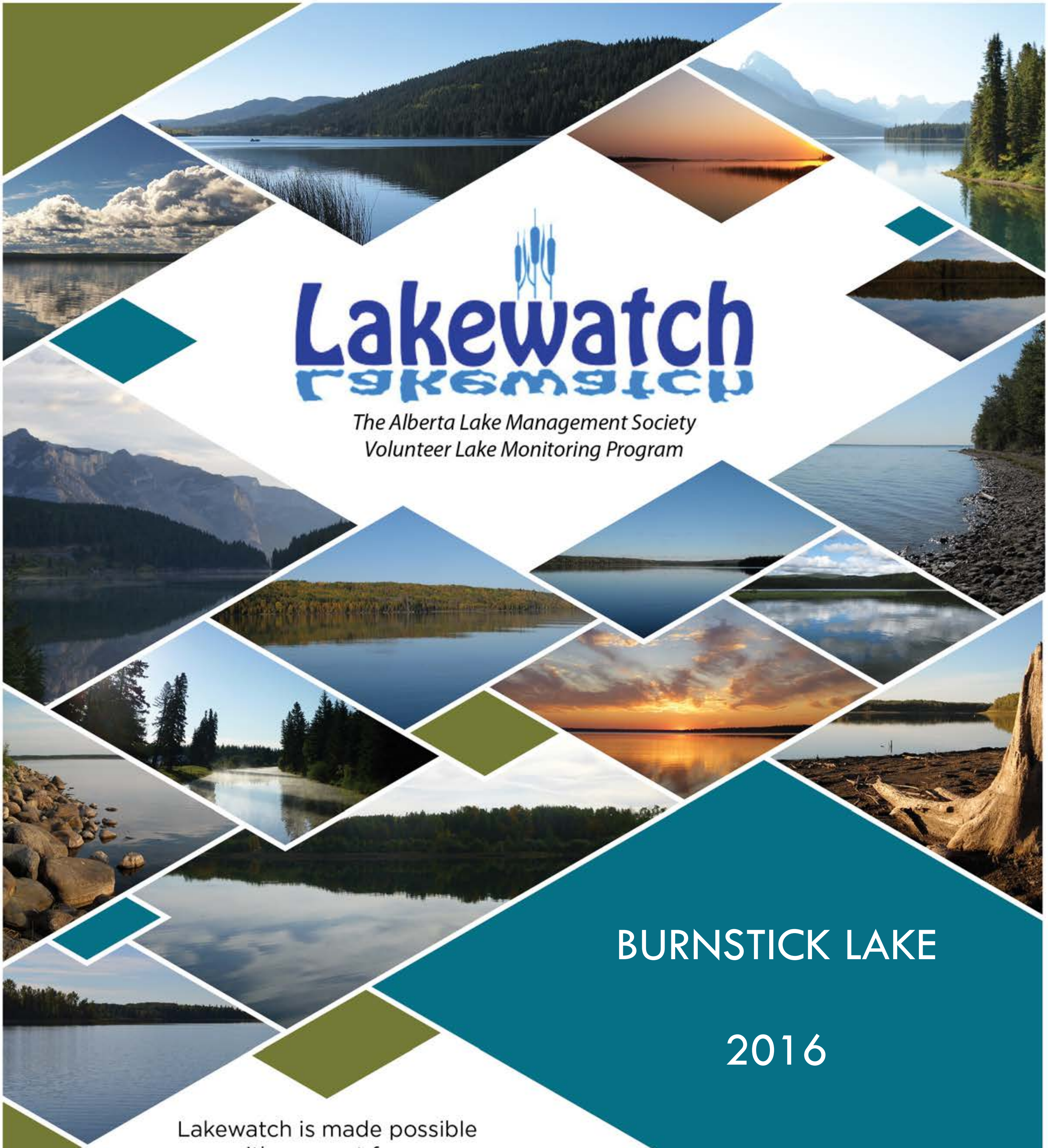

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

BURNSTICK 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.

This report has been prepared with un-validated data. Historical data has not been re-queried for this report.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Bill Post for the time and energy put into sampling Burnstick Lake in 2016, and to Brenda Madge for initiating the 2016 sampling. 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.

BURNSTICK LAKE

Located in the southern half of the province, Burnstick Lake is a moderately small water body tucked into the Boreal Foothills southwest of Caroline. Its primary inflow is West Stony Creek at the southwest end, although other streams may contribute intermittently when conditions are wet enough. Outflow is via East Stony Creek at the lake's easternmost point, which eventually flows into the James River as part of the Red Deer River Basin.

Bathymetric map of Burnstick Lake (Angler's Atlas)

The surrounding landscape is primarily native vegetation occurring in a mix of forests and wetlands. The area is also home to the regionally uncommon round-leafed bog-orchid (*Habernaria orbiculata*). The lake supports an active sport fishery for northern pike, yellow perch and walleye, the perch having been introduced in the 1970s[1]. Extensive marshy and ponded areas around the lake provide excellent nesting sites for a variety of waterfowl and amphibians. Bald eagles have been known to nest along the lakeshore for multiple years[1]. Land ownership throughout the watershed is primarily crown with private near-lake properties. Most crown land is under lease as cattle grazing reserves. Private lands consist of a municipal campground at the lake's east end, the Summer Village of Burnstick Lake midway along the north shore, and the Burnstick Lake Resort on the south shore across the lake from the summer village[1].

The watershed area for Burnstick Lake is 52.46 km^2 and the lake area is 4.70 km^2. The lake to watershed ratio of Burnstick Lake is 1:11. A map of the Burnstick Lake watershed area can be found here.

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.

Water chemistry values have not changed appreciably since monitoring began in 1993. The average total phosphorus (TP) concentration in 2016 was 9 µg/L (Table 2). This puts Burnstick Lake in the mesotrophic

[1] Alberta Environment Report. Burnstick Management Plan. 1996

classification. TP concentrations varied throughout the summer, and on July 14th, it was at its maximum value of 11 µg/L (Figure 1). This is the lowest average TP concentration measured at Burnstick Lake since 1993 (Table 1).

Chlorophyll-*a* concentrations were stable over the course of the sampling season in 2016 (Figure 1). The average chlorophyll-*a* concentration was 3.9 µg/L (Table 2). This corroborates with TP concentrations, also placing Burnstick Lake into the mesotrophic classification.

Total Kjeldahl Nitrogen (TKN) concentrations fluctuated through the sampling season of 2016 (Figure 1). The average TKN concentration of Burnstick Lake was 0.36 mg/L.

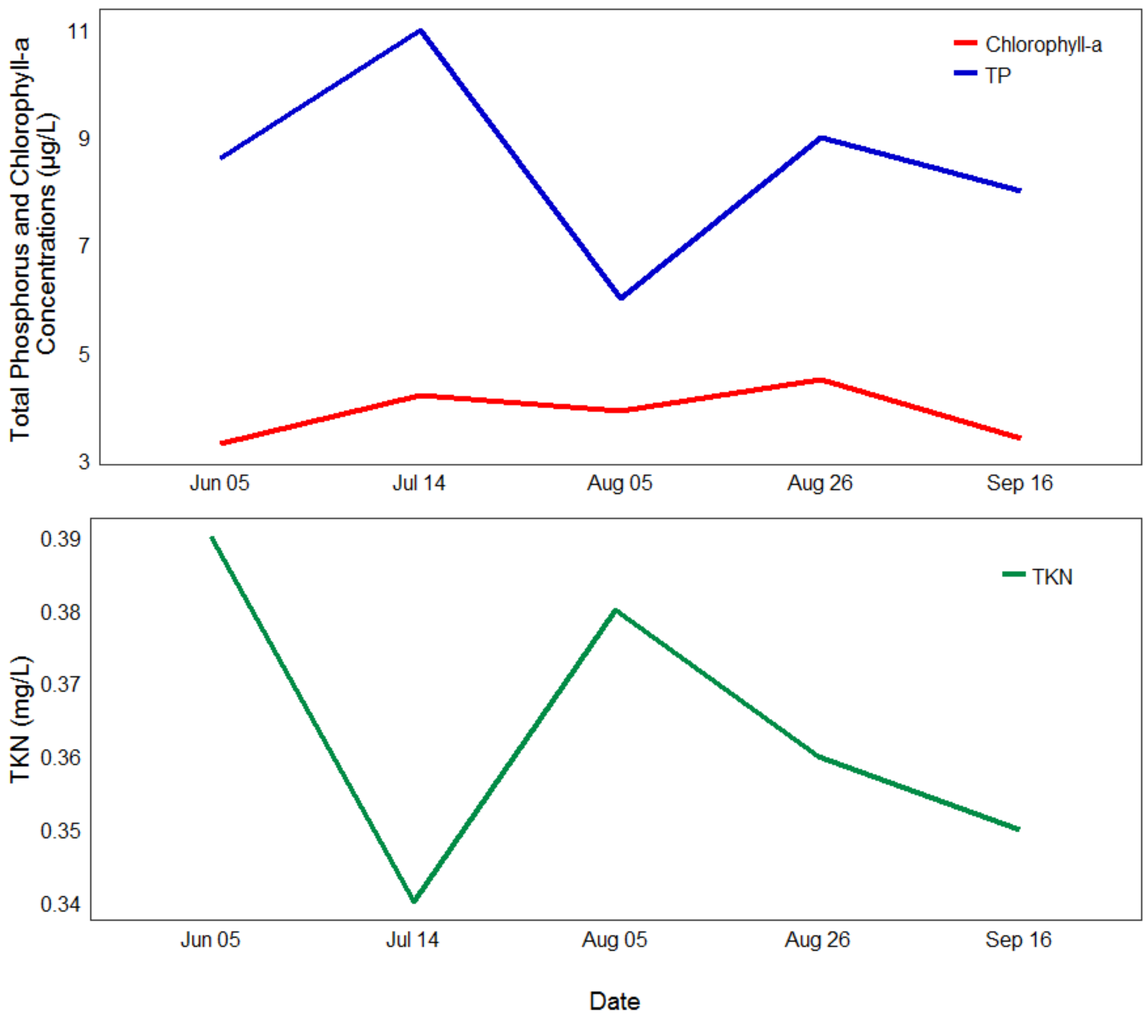

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured five times over the course of the summer at Burnstick Lake.

Average pH measured as 8.25 in 2016, buffered by moderate alkalinity (150 mg/L $CaCO_3$) and bicarbonate (182 mg/L HCO_3). Calcium was the dominant ion contributing to a low conductivity measure of 280 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 Burnstick Lake 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 disk depth. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Water clarity remained stable through the sampling season of 2016 (Figure 2). The average Secchi depth of Burnstick Lake in 2016 was 4.86 m (Table 2). This places Burnstick Lake in the oligotrophic, or unproductive, classification.

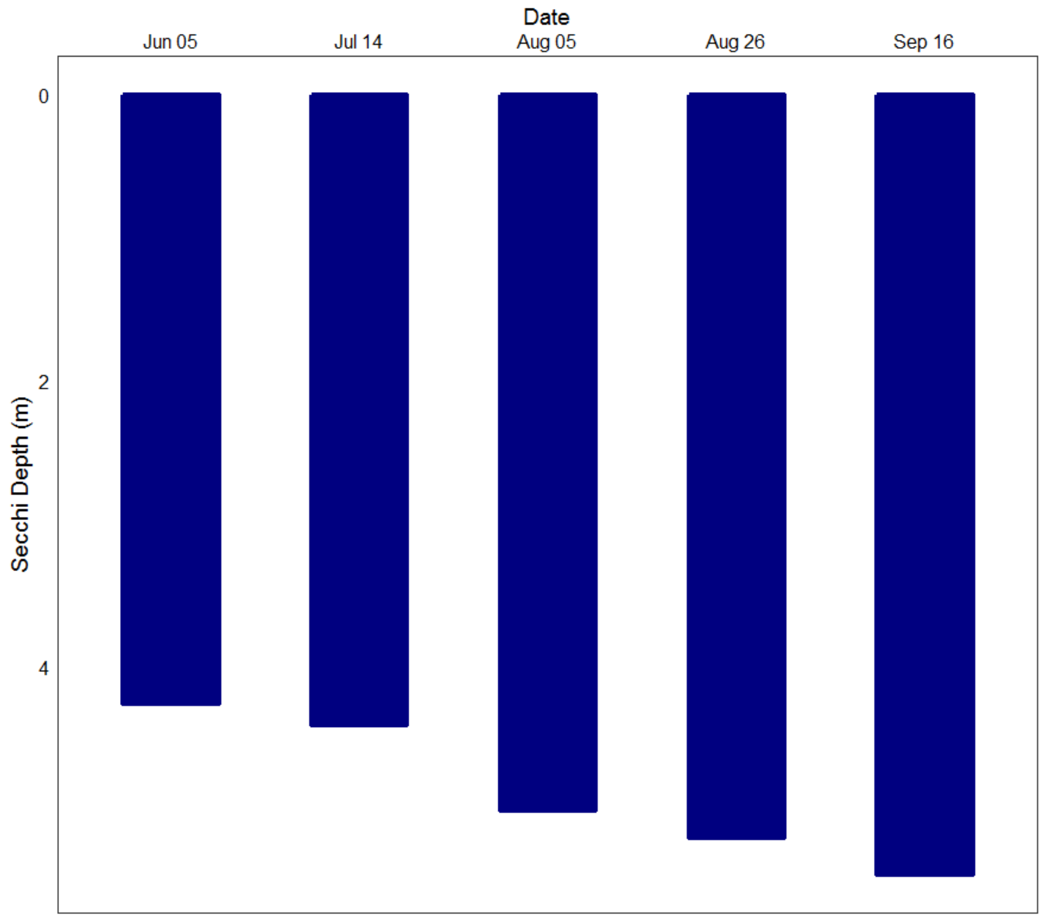

Figure 2 – Secchi depth values measured five times over the course of the summer at Burnstick Lake in 2016.

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.

Burnstick Lake remained thermally stratified throughout the sampling season in 2016 (Figure 3a). The thermocline deepened over the course of the summer, as water temperatures increased. The maximum surface water temperature was 18.83 °C on August 5th. The thermal stratification of Burnstick Lake was important to the oxygenation of the water column.

Burnstick 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). At all five sampling times except August 5th, Burnstick Lake reached anoxia at lake bottom. This was associated with the thermal stratification that kept oxygenated waters separated from bottom waters.

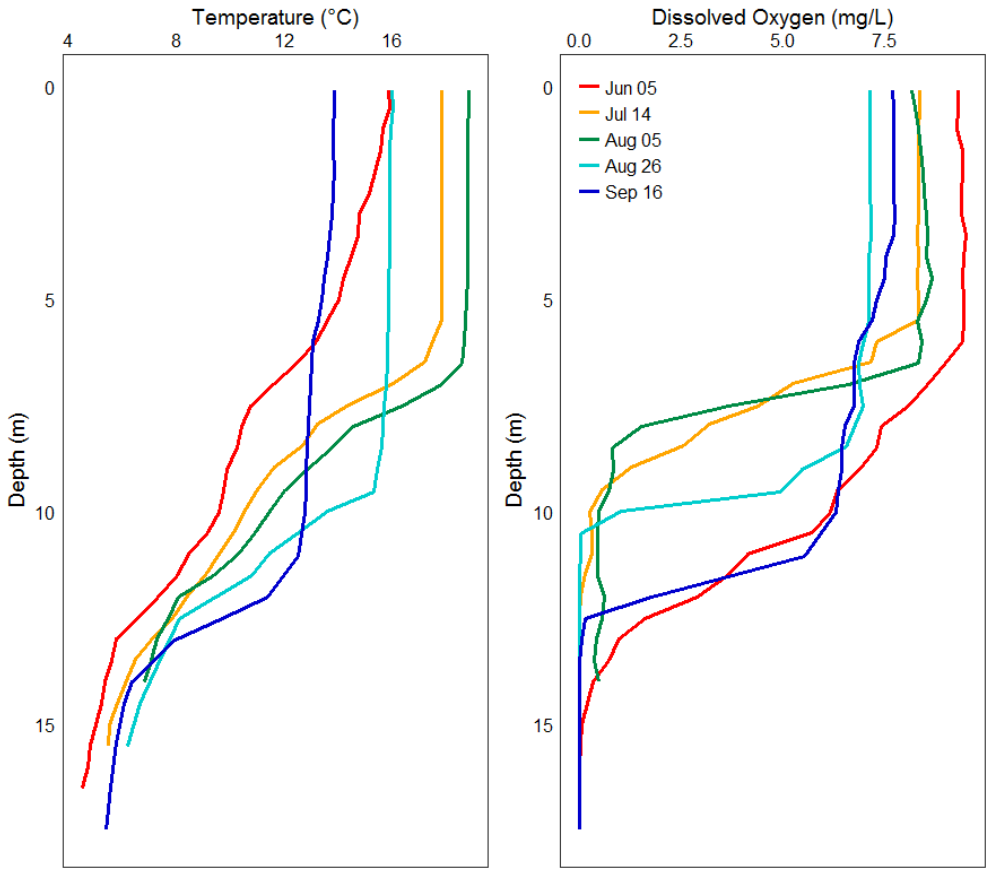

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Burnstick Lake measured five times over the course of the summer of 2016.

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 five times at Burnstick Lake in 2016. All measurements remained well below the recommended limit for recreational use.

Date	Microcystin Concentration (μg/L)
Jun 5	0.05
Jul 14	0.12
Aug 5	0.05
Aug 26	0.10
Sep 16	0.05
Average	0.07

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 Burnstick Lake.

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

Parameter	1993	1994	1999	2004	2016
TP (µg/L)	15	16	14	11	9
TDP (µg/L)	/	/	5.4	4.2	4
Chlorophyll-*a* (µg/L)	2.3	2.7	2.6	2.9	3.9
Secchi depth (m)	6.50	5.80	6.10	5.60	4.86
TKN (mg/L)	/	/	0.5	0.4	0.36
NO_2 and NO_3 (µg/L)	8.4	9.8	8.4	9	6.22
NH_3 (µg/L)	/	/	15	17	38.4
DOC (mg/L)	/	/	/	/	4.46
Ca (mg/L)	30.6	33.5	30.3	28.5	40.6
Mg (mg/L)	11.4	11.7	11.3	10.4	13.8
Na (mg/L)	2.8	3.2	2.5	2.8	3.2
K (mg/L)	0.5	0.5	0.5	0.7	0.6
SO_4^{2-} (mg/L)	<3	<3	3.4	8	2.32
Cl^- (mg/L)	0.5	<0.5	3	0.4	0.5
CO_3 (mg/L)	/	/	<5	4.0	0.25
HCO_3 (mg/L)	156.4	167.3	157.6	151.7	182
pH	8.2	8.2	8.2	8.3	8.25
Conductivity (µS/cm)	239.2	253.8	244.0	217.0	280
Hardness (mg/L)	/	/	/	/	160
TDS (mg/L)	124.6	133.2	126.0	122.7	158
Microcystin (µg/L)	/	/	/	/	0.07
Total Alkalinity (mg/L $CaCO_3$)	/	/	/	/	150

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

Metals (Total Recoverable)	2004	2016	Guidelines
Aluminum µg/L	18.7	4.2	100[a]
Antimony µg/L	0.0	0.059	6[d]
Arsenic µg/L	0.3	0.3	5
Barium µg/L	126.0	157	1000[d]
Beryllium µg/L	<0.003	0.018	100[c,e]
Bismuth µg/L	<0.001	0.03	/
Boron µg/L	4.4	6.6	1500
Cadmium µg/L	<0.002	0.023	0.23[b]
Chromium µg/L	0.1	0.1	/
Cobalt µg/L	0.0	0.001	1000[e]
Copper µg/L	0.9	0.32	4[b]
Iron µg/L	4.0	26.6	300
Lead µg/L	0.1	0.026	7[b]
Lithium µg/L	2.0	2.3	2500[f]
Manganese µg/L	11.4	12.9	200[f]
Molybdenum µg/L	0.2	0.427	73[c]
Nickel µg/L	<0.005	0.004	150[b]
Selenium µg/L	<0.1	0.07	1
Silver µg/L	0.0347	0.02	0.25
Strontium µg/L	73.3	86.1	/
Thallium µg/L	0.0008	0.117	0.8
Thorium µg/L	0.0053	0.0541	/
Tin µg/L	0.13	0.014	/
Titanium µg/L	1	1.08	/
Uranium µg/L	0.19	0.266	15
Vanadium µg/L	0.104	0.1	100[e,f]
Zinc µg/L	14.7	0.6	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness 160 mg/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.