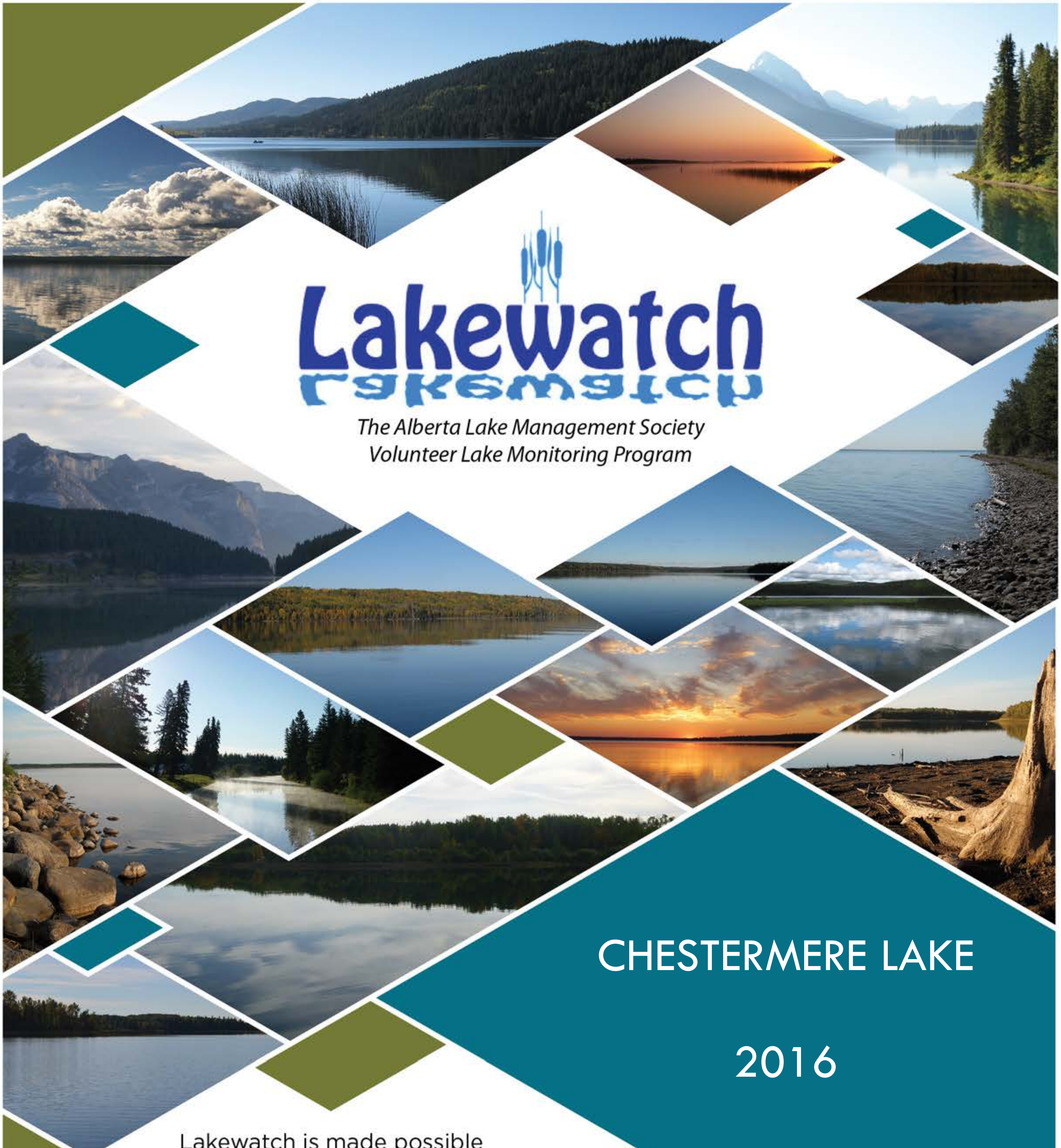

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

CHESTERMERE LAKE

2016

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LICA Lakeland Industry & Community Association
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.

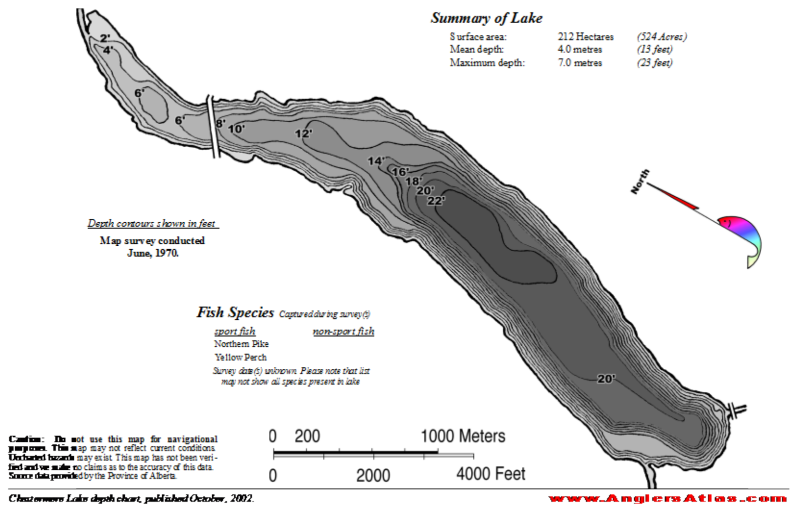
ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health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

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Jay & Kathy Speck for the time and energy put into sampling Chestermere Lake in 2016. 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.

CHESTERMERE LAKE

Situated in the Town of Chestermere just minutes East of Calgary, Chestermere Lake is a popular recreational lake and a highly developed, urban, man-made reservoir. Chestermere Lake was originally built by the Canadian Pacific Railroad (CPR) in the 1880’s as a waterbalancing reservoir, supplying water at 50 cents per acre to CPR land. In the 1940’s, the CPR offered to forgive mortgages held on their land in return for settlers giving up their water rights. The irrigation system was turned over to the Western Irrigation District (WID), which currently owns and operates the structures feeding water to and from Chestermere Lake (Mitchell and Prepas, 1990). The drainage basin for the lake is only 7.65 km^2 including the 2.65 km^2 ‘reservoir’ at its maximum capacity. Chestermere Lake is surrounded by urban development.



Bathymetric map of Chestermere Lake (Anglers Atlas)

Chestermere Lake is shallow over most of its depth (<2.0 m over 50% of its area). During the original survey conducted by the Alberta Government, Chestermere Lake was more than seven meters deep. The deepest areas of the lake have accumulated little sediment as maximum depth still remains between five to seven meters depending on water levels. Sediment accumulation has been heaviest at the WID canal inflow (south) where as much as two meters of sediment has accumulated. Likely due to its shallow depth, aquatic weeds are prevalent in Chestermere Lake. Chestermere is an important site for recreational use and mechanical removal of weeds using harvesters is maintained on a continuous basis. Chestermere Lake receives a large volume of water during summer months, enough to replace the entire lake volume in eight days. Flushing of this magnitude may actually help to maintain the waters clarity and thus the success of weeds in comparison to other Alberta lakes of similar depth.

In 2016, two species of bryozoans were identified in Chestermere Lake: *Plumatella* sp. and *Cristatella* mucedo.

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 of Chestermere Lake in 2016 was 13 µg/L (Table 2). This puts Chestermere Lake in the mesotrophic classification, and is historically low. TP concentrations increased until August 11th, and then decreased in the fall (Figure 1).

The average chlorophyll-*a* concentration was 8.7 µg/L, which was on the upper end of historic values (Table 2). Chlorophyll-*a* concentrations correlated with TP concentrations (r= -0.88, df= 3, p-*value*= 0.05). This likely means that increases in nutrients drove phytoplankton growth in Chestermere Lake. However, since average TP concentrations are historically low, there may be other contributing factors to phytoplankton growth.

Average TKN concentration was 0.28 mg/L, which was also on the lower end of historical data (Table 2). TKN peaked on August 11, the same sampling date that TP peaked.

Average pH measured as 8.29 in 2016, buffered by moderate alkalinity (122 mg/L $CaCO_3$) and bicarbonate (150 mg/L HCO_3). Calcium was the dominant ions contributing to a low conductivity measure of 430 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 Chestermere Lake and all measured values fell within their respective guidelines (Table 3).

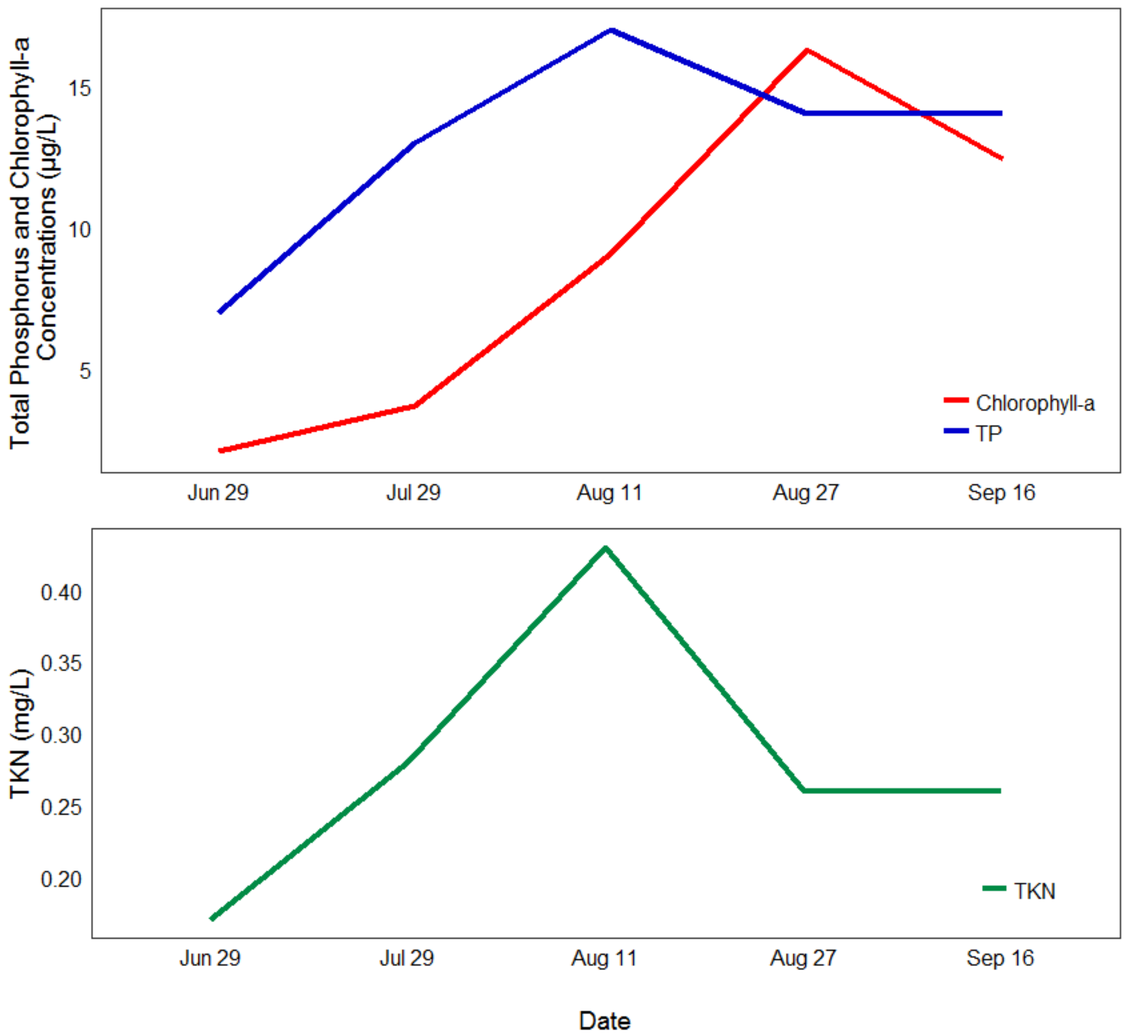


Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured five times over the course of the summer at Chestermere Lake.

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.

In Chesterrmere Lake, water was clear in June and July, but Secchi depth decreased in August (Figure 2). Given that Chestermere Lake is shallow, and its maximum depth is only 6 m, the euphotic zone reached lake bottom across most of the lake. The average Secchi depth was 2.7 m, although it was as deep as 4 m on July 29th (Table 2).

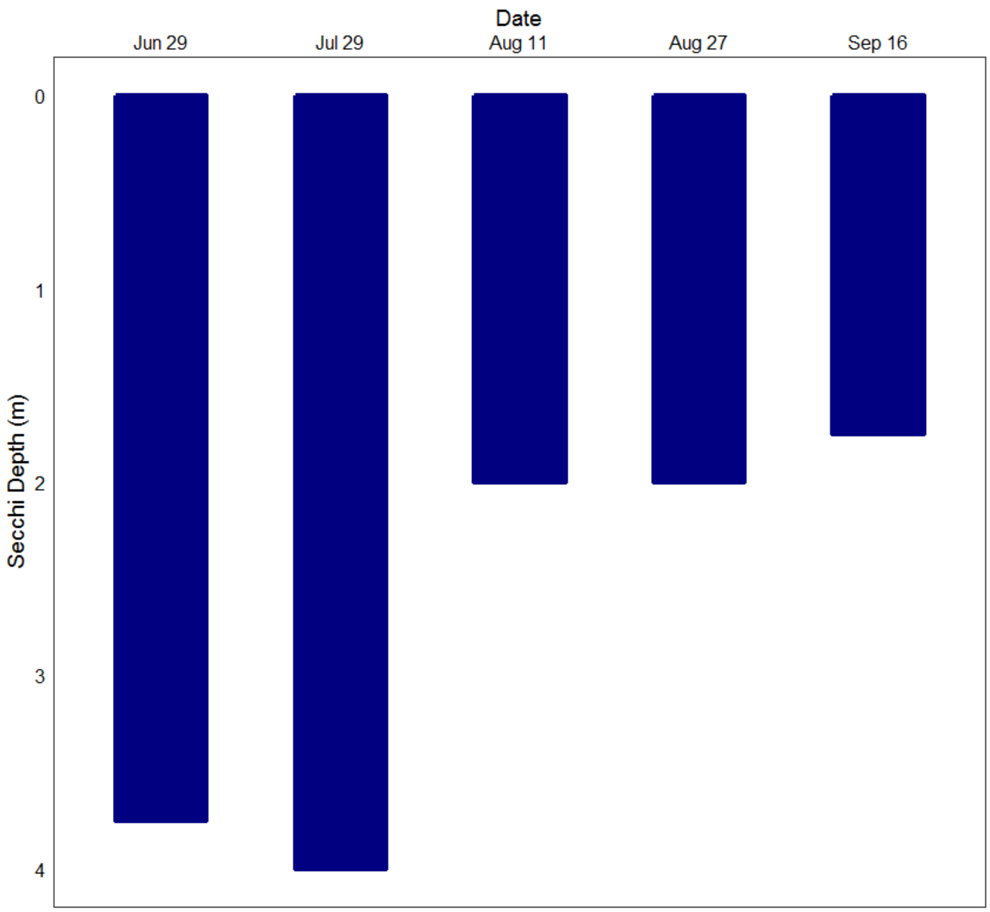


Figure 2 – Secchi depth values measured five times over the course of the summer at Chestermere Lake in 2016.

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.

Given the shallow depth of Chestermere Lake, it can be classified as polymictic, because it does not stratify over the course of the ice-off season (Figure 3a). This means that temperatures are consistent through the water column on each individual sampling date. The maximum surface water temperature of 21.92 °C was measured on July 29th.

Chestermere 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). The water column remained oxygenated throughout, because the lake had multiple mixing and turnover events throughout the summer. However, on August 11, Chestermere Lake reached low oxygen levels at the lake bottom.

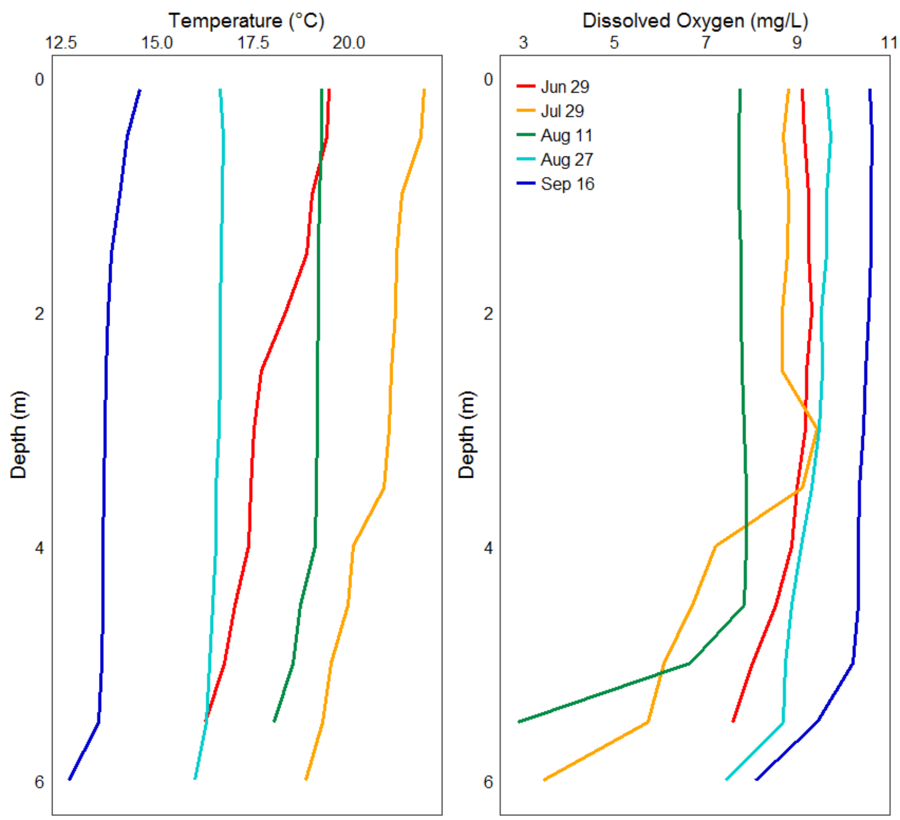


Figure 3– a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Chestermere Lake measured five times over the course of the summer of 2016.

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 Chestermere Lake in 2016. All measured concentrations fell below the recommended guideline for recreational use in 2016.

Date	**Microcystin Concentration (µg/L)**
Jun 29	0.05
Jul 29	0.05
Aug 11	0.05
Aug 27	0.05
Sep 16	0.05
Average	0.05

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 Chestermere 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 Chestermere Lake have remained relatively stable since Environment Canada began monitoring the lake in 1991 (Figure 4). Water levels of the reservoir fluctuated each year between 1023.5 m asl and 1025.7 m asl. Data from Environment Canada was only available until 2013.

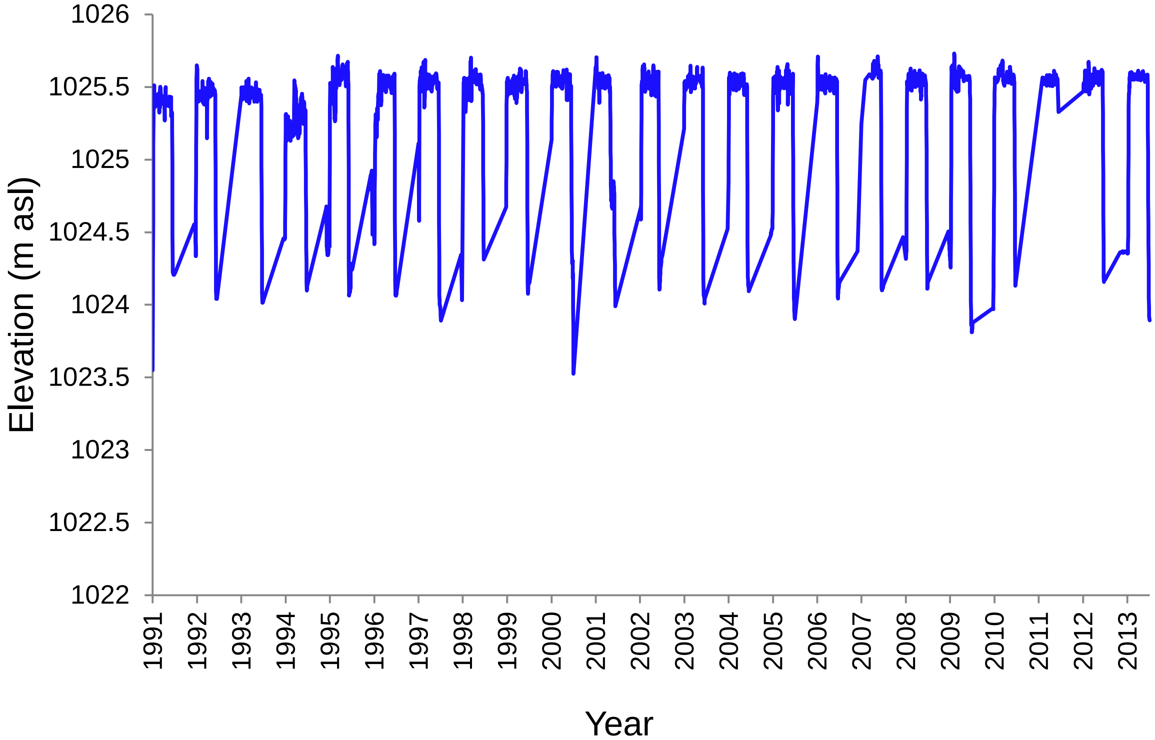


Figure 4- Water levels measured in meters above sea level (m asl) from 1991-2013. Data retrieved from Environment Canada.

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

Parameter	1983	1999	2000	2001	2007	2010	2011	2013	2015	2016
TP (µg/L)	36	32	25	19	31	24	24.3	18	16	13
TDP (µg/L)	/	/	/	/	11	7	8.1	4.625	4	4
Chlorophyll-a (µg/L)	5.5	9	7.6	3.4	2.725	3.365	8.01	3.09	6.38	8.7
Secchi depth (m)	2.9	2.6			3.9	4.25	3.43	2.98	2.22	2.7
TKN (mg/L)	0.44	0.34	0.2	0.72	0.54	0.32	0.35	0.28	0.3	0.28
NO2 and NO3 (µg/L)	/	/	229	739	226.25	29.5	86.8	84.75	26.6	33.24
NH3 (µg/L)	/	/	/	/	/	18.25	18.25	13.75	25	25
DOC (mg/L)	/	/	/	/	4.275	2.23	3.1	2.7	2.38	2.28
Ca (mg/L)	35	37	37	37	41.875	32.23	43.1	43.3	38.6	42.4
Mg (mg/L)	12	15	13	14	15.1625	16.63	17.9	15.9	15.8	18.2
Na (mg/L)	7	15	8	5	46.225	19.03	22.9	17.7	18	23.8
K (mg/L)	1	1	1	1	2.5	1.13	1.77	1.47	1.23	1.71
SO42- (mg/L)	38	/	43	38	100	58	65.7	49.3	60.4	74
Cl- (mg/L)	4	7	5	3	37.425	12.7	16	10.8	13.78	17.4
CO3 (mg/L)	/	/	/	/	1.85	0.5	1.5	2.25	0.84	0.752
HCO3 (mg/L)	/	/	/	/	158	146	162	175.25	142	150
pH	/	/	/	/	8.31	8.42	8.34	8.38	8.308	8.29
Conductivity (µS/cm)	/	/	/	/	563	149	432	420.75	392	430
Hardness (mg/L)	/	/	/	/	185	375	181	173.3	162	180
TDS (mg/L)	/	/	/	/	329.75	212	251	226.7	220	254
Microcystin (µg/L)	/	/	/	/	/	0.025	0.0786	0.05	<0.1	0.05
Total Alkalinity (mg/L CaCO3)	111	/	116	110	132	120	135	147.25	116	122

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

Metals (Total Recoverable)	2013	2015	2016	Guidelines
Aluminum µg/L	95.6	227	28.5	100[a]
Antimony µg/L	0.1165	0.148	0.145	6[d]
Arsenic µg/L	0.5775	0.6335	0.802	5
Barium µg/L	54.45	51.25	46.7	1000[d]
Beryllium µg/L	0.0015	0.0065	0.004	100[c,e]
Bismuth µg/L	0.0077	0.00225	0.012	/
Boron µg/L	14.2	18.65	18.7	1500
Cadmium µg/L	0.0226	0.033	0.019	0.26[b]
Chromium µg/L	0.317	0.57	0.21	/
Cobalt µg/L	0.06575	0.1055	0.047	1000[e]
Copper µg/L	1.303	4.295	1.32	4[b]
Iron µg/L	90.15	298.5	73.7	300
Lead µg/L	0.136	0.338	0.107	7[b]
Lithium µg/L	4.89	5.125	6.21	2500[f]
Manganese µg/L	7.185	19.9	9.71	200[f]
Molybdenum µg/L	0.9945	1.08	1.08	73[c]
Nickel µg/L	0.438	0.3875	0.302	150[b]
Selenium µg/L	0.9035	0.58	0.92	1
Silver µg/L	0.0255	0.0055	0.008	0.25
Strontium µg/L	237	225.5	239	/
Thallium µg/L	0.0057	0.0094	0.0528	0.8
Thorium µg/L	0.0208	0.025025	0.0348	/
Tin µg/L	0.02805	0.057	0.026	/
Titanium µg/L	1.35	4.875	0.91	/
Uranium µg/L	1.065	1.16	1.25	15
Vanadium µg/L	0.5045	0.655	0.36	100[e,f]
Zinc µg/L	1.58	3.35	1.5	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness > 180mg/L (as CaCO3)
[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.