampled Date**	***Detection Limit***	***0.005***	***0.005***	***0.01***	***0.025***	***0.07***	***0.01***	***0.005***	***0.01***
SNWQ	2021-08-26		0.048	**0.476**	0.04	0.806	1.46	<0.01	<0.005	<0.01
SSWQ	2021-08-26		0.016	**0.282**	<0.01	0.094	1.08	<0.01	<0.005	<0.01

* Bolded values are exceedances of the Alberta Surface Water Quality Guidelines for the Protection of Freshwater Aquatic Life (ASWQG-FAL) (Alberta Environment, 1999).

Table B4. Routine water quality results for Summerside Lake at the north and south sites, August 26, 2021.

Parameter Name	Unit	*Detection Limit*	Site Id	
			SNWQ	SSWQ
pH	N/A	*1*	7.8	7.84
Temperature of observed pH	°C		20.4	20.4
Electrical Conductivity (at 25°C)	µS/cm	*1*	667	656
Calcium (Dissolved)	mg/L	*0.2*	48	46
Magnesium (Dissolved)	mg/L	*0.2*	24.4	24.4
Sodium (Dissolved)	mg/L	*0.4*	57.9	57.4
Potassium (Dissolved)	mg/L	*0.4*	4.5	4.3
Iron (Dissolved)	mg/L	*0.01*	<0.01	<0.01
Manganese (Dissolved)	mg/L	*0.005*	<0.005	<0.005
Chloride (Dissolved)	mg/L	*0.4*	10.2	10.1
Sulfate (SO4) (Dissolved)	mg/L	*0.9*	225	234
Hydroxide	mg/L	-	<5	<5
Carbonate	mg/L	-	<6	<6
Bicarbonate	mg/L	-	118	111
P-Alkalinity (as CaCO3)	mg/L	*5*	<5	<5
T-Alkalinity (as CaCO3)	mg/L	*5*	97	91
Total Dissolved Solids (Calculated)	mg/L	*1*	430	431
Hardness (Dissolved as CaCO3)	mg/L	-	220	215
Ionic Balance (Dissolved)	%	-	103	99

Table B5. Dissolved metals water quality results for Summerside Lake at the north and south sites, August 26, 2021.

Parameter Name	**Unit**	***Detection Limit***	**Site Id**	
			SNWQ	SSWQ
Dissolved				
Aluminum	mg/L	*0.002*	<0.002	<0.002
Antimony	mg/L	*0.0002*	<0.0002	<0.0002
Arsenic	mg/L	*0.0002*	0.0021	0.0019
Barium	mg/L	*0.001*	0.037	0.035
Beryllium	mg/L	*0.0001*	<0.0001	<0.0001
Bismuth	mg/L	*0.0005*	<0.0005	<0.0005
Boron	mg/L	*0.002*	0.066	0.068
Cadmium	mg/L	*0.00001*	<0.00001	<0.00001
Chromium	mg/L	*0.0005*	<0.0005	<0.0005
Cobalt	mg/L	*0.0001*	<0.0001	<0.0001
Copper	mg/L	*0.001*	0.002	<0.001
Lead	mg/L	*0.0001*	<0.0001	<0.0001
Lithium	mg/L	*0.001*	0.032	0.033
Molybdenum	mg/L	*0.001*	<0.001	<0.001
Nickel	mg/L	*0.0005*	0.0009	0.0009
Selenium	mg/L	*0.0002*	<0.0002	<0.0002
Silicon	mg/L	*0.05*	0.4	0.13
Silver	mg/L	*0.00001*	<0.00001	<0.00001
Strontium	mg/L	*0.001*	0.56	0.564
Sulfur	mg/L	*0.3*	75.1	78
Thallium	mg/L	*0.00005*	<0.00005	<0.00005
Tin	mg/L	*0.001*	<0.001	<0.001
Titanium	mg/L	*0.0005*	<0.0005	<0.0005
Uranium	mg/L	*0.0005*	<0.0005	<0.0005
Vanadium	mg/L	*0.0001*	<0.0001	<0.0001
Zinc	mg/L	*0.001*	0.001	0.001

Table B6. Total metals water quality results for Summerside Lake at the north and south sites, August 26, 2021.

Parameter Name	Unit	*Detection Limit*	Site Id	
			SNWQ	SSWQ
Total				
Aluminum	mg/L	*0.02*	<0.02	0.02
Calcium	mg/L	*0.2*	47	46.5
Iron	mg/L	*0.05*	0.07	<0.05
Magnesium	mg/L	*0.2*	24.3	24.9
Manganese	mg/L	*0.005*	0.522	0.132
Potassium	mg/L	*0.4*	4.4	4.4
Silicon	mg/L	*0.05*	0.46	0.2
Sodium	mg/L	*0.4*	57.7	58.7
Sulfur	mg/L	*0.3*	74.9	78.1
Mercury	mg/L	*0.000005*	<0.000005	<0.000005
Antimony	mg/L	*0.0002*	<0.0002	<0.0002
Arsenic	mg/L	*0.0002*	0.0023	0.0019
Barium	mg/L	*0.001*	0.039	0.035
Beryllium	mg/L	*0.0001*	<0.0001	<0.0001
Bismuth	mg/L	*0.0005*	<0.0005	<0.0005
Boron	mg/L	*0.002*	0.065	0.067
Cadmium	mg/L	*0.00001*	<0.00001	<0.00001
Chromium	mg/L	*0.0005*	<0.0005	<0.0005
Cobalt	mg/L	*0.0001*	0.0001	<0.0001
Copper	mg/L	*0.001*	0.009	**0.086**
Lead	mg/L	*0.0001*	0.0004	0.0002
Lithium	mg/L	*0.001*	0.033	0.034
Molybdenum	mg/L	*0.001*	<0.001	<0.001
Nickel	mg/L	*0.0005*	0.0011	0.0016
Selenium	mg/L	*0.0002*	<0.0002	<0.0002
Silver	mg/L	*0.00001*	<0.00001	<0.00001
Strontium	mg/L	*0.001*	0.565	0.556
Thallium	mg/L	*0.00005*	<0.00005	<0.00005
Tin	mg/L	*0.001*	<0.001	<0.001
Titanium	mg/L	*0.0005*	<0.0005	<0.0005
Uranium	mg/L	*0.0005*	<0.0005	<0.0005
Vanadium	mg/L	*0.0001*	0.0003	0.0002
Zinc	mg/L	*0.004*	0.008	**0.0**4
Zirconium	mg/L	*0.001*	<0.001	<0.001

* Bolded values are exceedances of the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta, 2018) and the Water Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 1999.)

Table B7. Chlorophyll-a and phaeophytin results for Summerside Lake at the north and south sites, September 9, 2021.

Parameter Name	Unit	*Detection Limit*	Site Id	
			SNWQ	SSWQ
Chlorophyll-a	µg/L	0.5	4	5
Phaeophytin	µg/L	0.5	2	2

Appendix C LSI Limnological Solutions International Report

Summerside Lake

Short evaluation of water and sediment quality data and the potential use of Phoslock

30 June 2021
LSI Limnological Solutions International
Dr Said Yasseri

1 Introduction

Summerside Lake is a relatively shallow 'blob' shaped artificial lake within the Summerside residence area in Edmonton. Domestic city water is pumped into the lake regularly to compensate for evaporation loss. The lake is used as a recreational area and a beach has been built on the western shore line. Recent problems with high nutrient levels have caused massive macrophyte growth, algae blooms and cercaria presence. The lake is attracting waterfowl which are the reason for swimmer's itch. To ensure good water conditions, maintenance measures such as fish removal (yellow perch), macrophyte mowing and snail removal have been undertaken.

Aquality Environmental Consulting assumes the main cause of the eutrophication in Summerside Lake to be sediment nutrient release. Sediment core samples were taken from the lake in March 2021 and sent to Wageningen/NL to be analysed for phosphorus content and to determine the releasable P fraction.

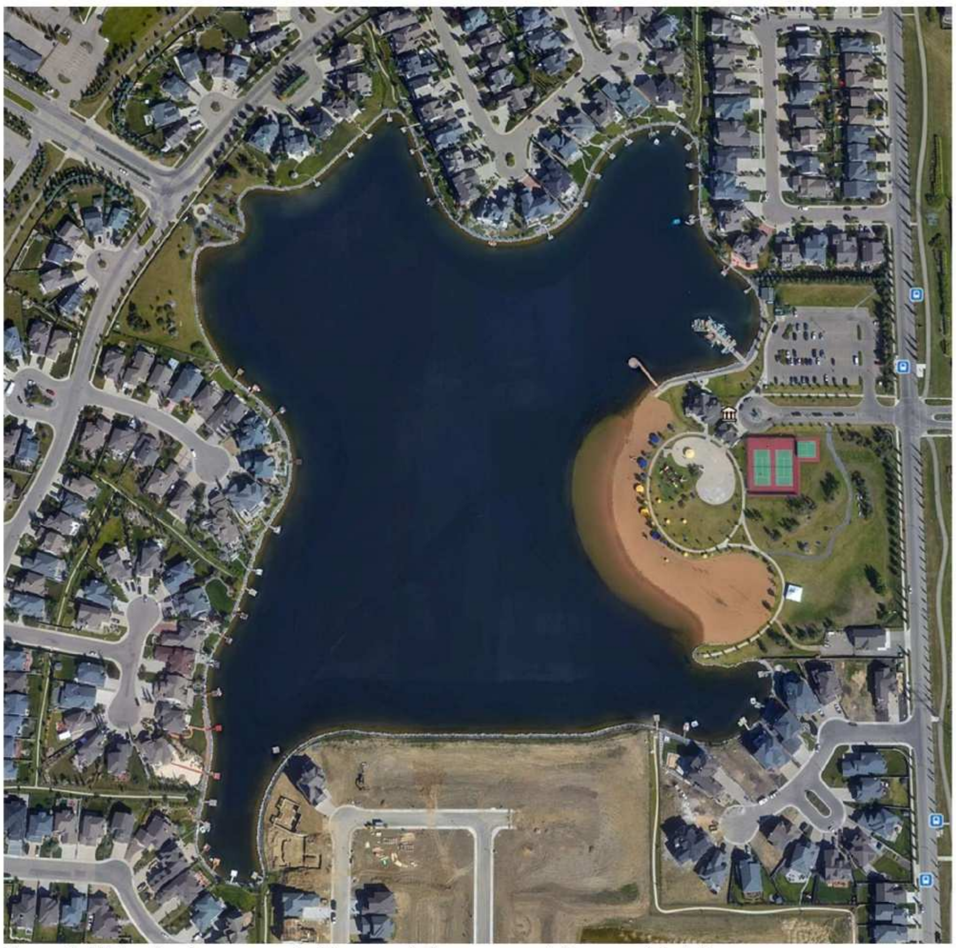


Figure 1. Water has been sampled from each for corners at Summerside Lake

2 Lake data

Lake Origin:	Excavation, artificial, clay liner
Age:	20 years
Water body:	filled with domestic city water
Lake Surface Area:	12 ha
Lake Volume:	ca. 360,000 m^3 (estimated)
Mean Depth:	ca. 3 m (estimated)
Maximum Depth:	9 m
Inflows:	no inflows and no outflows
Aeration:	1 fountain
Fish population:	trout, triploid (gras?)carp and yellow perch
Location:	1720 88 St SW, Edmonton, AB T6X 1J7, Canada
Limiting Nutrient:	most likely phosphorus

3 Discussion

The lake water quality is affected by nutrients that enter the lake continuously through the water that is added to the lake and from swimmers, waterfowl and most likely runoff from the surrounding residential area. These inputs of nutrients have resulted in macrophyte growth and algae blooms. Although water nutrient data are available, unfortunately no detailed data about the sediments were available prior to March this year. Our recent sediment analysis of releasable phosphorus concentrations measured in the top 5 cm sediment layer defines how much phosphorus can be released under specific conditions such as anoxia in deep water layers and in high alkaline water during an algal bloom. When pH values increase to more than 8.5, e.g. during an algal bloom, the bond between aluminium and phosphate can also be weakened due to an excess of hydroxide ions (OH^-) and as a result phosphate bound to aluminium in sediments can be released. As a result, aluminium bound phosphate should be considered to be potentially releasable in shallow lakes where such high pH levels can occur. In studies undertaken on sediment phosphorus fractions measured in comparable shallow lakes, approximately half of the aluminium phosphate pool was determined to be released.

Table 1. Summerside Lake phosphorus concentrations in bottom sediments

Lab.-No.			2105813	2105814	2105815	2105816
		Sample	SG-1 0-5 cm	SG-2 0-5 cm	SG-3 0-5 cm	SG-4 0-5 cm
Parameter	Method	Unit				
Density		g/ml	1.36	1.65	1.63	1.72
Dry weight	ISO 11456/EN 14346	% (m/m)	42.4	64.8	60.4	71.8
LOI 550°C	DIN EN 15169 2007-05	% TS	5.00	3.90	3.70	3.50
Total phosphorus	ISO 11885 E22 2009-11	mg/kg DW	430	550	550	580
Iron	ISO 11885-E22:2009-11	mg/kg DW	27000	30000	30000	29000
Calcium	ISO 11885-E22:2009-11	mg/kg DW	32000	14000	20000	13000
Aluminium	ISO 11885-E22:2009-11	mg/kg DW	23000	20000	17000	19000
Lanthanum	ISO 11885-E22:2009-11	mg/kg DW	15	18	16	17

The PO_4-P concentrations that have been provided indicate that the lake is at least mesotrophic. The trophic state of the lake cannot be determined on the basis of total phosphorus from the data provided due to the high detection limits that were used for analysing total phosphorus. Based on there being an average concentration of 45 µg P/l and a lake volume of 360,000 m^3 , we estimate that Summerside Lake contains a total phosphorus load of 16.2 kg P in the water body.
One of the data gaps relates to the fish population. Carp destroy natural plant communities (and are sometimes introduced to lakes intentionally to do this) and can promote growth of fast and high growing macrophytes. A natural macrophyte community (in a bay or corner of the lake) can provide habitats for fish, amphibians and other aquatic fauna and can compete with phytoplankton growth.

Our sediment analysis (Table 1) shows that the concentrations of phosphorus, iron, calcium and aluminium in Summerside Lake are relatively low, indicating that the quantity of phosphorus that may be released in anoxic or alkaline conditions may also be relatively. As a result, a lower percentage of the phosphorus can be defined as releasable (Table 2).

Table 2: Results of the sequential phosphorus extraction (according to Psenner methodology)

Fraction (unit: mg P/kg DW)	Location	SG-1	SG-2	SG-3	SG-4
	Depth	0-5 cm	0-5 cm	0-5 cm	0-5 cm
Step 1					
Water labile P	TP	1.70	2.51	2.18	6.88
Step 2					
Fe/Mn bound P and reductive releasable org-P	TP	15.1	30.5	25.4	23.7
Step 3					
Base releasable P, Al/Fe oxides (pH 14)	SRP	12.4	6.10	12.8	12.7
Organic bound P (Microorg., detritus, humic substances)	NRP	14.5	3.94	7.20	5.95
Available P (TP step 1 + TP step 2 + NRP step 3)		31.3	36.9	34.8	36.5
TP (measured by ICP)		386	507	502	531
% available P		7.27	6.71	6.33	6.30

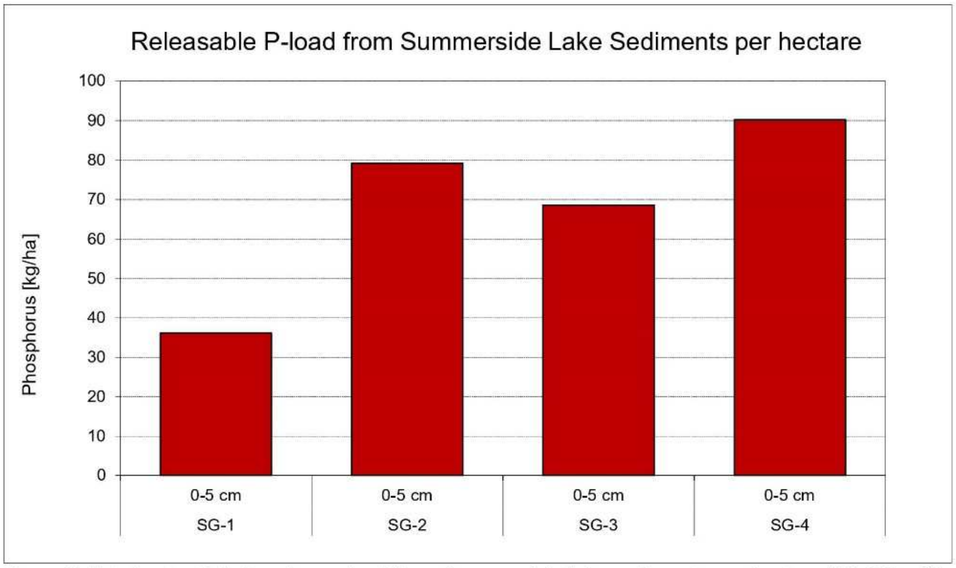


Figure 3. Total potential phosphorus load from Summerside Lake sediments per hectare (10,000 m^2)

Taken over the whole surface area of the lake, our data suggest that that a maximum of 274 kg phosphorus could be released either from sediment pore water or under reduced conditions. This quantity does not however include aluminium bound P which could potentially also be increased as pH values increase (e.g. during phytoplankton blooms), at least in the shallower areas of the lake. The pool of aluminium bound P in the top 5 cm of the lake is calculated to be 83.9 kg for the whole lake area (Table 3).

If all releasable P (pore water P, redox sensitive P and aluminium bound P) would be released suddenly and at one time the water P concentrations would increase to 1 mg/l. Although it is highly unlikely that this could happen, it should be borne in mind and a measure to bind the potentially available P (e.g. an application of Phoslock) could be undertaken to permanently immobilize this P pool and render it unavailable for algal growth. The maximum quantity of P that would need to be bound with Phoslock would be 358 kg (= 274 + 83.9) and this would require an application of 35.8 tonnes of Phoslock.

Table 3: P load calculations on the whole lake area. Aluminium bound p can be released under alkaline conditions (pH >8.5) in shallow lake areas.

4 locations at the lake	corresponding lake area	labile, iron and organic P (kg)	aluminium bound P (kg)
Sample 1	4 ha	36.2	14.4
Sample 2	4 ha	79.1	13.1
Sample 3	4 ha	68.5	25.2
Sample 4	4 ha	90.2	31.2
Sum	**12 ha**	**274**	**83.9**

We fully agree with the proposed measures for lake nutrient load maintenance. It is important to control the external nutrient load as well. This is the key measure to reduce algal blooms and change optimal conditions for pathogenic bacteria and provides a stable ecosystem.

Goose populations often cause problems on small water bodies, as do designed grassland (short cut grass) and artificial water bodies. Geese are often attracted to quiet areas. If it is not possible to scare the geese away, providing more attractive areas near the lake could help reduce the bird population on and around the lake.

A nutrient remediation treatment (e.g. an application of Phoslock) can support the effect of maintenance measures which are being undertaken to reduce the nutrient load. Any treatment that is undertaken would need to be repeated regularly (smaller dose than the initial one) to keep the nutrient values low for a longer period.

Last but not least more information about the fish population is necessary. Carp or other bottom dwelling fish disturb sediments resulting in more phosphorus release from sediment layers. Biomanipulation might help to reduce the internal P release as well.

Appendix D Fish Data

Table D1. Raw fish data for representative Yellow Perch captured from Summerside Lake, April 27 to 29, 2021.

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	GN1	92	9	M	27-Apr-21	1"	
YLPR	GN1	103	14.4	M	27-Apr-21	1"	
YLPR	GN1	89	8.9	M	27-Apr-21	1"	
YLPR	GN1	87	9.1	M	27-Apr-21	1"	
YLPR	GN1	89	8.4	M	27-Apr-21	1"	
YLPR	GN1	90	8.6	M	27-Apr-21	1"	
YLPR	GN1	87	8.5	M	27-Apr-21	1"	
YLPR	GN1	91	9	M	27-Apr-21	1"	
YLPR	GN1	88	9.4	M	27-Apr-21	1"	
YLPR	GN1	90	8.7	M	27-Apr-21	1"	
YLPR	GN1	90	9	M	27-Apr-21	1"	
YLPR	GN1	98	10.7	F	27-Apr-21	1"	post-spawner
YLPR	GN1	96	11.5	F	27-Apr-21	1"	SO FR OP / eggs + photos
YLPR	GN1	85	7.8	M	27-Apr-21	1"	
YLPR	GN1	90	9	M	27-Apr-21	1"	
YLPR	GN1	88	8.8	M	27-Apr-21	1"	
YLPR	GN1	85	8.1	M	27-Apr-21	1"	
YLPR	GN1	91	9.6	M	27-Apr-21	1"	
YLPR	GN1	92	9.4	M	27-Apr-21	1"	
YLPR	GN1	88	8.9	M	27-Apr-21	1"	
YLPR	GN1	96	10.4	M	27-Apr-21	1"	
YLPR	GN1	91	9.3	M	27-Apr-21	1"	
YLPR	GN1	91	9.3	M	27-Apr-21	1"	
YLPR	GN1	85	7.2	M	27-Apr-21	1"	
YLPR	GN1	97	11.3	M	27-Apr-21	1"	
YLPR	GN1	91	10.5	M	27-Apr-21	1"	
YLPR	GN1	87	9.8	M	27-Apr-21	1"	
YLPR	GN1	100	12.2	M	27-Apr-21	1"	
YLPR	GN1	98	10.9	M	27-Apr-21	1"	
YLPR	GN1	87	9.3	M	27-Apr-21	1"	
YLPR	GN1	86	9.2	M	27-Apr-21	1"	
YLPR	GN1	93	9.7	M	27-Apr-21	1"	
YLPR	GN1	87	8.8	M	27-Apr-21	1"	
YLPR	GN1	98	10.7	M	27-Apr-21	1"	
YLPR	GN1	91	9.2	M	27-Apr-21	1"	
YLPR	GN1	94	9.9	M	27-Apr-21	1"	
YLPR	GN1	84	7.7	M	27-Apr-21	3/4"	
YLPR	GN1	94	9.2	M	27-Apr-21	3/4"	
YLPR	GN1	86	7.7	M	27-Apr-21	3/4"	
YLPR	GN1	86	7.8	M	27-Apr-21	3/4"	
YLPR	GN1	87	7.4	M	27-Apr-21	3/4"	

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	GN1	92	8.5	M	27-Apr-21	3/4"	
YLPR	GN1	91	8.4	M	27-Apr-21	3/4"	
YLPR	GN1	90	8.4	M	27-Apr-21	3/4"	
YLPR	GN1	85	7.4	M	27-Apr-21	3/4"	
YLPR	GN1	83	6.4	M	27-Apr-21	3/4"	
YLPR	GN1	89	7.6	M	28-Apr-21	3/4"	
YLPR	GN1	90	8.6	M	28-Apr-21	3/4"	
YLPR	GN1	90	7.9	M	28-Apr-21	3/4"	
YLPR	GN1	90	7.6	M	28-Apr-21	3/4"	
YLPR	GN1	93	8.2	M	28-Apr-21	3/4"	
YLPR	GN1	99	10.3	M	28-Apr-21	3/4"	
YLPR	GN1	89	7.1	F	28-Apr-21	3/4"	
YLPR	GN1	98	10.4	F	28-Apr-21	3/4"	
YLPR	GN1	105	14	F	28-Apr-21	3/4"	Gravid OTFR
YLPR	GN1	107	13.6	F	28-Apr-21	3/4"	Gravid OTFR
YLPR	GN1	98	9.8	F	28-Apr-21	3/4"	IMM
YLPR	GN1	98	9.9	F	28-Apr-21	3/4"	IMM
YLPR	GN1	91	7.9	M	28-Apr-21	3/4"	
YLPR	GN1	82	5.8	M	28-Apr-21	3/4"	OTFR
YLPR	GN1	94	8.6	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	103	11.6	F	28-Apr-21	3/4"	Gravid OTFR
YLPR	GN1	88	7	F	28-Apr-21	3/4"	IMM
YLPR	GN1	87	7.2	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	96	10	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	100	9.8	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	94	8.9	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	98	10.1	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	91	7.7	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	94	8.9	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	92	8.8	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN1	93	9.1	F	28-Apr-21	3/4"	IMM
YLPR	GN1	92	9.5	F	28-Apr-21	3/4"	IMM
YLPR	GN1	89	7.3	F	28-Apr-21	3/4"	IMM
YLPR	GN1	90	7.7	F	28-Apr-21	3/4"	IMM
YLPR	GN1	93	8.5	F	28-Apr-21	3/4"	IMM
YLPR	GN1	98	10.1	M	28-Apr-21	3/4"	Spent
YLPR	GN1	91	8.9	F	28-Apr-21	3/4"	IMM
YLPR	GN1	91	8.1	F	28-Apr-21	3/4"	IMM
YLPR	GN1	90	6.7	F	28-Apr-21	3/4"	IMM
YLPR	GN1	91	8.6	F	28-Apr-21	3/4"	IMM
YLPR	GN1	96	10.3	F	28-Apr-21	3/4"	IMM
YLPR	GN1	95	9.5	F	28-Apr-21	3/4"	IMM
YLPR	GN1	92	8.3	F	28-Apr-21	3/4"	IMM

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	GN1	85	6.4	F	28-Apr-21	3/4"	IMM
YLPR	GN1	95	8.6	F	28-Apr-21	3/4"	IMM + tapeworm
YLPR	GN1	95	8.9	F	28-Apr-21	3/4"	IMM
YLPR	GN1	93	9.7	F	28-Apr-21	3/4"	IMM + tapeworm
YLPR	GN1	88	7.7	F	28-Apr-21	3/4"	IMM
YLPR	GN1	95	8.9	F	28-Apr-21	3/4"	IMM
YLPR	GN1	88	7.5	F	28-Apr-21	3/4"	IMM
YLPR	GN1	100	11	F	28-Apr-21	3/4"	Gravid
YLPR	GN1	92	9.4	F	28-Apr-21	3/4"	IMM
YLPR	GN1	89	8.9	M	28-Apr-21	3/4"	Post spawn + tapeworm
YLPR	GN1	96	9.3	F	28-Apr-21	3/4"	IMM
YLPR	GN1	95	9.3	F	28-Apr-21	3/4"	IMM
YLPR	GN1	90	8.5	F	28-Apr-21	3/4"	IMM
YLPR	GN1	95	9.8	F	28-Apr-21	3/4"	Gravid
YLPR	GN1	-	-	-	28-Apr-21	3/4"	Unidentified likely IMM F
YLPR	GN1	96	11.2	F	28-Apr-21	3/4"	Gravid
YLPR	GN1	89	7.8	M	29-Apr-21	1"	OTFROP
YLPR	GN1	91	8.7	M	29-Apr-21	1"	OTFROP
YLPR	GN1	109	13.7	M	29-Apr-21	1"	OTFROP
YLPR	GN1	98	11.4	F	29-Apr-21	1"	OTFROP
YLPR	GN1	92	8.8	M	29-Apr-21	1"	OTFROP
YLPR	GN1	91	8.6	M	29-Apr-21	1"	OTFROP
YLPR	GN1	95	10.2	M	29-Apr-21	1"	OTFROP
YLPR	GN1	95	10.5	M	29-Apr-21	1"	OTFROP
YLPR	GN1	94	9.6	M	29-Apr-21	1"	OTFROP
YLPR	GN1	85	7.3	M	29-Apr-21	1"	OTFROP
YLPR	GN1	89	8.3	M	29-Apr-21	1"	
YLPR	GN1	85	7.9	M	29-Apr-21	1"	
YLPR	GN1	84	7.7	M	29-Apr-21	1"	
YLPR	GN1	99	10.5	M	29-Apr-21	1"	
YLPR	GN1	91	9.6	M	29-Apr-21	1"	
YLPR	GN1	108	13.6	M	29-Apr-21	1"	
YLPR	GN1	85	7.4	M	29-Apr-21	1"	
YLPR	GN1	97	10.7	M	29-Apr-21	1"	
YLPR	GN1	93	9.1	M	29-Apr-21	1"	
YLPR	GN1	95	9.6	M	29-Apr-21	1"	
YLPR	GN1	87	6.7	M	29-Apr-21	3/4"	
YLPR	GN1	86	7.4	M	29-Apr-21	3/4"	
YLPR	GN1	87	8.1	M	29-Apr-21	3/4"	
YLPR	GN1	85	7.3	M	29-Apr-21	3/4"	
YLPR	GN1	82	6.5	M	29-Apr-21	3/4"	
YLPR	GN1	89	8.6	M	29-Apr-21	3/4"	
YLPR	GN1	95	9.6	M	29-Apr-21	3/4"	

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	GN1	89	8	M	29-Apr-21	3/4"	
YLPR	GN1	87	7.2	F	29-Apr-21	3/4"	IMM OTFROP
YLPR	GN1	93	7.9	F	29-Apr-21	3/4"	IMM OTFROP
YLPR	GN2	91	8.7	M	28-Apr-21	1"	OTFR spent
YLPR	GN2	94	9.5	M	28-Apr-21	1"	OTFR
YLPR	GN2	88	8.4	M	28-Apr-21	1"	OTFR
YLPR	GN2	94	9.8	M	28-Apr-21	1"	OTFR
YLPR	GN2	102	12.4	M	28-Apr-21	1"	
YLPR	GN2	99	10.4	M	28-Apr-21	1"	OTFR
YLPR	GN2	88	7.7	M	28-Apr-21	1"	OTFR
YLPR	GN2	100	11.8	M	28-Apr-21	1"	OTFR spent
YLPR	GN2	93	8.8	M	28-Apr-21	1"	OTFR
YLPR	GN2	97	10.5	M	28-Apr-21	1"	
YLPR	GN2	91	8.9	M	28-Apr-21	3/4"	OTFR
YLPR	GN2	95	9.2	M	28-Apr-21	3/4"	OTFR
YLPR	GN2	92	9	M	28-Apr-21	3/4"	OTFR (1 collected)
YLPR	GN2	86	6.8	M	28-Apr-21	3/4"	OTFR
YLPR	GN2	88	7.1	M	28-Apr-21	3/4"	OTFR
YLPR	GN2	91	7.3	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN2	86	7	F	28-Apr-21	3/4"	IMM OTFR
YLPR	GN2	89	8.1	M	28-Apr-21	3/4"	OTFR
YLPR	GN2	86	7.7	M	28-Apr-21	3/4"	OTFR
YLPR	GN2	90	7.8	M	28-Apr-21	3/4"	OTFR
YLPR	GN3	89	8.8	M	27-Apr-21	1"	
YLPR	GN3	88	7.9	M	27-Apr-21	1"	
YLPR	GN3	87	8	M	27-Apr-21	1"	
YLPR	GN3	95	8.9	M	27-Apr-21	1"	
YLPR	GN3	94	9.3	M	27-Apr-21	1"	
YLPR	GN3	86	7.9	M	27-Apr-21	1"	
YLPR	GN3	93	9.5	?	27-Apr-21	1"	non-binary (IMM F?)
YLPR	GN3	90	8.7	M	28-Apr-21	1"	
YLPR	GN3	95	10.5	M	28-Apr-21	1"	OTFR
YLPR	GN3	97	10.1	F	28-Apr-21	1"	IMM OTFR
YLPR	GN3	98	10.3	F	28-Apr-21	1"	IMM OTFR
YLPR	GN3	102	11.5	M	28-Apr-21	1"	OTFR
YLPR	GN3	92	8.4	M	28-Apr-21	1"	OTFR
YLPR	GN3	100	11.6	F	28-Apr-21	1"	IMM OTFR
YLPR	GN3	97	10.2	M	28-Apr-21	1"	OTFR
YLPR	GN3	105	11.6	F	28-Apr-21	1"	OTFR spent
YLPR	GN3	101	12.7	F	28-Apr-21	1"	OTFR (eggs present)
YLPR	GN3	93	9.3	M	29-Apr-21	1"	
YLPR	GN3	96	10.6	M	29-Apr-21	1"	
YLPR	GN3	102	12.2	M	29-Apr-21	1"	

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	GN3	91	8.4	M	29-Apr-21	1"	
YLPR	GN3	94	9.1	M	29-Apr-21	1"	
YLPR	GN3	97	10	M	29-Apr-21	1"	
YLPR	GN3	91	8.3	M	29-Apr-21	1"	
YLPR	GN3	88	7.9	M	29-Apr-21	1"	
YLPR	GN3	94	9.3	M	29-Apr-21	1"	
YLPR	GN3	91	8.9	M	29-Apr-21	1"	
YLPR	GN3	91	8.2	F	29-Apr-21	3/4"	IMM OTFR
YLPR	GN3	89	7.8	M	29-Apr-21	3/4"	OTFR
YLPR	GN3	86	7	M	29-Apr-21	3/4"	OTFR
YLPR	GN3	84	7.3	M	29-Apr-21	3/4"	OTFR
YLPR	GN3	91	8.6	M	29-Apr-21	3/4"	OTFR
YLPR	GN3	88	7.6	F	29-Apr-21	3/4"	IMM OTFR
YLPR	GN3	91	8.7	M	29-Apr-21	3/4"	OTFR
YLPR	GN3	90	7.8	M	29-Apr-21	3/4"	OTFR
YLPR	GN3	80	6.8	M	29-Apr-21	3/4"	OTFR
YLPR	GN4	83	7.3	M	27-Apr-21	3/4"	
YLPR	GN4	91	9.1	M	27-Apr-21	3/4"	
YLPR	GN4	75	7.5	M	27-Apr-21	3/4"	
YLPR	GN4	88	9.3	M	27-Apr-21	3/4"	
YLPR	GN4	86	7.1	M	27-Apr-21	3/4"	
YLPR	GN4	99	11.7	M	28-Apr-21	1"	OTFR
YLPR	GN4	90	7.9	M	28-Apr-21	1"	OTFR
YLPR	GN4	95	9.1	M	28-Apr-21	1"	OTFR
YLPR	GN4	102	11.2	M	28-Apr-21	1"	OTFR
YLPR	GN4	106	12.4	M	28-Apr-21	1"	OTFR
YLPR	GN4	94	9.1	M	28-Apr-21	1"	OTFR
YLPR	GN4	93	10.3	M	28-Apr-21	1"	OTFR
YLPR	GN4	95	9.3	M	28-Apr-21	1"	OTFR
YLPR	GN4	92	9	M	28-Apr-21	1"	OTFR
YLPR	GN4	98	10.9	M	28-Apr-21	1"	OTFR
YLPR	GN4	129	30.5	F	28-Apr-21	3/4"	OTFROP / 5.8 ovary weight
YLPR	GN4	134	28.7	F	28-Apr-21	3/4"	OTFROP spent
YLPR	GN4	90	8.5	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	92	9.2	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	88	7.9	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	92	8.9	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	82	6.9	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	91	10.9	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	88	8	M	28-Apr-21	3/4"	OTFROP
YLPR	GN4	90	6.8	F	28-Apr-21	3/4"	IMM OTFROP
YLPR	GN4	98	10.9	M	29-Apr-21	1"	
YLPR	GN4	113	17.5	M	29-Apr-21	1"	OTFROP

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	GN4	103	13.5	M	29-Apr-21	1"	OTFROP
YLPR	GN4	98	10.8	M	29-Apr-21	1"	
YLPR	GN4	89	9.2	M	29-Apr-21	1"	
YLPR	GN4	97	9.7	M	29-Apr-21	1"	
YLPR	GN4	95	9.9	M	29-Apr-21	1"	
YLPR	GN4	99	10.9	M	29-Apr-21	1"	
YLPR	GN4	86	7.7	M	29-Apr-21	1"	
YLPR	GN4	91	8.4	M	29-Apr-21	1"	
YLPR	GN4	90	9	M	29-Apr-21	3/4"	
YLPR	GN4	91	8.6	M	29-Apr-21	3/4"	
YLPR	GN4	93	8.8	M	29-Apr-21	3/4"	
YLPR	GN4	85	7.2	M	29-Apr-21	3/4"	
YLPR	GN4	87	7.1	M	29-Apr-21	3/4"	
YLPR	GN4	93	9	M	29-Apr-21	3/4"	
YLPR	GN4	83	6.8	M	29-Apr-21	3/4"	
YLPR	GN4	87	7.8	M	29-Apr-21	3/4"	
YLPR	GN4	85	7.1	M	29-Apr-21	3/4"	
YLPR	GN4	94	8.7	M	29-Apr-21	3/4"	
YLPR	MT1	101	10.8	M	28-Apr-21		
YLPR	MT1	111	16.9	M	28-Apr-21		
YLPR	MT1	104	12.3	M	28-Apr-21		
YLPR	MT1	88	8.6	M	28-Apr-21		
YLPR	MT1	97	9.9	M	28-Apr-21		
YLPR	MT3	109	15.3	M	28-Apr-21		OTFR
YLPR	MT3	89	7.8	M	28-Apr-21		
YLPR	MT3	97	9.5	M	28-Apr-21		OTFR
YLPR	MT3	108	13.6	M	28-Apr-21		OTFR
YLPR	MT3	92	7.9	M	28-Apr-21		
YLPR	MT3	99	10.8	M	28-Apr-21		
YLPR	MT3	104	13.1	M	28-Apr-21		OTFR
YLPR	MT3	92	8.5	M	28-Apr-21		
YLPR	MT3	91	7.9	M	28-Apr-21		
YLPR	MT3	98	9.5	M	28-Apr-21		
YLPR	MT5	90	7.7	M	28-Apr-21		OTFR
YLPR	MT6	96	8.7	M	27-Apr-21		
YLPR	MT6	92	8.3	M	27-Apr-21		
YLPR	MT6	87	6.9	M	27-Apr-21		
YLPR	MT6	95	9.4	M	27-Apr-21		
YLPR	MT6	95	8.6	M	27-Apr-21		
YLPR	MT6	109	13.9	M	28-Apr-21		OTFR
YLPR	MT6	108	14.2	M	28-Apr-21		
YLPR	MT6	108	13.4	M	28-Apr-21		
YLPR	MT6	98	9.6	M	28-Apr-21		

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	MT6	96	9.8	M	28-Apr-21		
YLPR	MT6	101	11.4	M	28-Apr-21		
YLPR	MT6	92	8.3	M	28-Apr-21		
YLPR	MT6	91	8.9	M	29-Apr-21		
YLPR	MT6	93	9.1	M	29-Apr-21		
YLPR	MT6	87	8	M	29-Apr-21		
YLPR	MT6	94	10.4	M	29-Apr-21		
YLPR	MT6	92	9	M	29-Apr-21		
YLPR	MT6	85	7.4	M	29-Apr-21		
YLPR	MT6	89	9.2	M	29-Apr-21		
YLPR	MT6	93	9.4	M	29-Apr-21		
YLPR	MT6	86	7.9	M	29-Apr-21		
YLPR	MT6	95	11.5	M	29-Apr-21		OTFROP
YLPR	MT6	110	15.9	M	29-Apr-21		OTFROP (1 OP)
YLPR	MT6	105	12.7	M	29-Apr-21		OTFROP
YLPR	MT6	85	6.5	M	29-Apr-21		OTFROP
YLPR	MT6	94	9.8	M	29-Apr-21		OTFROP
YLPR	MT6	94	100	M	29-Apr-21		OTFROP
YLPR	MT6	108	10.7	M	29-Apr-21		OTFROP
YLPR	MT6	84	7	M	29-Apr-21		OTFROP
YLPR	MT6	85	8.6	M	29-Apr-21		OTFROP
YLPR	MT6	91	8.7	M	29-Apr-21		OTFROP
YLPR	MT6	83	6.3	M	29-Apr-21		OTFROP
YLPR	MT7	98	9.7	M	27-Apr-21		
YLPR	MT7	104	11.4	M	27-Apr-21		
YLPR	MT7	89	7.5	M	27-Apr-21		
YLPR	MT7	75	4.1	M	27-Apr-21		
YLPR	MT7	98	9.3	M	27-Apr-21		
YLPR	MT7	97	9.4	M	27-Apr-21		
YLPR	MT7	93	8.3	M	29-Apr-21		OTFROP
YLPR	MT7	97	10.6	M	29-Apr-21		OTFROP
YLPR	MT7	101	12	M	29-Apr-21		OTFROP
YLPR	MT7	100	10.2	M	29-Apr-21		OTFROP
YLPR	MT7	86	7.9	M	29-Apr-21		OTFROP
YLPR	MT7	91	8.1	M	29-Apr-21		OTFROP spent
YLPR	MT7	93	9	M	29-Apr-21		OTFROP
YLPR	MT7	86	7.6	M	29-Apr-21		OTFROP
YLPR	MT8	104	104	M	28-Apr-21		OTFR
YLPR	MT8	103	103	M	28-Apr-21		
YLPR	MT8	87	87	M	28-Apr-21		
YLPR	MT9	104	12.5	M	28-Apr-21		
YLPR	MT9	101	10.5	M	28-Apr-21		
YLPR	MT9	92	8.6	M	28-Apr-21		

Species [1]	Method [2]	FL (mm)	WT (g)	Sex	Date	Mesh	Comments [3]
YLPR	MT9	97	10.3	M	28-Apr-21		OTFR
YLPR	MT9	94	8.6	M	28-Apr-21		
YLPR	MT9	91	8.3	M	28-Apr-21		
YLPR	MT9	93	8.5	M	28-Apr-21		
YLPR	MT9	96	9.6	M	28-Apr-21		
YLPR	MT9	90	8.1	M	28-Apr-21		
YLPR	MT9	90	7.5	M	28-Apr-21		
YLPR	MT9	93	8.9	M	28-Apr-21		
YLPR	MT9	86	6.8	M	28-Apr-21		OTFR
YLPR	MT9	93	8.1	M	28-Apr-21		Spent

[1] YLPR = Yellow Perch

[2] GN = Gill Net; MT = Minnow Trap

[3] FR = Fin Ray; OP = Operculum; OT = Otolith

Appendix E Invert Solutions Data

Table E1. Invert Solutions zooplankton lab results from Summerside north site, August 26, 2021.

Lake:	Summerside North	**Date Counted:**	14-Sep-21
Project No.	20-074	**Rotifer Sample**	
Station No.	-	**Total Volume (mL)**	10
Sample No.	-	**Subsample volume (mL)**	0.5
Sample Date:	26-Aug-21		
Sample Time:	12:05	**Crustacea**	
Net Size (m) (13cm= 0.065) or (20 cm=0.1)	0.065	**Total Volume (mL)**	10
Sampling depth (m):	9.2	**Subsample volume (mL)**	0.25
Volume of Water Sampled	122.114		

Species	Total # in sub sample	Sample Abundance	Abundance/L	Total Biomass (µg/L)	Mean Length (mm)	Mean Width (mm)	Max Length (mm)	Min Length (mm)	Mean Individual Biovolume (mm^3)	Total Biovolume (mm^3/L)	Ln (L)	Lnα	β	Source
Rotifera														
Ascomorpha sp.	123	2460	20.145	6.40E-09	0.11		0.13	0.09	0.000157758	0.003178				McCauley 1984
Conochilus sp.	2	40	0.328	1.32E-12	0.10	0.07	0.10	0.09	0.000122864	0.000040				McCauley 1984
Collotheca sp.	54	1080	8.844	1.83E-08	0.08	0.04	0.09	0.05	0.002338909	0.020686				McCauley 1984
Gastropus sp.	25	500	4.095	5.59E-10	0.12		0.14	0.11	0.000333585	0.001366				McCauley 1984
Kellikottia longispina	6	120	0.983	9.74E-12	0.15		0.15	0.14	0.000100887	0.000099				McCauley 1984
Keratella cochlearis	52	1040	8.517	7.62E-10	0.17		0.19	0.16	0.000105123	0.000895				McCauley 1984
Lecane lunaris	1	20	0.164	1.40E-12	0.17		0.17	0.17	0.000523681	0.000086				McCauley 1984
Polyarthra sp.	570	11400	93.356	3.25E-07	0.11		0.13	0.09	0.000372391	0.034765				McCauley 1984
Cladocerans														
Bosminidae														
Bosmina sp.	120	4800	39.308	22.50	0.30		0.36	0.24			-1.19996	3.09	3.04	Bot76
Daphniidae														
Ceriodaphnia sp.	348	13920	113.992	128.00	0.48		0.58	0.35			-0.73237	2.562	3.34	Bot76
Daphnia Longispina complex	44	1760	14.413	56.55	0.96		1.19	0.92			-0.03922	1.478	2.83	Bot76
Sididae														
Diaphanosoma sp.	21	840	6.879	9.72	0.66		0.88	0.42			-0.41902	1.624	3.05	Bot76
Calanoida														
Skistodiaptomus oregonensis	20	800	6.551	56.39	1.09		1.16	1.04			0.083189	1.953	2.40	Bot76
Cyclopoida														
Diacyclops thomasi	9	360	2.948	17.30	0.93		1.08	0.77			-0.07648	1.953	2.40	Bot76
Mesocyclops edax	1	40	0.328	1.87	0.92		0.92	0.92			-0.08811	1.953	2.40	Bot76
Juvenile Copepodids/Cladocera														
Calanoid Juvenile	1	40	0.328	1.87	0.92		0.92	0.92			-0.08811	1.953	2.40	Bot76
Cyclopoid Juvenile	62	2480	20.309	19.03	0.43		0.89	0.31			-0.84089	1.953	2.40	Bot76
Daphnia sp. (juvenile)	158	6320	51.755	85.29	0.71		0.88	0.46			-0.34575	1.478	2.83	Bot76
Nauplii	379	15160	124.147	13.51	0.18		0.22	0.10			-1.73782	1.953	2.40	Bot76

Notes:

Daphnia Longispina complex includes Daphnia mendotae and Daphnia dentifera

Table E2. Invert Solutions zooplankton lab results from Summerside north site, August 26, 2021.

Lake:	Summerside South	**Date Counted:**	16-Sep-21
Project No.	20-074	**Rotifer Sample**	
Station No.	-	**Total Volume (mL)**	10
Sample No.	-	**Subsample volume (mL)**	0.75
Sample Date:	26-Aug-21		
Sample Time:	14:20	**Crustacea**	
Net Size (m) (13cm= 0.065) or (20 cm=0.1)	0.065	**Total Volume (mL)**	10
Sampling depth (m):	8.4	**Subsample volume (mL)**	0.25
Volume of Water Sampled	111.495		

Species	Total # in sub sample	Sample Abundance	Abundance/L	Total Biomass (µg/L)	Mean Length (mm)	Mean Width (mm)	Max Length (mm)	Min Length (mm)	Mean Individual Biovolume (mm^3)	Total Biovolume (mm^3/L)	Ln (L)	Lnα	β	Source
Rotifera														
Ascomorpha sp.	562	7493	67.208	6.19E-08	0.10		0.11	0.10	0.000137029	0.009209				McCauley 1984
Asplanchna sp.	1	40	0.359	1.11E-10	0.46		0.46	0.46	0.022072135	0.007919				McCauley 1984
Conochilus sp.	19	253	2.272	6.11E-11	0.10	0.07	0.11	0.08	0.000118384	0.000269				McCauley 1984
Collotheca sp.	39	520	4.664	3.87E-09	0.07	0.05	0.09	0.06	0.0017771	0.008288				McCauley 1984
Filinia sp.	1	13	0.120	4.19E-13	0.13		0.13	0.13	0.000292837	0.000035				McCauley 1984
Gastropus sp.	52	693	6.219	1.04E-09	0.11		0.12	0.10	0.000270233	0.001680				McCauley 1984
Kellikottia longispina	3	40	0.359	1.17E-12	0.14		0.15	0.13	9.10248E-05	0.000033				McCauley 1984
Keratella quadrata	5	67	0.598	2.40E-11	0.14		0.15	0.14	0.000671441	0.000401				McCauley 1984
Keratella cochlearis	73	973	8.730	8.87E-10	0.18		0.19	0.16	0.000116445	0.001017				McCauley 1984
Lecane copeis	1	13	0.120	1.52E-13	0.10		0.10	0.10	0.000106591	0.000013				McCauley 1984
Lecane lunaris	2	27	0.239	3.00E-12	0.17		0.18	0.16	0.000523681	0.000125				McCauley 1984
Polyarthra sp.	550	7333	65.773	1.70E-07	0.11		0.12	0.10	0.00039387	0.025906				McCauley 1984
Cladocerans														
Bosminidae														
Bosmina sp.	168	6720	60.272	37.08	0.31		0.36	0.24			-1.17625	3.09	3.04	Bot76
Daphniidae														
Ceriodaphnia sp.	260	10400	93.278	160.35	0.55		0.65	0.42			-0.60485	2.562	3.34	Bot76
Daphnia Longispina complex	3	120	1.076	3.91	0.94		0.96	0.92			-0.06625	1.478	2.83	Bot76
Sididae														
Diaphanosoma sp.	16	640	5.740	4.91	0.56		0.85	0.38			-0.58395	1.624	3.05	Bot76
Calanoida														
Skistodiaptomus oregonensis	24	960	8.610	78.12	1.11		1.23	1.04			0.10512	1.953	2.40	Bot76
Cyclopoida														
Diacyclops thomasi	8	320	2.870	19.80	0.99		1.18	0.82			-0.00908	1.953	2.40	Bot76
Mesocyclops edax	2	80	0.718	4.22	0.93		0.94	0.92			-0.07504	1.953	2.40	Bot76
Juvenile Copepodids/Cladocera														
Calanoid Juvenile	3	120	1.076	6.81	0.96		0.99	0.92			-0.04518	1.953	2.40	Bot76
Cyclopoid Juvenile	37	1480	13.274	52.82	0.79		1.06	0.46			-0.23832	1.953	2.40	Bot76
Daphnia sp. (juvenile)	159	6360	57.043	96.92	0.72		0.88	0.46			-0.33493	1.478	2.83	Bot76
Nauplii	318	12720	114.086	11.62	0.17		0.19	0.12			-1.7656	1.953	2.40	Bot76

Notes:

Daphnia Longispina complex includes *Daphnia mendotae* and *Daphnia dentifera*

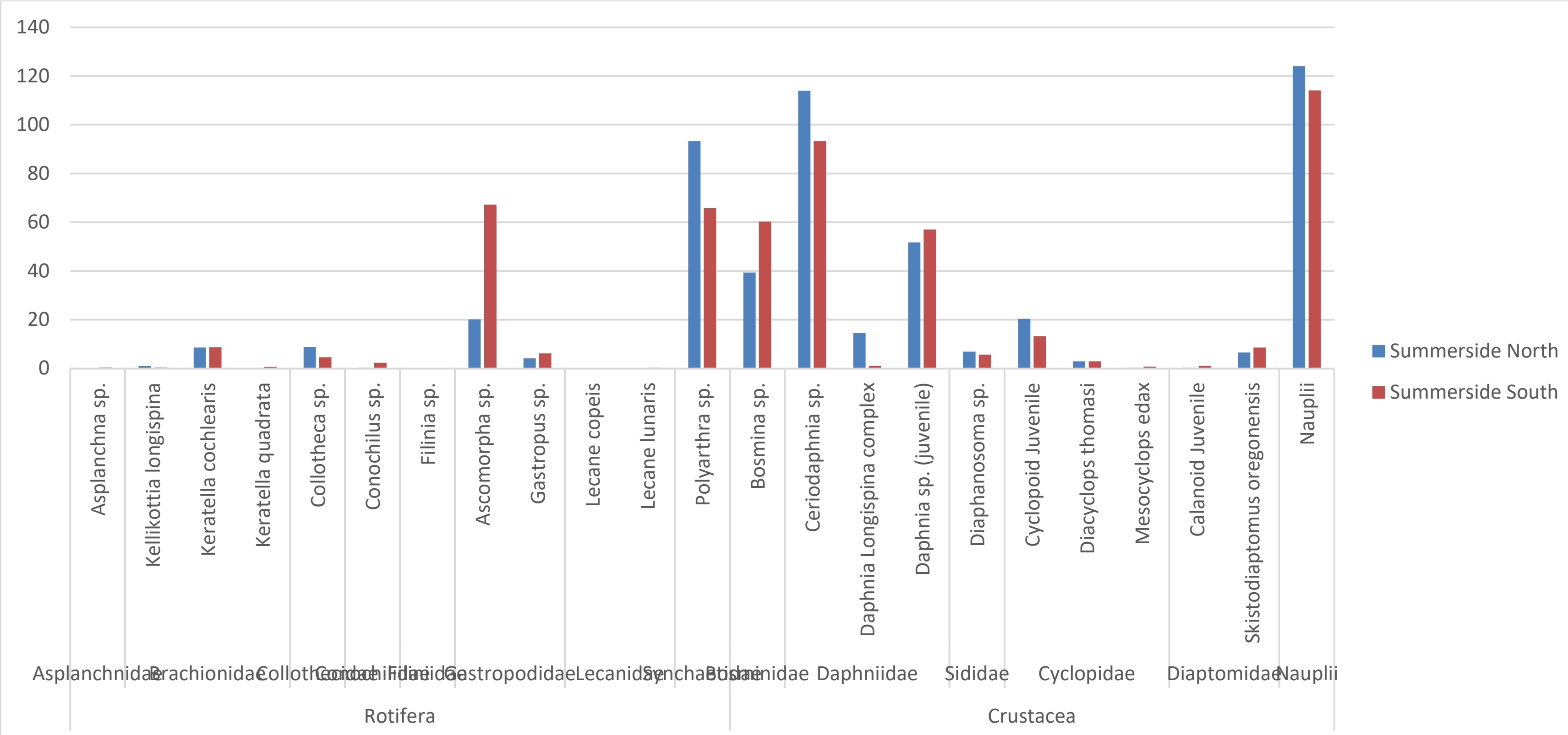


Figure E1. Comparison of the overall Rotifera zooplankton abundance for the Summerside north and south sites, August 26, 2021.

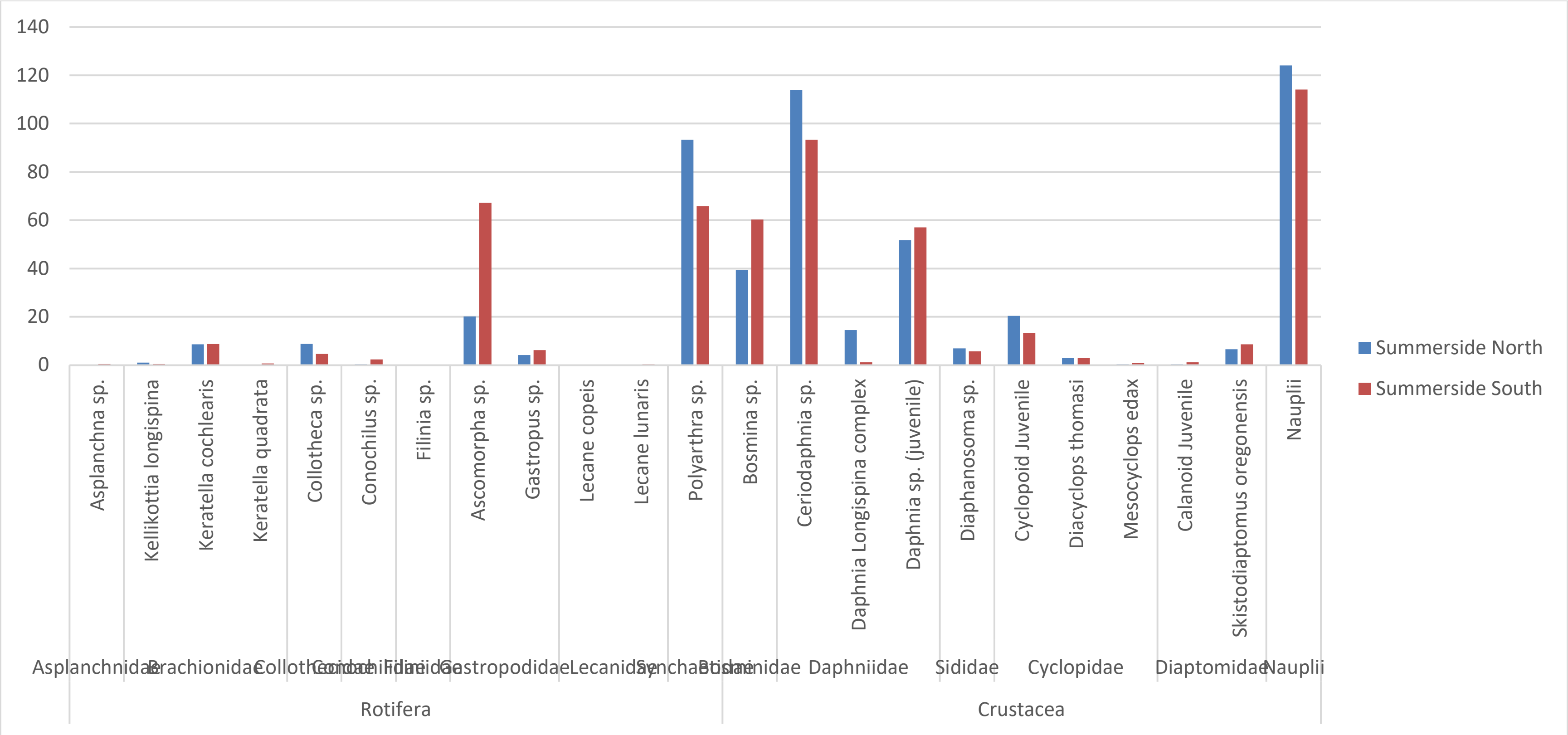


Figure E2. Comparison of the overall Crustacea zooplankton abundance for the Summerside north and south sites, August 26, 2021.

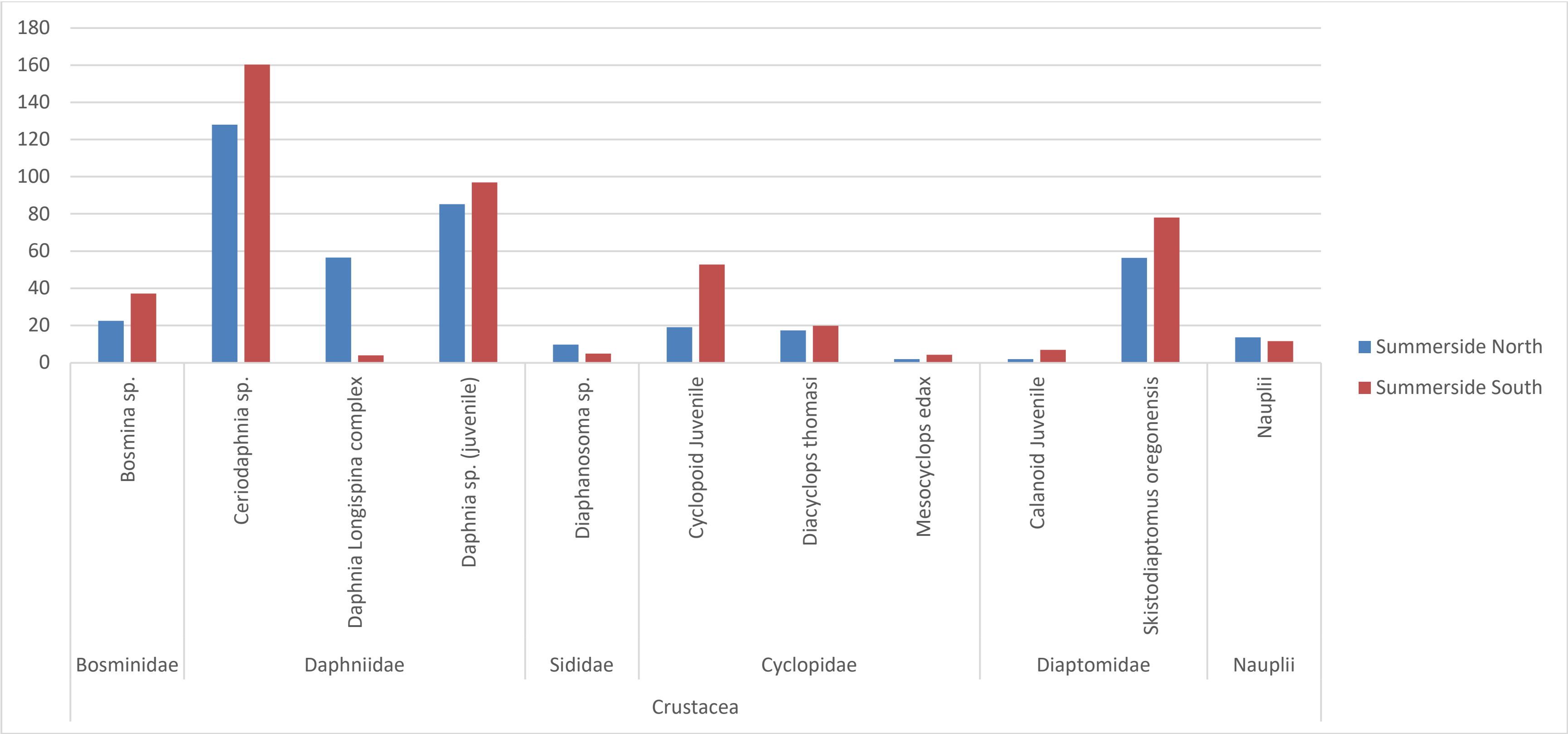


Figure E3. Comparison of the overall Rotifera zooplankton biomass for the Summerside north and south sites, August 26, 2021.

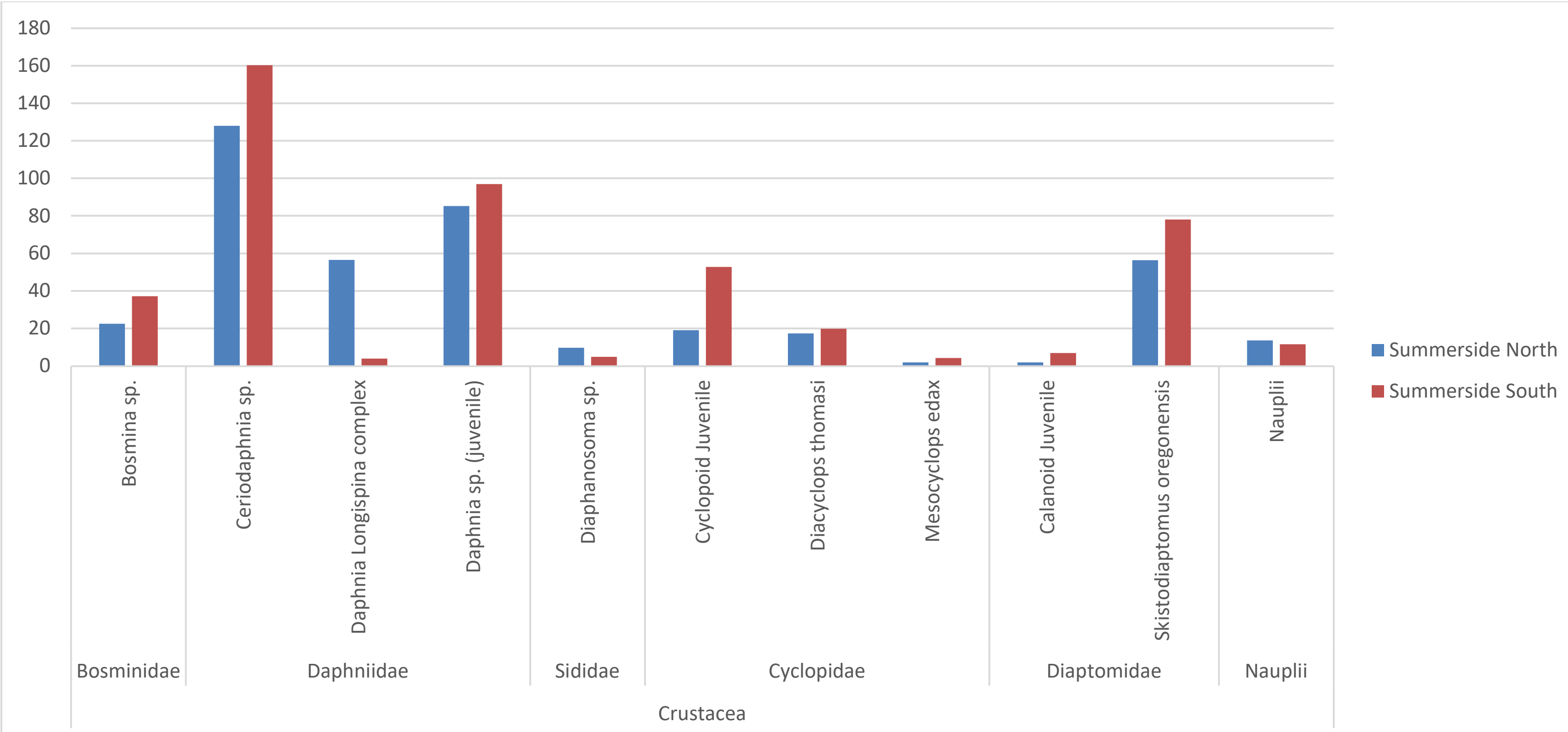


Figure E4. Comparison of the overall Crustacea zooplankton biomass for the Summerside north and south sites, August 26, 2021.

Table E3. Total biomass of zooplankton sampled at Summerside north and south sites, August 26, 2021.

Sum of Abundance/L	Column Labels		
Row Labels	**Summerside North**	**Summerside South**	**Grand Total**
Rotifera	**136.4302213**	**156.6585708**	**293.0887922**
Asplanchnidae		**0.358760086**	**0.358760086**
Asplanchna sp.		0.358760086	0.358760086
Brachionidae	**9.499343143**	**9.686522318**	**19.18586546**
Kellikottia longispina	0.98269067	0.358760086	1.341450756
Keratella cochlearis	8.516652473	8.729828756	17.24648123
Keratella quadrata		0.597933476	0.597933476
Collothecidae	**8.84421603**	**4.663881116**	**13.50809715**
Collotheca sp.	8.84421603	4.663881116	13.50809715
Conochilidae	**0.327563557**	**2.27214721**	**2.599710767**
Conochilus sp.	0.327563557	2.27214721	2.599710767
Filiniidae		**0.119586695**	**0.119586695**
Filinia sp.		0.119586695	0.119586695
Gastropodidae	**24.23970319**	**73.42623091**	**97.6659341**
Ascomorpha sp.	20.14515873	67.20772275	87.35288149
Gastropus sp.	4.094544458	6.218508155	10.31305261
Lecanidae	**0.163781778**	**0.358760086**	**0.522541864**
Lecane copeis		0.119586695	0.119586695
Lecane lunaris	0.163781778	0.239173391	0.402955169
Synchaetidae	**93.35561365**	**65.77268241**	**159.1282961**
Polyarthra sp.	93.35561365	65.77268241	159.1282961
Crustacea	**380.9564164**	**358.0425657**	**738.9989821**
Bosminidae	**39.3076268**	**60.27169443**	**99.57932122**
Bosmina sp.	39.3076268	60.27169443	99.57932122
Daphniidae	**180.1599562**	**151.3967562**	**331.5567124**
Ceriodaphnia sp.	113.9921177	93.27762232	207.26974
Daphnia Longispina complex	14.41279649	1.076280258	15.48907675
Daphnia sp. (juvenile)	51.75504195	57.04285365	108.7978956
Sididae	**6.87883469**	**5.740161374**	**12.61899606**
Diaphanosoma sp.	6.87883469	5.740161374	12.61899606
Cyclopidae	**23.58457608**	**16.86172404**	**40.44630012**
Cyclopoid Juvenile	20.30894051	13.27412318	33.58306369
Diacyclops thomasi	2.94807201	2.870080687	5.818152697
Mesocyclops edax	0.327563557	0.717520172	1.045083728
Diaptomidae	**6.87883469**	**9.686522318**	**16.56535701**
Calanoid Juvenile	0.327563557	1.076280258	1.403843814
Skistodiaptomus oregonensis	6.551271133	8.610242061	15.16151319
Nauplii	**124.146588**	**114.0857073**	**238.2322953**
Nauplii	124.146588	114.0857073	238.2322953
Grand Total	**517.3866377**	**514.7011365**	**1032.087774**