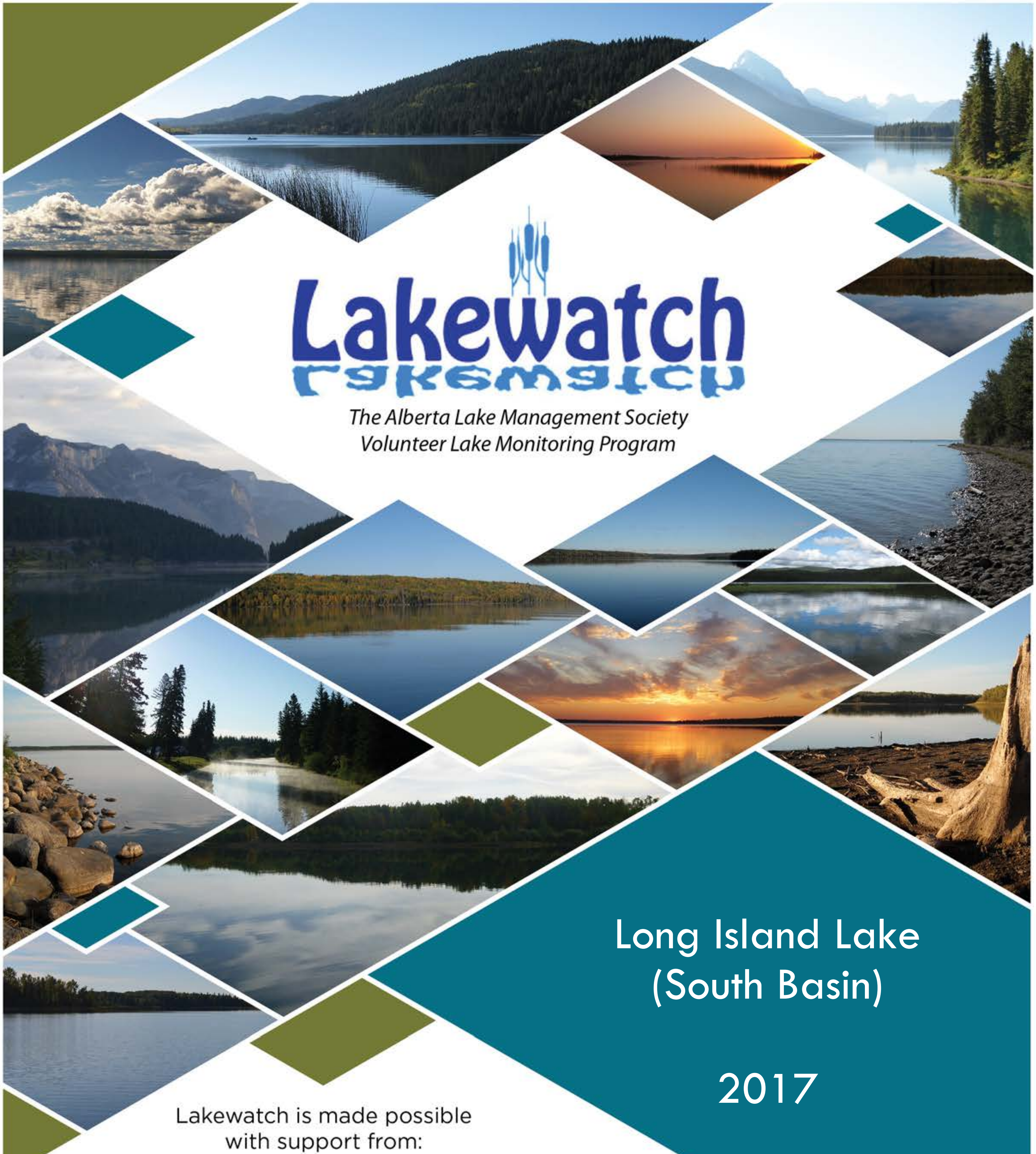

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Long Island Lake (South Basin)

2017

Lakewatch is made possible with support from:

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LICA Lakeland Industry & Community Association
Red Deer River Watershed Alliance
Beaver River Watershed Alliance
Alberta Environment and Parks

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, 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 a lay 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 people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health of our environment.

ALMS is happy to discuss the results of this report with our stakeholders. If you would like information or a public presentation, contact us at info@alms.ca.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Ken Schauenbergk for the time and energy put into sampling Long Island Lake in 2017. We would also like to thank Elashia Young and Melissa Risto who were summer technicians in 2017. Executive Director Bradley Peter and LakeWatch Coordinator Laura Redmond was instrumental in planning and organizing the field program. This report was prepared by Laura Redmond and Bradley Peter. The Beaver River Watershed, the Lakeland Industry and Community Association, Environment Canada, and Alberta Environment and Parks are major sponsors of the LakeWatch program.

LONG ISLAND LAKE

Long Island Lake is a beautiful spring fed lake, located north of Edmonton on Highway 44 to Westlock, Township Road 63 and Range Road 25. Long Island Lake has an average depth of 7.4 m with a maximum depth of 14 m. The lake is comprised of 2 basins encompassing an area of 216 hectares (2.16 km^2) the north basin is larger and deeper than the south basin, and it is in the north basin that an island exists with a surface area of 16.2 hectares (0.16 km^2). The shoreline length of Long Island Lake is 15.9 km. The south basin has a Summer Village and the North Basin has cottages and a campground.

Long Island Lake—Photo by Heather Jones

Algae blooms are known to occur during the late summer months due to the lakes natural productivity. The lake is eutrophic and has a moderate littoral area in relation to its surface area. A detailed algal composition has not been completed for the lake. The siltclay lake bed supports dense aquatic vegetation. In the north and south basins bulrush (*Scirpus* spp.), cattail (*Typha* spp.) and sedges (*Carex* spp.) are common. Terrestrial vegetation is mainly spruce (*Picea* spp.), willow (*Salix* spp.) and balsam poplar (*Populus balsamifera*). The only reported sport fish in the lake is Northern pike (*Esox lucius*) (AENV, 1983).

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. On one visit per season, metals are collected at the profile site by hand grab from the surface and at some lakes, 1 m off bottom using a Kemmerer.

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 Alberta Innovates Technology Futures (AITF), and microcystin is analyzed by the Alberta Centre for Toxicology (ACTF). In lakes where mercury samples are taken, they are analyzed by the Biogeochemical Analytical Service Laboratory (BASL).

Invasive Species: Monitoring for invasive quagga and zebra mussels involved two components: monitoring for juvenile mussel veligers using a 63 µm plankton net at three sample sites and monitoring for attached adult mussels using substrates installed at each lake.

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 aep.alberta.ca/water.

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 TP, chlorophyll-*a,* 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 Long Island Lake was 21 μg/L (Table 2), falling into the mesotrophic, or moderately productive, trophic classification. TP increased over the course of the sampling season (Figure 1).

Average chlorophyll-*a* concentrations in 2017 was 7.6 μg/L (Table 2), also putting Long Island Lake into the mesotrophic classification. This falls well within the range of historical averages for chlorophyll-*a*. Chlorophyll-*a* concentrations increased over the sampling season, reaching a maximum concentration of 13.2 μg/L on September 14.

Finally, the average TKN concentration was 0.99 mg/L (Table 2), and the maximum concentration was measured on September 14.

Average pH was measured as 8.16 in 2017, buffered by moderate alkalinity (109.5 mg/L $CaCO_3$) and bicarbonate (134 mg/L HCO_3). Calcium was the dominant ions contributing to a low conductivity of 220 μS/cm (Table 2).

METALS

Samples were analyzed for metals (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 on September 14 at Long Island Lake at the surface. In 2017, all measured values fell within their respective guidelines (Table 3). Total mercury was measured at the surface (0.48 ng/L) as well as the bottom (1.01 ng/L), and both fell below the guideline.

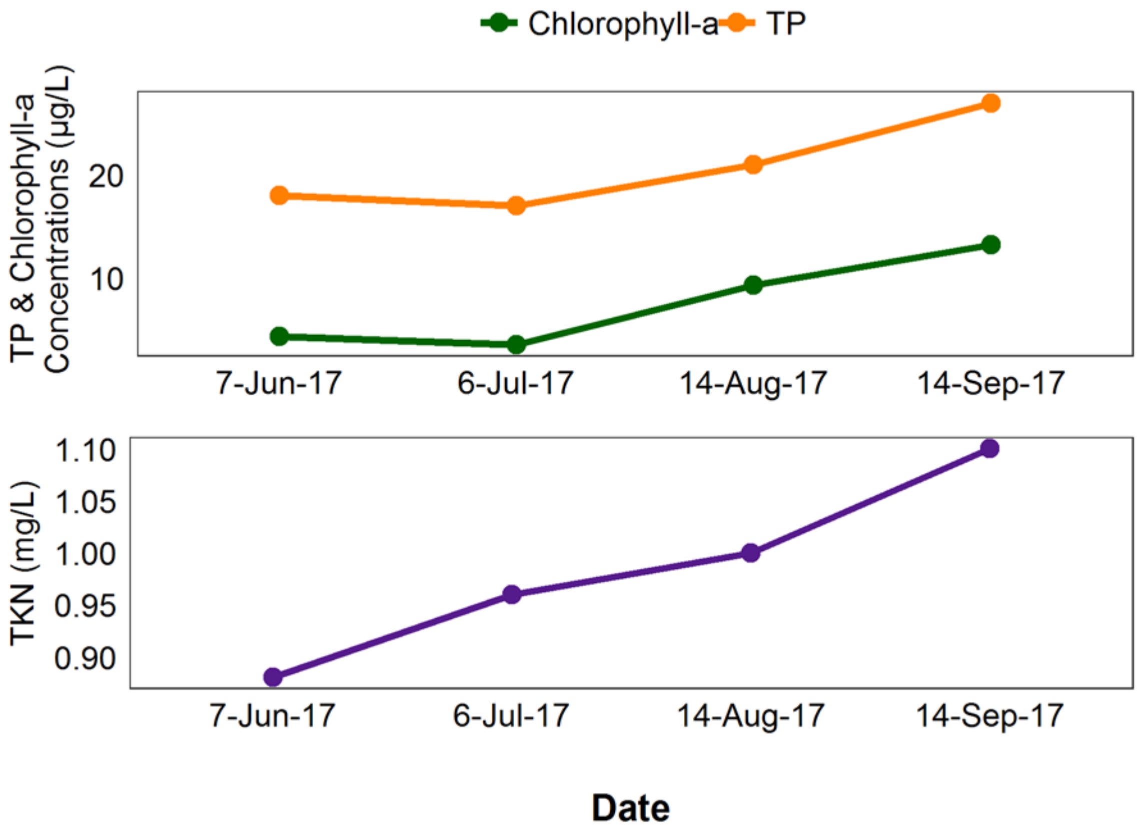

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at the south basin of Long Island Lake.

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 Long Island Lake in 2017 was 2.68 m (Table 2). Water clarity measured as Secchi depth decreased over the course of the season. The decreasing water clarity could be associated with increasing algae biomass in the warmer months of the summer.

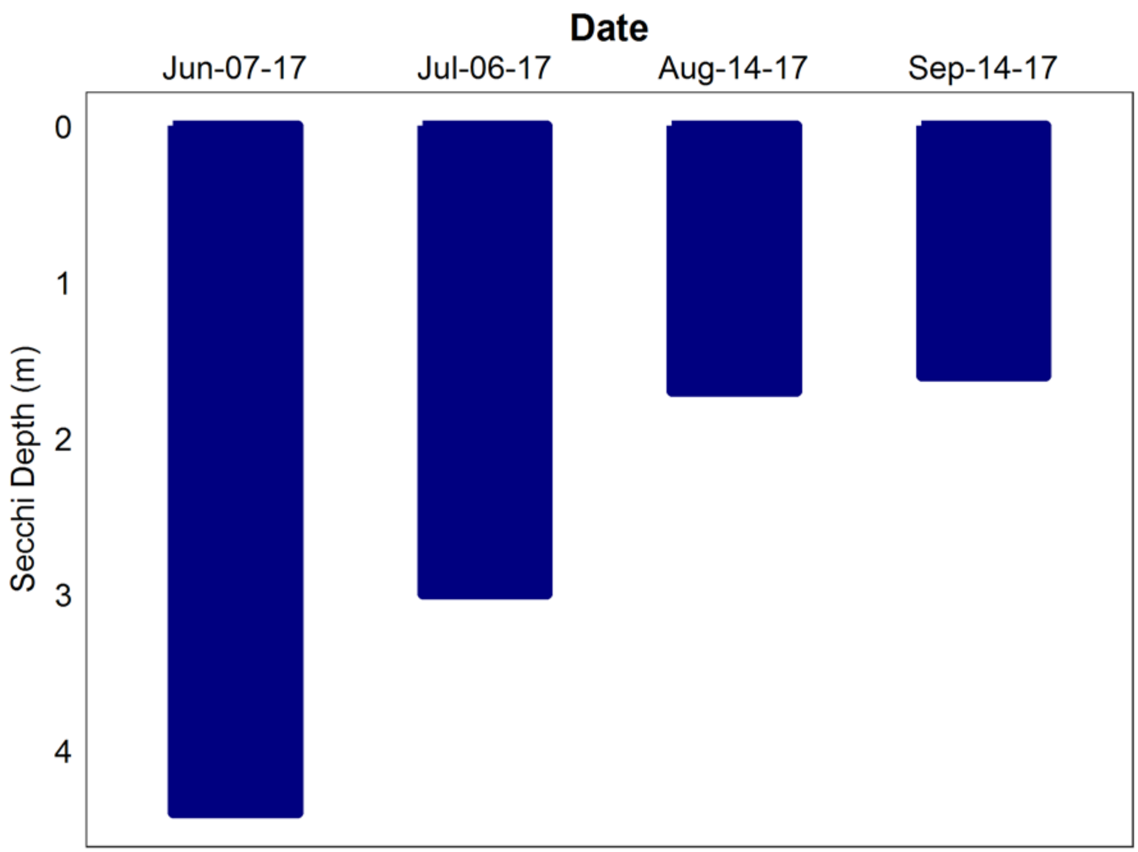

Figure 2 – Secchi depth values measured four times over the course of the summer at the south basin of Long Island Lake in 2017.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen 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 Long Island Lake varied throughout the summer, with a maximum temperature of 21.9 °C measured at the surface on July 6 (Figure 3a). The lake was strongly stratified for the entire sampling season, with the thermocline deepening as the summer progressed.

Long Island Lake remained well oxygenated at the surface throughout the summer, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). During thermal stratification, oxygen levels reached anoxia near the bottom because it is cut off from atmospheric oxygen that is circulated at the water surface.

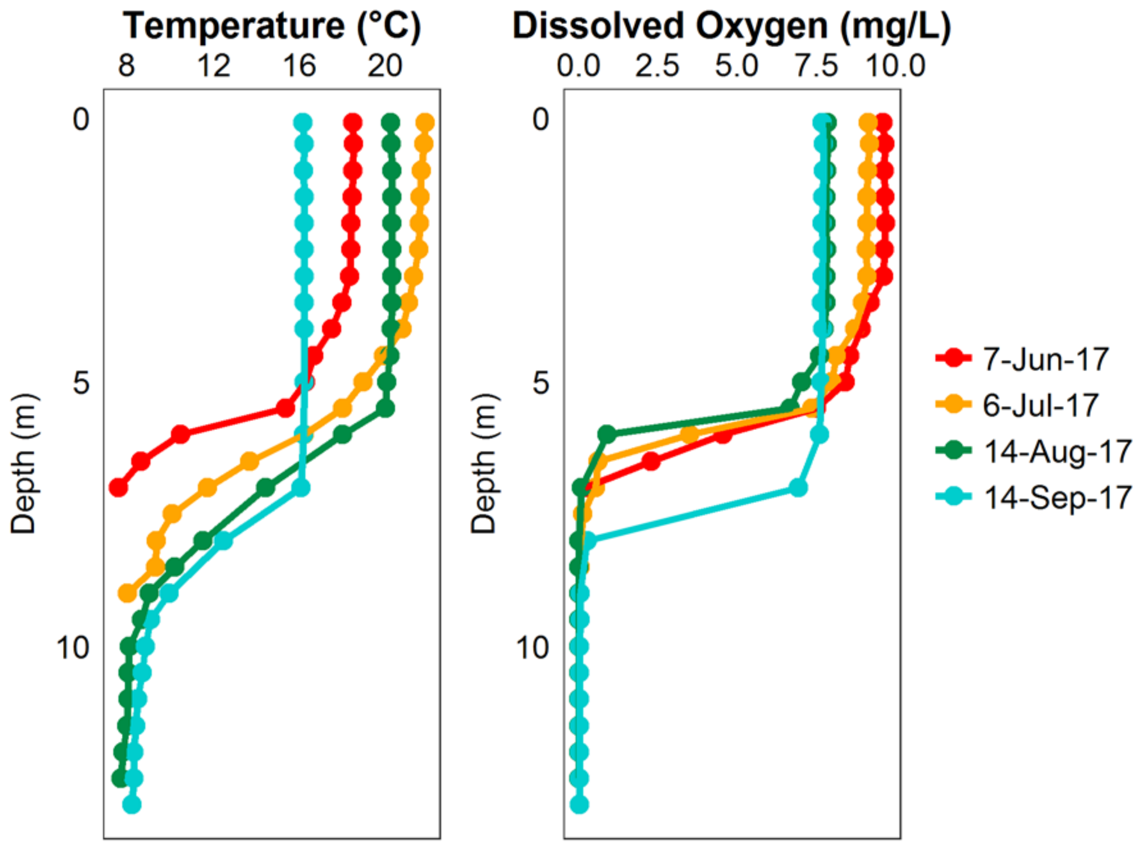

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for the south basin of Long Island Lake measured four times over the course of the summer of 2017.

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.

Microcystin levels in Long Island Lake fell below the recreational guideline for the entire sampling period of 2017 (Table 1).

Table 1 – Microcystin concentrations measured four times at the south basin of Long Island Lake in 2017.

Date	Microcystin Concentration (μg/L)
Jun-07-17	0.11
Aug-14-17	0.23
Sep-14-17	0.23
Jul-06-17	0.11
Average	0.17

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 two components: monitoring for juvenile mussel veligers using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. No mussels have been detected in Long Island Lake.

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.

Water levels in Long Island Lake have been relatively consistent since monitoring began in 1961 (Figure 4). Water levels have remained within a range of about 1 m, although there was a decline that began in the late 1990s. Water level data for 2016 and 2017 were not available.

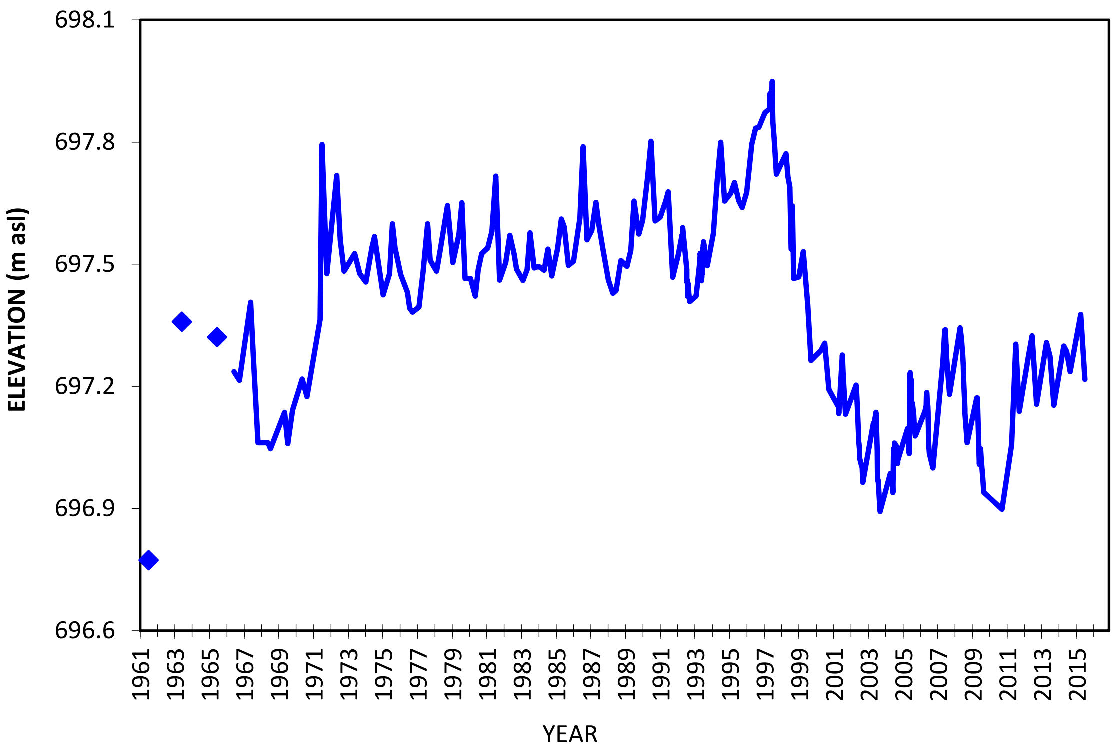

Figure 4- Water levels measured in metres above sea level (m asl) from 1961-2015. Data retrieved from Alberta Environment.

Table 2: Average Secchi depth and water chemistry values for the south basin of Long Island Lake. Historical values are given for reference.

Parameter	1992	2004	2007	2017
TP (µg/L)	25	30	28	21
TDP (µg/L)	11	11	13.3	6.5
Chlorophyll-*a* (µg/L)	8.9	15.7	5.3	7.6
Secchi depth (m)	4.6	2.95	3.7	2.68
TKN (mg/L)	0.92	1.08	0.97	0.99
NO_2-N and NO_3-N (µg/L)	3.2	5.2	<5	5.05
NH_3-N (µg/L)	/	/	/	18.5
DOC (mg/L)	-	-	16.0	13.25
Ca (mg/L)	28.2	27.6	30.3	26.25
Mg (mg/L)	11.4	11.6	12.6	11.35
Na (mg/L)	2.8	3	4.4	3.15
K (mg/L)	4.1	5	4.7	4.7
SO_4^{2-} (mg/L)	-	3	<3	0.5
Cl^- (mg/L)	0.567	0.7	1.1	1.9
CO_3 (mg/L)	-	4	6	0.25
HCO_3 (mg/L)	125	162	160	134
pH	8.2	8.33	8.2	8.16
Conductivity (µS/cm)	237	253	318	220
Hardness (mg/L)	/	/	/	112.75
TDS (mg/L)	/	/	135.7	115.75
Microcystin (µg/L)	/	/	/	0.17
Total Alkalinity (mg/L $CaCO_3$)	118	129	134.3	109.5

Table 3: Concentrations of metals measured in the south basin of Long Island Lake. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	2004	2017	Guidelines
Aluminum µg/L	26.6	3	100[a]
Antimony µg/L	0.824	0.037	/
Arsenic µg/L	0.83	0.74	5
Barium µg/L	59.1	55.6	/
Beryllium µg/L	<0.003	0.006	100[c,d]
Bismuth µg/L	0.002	0.003	/
Boron µg/L	32.9	32.1	1500
Cadmium µg/L	0.0044	0.005	0.26[b]
Chromium µg/L	0.13	0.05	/
Cobalt µg/L	0.042	0.034	1000[d]
Copper µg/L	0.813	0.42	4[b]
Iron µg/L	85.4	58.2	300
Lead µg/L	0.044	0.021	7[b]
Lithium µg/L	8.3	7.21	2500[e]
Manganese µg/L	23.7	21.2	200[e]
Mercury (dissolved) ng/L	/	0.24	/
Mercury (total) ng/L	/	0.48	26
Molybdenum µg/L	0.24	0.236	73[c]
Nickel µg/L	0.03	0.32	150[b]
Selenium µg/L	<0.04	0.1	1
Silver µg/L	0.004	0.004	0.25
Strontium µg/L	125.5	107	/
Thallium µg/L	0.044	0.007	0.8
Thorium µg/L	0.009	0.013	/
Tin µg/L	<0.03	0.03	/
Titanium µg/L	0.7	0.31	/
Uranium µg/L	0.3975	0.273	15
Vanadium µg/L	0.183	0.055	100[d,e]
Zinc µg/L	6.66	0.4	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness > 180mg/L (as $CaCO_3$)
[c] CCME interim value.
[d] Based on CCME Guidelines for Agricultural use (Livestock Watering).
[e] Based on CCME Guidelines for Agricultural Use (Irrigation).
A forward slash (/) indicates an absence of data or guidelines.