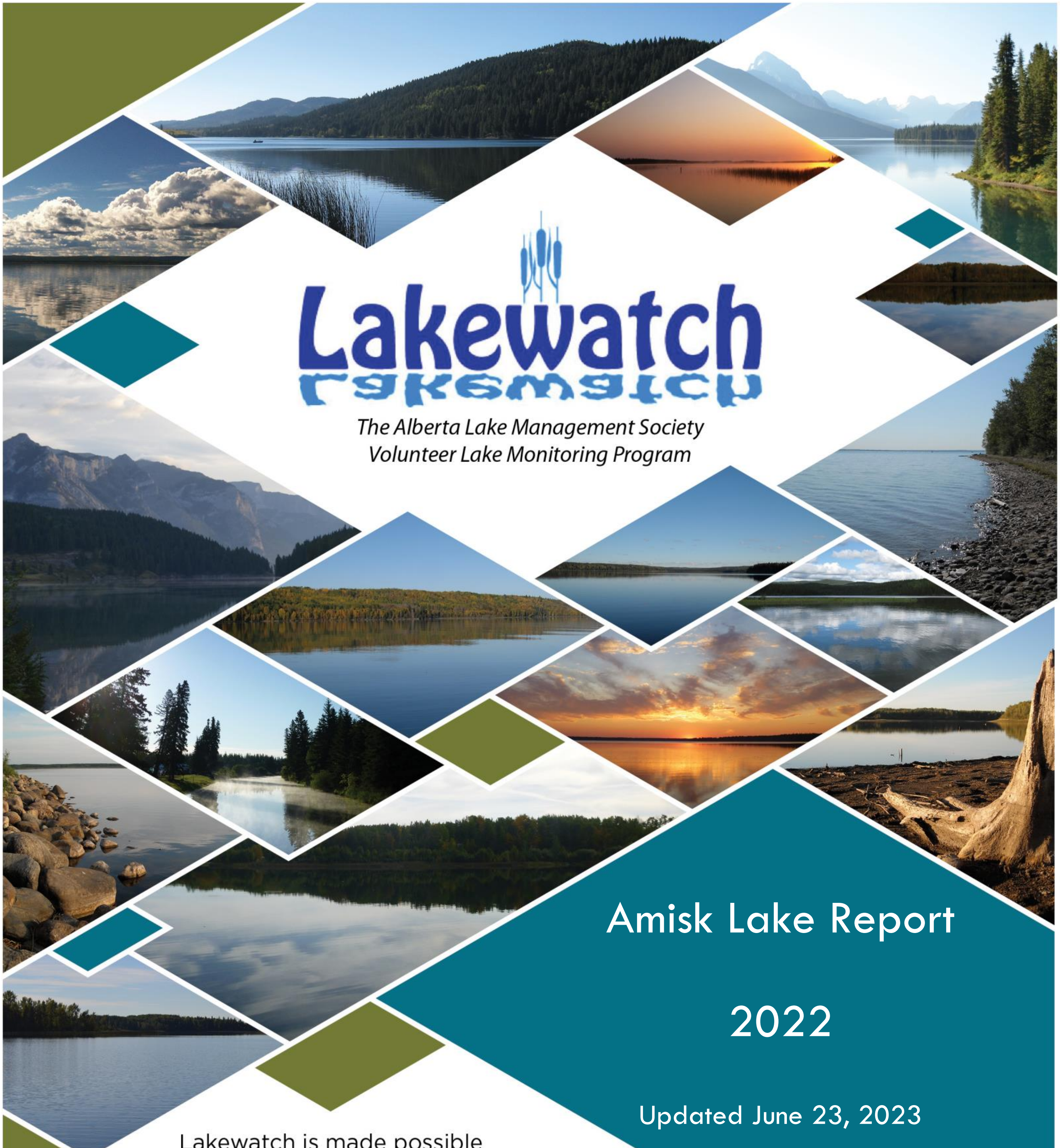

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Amisk Lake Report

2022

Updated June 23, 2023

Lakewatch is made possible with support from:

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PIGEON LAKE WATERSHED ASSOCIATION

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data from Alberta's Lakes. Equally important is educating lake users about aquatic environments, 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 the widest 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 require 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 Rob Marshall for his commitment to collecting data at Amisk Lake. We would also like to thank Kurstyn Perrin and Dominic Wong, who were summer technicians in 2022. Executive Director Bradley Peter and Program Manager Caleb Sinn were instrumental in planning and organizing the field program. This report was prepared by Caleb Sinn and Bradley Peter.

AMISK LAKE

Amisk Lake is located within Athabasca County in central Alberta. It is 175 km northeast of the city of Edmonton and 15 km east of the village of Boyle. The lake is long and narrow with its main axis running north and south. It has two distinct basins: the larger south basin is very deep (60 m) and the north basin is moderately deep (33 m). The lake derived its name from the local abundance of beaver, *Amisk*, in Cree.

Amisk Lake lies at the western edge of the Beaver River Watershed. Skeleton Lake drains into Amisk Lake from the west; Long Lake drains into Amisk Lake from the south. Water from Amisk Lake flows over a small control structure at the north end of the lake into the Amisk River.

Amisk Lake during the LakeWatch sampling in 2008.

In the early 1940's a mink farm and resort with boat and cabin rentals were established on the northwest shore of the lake. The mink were fed with fish from the lake. Over the years these developments were replaced by two subdivisions and a trailer park built at the north end of the lake.

The majority of the shoreline, however, remains undeveloped. Fishing, boating and swimming are popular on Amisk Lake. A public boat launch and a day-use area on the northwest side are operated by the Recreation Board of the County of Athabasca. The sport fishery includes yellow perch (*Perca flavescens),* northern pike (*Esox lucius*) and walleye (*Sander vitreus*). The water quality in Amisk Lake reflects the rich soils in the drainage basin. The lake is surrounded by aspen, willow, and clumps of white spruce and lodgepole pine. Waterfowl and shorebirds are abundant, especially in the shallow marshy bays.

Amisk Lake is typical of many deep parkland/boreal lakes of Alberta: it experiences high summer algal biomass and phosphorus levels and very low hypolimnetic oxygen levels in mid to late summer and during the last half of ice-cover. In May 1988 researchers from the University of Alberta, the National Water Research Institute (Environment Canada) and Linde (Union Carbide Canada) designed and installed a system to inject pure oxygen into the deep waters of the north basin. The main objective of this unique long-term project is to increase dissolved oxygen levels in the bottom waters (hypolimnion) of the north basin. It is anticipated that this will lead to improved water quality as a consequence of decreased phosphorus release from the lake's bottom sediments.

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 Amisk Lake was 32 µg/L (Table 2), falling into the eutrophic, or highly productive trophic classification. This value is consistent with observed historical averages going back to 2008 (Table 2). TP ranged from a minimum of 24 µg/L on the August 16th sampling, to a maximum of 52 µg/L on June 7th (Figure 1).

Average chlorophyll-*a* concentration in 2022 was 23.6 µg/L (Table 2), falling into the eutrophic, or highly productive trophic classification. Chlorophyll-*a* was lowest earliest in the season, at 18.1 µg/L on June 7th and peaked at 30.6 µg/L on July 13th. Interestingly, the seasonal changes of chlorophyll-a and TP appeared to mirror one another (Figure 1).

The average TKN concentration was 1.2 mg/L (Table 2). TKN displayed some variation through the season, (Figure 1).

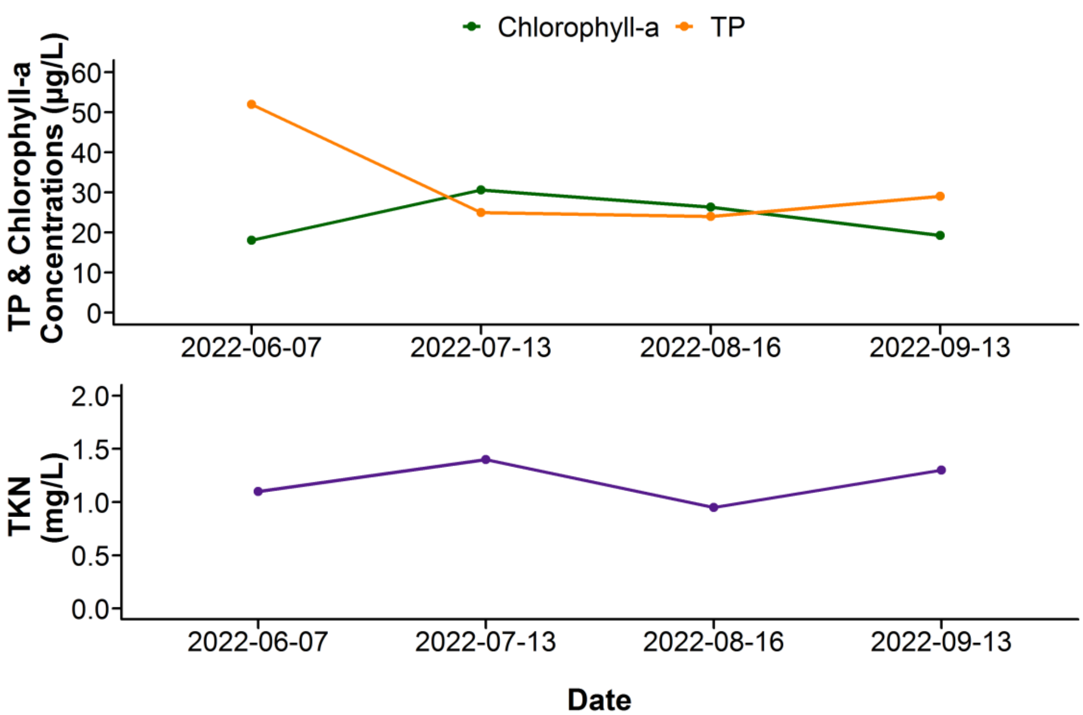

Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Amisk Lake.

Average pH was measured as 8.55 in 2022, buffered by moderate alkalinity (182 mg/L $CaCO_3$) and bicarbonate (208 mg/L HCO_3). Aside from bicarbonate, sodium, calcium, and sulphate were higher than all other major ions, and together contributed to a low conductivity of 405 µS/cm (Figure 2, top; Table 2). Amisk Lake is in the average to low end range of ion levels, compared to other LakeWatch lakes sampled in 2022 (Figure 2, bottom).

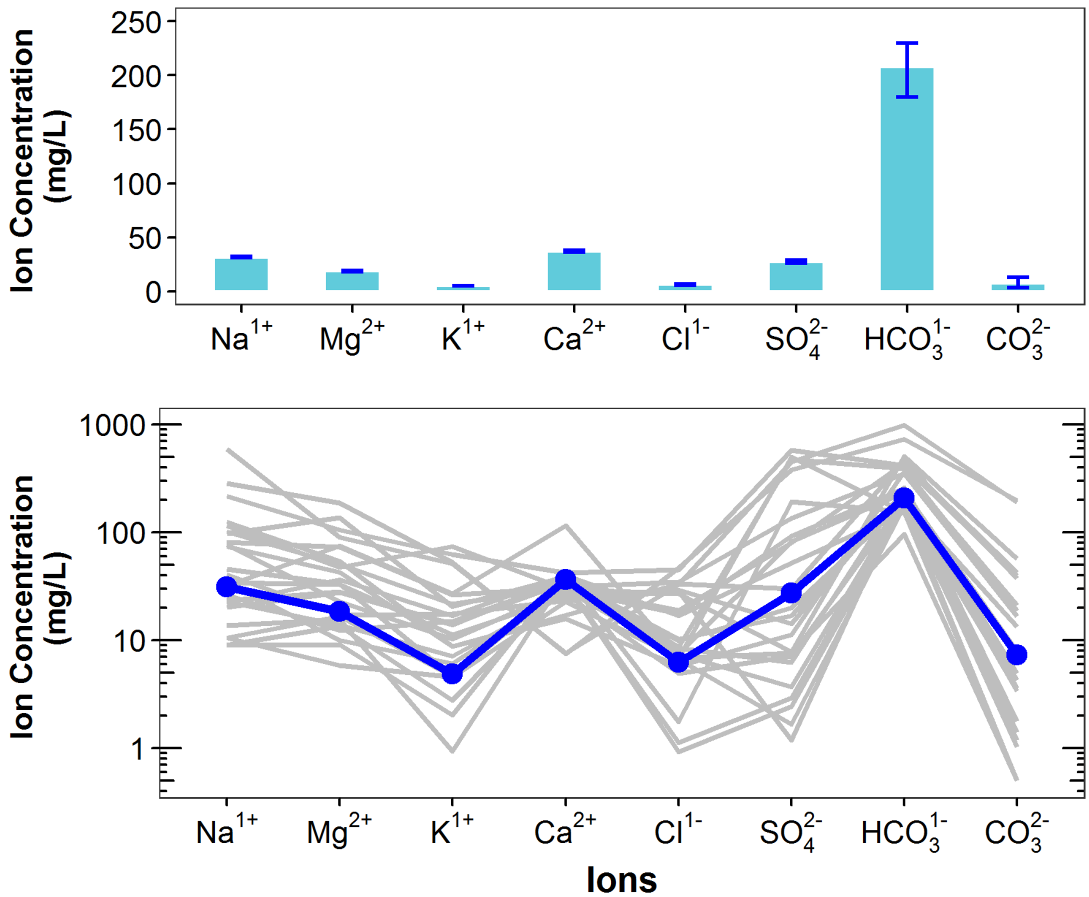

Figure 2. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) from four measurements over the course of the summer at Amisk Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Amisk Lake (blue line) compared to 26 lake basins (gray lines) sampled through the LakeWatch program in 2022 (note log_{10} scale on y-axis of bottom figure).

METALS

Metals will naturally be present in aquatic environments due to in-lake processes or the erosion of rocks, or introduced to the environment from human activities such as urban, agricultural, or industrial developments. Many metals have a unique guideline as they may become toxic at higher concentrations. Where current metal data are not available, historical concentrations for 27 metals have been provided (Table 3).

Metals were measured at Amisk Lake in 2022, and no metal exceeds CCME guidelines (Table 3).

WATER CLARITY AND EUPHOTIC 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 euphotic depth of Amisk Lake in 2022 was 3.50 m, corresponding to an average Secchi depth of 1.75 m (Table 2). Euphotic depth varied little over the season, ranging from as deep as 4.5 m on June 7th to 3.10 m on both July 13th and August 16th, and then 3.30 m on September 13th (Figure 3). Euphotic depth changed similarly throughout the season to chlorophyll-*a*, indicating water clarity changes were related in part to algae and cyanobacteria growth.

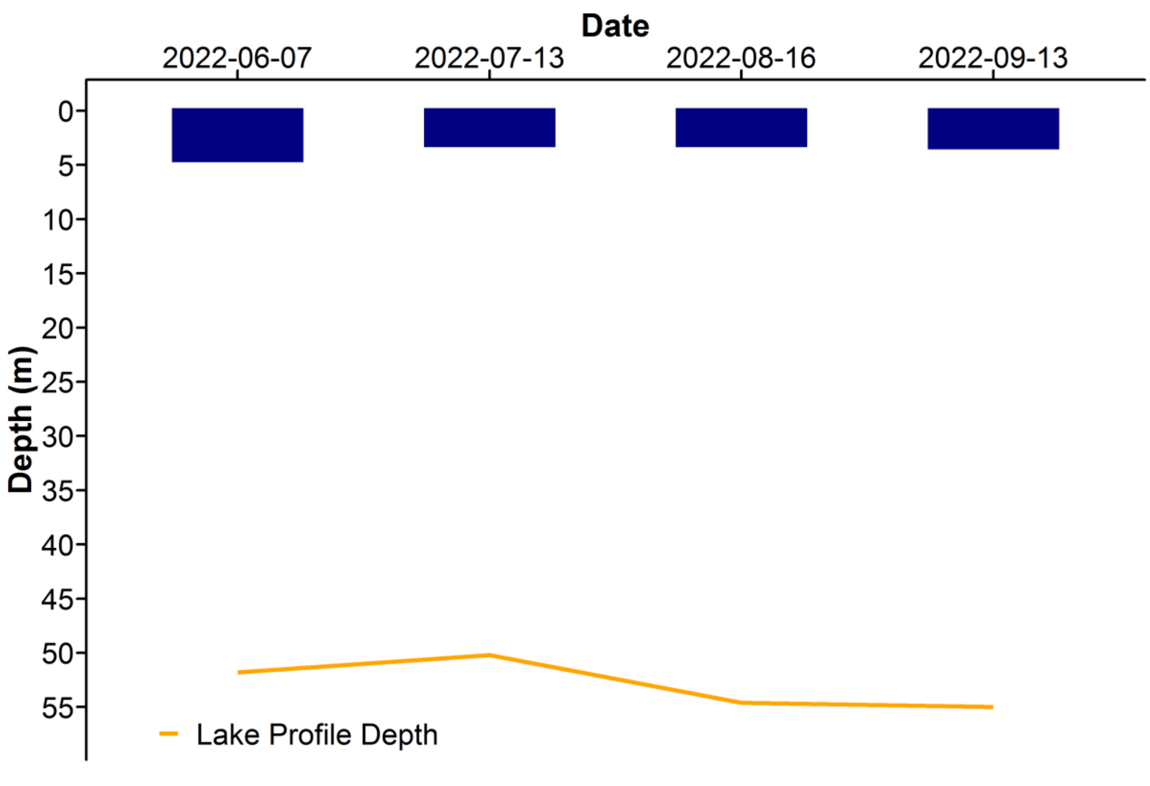

Figure 3. Euphotic depth values measured four times over the course of the summer at Amisk Lake in 2022.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen (DO) 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.

Surface temperatures of Amisk Lake varied throughout the summer, with the August 16th sampling date having the warmest temperatures at 22.0°C (Figure 4a). The lake was stratified during all sampling trips, with the largest changes in temperature (thermocline) beginning between 3 and 6 m, depending on the sampling date.

Amisk Lake was well oxygenated in the surface waters on all sampling dates, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen (Figure 4b). There was an appreciable reduction in surface oxygen during the September 13th sampling event – this is likely due to the lake mixing to a deeper depth where oxygen levels were observed to be lower during the previous August 16th sampling event. All dates displayed decreases in oxygen between 7 and 37m depth, below which oxygen was 0 mg/L.

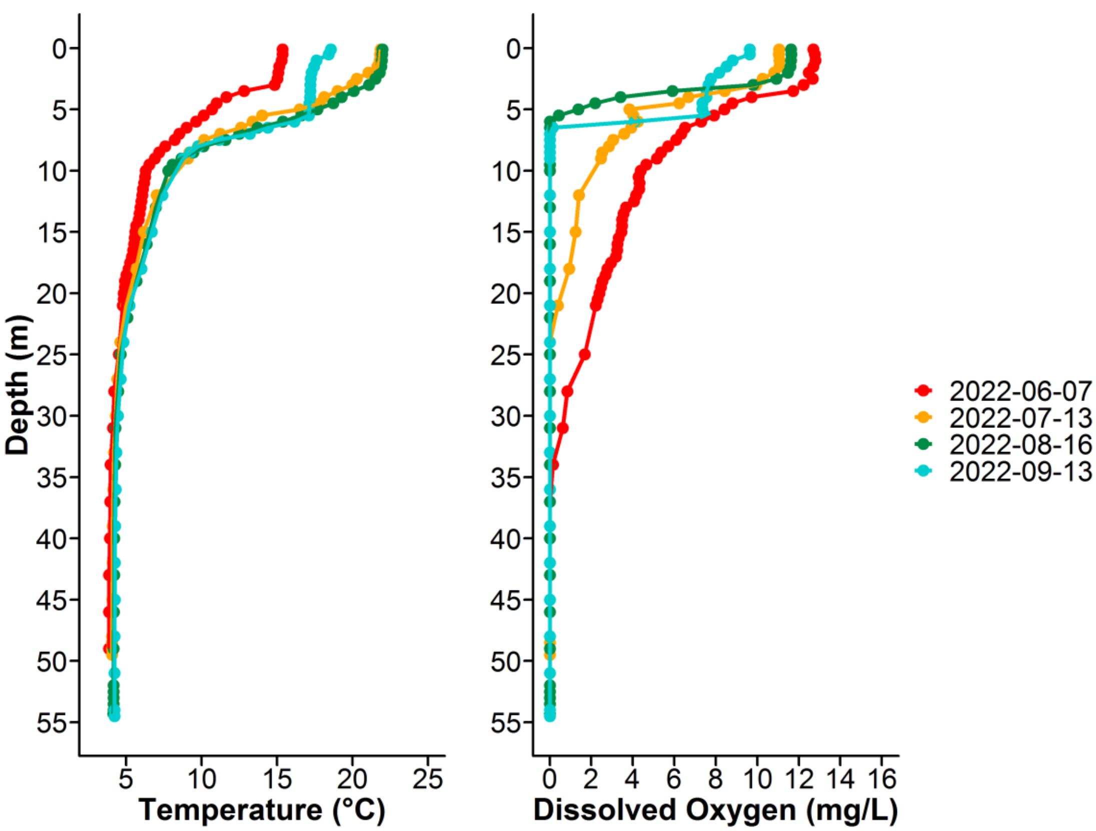

Figure 4. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Amisk Lake measured four times over the course of the summer of 2022.

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 one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 10 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 Amisk Lake fell below the recreational guideline of 10 µg/L during every sampling event in 2022. In addition, microcystin levels from each June 6th and July 13th were below the laboratory detection limit of 0.10 µg/L. A value of 0.05 µg/L is assigned to each date that is below detection, in order to calculate an average. Even though low levels of microcystin were detected, caution should always be observed when recreating around cyanobacteria.

Table 1. Microcystin concentrations measured four times at Amisk Lake in 2022.

Date	**Microcystin Concentration (µg/L)**
6-Jun-22	<0.10
13-Jul-22	<0.10
16-Aug-22	1.73
13-Sep-22	1.42
Average	0.81

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 can change lake conditions which can then lead to toxic cyanobacteria blooms, decrease the amount of nutrients needed for fish and other native species, and cause millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities. Spiny water flea pose a concern for Alberta because they alter the abundance and diversity of native zooplankton, as they are aggressive zooplankton predators. Through over-predation, they will impact higher trophic levels such as fish. They also disrupt fishing equipment by attaching in large numbers to fishing lines.

Monitoring for aquatic invasive species involved sampling with a 63 µm plankton net at three sample sites. This monitoring is designed to detect juvenile Dreissenid mussel veligers and spiny water flea. In 2022, no mussels or spiny water flea were detected at Amisk Lake.

Eurasian watermilfoil is a non-native aquatic plant that poses a threat to aquatic habitats in Alberta because it grows in dense mats preventing light penetration through the water column, reduces oxygen levels when the dense mats decompose, and outcompetes native aquatic plants. Eurasian watermilfoil can look similar to the native Northern watermilfoil, thus genetic analysis is ideal for suspect watermilfoil species identification.

No suspect watermilfoil was observed or collected from Amisk Lake in 2022.

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 Protected Areas.

Water levels at Amisk Lake in 2022 were slightly above the historical average, and have been relatively stable since measurements began in 1969 (Figure 5).

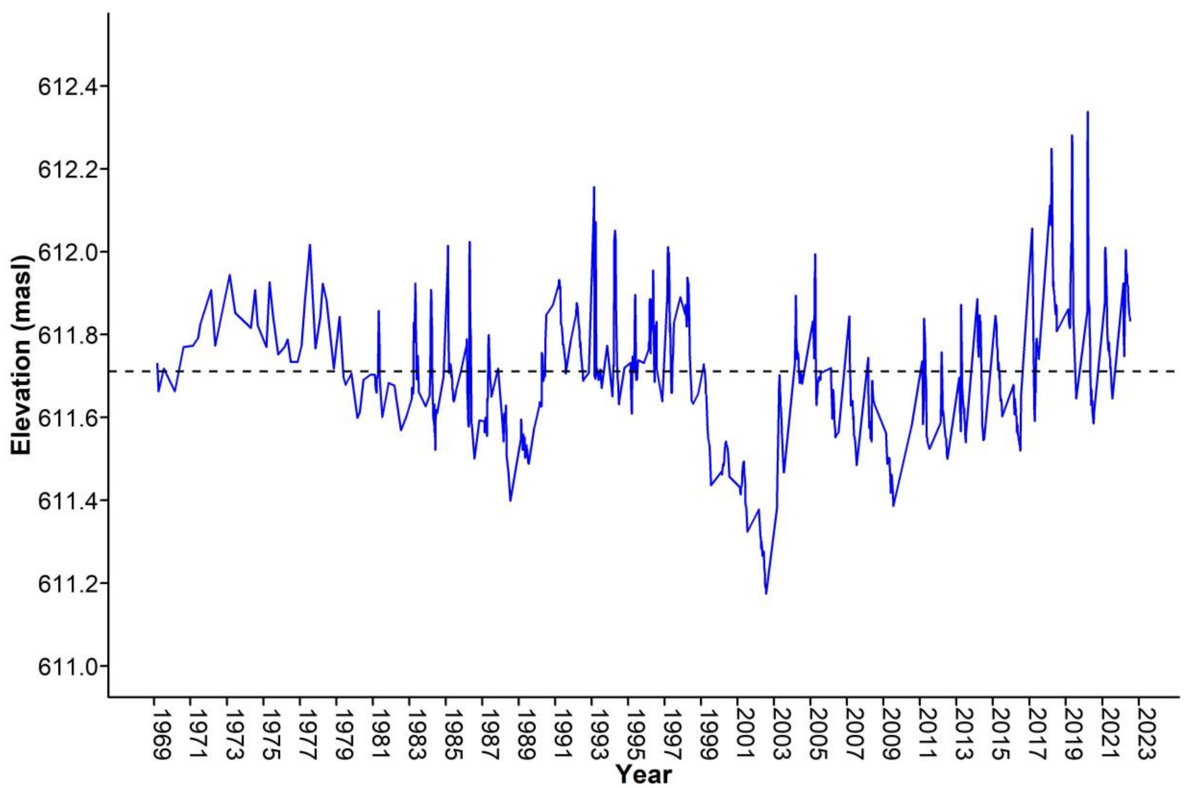

Figure 5. Water levels measured at Amisk Lake in metres above sea level (masl) from 1969-2022. Data retrieved from Alberta Environment and Protected Areas and/or Environment and Climate Change Canada. Black dashed line represents historical yearly average water level.

WEATHER & LAKE STRATIFICATION

Air temperature will directly impact lake temperatures, and result in different temperature layers (stratification) throughout the lake, depending on its depth. Wind will also impact the degree to which a lake mixes, and how it will stratify. The amount of precipitation that falls within a lake's watershed will have important implications, depending on the context of the watershed and the amount of precipitation that has fallen. Solar radiation represents the amount of energy that reaches the earth's surface, and has implications for lake temperature & productivity.

Amisk Lake experienced a warmer, slightly wetter, and windier summer than normal (Figure 6). Warm days preceding the July and August sampling events lead to higher surface water temperatures. Despite the higher than normal wind, the lake displays little variation in depth of mixing, relative to how deep the lake is.

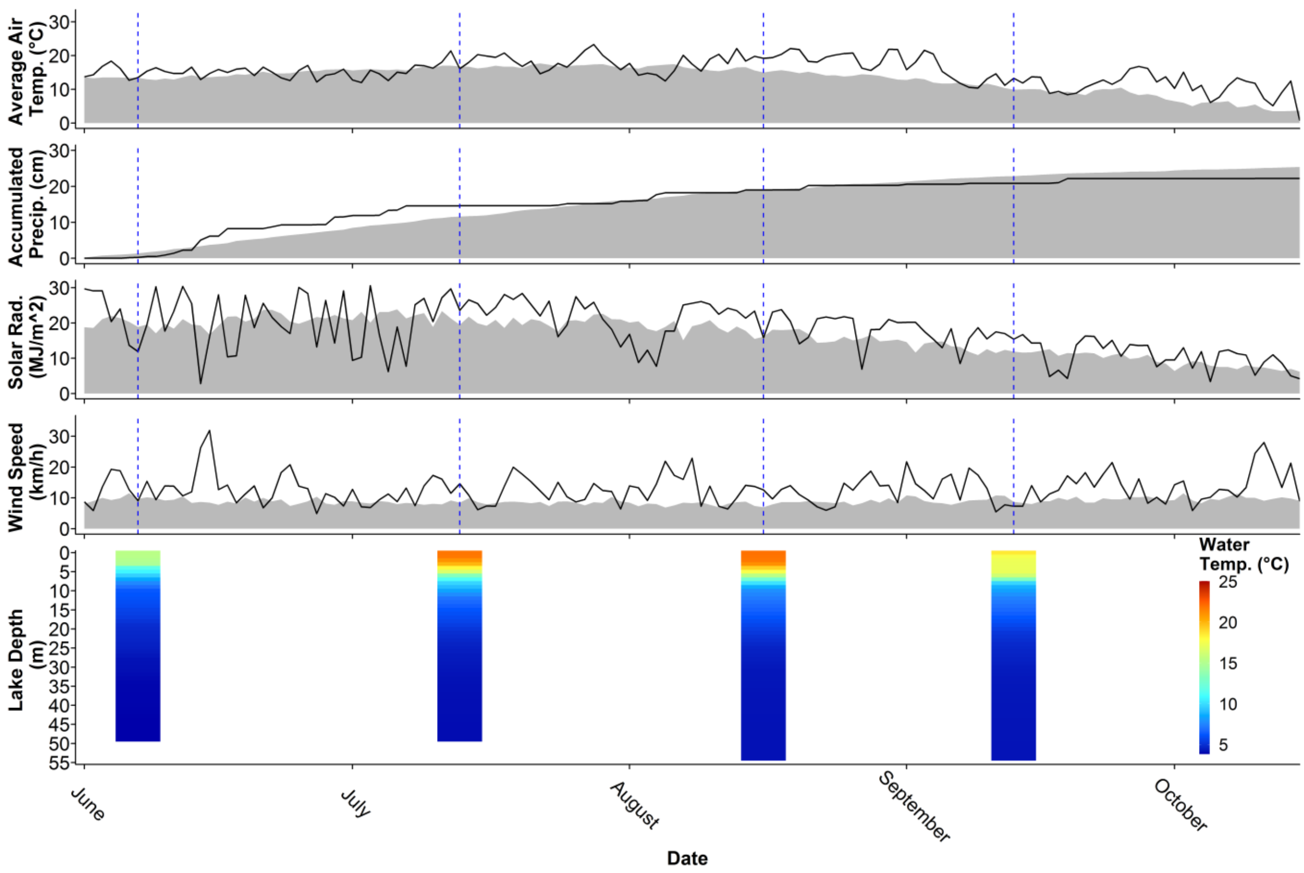

Figure 6. Average air temperature (°C), accumulated precipitation (cm), solar radiation (MJ/m^2), and wind speed (km/h) measured from Kinikinik AGCM, as well as Amisk Lake temperature profiles, interpolated (°C). Black lines indicate 2022 levels, gray indicates long-term normals, and blue lines indicate sampling dates for Amisk Lake over the summer. Further information about the weather data provided is available in the LakeWatch 2022 Methods report. Weather data provided by Agriculture, Forestry and Rural Economic Development, Alberta Climate Information Service (ACIS) https://acis.alberta.ca (retrieved March 2023).

Table 2. Average Secchi depth and water chemistry values for Amisk Lake.

Parameter	2008	2022
TP (µg/L)	33	32
TDP (µg/L)	14	12
Chlorophyll-*a* (µg/L)	6.5	23.6
Secchi depth (m)	2.60	1.75
TKN (mg/L)	1.0	1.2
NO_2-N and NO_3-N (µg/L)	8	3
NH_3-N (µg/L)	15	22
DOC (mg/L)	15	20
Ca^{2+} (mg/L)	31	36
Mg^{2+} (mg/L)	17	18
Na^{+} (mg/L)	29	31
K^{+} (mg/L)	4	5
SO_4^{2-} (mg/L)	21	27
Cl^{-} (mg/L)	4	6
CO_3^{2-} (mg/L)	7.3	7.0
HCO_3^{-} (mg/L)	201	208
pH	8.53	8.55
Conductivity (µS/cm)	380	405
Hardness (mg/L)	146	168
TDS (mg/L)	212	235
Microcystin (µg/L)	/	0.81
Total Alkalinity (mg/L $CaCO_3$)	178	182

Table 3. Concentrations of metals measured in Amisk Lake. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference. Note that metal sample collection method changed in 2016 from composite to single surface grab at the profile location.

Metals (Total Recoverable)	2008	2022	Guidelines
Aluminum μg/L	6.45	17.2	100[a]
Antimony μg/L	0.0356	0.047	/
Arsenic μg/L	1.02	1.2	5
Barium μg/L	64.5	61.7	/
Beryllium μg/L	<0.003	0.0015	100[c,d]
Bismuth μg/L	0.0086	0.0015	/
Boron μg/L	77.6	96	1500
Cadmium μg/L	0.002	0.005	0.24[b]
Chromium μg/L	0.1255	0.05	/
Cobalt μg/L	0.0213	0.075	50,1000[c,d]
Copper μg/L	0.332	0.23	3.7[b]
Iron μg/L	9.97	37.8	300
Lead μg/L	0.029	0.021	6.1[b]
Lithium μg/L	15.95	18.5	2500[d]
Manganese μg/L	5.94	4.18	180[e]
Molybdenum μg/L	0.152	0.268	73
Nickel μg/L	<0.005	0.41	141.5[b]
Selenium μg/L	0.331	0.1	1
Silver μg/L	0.0017	5.00E-04	0.25
Strontium μg/L	188	180	/
Thallium μg/L	0.0039	0.001	0.8
Thorium μg/L	0.031	0.005	/
Tin μg/L	<0.03	0.03	/
Titanium μg/L	0.519	0.41	/
Uranium μg/L	0.253	0.296	15
Vanadium μg/L	0.187	0.277	100[c,d]
Zinc μg/L	1.25	0.9	30[f]

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on 2022 avg. water hardness (as CaCO3) with CCME equation
[c] Based on CCME Guidelines for Agricultural use (Livestock).
[d] Based on CCME Guidelines for Agricultural Use (Irrigation).
[e] Based on CCME Manganese variable calculation (https://ccme.ca/en/chemical/129#_aql_fresh_concentration), using 2022 avg. water hardness (as CaCO3) and avg. pH
[f] Based on 2022 avg. water hardness (as CaCO3), avg. pH, and avg. DOC with CCME equation
A forward slash (/) indicates an absence of data or guideline