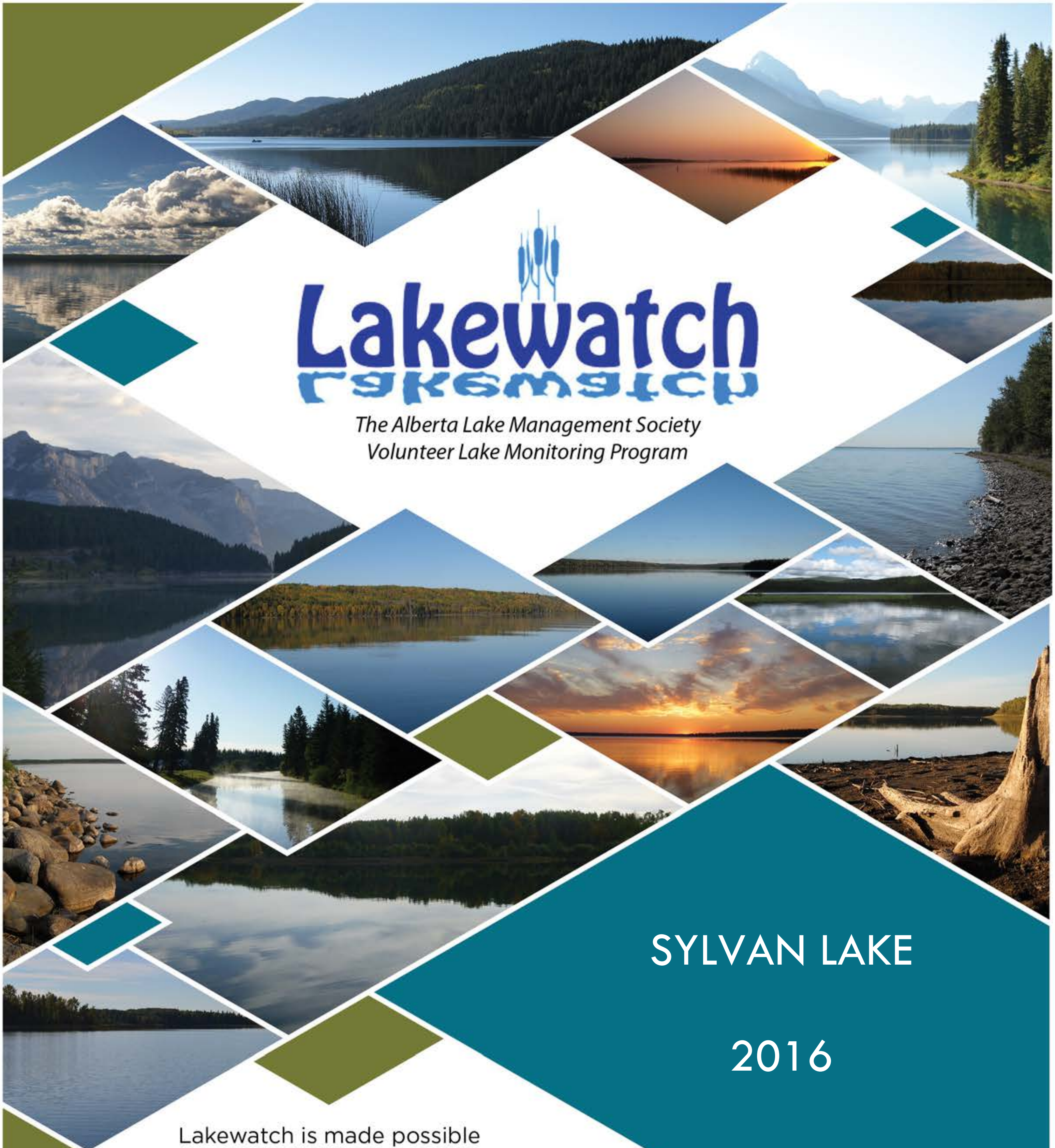

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

SYLVAN LAKE

2016

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Beaver River Watershed Alliance
Red Deer River Watershed Alliance
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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.

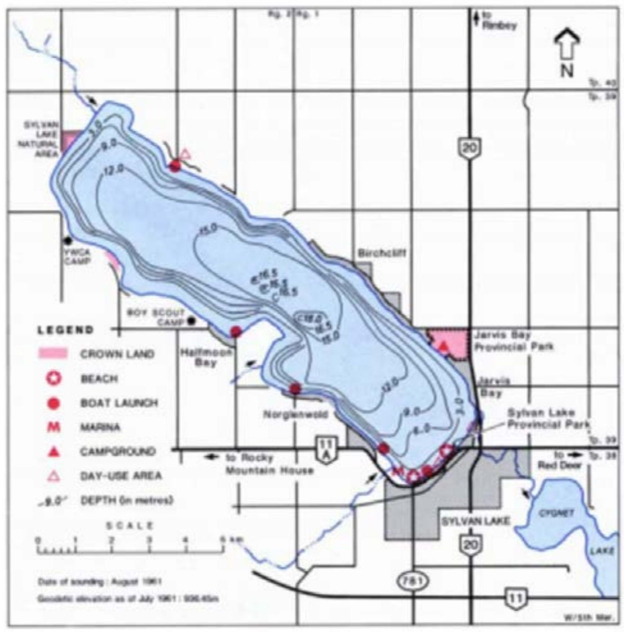
ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health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

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a thank you to all of the volunteers who assisted with sampling in 2016 – and a special thanks to Graeme Strathdee for coordinating the 2016 program. We would also like to thank Alicia Kennedy, Ageleky Bouzetos, and Breda Muldoon who were summer technicians in 2016. Executive Director Bradley Peter was instrumental in planning and organizing the field program. Alicia Kennedy was instrumental in report design. This report was prepared by Bradley Peter and Laura Redmond. The Beaver River Watershed, the Lakeland Industry and Community Association, Environment Canada, and Alberta Environment and Parks are major sponsors of the LakeWatch program.

SYLVAN LAKE

Sylvan Lake is a large (42.8 km^2), moderately deep (maximum depth =18.3 m) lake located west of the city of Red Deer. The lake was first named “Snake Lake” from the First Nations name Kinabik, which referred to the numerous garter snakes in the area. The name was officially changed to Sylvan Lake in 1903. “Sylvan” is from the Latin sylvanus, which means “of a forest”. Most of the surrounding land was originally forested with trembling aspen. However, approximately 90% of the watershed has been converted to agriculture.



Bathymetric map of Sylvan Lake (Mitchell & Prepas 1990)

Sylvan Lake was first settled in 1899 and within 5 years time (by 1904) had become a summer resort area. Its popularity was due to the lake’s picturesque shoreline. Since this time, the shore of Sylvan Lake has undergone intensive development with four summer villages, the town of Sylvan Lake, and six subdivisions. Two provincial parks also occupy the lakeshore, namely, Jarvis Bay and Sylvan Lake. Large sandstone banks, reaching up to 20 m above the lake level, are located along the northeast shore. The lake’s shoreline is generally composed of sand or a mixture of rock and gravel. Rooted aquatic plants occur in patches in sheltered areas and around the lake and grow densely in the northwest end of the lake. The most common emergent species are bulrush (*Scirpus sp.)* and common cattail (*Typha latifolia*). Submergent macrophytes, which can grow up to a lake depth of 3.5 m, include pondweeds (*Potamogeton spp*.), water buttercup (*Ranunculus circinata*), Canada waterweed (*Elodea Canadensis*) and the macroalgae (*Chara sp.).* In 2014, a macrophyte analysis was conducted on Sylvan Lake and the report can be viewed on the ALMS website. There are at least seven species of fish in Sylvan Lake: northern pike, yellow perch, walleye, burbot, spottail shiners, brook stickleback, and fathead minnows.

The watershed area for Sylvan Lake is 113.83 km^2 and the lake area is 42.23 km^2. The lake to watershed ratio of Sylvan Lake is 1:3. A map of the Sylvan Lake watershed area can be found online at http://alms.ca/wp-content/uploads/2016/12/Sylvan.pdf.

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.

Total phosphorus (TP) in Sylvan Lake had an average concentration of 14 µg/L in 2016, putting it in the mesotrophic trophic classification (Table 2). TP was relatively constant throughout the summer, with a maximum concentration of 19 µg/L on June 14 (Figure 1). As sampling was conducted on three occasions throughout the summer, seasonal trends are hard to assess.

Chlorophyll-*a* concentrations increased over the course of the summer, with an average concentration of 5.6 µg/L in 2016 (Table 2). This also puts Sylvan Lake in the mesotrophic trophic status class. A maximum concentration of 8.8 µg/L was reached on August 30 (Figure 1).

Sylvan Lake had an average TKN concentration of 0.6 mg/L over five sampling dates in 2016 (Table 2). On July 12, TKN concentrations were at a seasonal maximum of 0.67 mg/L, but declined over the course of the sampling season (Figure 1).

Average pH measured as 8.8 in 2016, buffered by moderate alkalinity (336.67 mg/L $CaCO_3$) and bicarbonate (370 mg/L HCO_3). Sodium and magnesium were the only dominant ions contributing to a relatively moderate conductivity measure of 623 uS/cm (Table 2).

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 at Sylvan Lake and all measured values fell within their respective guidelines (Table 3).

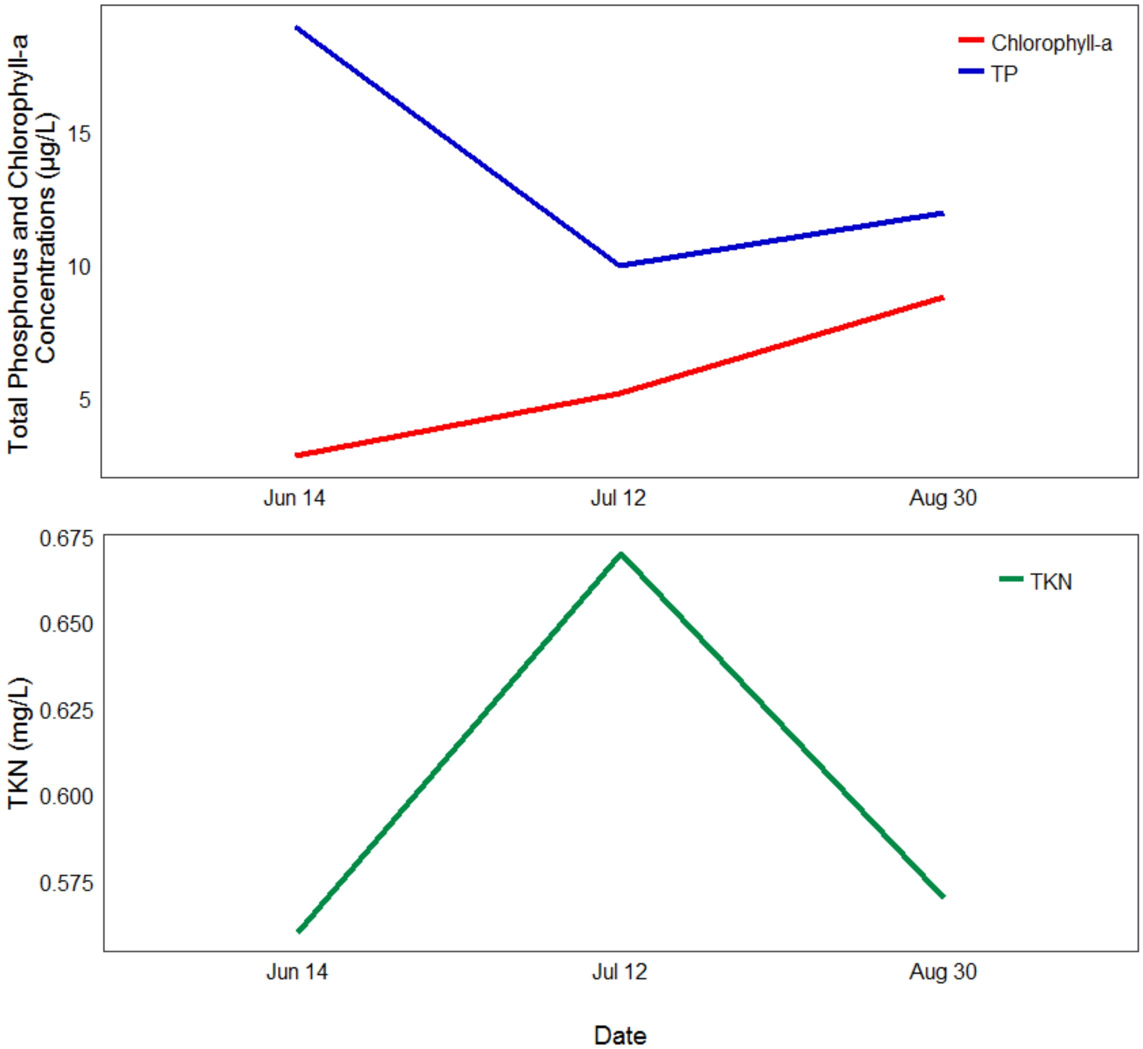


Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured three times over the course of the summer at Sylvan Lake.

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 disk depth. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Average Secchi depth in 2016 was 4.02 m, classifying Sylvan Lake as oligotrophic, or low productivity (Figure 2). A maximum Secchi depth of 4.8 m was recorded on June 14, but Secchi depth remained relatively constant with clear water clarity throughout the sampling season.

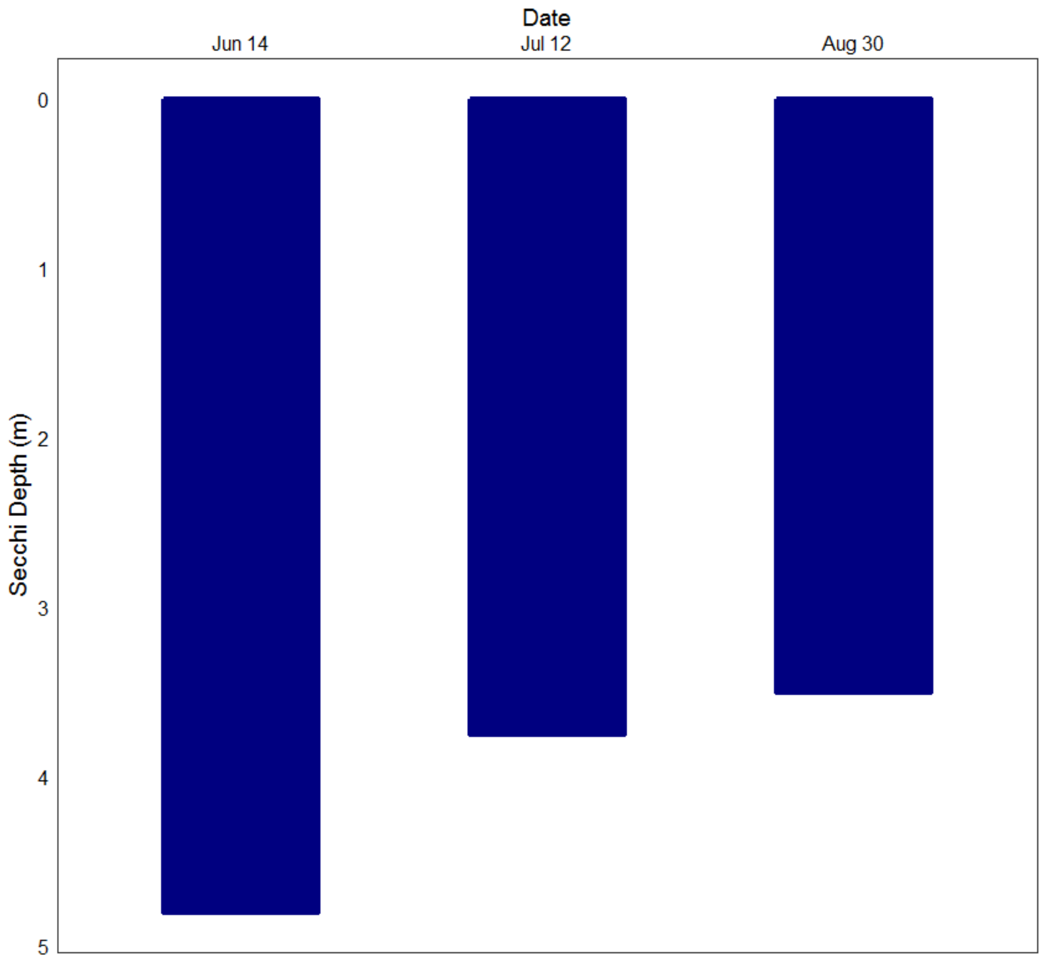


Figure 2 – Secchi depth values measured three times over the course of the summer at Sylvan Lake in 2016.

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.

Sylvan Lake water temperatures varied throughout the summer (Figure 3a). A maximum temperature of 18.38 °C was observed on July 12. Deep stratification occurred on the warmest sampling date, July 12. By August 30, the entire water column was mixed at 17 °C.

Sylvan Lake remained well oxygenated at the surface throughout the summer, measuring above the Canadian Council for Ministers of the Environment guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). Sylvan only reached near anoxic conditions at the bottom on the warmest visit on July 12. This could be due to the separation of atmospheric oxygen from the surface by way of thermal stratification.

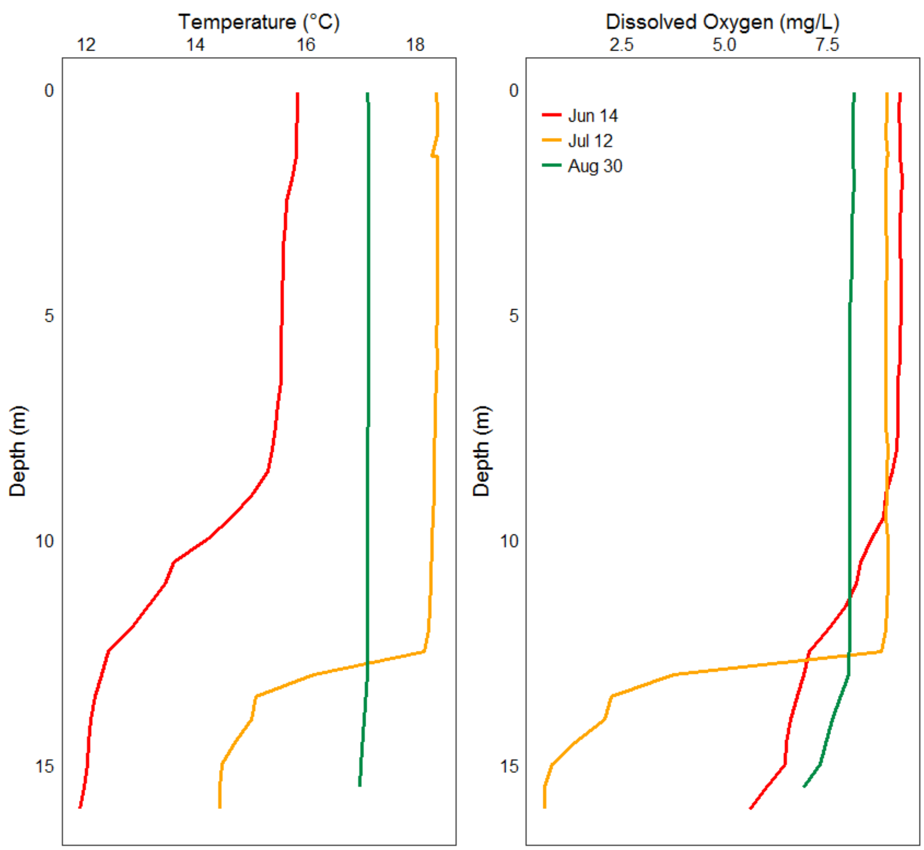


Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Sylvan Lake measured three times over the course of the summer of 2016.

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.

Table 1 – Microcystin concentrations measured three times at Sylvan Lake in 2016. All measured concentrations remained below the recommended guideline for recreational use.

Date	Microcystin Concentration (μg/L)
Jun 14	0.12
Jul 12	0.11
Aug 30	0.14
Average	0.123

Microcystin was present in low concentrations in Sylvan Lake in 2016 – this indicates that cyanobacteria capable of producing cyanotoxins are present in Sylvan Lake, though not in substantial quantities. Lake users should avoid recreating in cyanobacteria blooms.

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. In 2016, no invasive mussels were detected in Sylvan Lake.

WATER LEVELS

There are many factors influencing water quantity. Some of these factors include the size of the lakes 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 Sylvan Lake have remained relatively stable since Environment Canada began monitoring the lake in 1918 (Figure 4). Since 1918, Sylvan Lake water levels have fluctuated between a minimum of 936 m asl and a maximum of 937.2 m asl. Data from Environment Canada was only available until 2014.

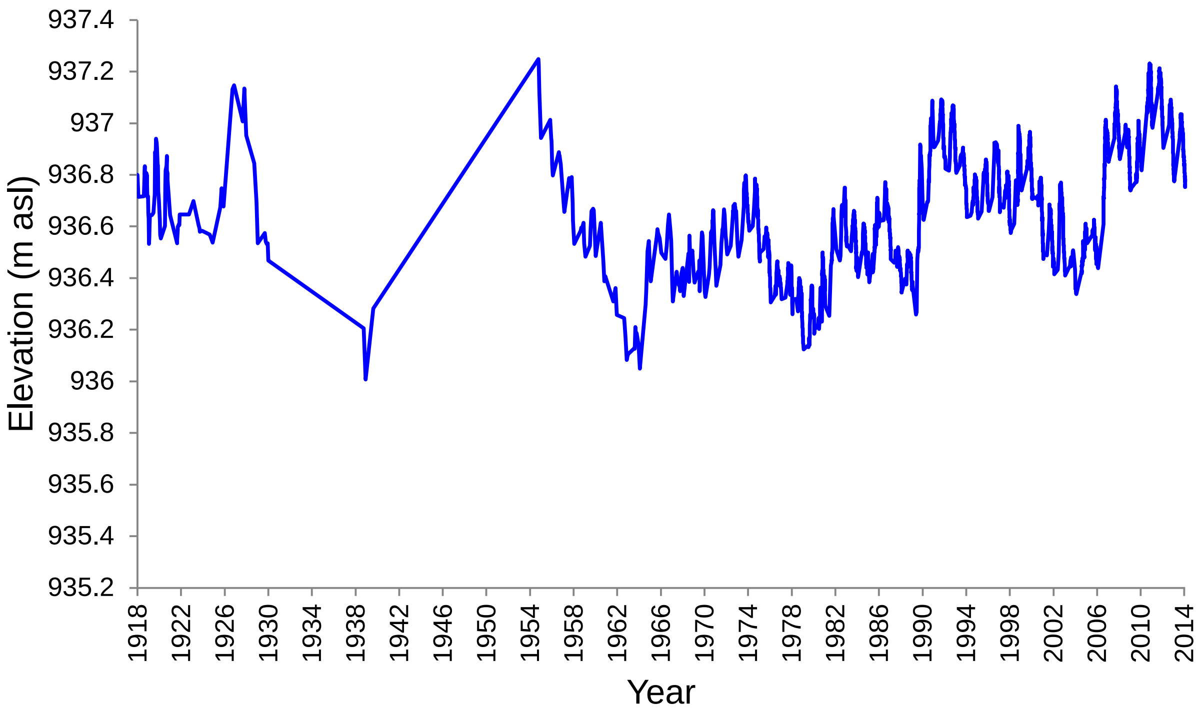


Figure 4- Water levels measured in meters above sea level (m asl) from 1918- 2014. Data retrieved from Environment Canada.

Table 2: Average Secchi depth and water chemistry values for Sylvan Lake. Historical values are presented for reference.

Parameter	1984	1986	2000	2001	2003	2006	2009	2010	2014	2016
TP (µg/L)	20	21	19	23	14	24.5	20	23	13	14
TDP (µg/L)	/	/	7.4	8	5	7.6	10.8	13	11.25	4
Chlorophyll-*a* (µg/L)	3.8	3.7	4.5	9	3.8	6.5	2.58	2.14	5	5.6
Secchi depth (m)	5	4.7	5	/	4.8	4.1	4.7	7	3.9	4.02
TKN (mg/L)	/	/	0.618	0.836	0.610	0.713	0.63	0.69	0.614	0.6
NO_2 and NO_3 (µg/L)	/	/	1.2	2	5	<5	6.75	9	26	2.5
NH_3 (µg/L)	/	/	6.9	9	8	12	9.5	12.3	13.8	25
DOC (mg/L)	/	/	/	/	/	/	6.93	7.55	7.97	7.67
Ca (mg/L)	/	18	17	17	17	17	16.2	14.15	16.3	16.7
Mg (mg/L)	/	37	37	36	37	36	34.1	38.9	37.3	41
Na (mg/L)	/	64	63	60	71	73	70.2	73.5	74.53	71.7
K (mg/L)	/	7	8	7	8	8	7.77	7.8	7.94	8.3
SO_4^{2-} (mg/L)	/	16	13	14	14	14	16.3	23	9.03	12.7
Cl^- (mg/L)	/	<1	2.8	3	2	2.7	3.26	3.75	4.1	4.7
CO_3 (mg/L)	/	21	18	22	26	26.3	22	22.5	34.44	22.7
HCO_3 (mg/L)	/	354	348	343	359	361.7	366	367.5	408.4	370
pH	/	8.9	8.7	9	8.8	8.86	8.79	8.81	8.76	8.8
Conductivity (µS/cm)	/	597	585	572	611	606	608	584.5	594	623
Hardness (mg/L)	/	/	/	/	193	191	181	196	194	213
TDS (mg/L)	/	/	/	/	350	353	350	353	373	363
Microcystin (µg/L)	/	/	/	/	/	0.04	0.11	0.07	0.08	0.12
Total Alkalinity (mg/L $CaCO_3$)	/	325	316	318	337	340	337	339	335	336

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

Metals (Total Recoverable)	2010	2011	2012	2013	2014	2015	2016	Guidelines
Aluminum μg/L	26.04	13.9	14.75	11.735	10.75	16.2	6.6	100[a]
Antimony μg/L	0.03635	0.02885	0.0307	0.0326	0.032	0.0315	0.03	6[d]
Arsenic μg/L	0.8565	0.8685	0.574	0.8165	0.7735	0.828	0.745	5
Barium μg/L	48.95	50.85	51.1	49.05	48.5	53.75	50.9	1000[d]
Beryllium μg/L	0.00585	0.0052	0.00645	0.0015	0.004	0.004	0.004	100[c,e]
Bismuth μg/L	0.00195	0.00215	0.0321	0.0143	0.00225	0.00925	5.00E-04	/
Boron μg/L	122.5	105.5	104.85	93.5	97.05	94.3	103	1500
Cadmium μg/L	0.0057	0.001	0.001	0.001	0.002	0.002	0.001	0.26[b]
Chromium μg/L	0.242	0.0765	0.1535	0.28	0.105	0.075	0.015	/
Cobalt μg/L	0.01845	0.01115	0.00955	0.02615	0.007	0.0185	0.001	1000[e]
Copper μg/L	0.1633	0.154	0.3698	0.1402	0.13	0.175	0.32	4[b]
Iron μg/L	7.73	3.59	7.2	21.95	2.875	7.5	3.8	300
Lead μg/L	0.0151	0.0137	0.01055	0.0168	0.0135	0.0275	0.007	7[b]
Lithium μg/L	31.7	33	28.1	26.65	27.95	28.7	32.7	2500[f]
Manganese μg/L	35.4	43.9	29	16.05	12.55	31.55	26	200[f]
Molybdenum μg/L	0.0627	0.05335	0.02955	0.03915	0.037	0.041	0.026	73[c]
Nickel μg/L	0.0025	0.0025	0.0025	0.05425	0.004	0.004	0.004	150[b]
Selenium μg/L	0.05	0.096	0.05	0.082	0.03	0.03	0.2	1
Silver μg/L	0.0013	0.003175	0.001525	0.007125	0.001	0.001	0.001	0.25
Strontium μg/L	176	187	166	180	180	194.5	193	/
Thallium μg/L	0.000725	0.0006	0.001225	0.0004	0.00045	0.0104	0.00045	0.8
Thorium μg/L	0.008025	0.00625	0.0313	0.01075	0.001175	0.00045	0.00045	/
Tin μg/L	0.015	0.015	0.38175	0.0377	0.0065	0.026	0.023	/
Titanium μg/L	0.336	0.676	0.2735	0.7785	0.2025	0.73	0.26	/
Uranium μg/L	0.1965	0.202	0.18	0.1995	0.211	0.205	0.201	15
Vanadium μg/L	0.214	0.1855	0.2035	0.1865	0.19	0.19	0.14	100[e,f]
Zinc μg/L	0.3085	0.41	0.4175	0.2805	0.55	0.25	0.3	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 Canadian Drinking Water Quality guideline values.

[e] Based on CCME Guidelines for Agricultural use (Livestock Watering).

[f] Based on CCME Guidelines for Agricultural Use (Irrigation).

A forward slash (/) indicates an absence of data or guidelines.