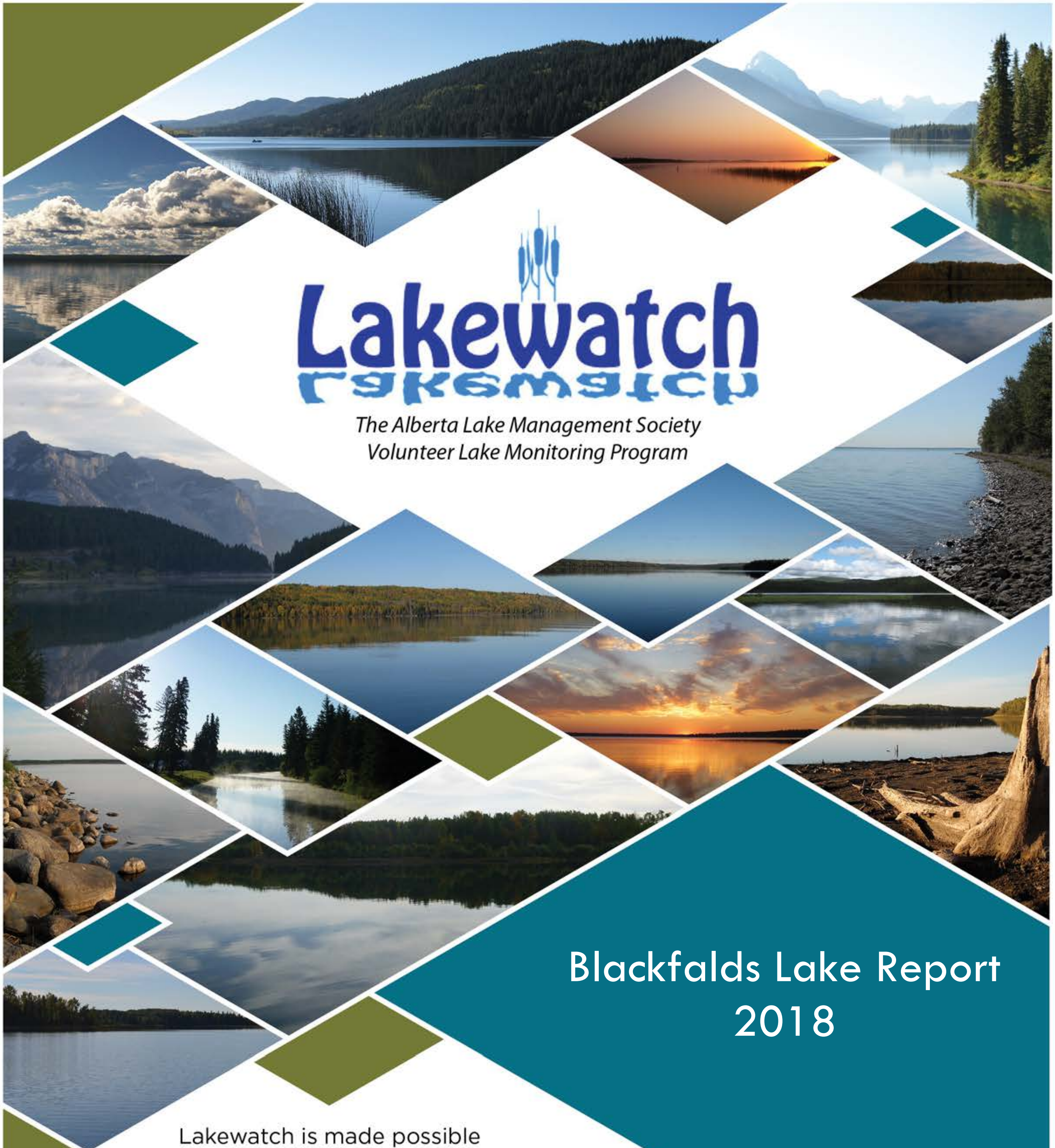

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Blackfalds Lake Report 2018

Lakewatch is made possible with support from:

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 leaders in stewardship give us hope that our water resources will not be the limiting factor in the health of our environment.

If you would like 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. A special thanks to Anita Hill for her support in sampling Blackfalds Lake. We would also like to thank Alanna Robertson, Lindsay Boucher and Shona Derlukewich, who were summer technicians in 2018. Executive Director Bradley Peter and Program Coordinator Laura Redmond were instrumental in planning and organizing the field program. This report was prepared by Caitlin Mader and Bradley Peter.

BLACKFALDS LAKE

Blackfalds Lake is a small, shallow lake north of Red Deer, Alberta and east of the town of Blackfalds, Alberta. The lake shoreline is approximately 842 m above sea level. The lake itself is approximately 3.4 km long, and is less than 500 m wide at its widest point. There is no indication that the lake has been depth-sounded in the past, as no bathymetric data is available from Alberta Environment.

Land surrounding Blackfalds Lake has primarily been developed for agricultural use, but a 100 m treed strip buffers the southeast shore of the lake and scattered trees are visible on the west shore. Potential road access appears to be south of Township Road 400 at Range Road 265, but it is not clear whether the lake has a boat launch or if public access is permitted.

Above: Blackfalds Lake, Alberta. Satellite image retrieved from Google Earth©, from a satellite photo taken on June 24, 2002.

Left: Spruce trees along the east bank of Blackfalds Lake, 2018. Photo by Lindsay Boucher.

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 Innotech, 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.

[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 Blackfalds Lake was 314 µg/L (Table 2), falling well into the category of hypereutrophic, or very highly productive trophic classification. This value is 12.6 times higher than was detected when Blackfalds Lake was last measured in 2008. Detected total phosphorus concentration peaked in mid July at 470 µg/L, and then fell throughout the remainder of the season until the final sampling at 60.4 µg/L in late September (Figure 1).

Average chlorophyll-*a* concentration in 2018 was 91.08 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. Chlorophyll-*a* was highest when first sampled in late June at 147 µg/L and fell to its lowest detected level of 57 µg/L in late August.

Finally, the average TKN concentration was 4.34 mg/L (Table 2) with concentrations decreasing over the course of the sampling season.

Average pH was measured as 8.646 in 2018, buffered by alkalinity of 342 mg/L $CaCO_3$ and bicarbonate (380 mg/L HCO_3). Sodium was the dominant ion (91.8 mg/L) contributing to a moderate conductivity of 854 µS/cm (Table 2).

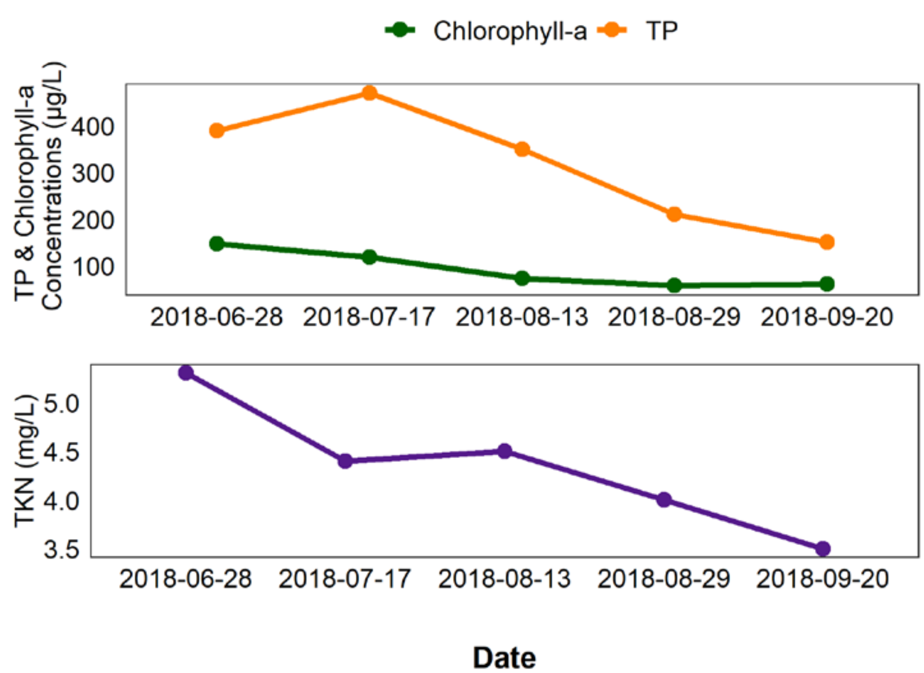

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured five times over the course of the summer at Blackfalds Lake.

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 not measured at Blackfalds 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 Blackfalds Lake in 2018 was 0.43 m (Table 2). Secchi depth increased slightly over sampling season, from 0.25 m in late June to 0.60 m in late September. (Figure 2).

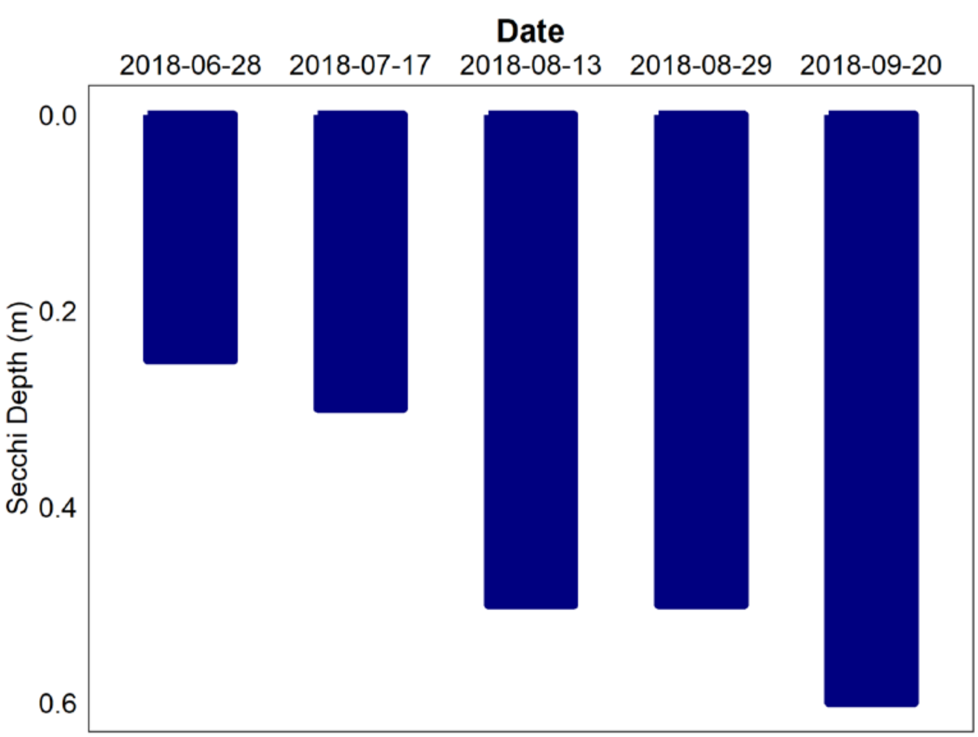

Figure 2 – Secchi depth values measured five times over the course of the summer at Blackfalds Lake in 2018.

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 Blackfalds Lake varied throughout the summer, with a max temperature of 20.74°C at 0.5 m on June 28, and a minimum temperature of 7.58°C measured at 1.5 m on Sep 20 (Figure 3a). The lake was not stratified during any of the sampling trips, with temperatures fairly constant from top to bottom, which indicates the potential for complete mixing throughout the season.

Blackfalds Lake remained well oxygenated through most of the water column during the summer, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). The oxygen level fell below this guideline at lake bottom on June 28, and through most of the water column excluding the surface on August 13.

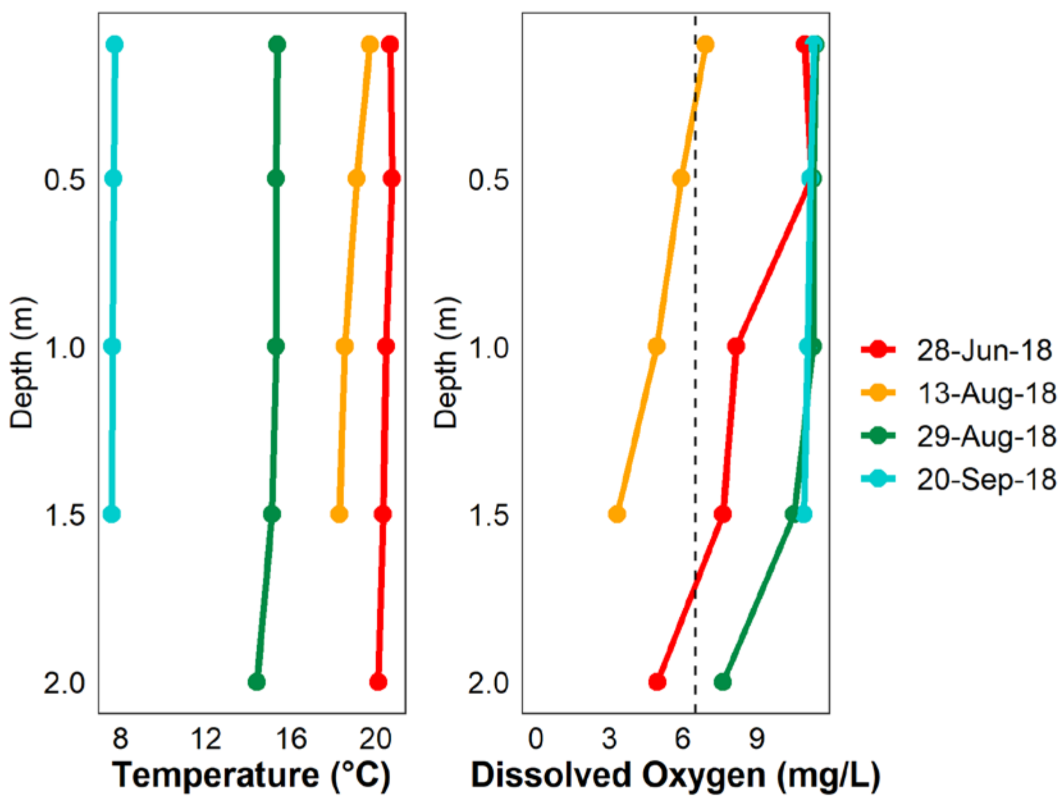

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Blackfalds Lake measured four times over the course of the summer of 2018. CCME guideline level for Dissolved Oxygen (6.5 mg/L) is indicated by the dashed line.

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 Blackfalds Lake fell below the recreational guideline of 20 μg/L in 2018. However, these do not capture the complete spatial and temporal range of Microcystin concentrations everywhere in the lake throughout the summer. During both August sampling dates, measured microcystin concentrations approached recreational limits. Concentrations may have been higher at other times or at specific locations in the lake. Recreation in cyanobacteria blooms should be avoided.

Table 1 – Microcystin concentrations measured five times at Blackfalds Lake in 2018.

Date	Microcystin Concentration (μg/L)
28-Jun-18	0.31
17-Jul-18	11.48
13-Aug-18	14.5
29-Aug-18	14.4
20-Sep-18	4.63
Average	9.06

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 mussels (veligers) using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. No mussels have been detected in Blackfalds 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 level data is not available for Blackfalds Lake.

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

Parameter	**2008**	**2018**
TP (µg/L)	25.6	314
TDP (µg/L)	18.8	86.6
Chlorophyll-*a* (µg/L)	48.8	91.08
Secchi disk depth (m)	1.08	0.43
TKN (µg/L)	3.15	4.34
$NO_{2,3}$ (µg/L)	35	11.92
NH_4 (µg/L)	186	96.6
Dissolved organic C (mg/L)	31.3	33
Ca (mg/L)	33.3	32.8
Mg (mg/L)	28.9	38.8
Na (mg/L)	81	91.8
K (mg/L)	25.9	32
SO_4^{2-} (mg/L)	74.5	73
Cl^- (mg/L)	30	36.4
TDS (mg/L)	452	548
pH	8.94	8.646
Conductivity (µS/cm)	734	854
Hardness (mg/L)	33.5	18.4
HCO_3 (mg/L)	294	380
CO_3 (mg/L)	202	240
Total Alkalinity (mg/L $CaCO_3$)	298	342
Microcystin (µg/L)	/	9.06