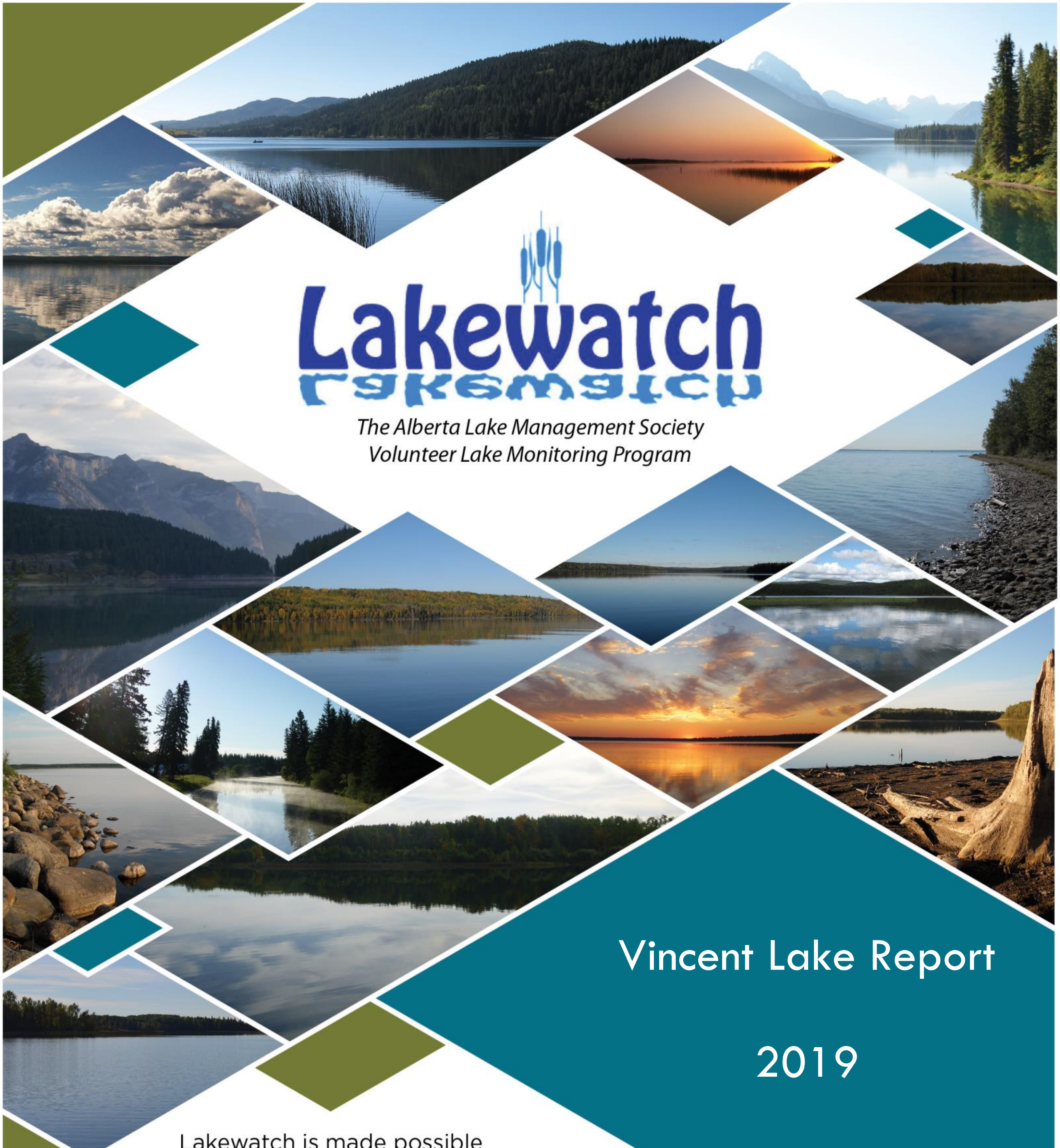


Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Vincent Lake Report

2019

Lakewatch is made possible with support from:

Alberta Environment and Parks

Pigeon Lake Watershed Association

Lacombe County

LICA Environmental Stewards

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data from Alberta's Lakes. Equally important is educating lake users about aquatic environments, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. LakeWatch reports are designed to summarize basic lake data in understandable terms for the widest audience, and are not meant to be a complete synopsis of information about specific lakes. Additional information is available for many lakes that have been included in LakeWatch, and readers requiring more information are encouraged to seek those sources.

ALMS would like to thank all who express interest in Alberta's aquatic environments, and particularly those who have participated in the LakeWatch program. These leaders in stewardship give us hope that our water resources will not be the limiting factor in the health of our environment.

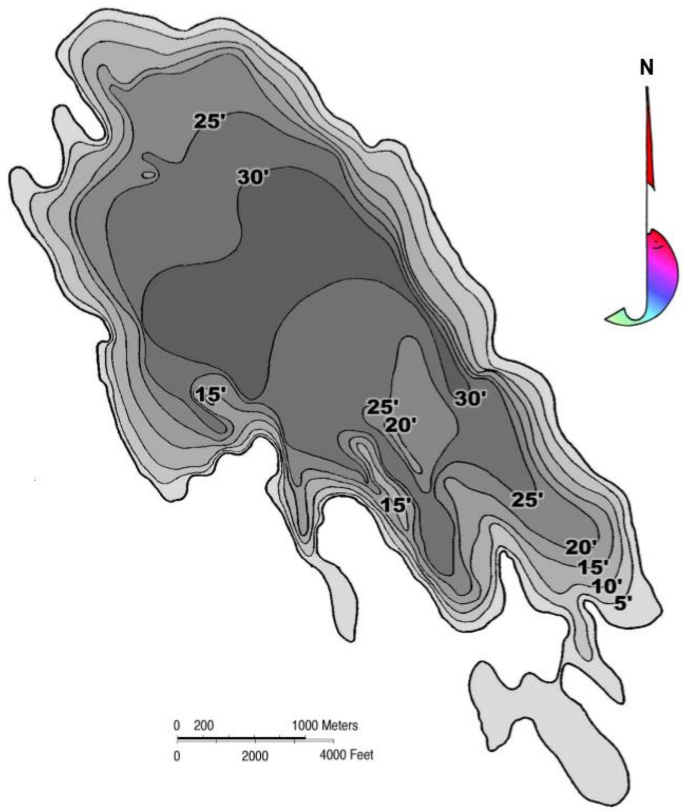
If you require data from this report, please contact ALMS for the raw data files.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. Special thanks to Patrick Traudt, who helped immensely with Vincent Lake sampling in 2019. We would also like to thank Sarah Davis Cornet, Caleb Sinn, and Pat Heney, who were summer technicians in 2019. Executive Director Bradley Peter and Program Coordinator Caitlin Mader were instrumental in planning and organizing the field program. This report was prepared by Pat Heney, Bradley Peter, and Caleb Sinn.

VINCENT LAKE

Vincent Lake is a small (7.9 km^2), and relatively shallow (mean and maximum depth 5.7 and 7.5 m, respectively) lake located approximately 17 km north of the town of St. Paul. The lake has a very abundant supply of nutrients and algae and is thus considered hypereutrophic. Algae regularly bloom, turning the water green and turbid, and surface clumps and mats of algae are common along the shoreline. Also, the lake is polymictic, meaning that its water column completely mixes periodically throughout the summer. Vincent Lake has a sandy bottom with some excellent sandy beaches. Submergent aquatic plants are abundant near the shore and in shallow areas and consist mostly of northern watermilfoil. Sport fish include northern pike, yellow perch, and walleye. The lake supports approximately 580 cottagers and about 130 farmers operate in its watershed (ACA, 2000). Farmers carry out a number of agricultural operations in the watershed including the production of forage, crops, and livestock. Agriculture occupies over half of Vincent Lake's drainage basin and contributes much of the nutrient inputs to the lake[1].



Bathymetric map[2] (in feet) of Vincent Lake, survey data from 1965[1].

Emergent vegetation along the shore of Vincent Lake. Photo by Shona Derlukewich, 2018.

[1] Mitchell, Patricia, and Ellie E. Prepas, eds. *Atlas of Alberta lakes*. University of Alberta, 1990.
[2] Anglers Atlas, retrieved 2019/02/04 from www.anglersatlas.com/place/102083/vincent-lake

METHODS

Profiles: Profile data is measured at the deepest spot in the main basin of the lake. At the profile site, temperature, dissolved oxygen, pH, conductivity and redox potential are measured at 0.5 – 1.0 m intervals. Additionally, Secchi depth is measured at the profile site and used to calculate the euphotic zone. For select lakes, metals are collected at the profile site by hand grab from the surface on one visit over the season.

Composite samples: At 10-sites across the lake, water is collected from the euphotic zone and combined across sites into one composite sample. This water is collected for analysis of water chemistry, chlorophyll-a, nutrients and microcystin. Quality control (QC) data for total phosphorus was taken as a duplicate true split on one sampling date. ALMS uses the following accredited labs for analysis: Routine water chemistry and nutrients are analyzed by Maxxam Analytics, chlorophyll-*a* and metals are analyzed by Innotech Alberta, and microcystin is analyzed by the Alberta Centre for Toxicology (ACTF).

Invasive Species: : Invasive mussel monitoring involved sampling with a 63 µm plankton net at three sample sites twice through the summer season to determine the presence of juvenile dreissenid mussel veligers. Technicians also harvested potential Eurasian watermilfoil (*Myriophyllum spicatum)* samples and submitted them for further analysis at the Alberta Plant Health Lab to genetically differentiate whether the sample was the invasive Eurasian watermilfoil or a native watermilfoil. In addition, select lakes were subject to a bioblitz, where a concerted effort to sample the lake's aquatic plant diversity took place.

Data Storage and Analysis: Data is stored in the Water Data System (WDS), a module of the Environmental Management System (EMS) run by Alberta Environment and Parks (AEP). Data goes through a complete validation process by ALMS and AEP. Users should use caution when comparing historical data, as sampling and laboratory techniques have changed over time (e.g. detection limits). For more information on data storage, see AEP Surface Water Quality Data Reports at www.alberta.ca/surface-water-quality-data.aspx.

Data analysis is done using the program R.[1] Data is reconfigured using packages tidyr [2] and dplyr [3] and figures are produced using the package ggplot2 [4]. Trophic status for each lake is classified based on lake water characteristics using values from Nurnberg (1996)[5]. The Canadian Council for Ministers of the Environment (CCME) guidelines for the Protection of Aquatic Life are used to compare heavy metals and dissolved oxygen measurements. Pearson's Correlation tests are used to examine relationships between total phosphorus (TP), chlorophyll-*a,* total kjeldahl nitrogen (TKN) and Secchi depth, providing a correlation coefficient (r) to show the strength (0-1) and a p-value to assess significance of the relationship.

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[1] R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

[2] Wickman, H. and Henry, L. (2017). tidyr: Easily Tidy Data with 'spread ( )' and 'gather ( )' Functions. R package version 0.7.2. https://CRAN.R-project.org/package=tidyr.

[3] Wickman, H., Francois, R., Henry, L. and Muller, K. (2017). dplyr: A Grammar of Data Manipulation. R package version 0.7.4. http://CRAN.R-project.org/package=dplyr.

[4] Wickham, H. (2009). ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York.

[5] Nurnberg, G.K. (1996). Trophic state of clear and colored, soft- and hardwater lakes with special consideration of nutrients, anoxia, phytoplankton and fish. Lake and Reservoir Management 12: 432-447.

BEFORE READING THIS REPORT, CHECK OUT A BRIEF INTRODUCTION TO LIMNOLOGY AT ALMS.CA/REPORTS

WATER CHEMISTRY

ALMS measures a suite of water chemistry parameters. Phosphorus, nitrogen, and chlorophyll-a are important because they are indicators of eutrophication, or excess nutrients, which can lead to harmful algal/cyanobacteria blooms. One direct measure of harmful cyanobacteria blooms are Microcystins, a common group of toxins produced by cyanobacteria. See Table 2 for a complete list of parameters.

The average total phosphorus (TP) concentration for Vincent Lake was 121 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. This value falls within the range of historical averages. Detected TP was lowest when first sampled in June at 95 µg/L, and rose throughout the season until it peaked in August at 160 µg/L (Figure 1).

Average chlorophyll-*a* concentrations in 2019 was 73.3 µg/L (Table 2), falling into the hypereutrophic, or very high productivity trophic classification. Following a similar trend to TP, Chlorophyll-*a* rose from a minimum of 19.1 µg/L in June to a maximum of 135 µg/L in mid August.

The average TKN concentration was 2.9 mg/L (Table 2), again with concentrations increasing over the course of the sampling season, dropping off in September.

Average pH was 8.89 in 2019, buffered by moderate alkalinity (240 mg/L $CaCO_3$) and bicarbonate (240 mg/L HCO_3). Sulphate was the dominant ion contributing to a medium conductivity of 663 µS/cm (Table 2).

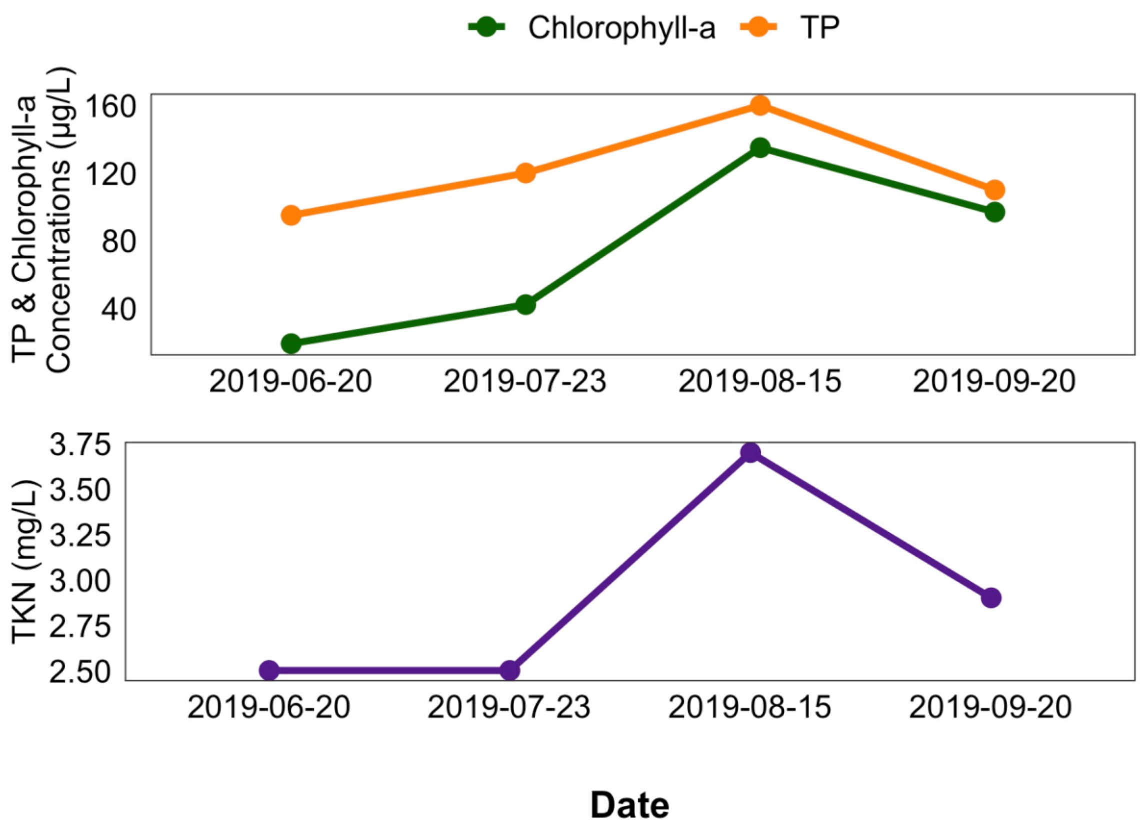

Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Vincent Lake.

METALS

Samples were analyzed for metals once throughout the summer (Table 3). In total, 27 metals were sampled for. It should be noted that many metals are naturally present in aquatic environments due to the weathering of rocks and may only become toxic at higher levels.

Metals were measured once on August 15 at Vincent Lake at the surface and all measured values fell within their respective guidelines (Table 3).

WATER CLARITY AND SECCHI DEPTH

Water clarity is influenced by suspended materials, both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring but then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi depth. Two times the Secchi depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

The average Secchi depth of Vincent Lake in 2019 was 1.33 m (Table 2). Secchi depth decreased by over 50% over the sampling season, rising slightly in September. This steady decrease in water clarity may have been due to increasing algae concentrations over the season, as indicated by increasing chlorophyll-a levels (Figure 2).

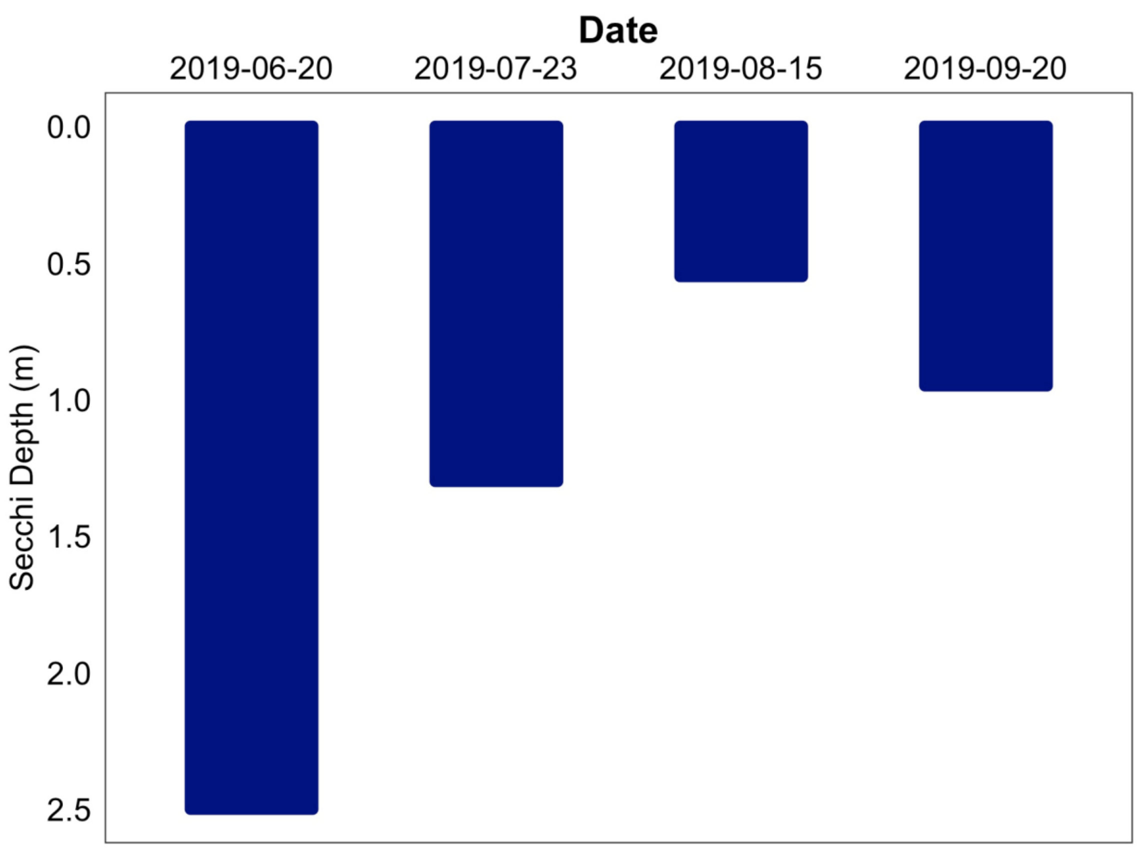

Figure 2. Secchi depth values measured four times over the course of the summer at Vincent Lake in 2019.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen (DO) profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

Temperatures of Vincent Lake varied throughout the summer with a maximum temperature of 23.1°C measured at the surface on July 4 (Figure 3a). The lake was not stratified during any of the sampling trips, with temperatures fairly constant from top to bottom, which indicates partial or complete mixing throughout the season.

Vincent Lake was well oxygenated through most of the water column on all sampling trips, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen (Figure 3b). On August 15, the surface of the lake was supersaturated while below 4 m the lake fell below the guideline of 6.5 mg/L. This may be due to several contributing factors, including a lack of water column mixing, and increased decomposition at the bottom of the lake due to the algal bloom.

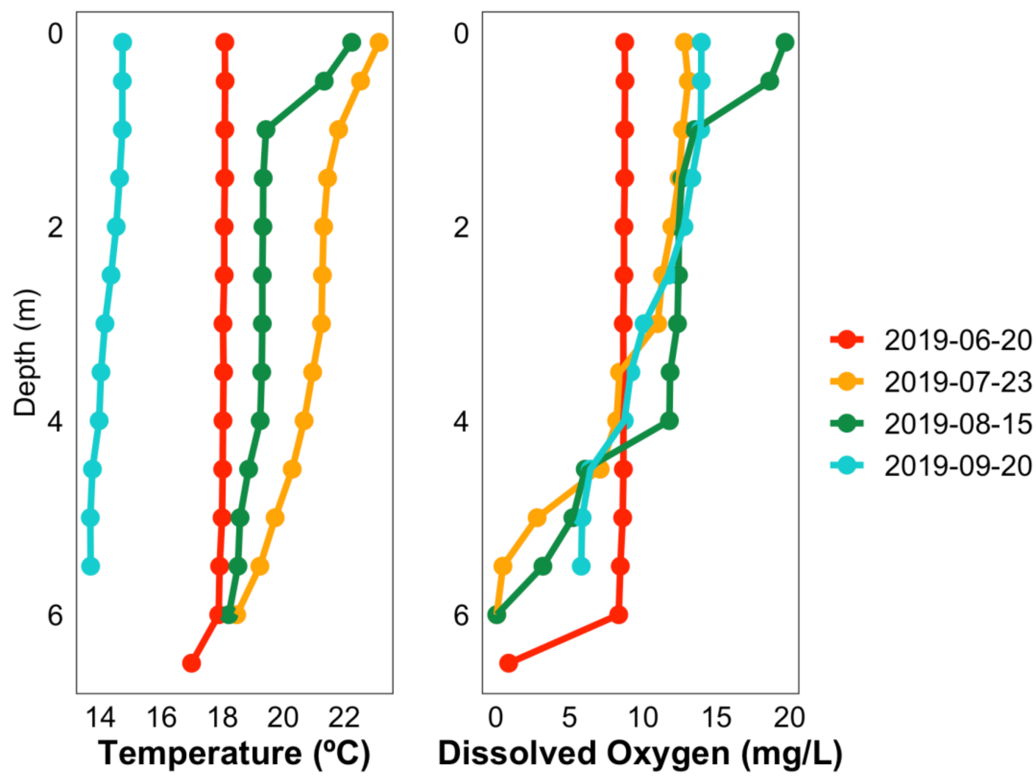

Figure 3. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Vincent Lake measured four times over the course of the summer of 2019.

MICROCYSTIN

Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested, can cause severe liver damage. Microcystins are produced by many species of cyanobacteria which are common to Alberta's Lakes, and are thought to be the one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 20 μg/L. Blue-green algae advisories are managed by Alberta Health Services. Recreating in algal blooms, even if microcystin concentrations are not above guidelines, is not recommended.

Composited microcystin levels in Vincent Lake fell below the recreational guideline of 20 μg/L in 2019. Individual locations on the lake may experience higher concentrations of toxins, therefore recreation should be avoided in cyanobacteria blooms.

Table 1. Microcystin concentrations measured four times at Vincent Lake in 2019.

Date	Microcystin Concentration (μg/L)
20-Jun-19	2.45
23-Jul-19	2.03
15-Aug-19	1.49
20-Sep-19	0.20
Average	1.54

INVASIVE SPECIES MONITORING

Dreissenid mussels pose a significant concern for Alberta because they impair the function of water conveyance infrastructure and adversely impact the aquatic environment. These invasive mussels have been linked to creating toxic algae blooms, decreasing the amount of nutrients needed for fish and other native species, and causing millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities.

Monitoring involved using a 63 μm plankton net at three sample sites to look for juvenile mussel veligers in each lake sampled. No mussels have been detected in Vincent Lake.

Eurasian watermilfoil is non-native aquatic plant that poses a threat to aquatic habitats in Alberta because it grows in dense mats preventing light penetration through the water column, reduces oxygen levels when the dense mats decompose, and outcompetes native aquatic plants.

Suspect samples collected from Vincent Lake on July 23 were confirmed to be the native Northern watermilfoil (*Myriophyllum sibiricum)*.

WATER LEVELS

There are many factors influencing water quantity. Some of these factors include the size of the lake's drainage basin, precipitation, evaporation, water consumption, ground water influences, and the efficiency of the outlet channel structure at removing water from the lake. Requests for water quantity monitoring should go through Alberta Environment and Parks Monitoring and Science division.

Records of water levels in Vincent Lake date back to 1966 (Figure 4). Water levels in the lake remained very stable from the late 1960s through the 1980s. In the early 1990s, Vincent Lake water levels began a slow decline of approximately 4 meters, until record lows in 2016. However, since 2016, levels have been on the rise again, but are still significantly lower than levels in the 1980s and before.

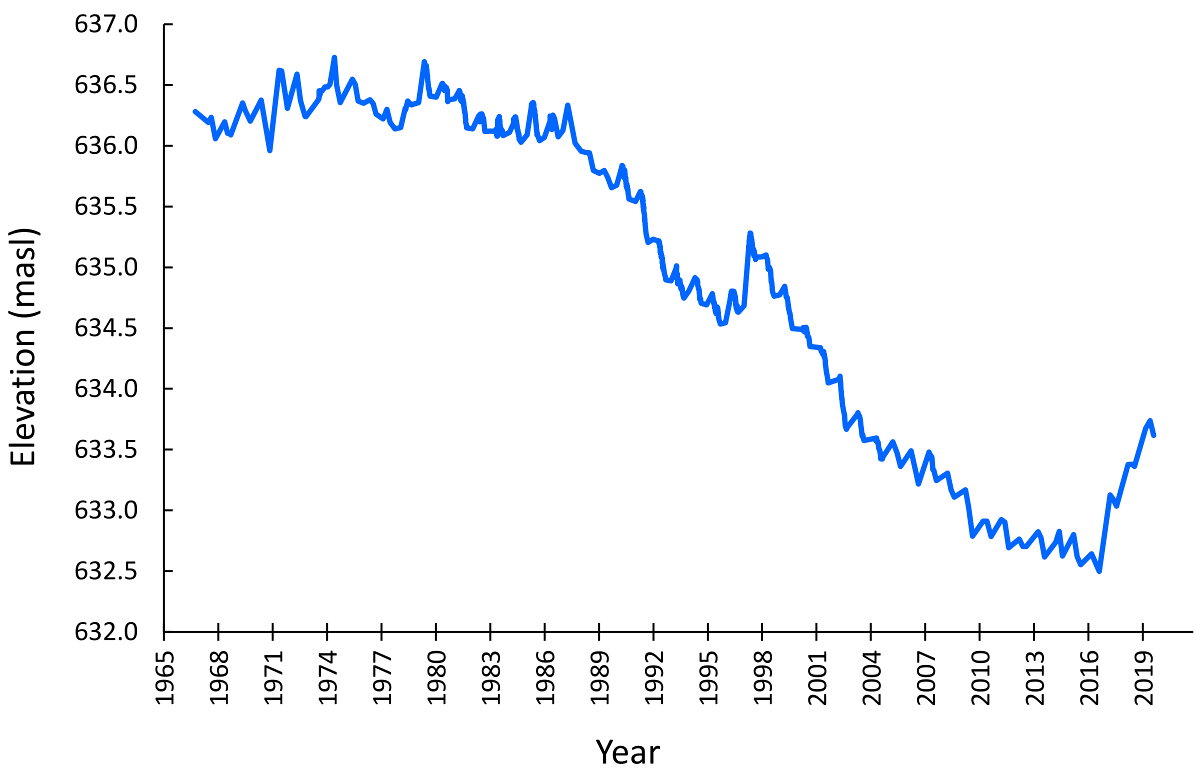

Figure 4. Surface elevation of Vincent Lake in meters above sea level (masl) from 1966 to 2019. Data retrieved from Alberta Environment and Parks.

Table 2. Average historical Secchi depth and water chemistry values for Vincent Lake.

Parameter	1983	2000	2001	2018	2019
TP (µg/L)	235	50	58	106	121
TDP (µg/L)	/	/	26	16	42
Chlorophyll-*a* (µg/L)	16.6	13.0	24.0	83.0	73.3
Secchi depth (m)	3.30	/	2.50	1.14	1.33
TKN (mg/L)	/	/	1.6	3.1	2.9
NO_2-N and NO_3-N (µg/L)	/	/	8	5	10
NH_3-N (µg/L)	/	/	8	88	57
DOC (mg/L)	/	/	/	24	25
Ca (mg/L)	/	/	28	29	31
Mg (mg/L)	/	/	37	49	47
Na (mg/L)	/	/	16	24	23
K (mg/L)	/	/	30	43	41
SO_4^{2-} (mg/L)	/	/	55	108	108
Cl^- (mg/L)	/	/	6	13	14
CO_3 (mg/L)	/	/	21	23	25
HCO_3 (mg/L)	/	/	114	246	240
pH	/	/	9.00	8.83	8.89
Conductivity (µS/cm)	/	/	500	672	663
Hardness (mg/L)	/	/	/	278	270
TDS (mg/L)	/	/	/	422	413
Microcystin (µg/L)	/	/	/	2.12	1.54
Total Alkalinity (mg/L $CaCO_3$)	/	/	218	240	240

Table 3. Concentrations of metals measured in Vincent Lake in 2019. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference. Values above these guidelines are presented in red.

Metals (Total Recoverable)	2019	Guidelines
Aluminum µg/L	3.1	100[a]
Antimony µg/L	0.06	/
Arsenic µg/L	2.11	5
Barium µg/L	64.4	/
Beryllium µg/L	0.0015	100[c,d]
Bismuth µg/L	0.0015	/
Boron µg/L	64.2	1500
Cadmium µg/L	0.005	0.26[b]
Chromium µg/L	0.05	/
Cobalt µg/L	0.057	1000[d]
Copper µg/L	0.7	4[b]
Iron µg/L	15.9	300
Lead µg/L	0.015	7[b]
Lithium µg/L	44.7	2500[e]
Manganese µg/L	65.9	5.2
Molybdenum µg/L	0.354	73[c]
Nickel µg/L	1.72	150[b]
Selenium µg/L	0.2	1
Silver µg/L	0.002	0.25
Strontium µg/L	238	/
Thallium µg/L	0.001	0.8
Thorium µg/L	0.008	/
Tin µg/L	0.03	/
Titanium µg/L	1.8	/
Uranium µg/L	0.358	15
Vanadium µg/L	0.32	100[d,e]
Zinc µg/L	0.5	30