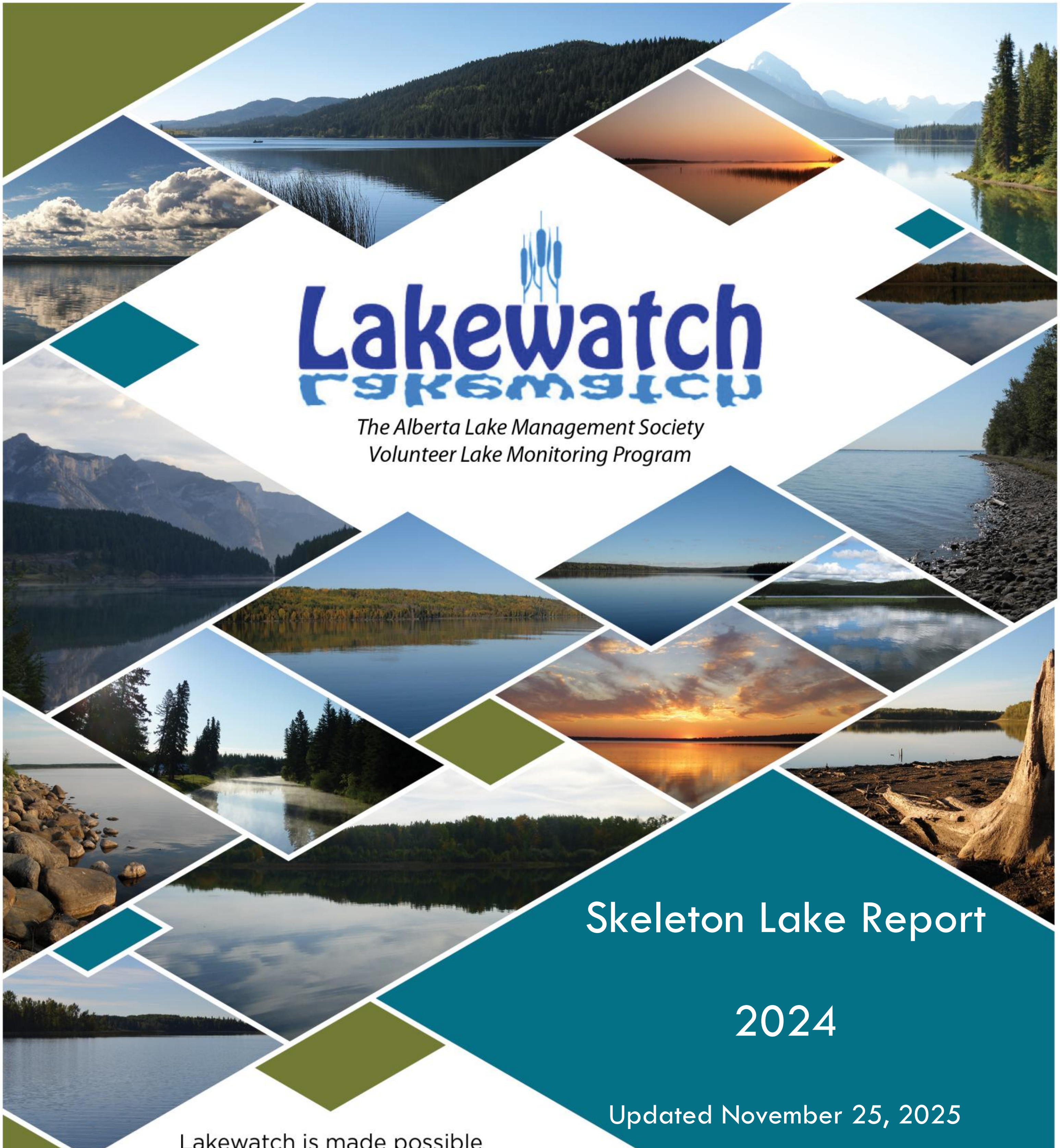

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Skeleton Lake Report

2024

Updated November 25, 2025

Lakewatch is made possible with support from:

Alberta

Lac La Biche County welcoming by nature.

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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 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

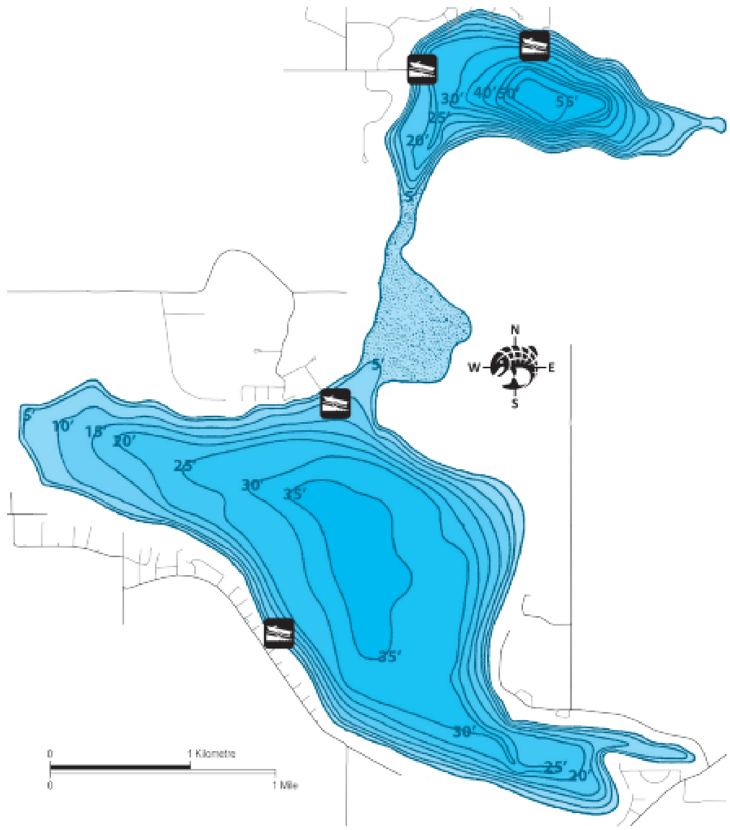
The LakeWatch program is made possible through the dedication of its volunteers. A special thanks to Orest Kitt, Rick Tiedemann, and Brian Harrison for their commitment to collecting data at Skeleton Lake. We would also like to thank Katherine Cundict and Jordyn Lajeunesse, who were summer technicians in 2024. Executive Director Bradley Peter and Program Manager Brittany Onysyk were instrumental in planning and organizing the field program. This report was prepared by Brittany Onysyk and Bradley Peter.

BEFORE READING THIS REPORT, CHECK OUT [A BRIEF INTRODUCTION TO LIMNOLOGY]

SKELETON LAKE

Skeleton Lake is a small lake located in the western portion of the Beaver River watershed. The lake's name is a translation of Cree "*Cîpay Sâkâhikan*", which means "place of the skeletons".[1] Cree legend tells of a Cree chief that was buried along the shores of the lake.[1]

The lake is located within the County of Athabasca, 160 km northeast of the city of Edmonton and 6.5 km northeast of the Village of Boyle. Skeleton Lake lies within the dry mixedwood subregion of the boreal mixedwood natural region.[2] The two basins of Skeleton Lake, North and South, are separated by "the Narrows" which is a small portion of low water and emergent vegetation that is impassible in low water conditions.



Historical bathymetric map of Skeleton Lake obtained from the Angler's Atlas.

Skeleton Lake has an extensively developed shoreline, with the summer villages of Mewatha and Bondiss on the southern and eastern shore of the lake. Additional cottages have been developed along the remainder of Skeleton Lake South Basin and on the northwest portion of the North Basin. There are numerous boat launches on the South Basin, and one public boat launch on the North Basin. The Skeleton Lake Golf & Country Club golf course is located directly east of the South Basin. Additionally, a campground has been developed on the southeastern shore, south of Bondiss.

For years, Skeleton Lake was the main source of drinking water for the Town of Boyle.[3] Since 2007, the town has received its drinking water from the Athabasca River.

The watershed surrounding Skeleton Lake is four times the size of the lake.[1] Much of the watershed remains relatively intact with mixed forest and peatlands. Agriculture occurs in much of the watershed, especially in the southern and northwestern sections, and includes cropland and grazing. Several small intermittent streams flow into the lake. The outlet is a small creek located at the southeast end of the lake, draining eastward into Amisk Lake. Beaver dams, however, often block the outlet.[1]

Although considered a fertile and productive lake for decades[1], over the last few years, Skeleton Lake North Basin has been facing regular public advisories for a dangerous toxin, microcystin, that is produced through cyanobacteria.[4] Skeleton Lake South Basin does not face this same challenge with its water quality.

As the water quality is so different, and the narrows connecting the basins cannot always be navigated safely, the basins are sampled separately as the North and South Basin, and water quality characteristics will be reported separately.

Top: Sampling Skeleton Lake North Basin on August 22, 2024.
Right: Sampling Skeleton Lake South Basin on June 10, 2024.

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[1]Mitchell, P. and E. Prepas. 1990. Atlas of Alberta Lakes.
[2]Strong, W.L. and K.R. Leggat. 1981. Ecoregions of Alberta.
[3] Skeleton Lake Stewardship Association. Background & History of Skeleton Lake. https://skeletonlakeab.com/skeleton-lake-2/
[4] Federal-Provincial-Territorial Committee on Drinking Water. 2002. Cyanobacterial Toxins — Microcystin-LR

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.

North Basin:

The average total phosphorus (TP) concentration for the North Basin was 74 µg/L (Table 3), falling into the eutrophic, or high productivity trophic classification. TP ranged from a minimum of 31 µg/L on the July 4 sampling event, and peaked at 130 µg/L on June 10 (Figure 1).

The average chlorophyll-*a* concentration in 2022 was 58 µg/L (Table 3), falling into the hypereutrophic, or very highly productive trophic classification. Chlorophyll-*a* was lowest at 28.9 µg/L on August 22 and peaked at 88.5 µg/L on June 10 (Figure 1).

The average total Kjeldahl nitrogen (TKN) concentration was 1.5 mg/L (Table 2) and varied through the season between 0.5-2 mg/L (Figure 1).

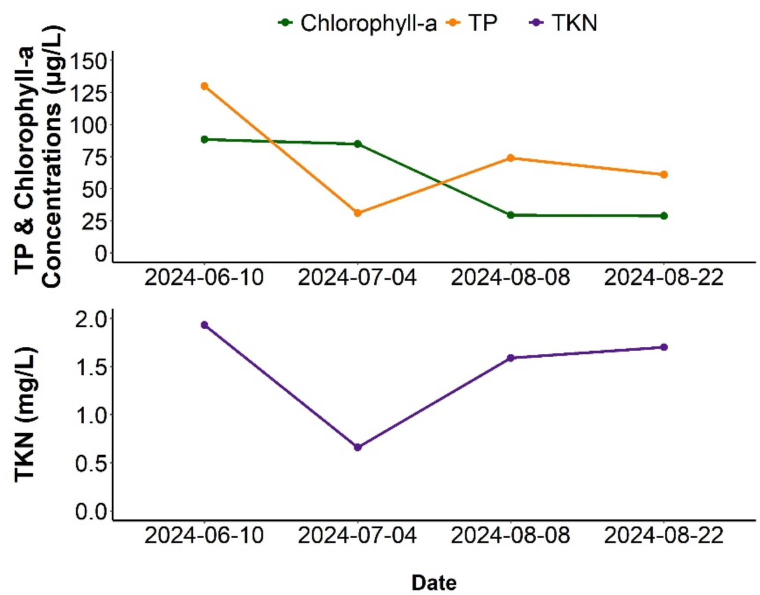

Figure 1. Total Phosphorus, Chlorophyll-*a*, and Total Kjeldahl Nitrogen concentrations measured over the course of the summer at Skeleton Lake North Basin in 2024.

South Basin:

The average TP concentration for the South Basin was 38 µg/L (Table 4), falling into the eutrophic, or high productivity trophic classification. TP ranged from a minimum of 16 µg/L on July 4 and peaked at 58 µg/L on August 22 (Figure 2).

Average chlorophyll-*a* concentrations in 2022 was 15.7 µg/L (Table 4), falling into the eutrophic, or highly productive trophic classification. Chlorophyll-*a* was lowest at 5.9 µg/L on July 4 and peaked at 24 µg/L on August 22 (Figure 2).

The average TKN concentration was 1 mg/L (Table 4) and also showed some variation over the summer, although less variable than TKN observed in the North Basin (0.5 - 1.1 mg/L) (Figure 2).

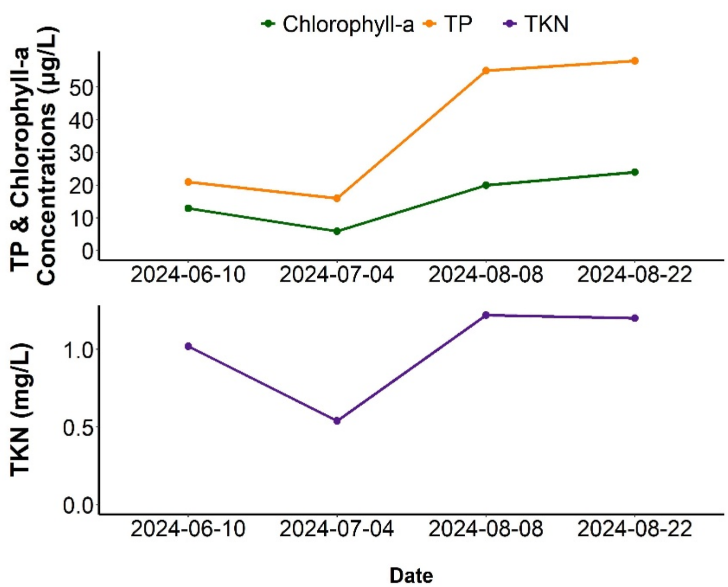

Figure 2. Total Phosphorus, Chlorophyll-*a*, and Total Kjeldahl Nitrogen concentrations measured over the course of the summer at Skeleton Lake North Basin in 2024.

North Basin:

Average pH was measured as 8.65 in 2024, buffered by moderate alkalinity (222 mg/L $CaCO_3$) and bicarbonate (240 mg/L HCO_3). Aside from bicarbonate, calcium, magnesium, and sodium were slightly higher than all other major ions, and together contributed to a moderate conductivity of 440 µS/cm (Figure 3; Table 3).

Compared to the South Basin, the North Basin had a higher abundance of sulphate (Figure 2, 3). Skeleton Lake North Basin displays moderate ion levels compared to other LakeWatch lakes sampled in 2024 (Figure 3, bottom).

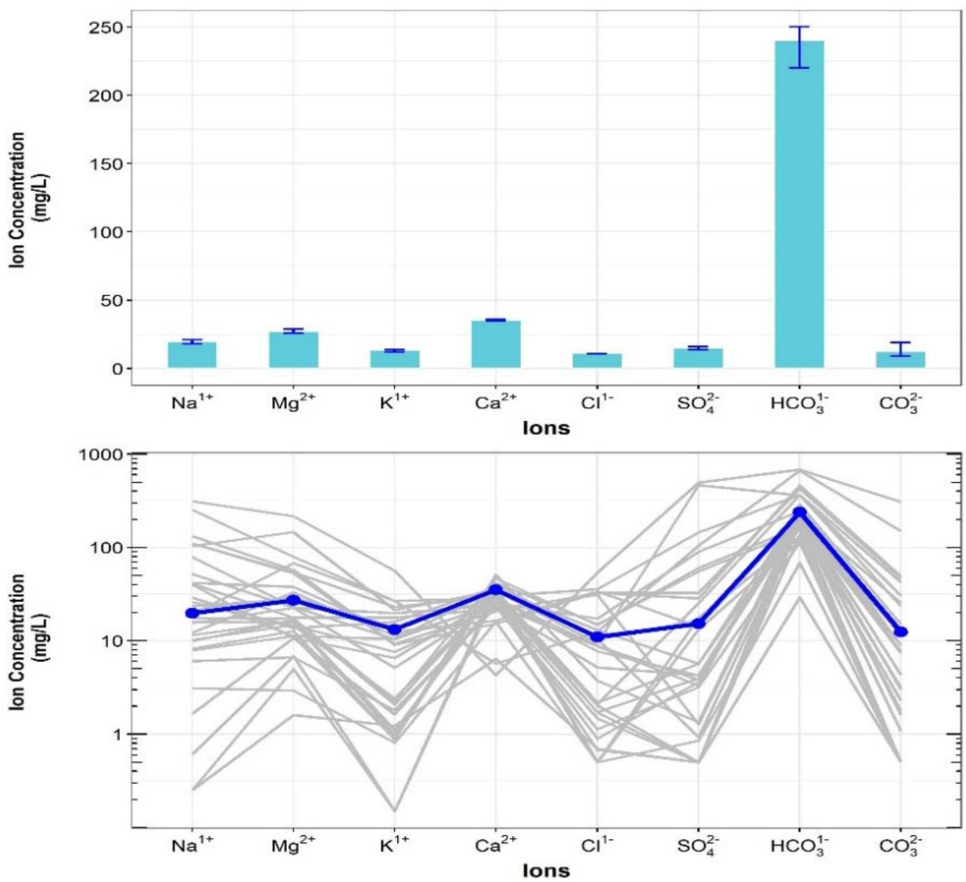

Figure 3. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) measured over the course of the summer at North Skeleton Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Skeleton Lake North Basin (blue line) compared to 26 lake basins (gray lines) sampled through the LakeWatch program in 2024 (note log10 scale on y-axis of bottom figure).

South Basin:

Average pH was measured as 8.54 in 2024, buffered by a moderate alkalinity (228 mg/L $CaCO_3$) and bicarbonate (255 mg/L HCO_3). Aside from bicarbonate, calcium, magnesium, and sodium were slightly higher than all other major ions, and together contributed to a moderate conductivity of 442 µS/cm (Figure 4; Table 4). Skeleton Lake South Basin displays moderate ion levels compared to other LakeWatch lakes sampled through the LakeWatch program in 2024 (Figure 4, bottom).

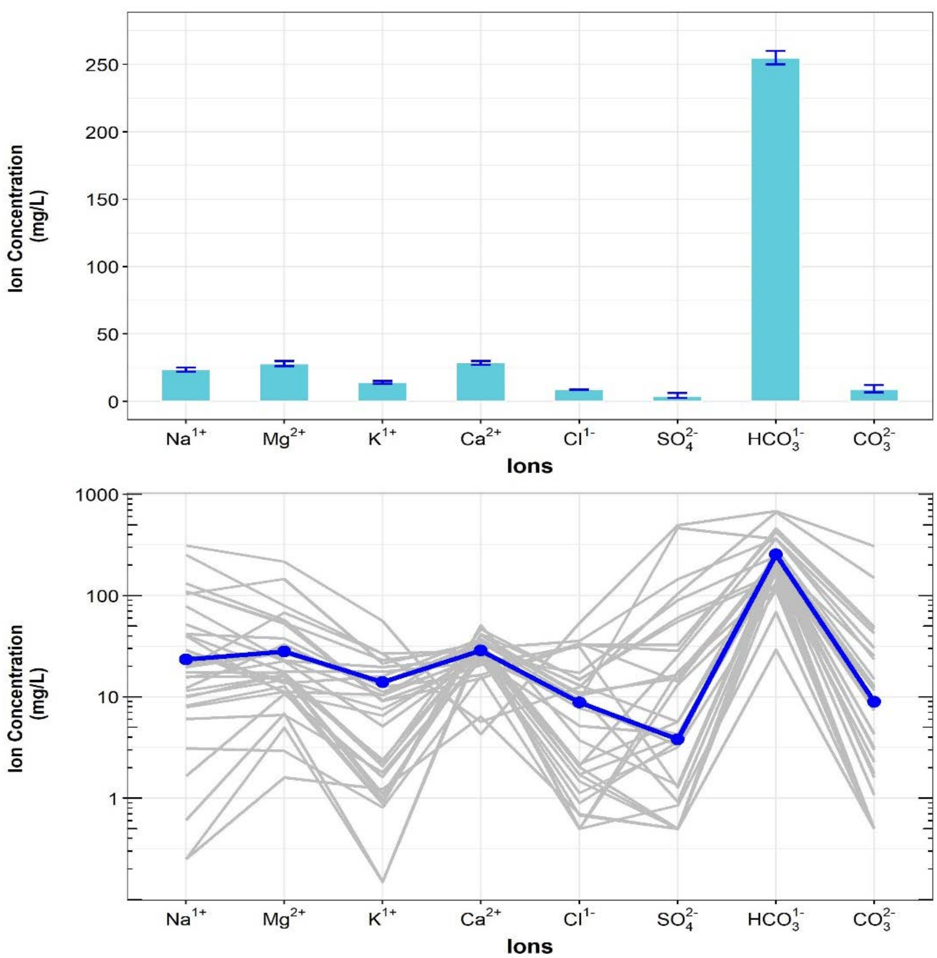

Figure 4. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) measured over the course of the summer at Skeleton Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Skeleton Lake South Basin (blue line) compared to 26 lake basins (gray lines) sampled through the LakeWatch program in 2024 (note log10 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 in both basins of Skeleton Lake in 2024. No metals exceeded the CCME guidelines for the protection of aquatic life[3] in either basin (Table 5, 6).

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[3] Canadian Water Quality Guidelines. 2019. Canadian Council of Ministers of the Environment.

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.

North Basin:

The average euphotic depth of the North Basin in 2024 was 1.04 m, corresponding to an average Secchi depth of 0.52 m (Table 3). Euphotic depth was consistently low over the season, ranging from as shallow as 0.4 m on July 4 to as deep as 1.6 m on August 22 (Figure 5). Relative to the depth of the lake, the water clarity for Skeleton Lake North Basin is low. This is likely due to the increased growth of a cyanobacteria species in the genus *Planktothrix*, as indicated by chlorophyll-*a* levels (Figure 1), as well as elevated microcystin levels (Table 1).

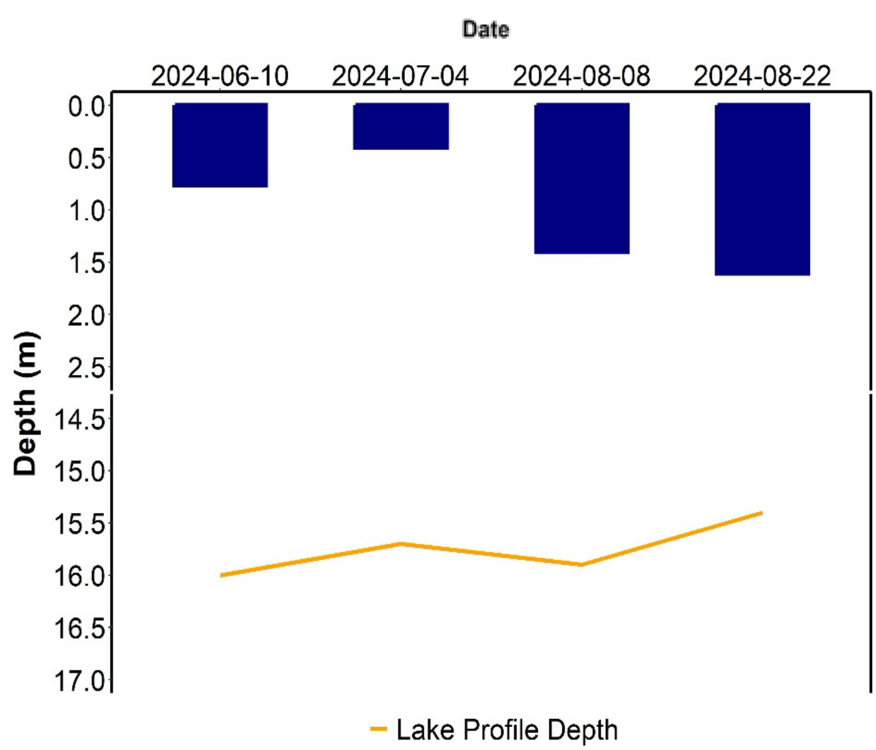

Figure 5. Euphotic depth values measured over the course of the summer at Skeleton Lake North Basin in 2024.

South Basin:

The average euphotic depth of the South Basin in 2024 was 5.12 m, corresponding to an average Secchi depth of 2.56 m (Table 4). Euphotic depth varied over the season, ranging from as shallow as 3.6 m on August 22 to as deep as 7.8 m on July 4 (Figure 6). The relatively lower water clarity measured during the August 8 and 22 sampling events is likely due to an increase in algal or cyanobacteria growth, as indicated by the elevated chlorophyll-*a* levels (Figure 2).

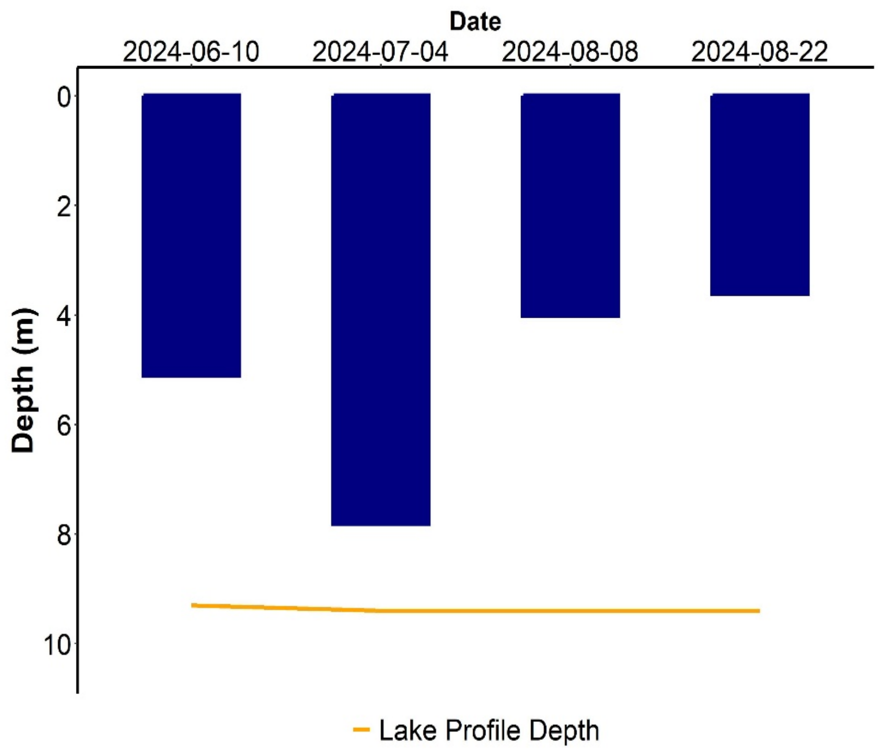

Figure 6. Euphotic depth values measured over the course of the summer at Skeleton Lake South Basin in 2024.

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.

North Basin:

Surface water temperatures in the North Basin varied throughout the summer, with a maximum temperature of 26.22°C measured at the surface on August 22, and June 10 surface water readings between 10-15°C (Figure 7). The temperature profiles indicate that the lake was weakly stratified during June sampling, where the thermocline was observed at about 10 m, with stronger stratification observed for the rest of the season, with the thermocline being about 3 m deep. Thermal stratification indicates the lake does not mix completely during the summer season. Past the thermocline, the temperature of the lake water approaches 4°C near the lake bottom.

Skeleton Lake North Basin remained well oxygenated at the surface throughout the summer, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen[4] (Figure 7). Due to thermal stratification and the lack of mixing, oxygen rapidly dropped during each sampling event to anoxic levels (dissolved oxygen <1 mg/L) at the depth of the thermocline (approximately 4 m).

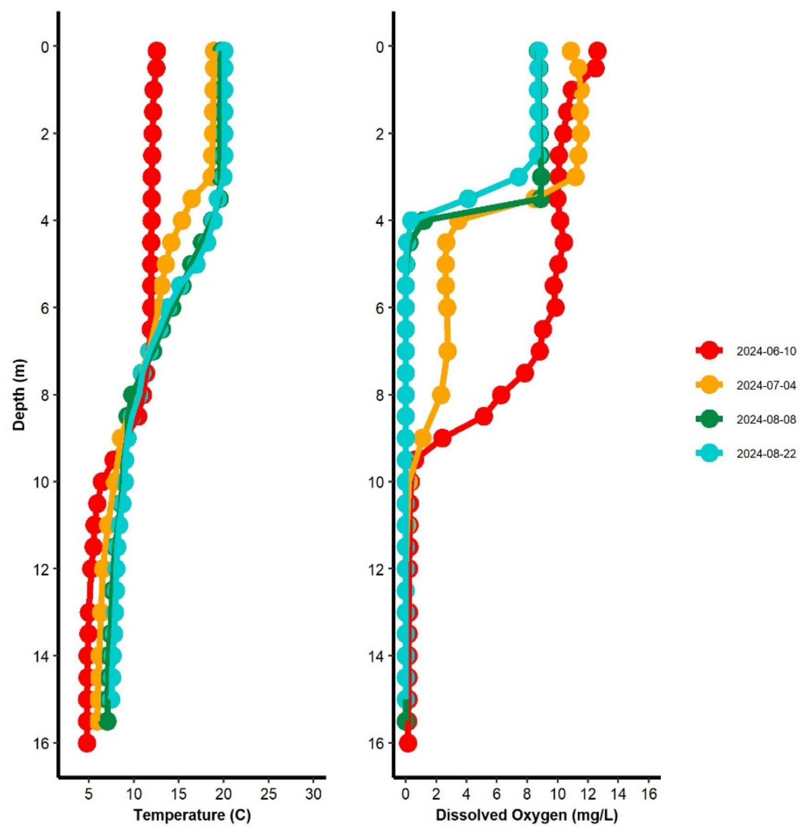

Figure 7. Temperature (°C) and dissolved oxygen (mg/L) profiles for Skeleton Lake North Basin measured over the course of the summer of 2024.

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[4] Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater).

South Basin:

Surface water temperatures in the South Basin varied throughout the summer, with a maximum temperature of 20.72°C measured at the surface on August 8 (Figure 8). The lake was well mixed during all sampling events, reflected by a steady temperature Profile to the bottom of the lake, with the exception of a small temperature drop near the bottom of the lake during the July 4 sampling trip (Figure 4). Because thermal stratification was not observed, the water column remained well mixed throughout the summer.

Due to the lack of thermal stratification, Skeleton Lake South Basin water column remained well oxygenated at the surface and throughout most of the water column through the summer, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen[4] (Figure 8). However, dissolved oxygen levels begin to drop near the bottom during all sampling events (Figure 8). During the July and August sampling events, dissolved oxygen decreases sharply at approximately 7 m, falling below 6.5 mg/L and approaching 0 mg/L (anoxia) near the bottom of the lake. The drop in dissolved oxygen near the bottom of the lake is likely due to decomposition processes that utilize oxygen.

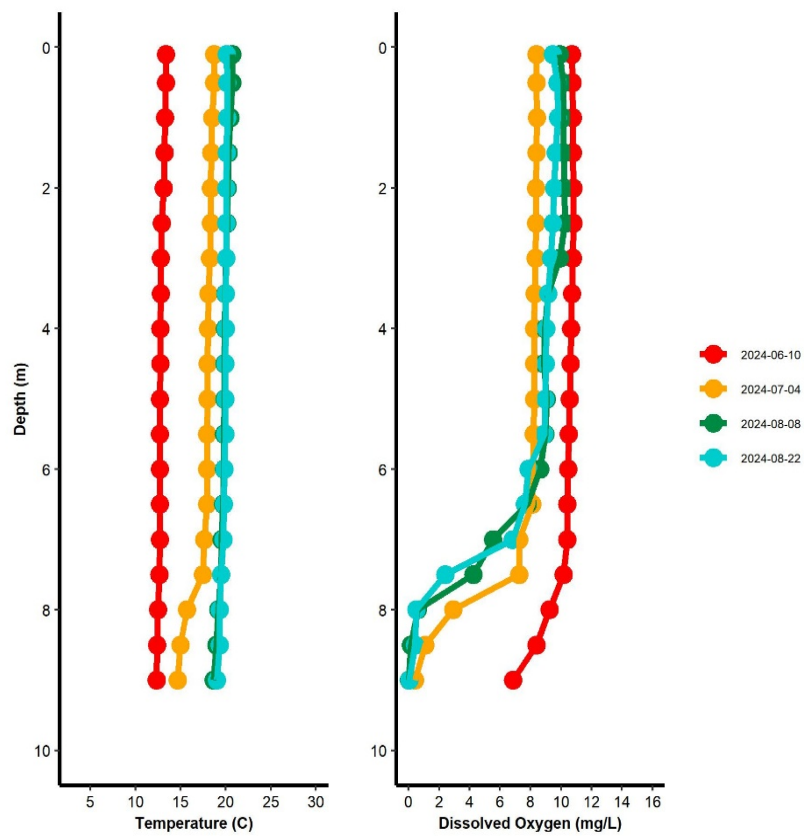

Figure 8. Temperature (°C) and dissolved oxygen (mg/L) profiles for Skeleton Lake South Basin measured over the course of the summer of 2024.

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[4] Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater).

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.

North Basin:

Microcystin levels in Skeleton Lake North Basin **exceeded** the recreational guidelines of 10 μg/L[5] during the June 10 and July 4 sampling events in 2024 (Table 1). Although microcystin levels fell below the guidelines during August and September sampling events, levels were still appreciably high. In recent years, a toxic species of cyanobacteria of the genus *Planktothrix* has been observed in Skeleton Lake North - this is likely the cause of the high levels of microcystin.

Table 1. Microcystin concentrations measured four times at Skeleton Lake North Basin in 2024.

Date	Microcystin Concentration (μg/L)
06/10/2024	13.98
07/04/2024	13.59
08/08/2024	6.24
08/22/2024	4.8
Average	**9.65**

South Basin:

Microcystin levels in Skeleton Lake South Basin fell below the recreational guideline of 10 μg/L[5] during every sampling event in 2024.

Table 2. Microcystin concentrations measured four times at Skeleton Lake South Basin in 2024.

Date	Microcystin Concentration (μg/L)
06/10/2024	0.23
07/04/2024	0.4
08/08/2024	0.69
08/22/2024	0.73
Average	**0.51**

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[5] Health Canada. 2022. Guidelines for Canadian Recreational Water Quality.

INVASIVE SPECIES

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. This monitoring is designed to detect juvenile Dreissenid mussel veligers and spiny water flea. No mussels or spiny water flea were detected at Skeleton Lake in 2024.

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.

Watermilfoil was not collected at Skeleton Lake in 2024.

WEATHER AND LAKE STRATIFICATION

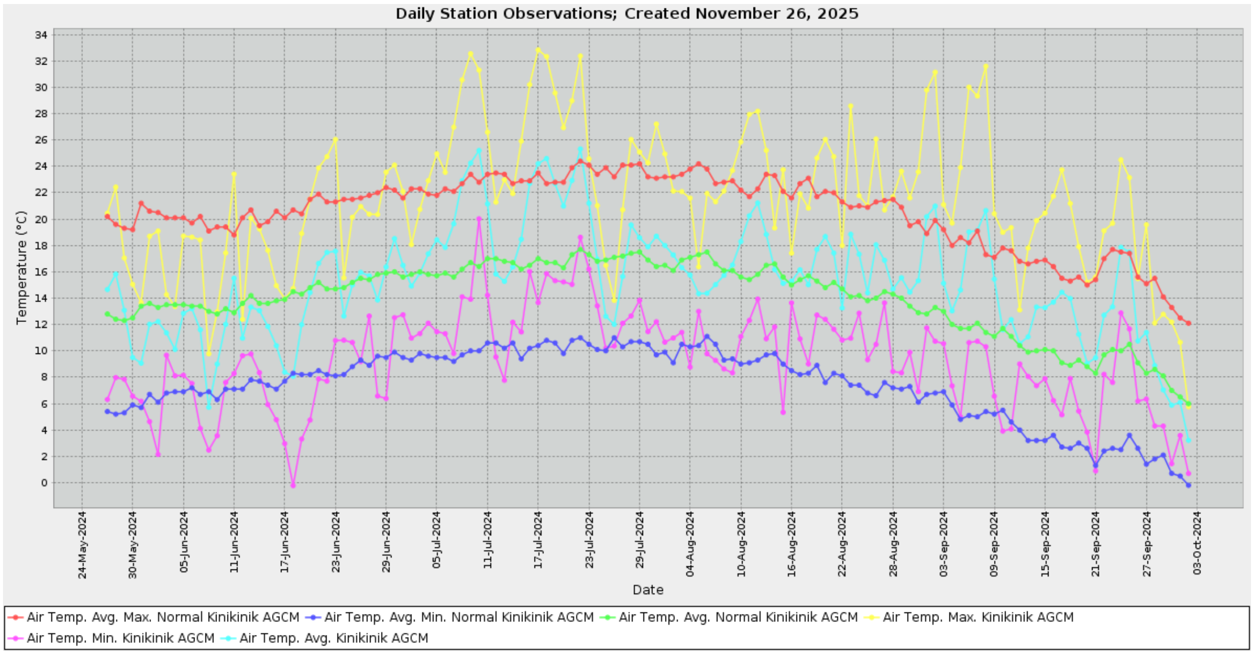
Air temperature will directly impact lake temperatures, and result in different temperature layers (stratification) throughout the lake, depending on its depth. Wind will also impact the degree to which a lake mixes, and how it will stratify. The amount of precipitation that falls within a lake's watershed 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.

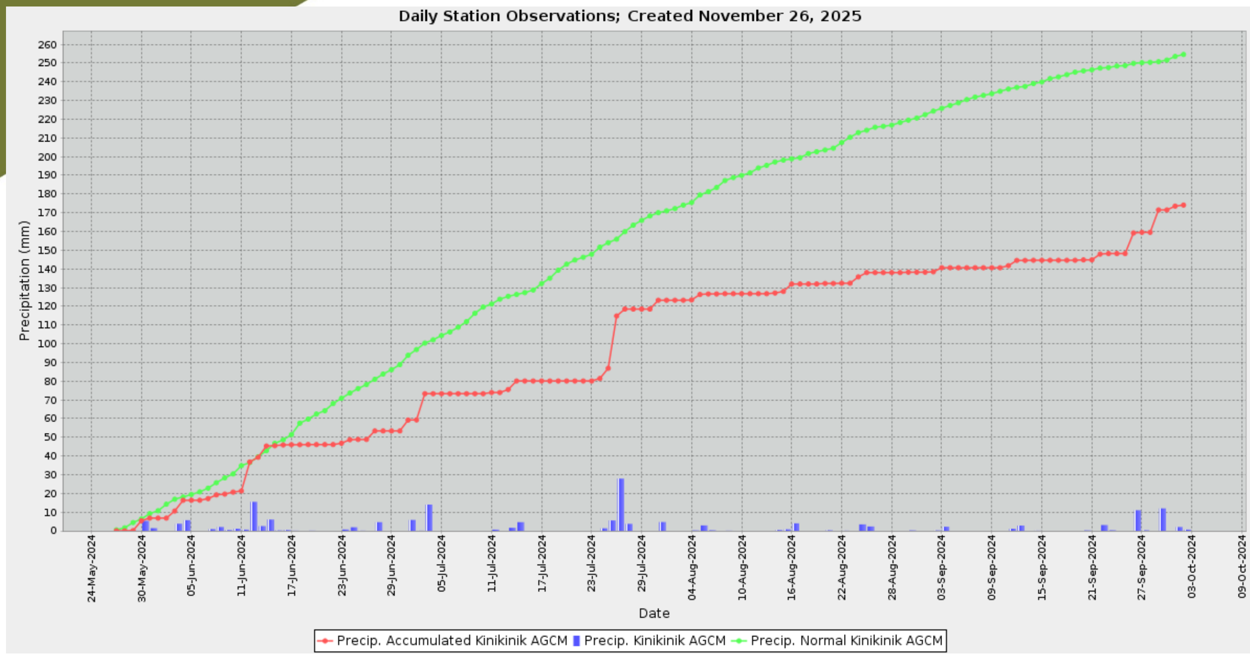
In 2024, Skeleton Lake experienced a warmer and windier summer compared to normal, with less than normal accumulated precipitation (Figure 9).

Although it was warmer overall, the beginning of the sampling season was unseasonably cold and wet, with the month of June near breaking the lowest temperatures on record on numerous days. The lowest temperature was recorded on June 18 at -0.2°C. July was the warmest month, with the average temperature being 19.2°C. 2024 also broke numerous heat records in the months of July and September, including the hottest day recorded on July 17 at 32.8°C. September was also a warmer than average month, with the average temperature being 13.5°C.

Skeleton Lake received less than normal precipitation in the summer of 2024 (approximately 170 mm total; Figure 5). Precipitation occurred in short bursts over the summer months, with nearly 30% of the season's precipitation falling within the first two weeks of June (Figure 5). This was followed by weeks of little to no precipitation, with the exception of almost 30 mm falling on July 27 (Figure 5). Very little precipitation fell in the months of August and September.

Strong winds were also observed throughout the sampling season.





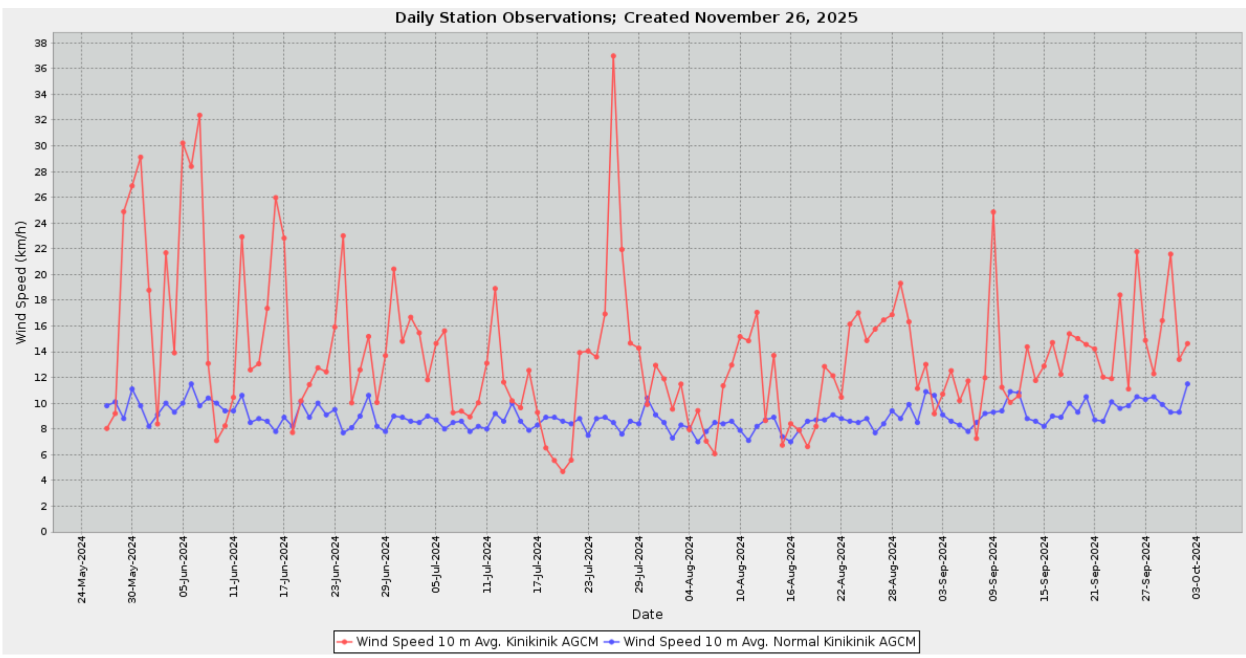


Figure 9. Air temperature (°C), precipitation (mm), wind speed (km/h) measured from Kinikinik weather station southwest of Skeleton Lake. Weather data provided by Agriculture, Forestry and Rural Economic Development, Alberta Climate Information Service (ACIS) https://acis.alberta.ca.

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.

"The Narrows" at Skeleton Lake between the South and North Basins in 2024.

Historically, Skeleton Lake North and South basins were connected by open water through a region of the lake called 'the Narrows.'[1] During dry periods, the Narrows between the two basins become un-navigable due to extensive aquatic plant growth in the shallow water. In 2024, the Narrows were navigable with the presence of open water between the two basins (photo right).

Water levels in Skeleton Lake South Basin have been monitored since 1965 (Figure 10). There was a significant decrease in water levels in the late 1980s and early 1990s. Levels then recovered to the initial historical range for a brief time in the late 1990s before plummeting to the lowest levels on record in 2016. Water levels recovered slightly in 2020, before a slight decline in 2021.

Water levels in Skeleton Lake North Basin have been monitored from 2012 to 2025, and remained relatively stable until 2020, where levels increased by about 1 m (Figure 11). Water levels followed a similar pattern to the South Basin and dropped slightly through 2021-2023, but showed a slight recovery over the winter of 2024 (Figure 11).

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[1]Mitchell, P. and E. Prepas. 1990. Atlas of Alberta Lakes.

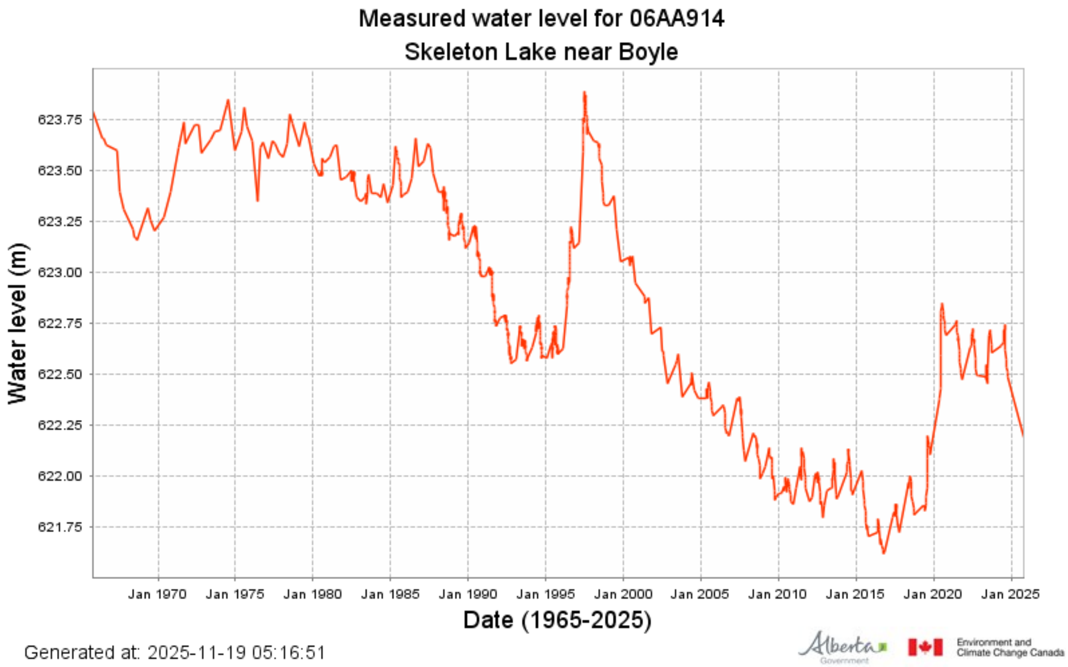


Figure 10. Water levels measured at Skeleton Lake South Basin in metres above sea level (masl) from 1965-2025. Obtained from Environment and Climate Change Canada.

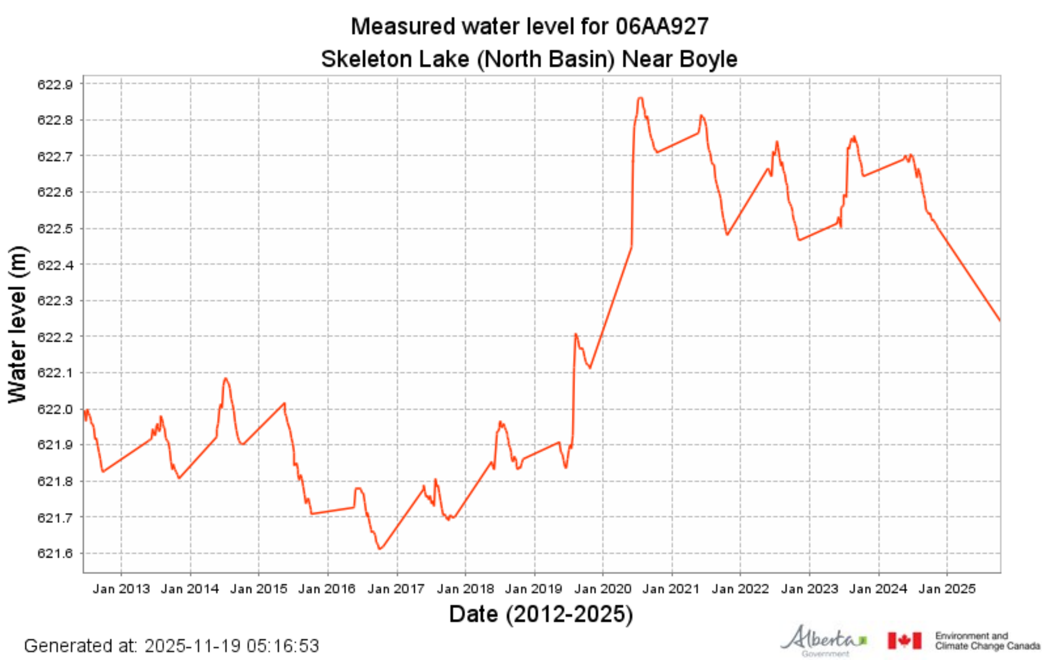


Figure 11. Water levels measured at Skeleton Lake North Basin in metres above sea level (masl) from 2012-2025. Obtained from Environment and Climate Change Canada.

Table 3. Average Secchi depth and water chemistry values for Skeleton Lake North Basin. Ion data using "extractable" analysis was excluded from this historical record in the years 2005-2014.

Parameter	1985	1986	2005	2010	2011	2012	2013	2014	2015	2016
TP (µg/L)	24	36	33	48	45	36	48	25	26	28
TDP (µg/L)	14	10	11	16	15	14	28	11	11	9
Chlorophyll-a (µg/L)	9.2	10.7	11.0	8.6	9.4	8.6	7.6	5.8	7.5	9.2
Secchi depth (m)	-	2.49	2.63	1.75	1.95	2.45	2.35	2.81	2	1.4
TKN (mg/L)	1.2	1.1	1.3	1.6	1.5	1.5	1.5	1.2	1.5	1.5
NO_2-N and NO_3-N (µg/L)	2	4	4	5	3	2	2	22	-	2
NH_3-N (µg/L)	21	32	13	83	39	21	23	33	-	25
DOC (mg/L)	15	15	17	19	18	18	18	19	17	18
Ca^{2+} (mg/L)	23	24	-	-	-	-	-	-	25	24
Mg^{2+}(mg/L)	19	19	-	-	-	-	-	-	26	28
Na^{+} (mg/L)	13	14	18	19	18	18	19	21	19	21
K^{+} (mg/L)	8	8	11	11	11	12	14	12	12	14
SO_4^{2-} (mg/L)	2	2	5	6	7	4	8	2	8	8
Cl^{-} (mg/L)	2	1	3	3	5	6	5	6	7	7
CO_3^{2-} (mg/L)	-	-	12	9.7	13.4	8.7	17.4	9.9	10.8	10
HCO_3^{2-} (mg/L)	-	-	204	217.67	210.8	226.4	212.8	215.6	228	226
pH	8.53	8.58	8.79	8.71	8.84	8.67	8.86	8.58	8.70	8.70
Conductivity (µS/cm)	318	324	334	372	374	388	390	390	402	392
Hardness (mg/L)	135	138	150	164	164	166	171	165	170	174
TDS (mg/L)	172	174	192	205	208	210	217	215	222	224
Microcystin (µg/L)	-	-	0.08	0.14	0.11	0.17	0.13	0.08	0.07	0.2
Total Alkalinity (mg/L CaCO3)	170	172	186	195	195	200	204	193	204	200

Parameter	2017	2018	2019	2020	2021	2022	2023	2024
TP (µg/L)	31	32	42	43	72	76	72	74
TDP (µg/L)	8	8	5	11	10	11	11	15
Chlorophyll-a (µg/L)	11.2	19.6	27.3	18.8	48.2	57.8	34.1	58.0
Secchi depth (m)	1.88	1.03	0.9	0.98	0.72	0.58	0.49	0.52
TKN (mg/L)	1.6	1.6	1.9	2.1	2.3	2.2	2.4	1.5
NO_2-N and NO_3-N (µg/L)	2	2	2	3	5	6	2	2
NH_3-N (µg/L)	28	19	36	83	26	11	24	14
DOC (mg/L)	17	19	19	20	18	22	16	20
Ca^{2+} (mg/L)	25	24	23	32	34	37	32	35
Mg^{2+}(mg/L)	28	26	27	26	26	28	26	27
Na^{+} (mg/L)	21	20	21	20	19	20	20	20
K^{+} (mg/L)	13	13	13	13	13	14	13	13
SO_4^{2-} (mg/L)	8	9	10	17	15	17	14	15
Cl^{-} (mg/L)	7	8	9	10	10	10	11	11
$CO\sim_3^{2-}$ (mg/L)	18	13.8	13.2	4.8	10.3	7.8	13.1	12.4
HCO_3^{2-} (mg/L)	206	208	215	232.5	245	240	235	240
pH	8.83	8.79	8.83	8.44	8.63	8.55	8.43	8.65
Conductivity (µS/cm)	390	390	392	415	440	450	418	455
Hardness (mg/L)	176	164	168	185	188	205	188	200
TDS (mg/L)	222	216	222	238	250	258	252	258
Microcystin (µg/L)	0.08	0.1	2.63	4.4	9.3	9.48	10.04	9.65
Total Alkalinity (mg/L CaCO3)	198	192	195	198	218	210	220	222

Table 4. Average Secchi depth and water chemistry values for Skeleton Lake South Basin. Ion data using "extractable" analysis was excluded from this historical record in the years 2005-2014.

Parameter	**1985**	**1986**	**2005**	**2006**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
TP (μg/L)	31	47	29	40	45	40	59	44	40	40	157
TDP (μg/L)	8	11	8	13	13	14	15	12	12	20	59
Chlorophyll-a (μg/L)	14.8	24.2	12.1	15.0	19.3	12.4	22.3	17.2	17.3	12.1	29.8
Secchi depth (m)	-	1.63	2.28	1.6	1.65	1.62	1.4	1.44	1.81	1.59	1.56
TKN (mg/L)	1.1	1.3	1.2	1.2	1.3	1.1	1.6	1.4	1.4	1.3	1.4
NO_2-N and NO_3-N (μg/L)	2	3	7	3	14	12	25	6	3	2	38
NH_3-N (μg/L)	14	-	13	27	19	-	22	-	-	21	56
DOC (mg/L)	14	15	14	15	16	15	16	14	14	14	17
Ca^{2+} (mg/L)	26	25	-	-	-	-	-	-	-	-	-
Mg^{2+}(mg/L)	19	19	-	-	-	-	-	-	-	-	-
Na^{+} (mg/L)	14	14	19	20	20	21	22	20	21	22	24
K^{+} (mg/L)	9	9	11	12	12	12	12	12	13	18	14
SO_4^{2-} (mg/L)	2	2	3	4	3	6	3	2	2	5	2
Cl^{-} (mg/L)	2	1	3	3	4	4	5	4	5	4	5
$CO\sim_3^{2-}$ (mg/L)	-	-	10.5	11.5	13	12.7	13.3	11.8	9.4	16	21.9
HCO_3^{2-} (mg/L)	-	-	226	232.5	223.67	231.33	229.33	229.25	246.75	227.8	210.8
pH	8.53	8.72	8.66	8.71	8.73	8.76	8.80	8.72	8.63	8.75	8.79
Conductivity (μS/cm)	333	327	360	389	374	381	391	388	406	410	398
Hardness (mg/L)	143	140	152	158	168	159	157	165	170	168	159
TDS (mg/L)	181	178	204	214	211	218	214	210	222	230	233
Microcystin (μg/L)	-	-	0.15	0.18	0.24	0.34	0.31	0.22	0.22	0.24	0.4
Total Alkalinity (mg/L CaCO3)	178	175	202	210	205	211	210	208	218	214	209

Parameter	2015	2017	2018	2019	2020	2021	2022	2023	2024
TP (µg/L)	27	39	40	15	29	45	50	68	38
TDP (µg/L)	9	7	7	6	5	13	16	13	16
Chlorophyll-a (µg/L)	14.1	27.3	31.6	6.3	21.4	17.7	20.9	67.5	15.7
Secchi depth (m)	2.5	1.4	1.18	2.45	1.51	2.87	2.7	0.99	2.56
TKN (mg/L)	1.4	1.5	1.5	1.1	1.5	1.3	1.2	1.8	1.0
NO_2-N and NO_3-N (µg/L)	-	2	2	2	2	7	11	4	2
NH_3-N (µg/L)	-	32	31	8	24	39	8	408	15
DOC (mg/L)	16	15	15	16	15	15	17	15	15
Ca^{2+} (mg/L)	24	24	24	24	29	32	34	26	29
Mg^{2+}(mg/L)	26	30	27	28	26	26	28	28	28
Na^{+} (mg/L)	21	25	25	24	22	22	23	23	24
K^{+} (mg/L)	13	15	14	14	14	14	14	14	14
SO_4^{2-} (mg/L)	2	2	3	3	5	6	6	3	4
Cl^{-} (mg/L)	6	6	7	7	8	9	8	9	9
CO_3^{2-} (mg/L)	12.7	17	13.1	11	5.4	7.5	4.2	14.9	9
HCO_3^{2-} (mg/L)	243.33	236	242	250	230	268	260	257.5	255
pH	8.72	8.79	8.71	8.73	8.49	8.51	8.36	8.57	8.54
Conductivity (µS/cm)	413	422	420	435	420	450	440	415	442
Hardness (mg/L)	167	184	172	175	180	188	202	180	188
TDS (mg/L)	227	240	238	240	225	252	250	245	248
Microcystin (µg/L)	0.37	0.5	0.79	0.12	0.31	0.3	0.61	2.78	0.51
Total Alkalinity (mg/L CaCO3)	220	222	220	230	195	228	220	235	228

Table 5. Concentrations of metals measured in Skeleton Lake North Basin. 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	2010	2011	2012	2013	2014	2015	2016	Guidelines
Aluminum (µg/L)	26.04	13.9	14.75	11.73	10.75	16.2	6.6	100[a]
Antimony (µg/L)	0.036	0.029	0.031	0.033	0.032	0.032	0.03	/
Arsenic (µg/L)	0.86	0.87	0.57	0.82	0.77	0.83	0.74	5
Barium (µg/L)	49	50.8	51.1	49	48.5	53.8	50.9	/
Beryllium (µg/L)	0.0059	0.0052	0.0064	0.0015	0.004	0.004	0.004	100[c,d]
Bismuth (µg/L)	0.0019	0.0022	0.0321	0.0143	0.0023	0.0092	5.00E-04	/
Boron (µg/L)	122.5	105.5	104.8	93.5	97	94.3	103	1500
Cadmium (µg/L)	0.006	0.001	0.001	0.001	0.002	0.002	0.001	0.36[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	500, 1000[c,d]
Copper (µg/L)	0.163	0.154	0.37	0.14	0.13	0.175	0.32	4[b]
Iron (µg/L)	7.73	3.59	7.2	21.95	2.88	7.5	3.8	300
Lead (µg/L)	0.015	0.014	0.011	0.017	0.014	0.027	0.007	7[b]
Lithium (µg/L)	31.7	33	28.1	26.65	27.95	28.7	32.7	2500[d]
Manganese (µg/L)	35.4	43.9	29	16.05	12.55	31.55	26	130[e]
Molybdenum (µg/L)	0.063	0.053	0.03	0.039	0.037	0.041	0.026	73
Nickel (µg/L)	0.002	0.002	0.002	0.054	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	0.0032	0.0015	0.0071	0.001	0.001	0.001	0.25
Strontium (µg/L)	176	187	166	180	180	194.5	193	/
Thallium (µg/L)	7.00E-04	6.00E-04	0.0012	4.00E-04	4.00E-04	0.0104	4.00E-04	0.8
Thorium (µg/L)	0.008	0.006	0.031	0.011	0.001	0	0	/
Tin (µg/L)	0.01	0.01	0.38	0.03	0.01	0.03	0.02	/
Titanium (µg/L)	0.336	0.676	0.273	0.778	0.202	0.73	0.26	/
Uranium (µg/L)	0.196	0.202	0.18	0.2	0.211	0.205	0.201	15
Vanadium (µg/L)	0.214	0.186	0.204	0.186	0.19	0.19	0.14	100[c,d]
Zinc (µg/L)	0.31	0.41	0.42	0.28	0.55	0.25	0.3	30[f]

Metals	2017	2018	2019	2020	2021	2022	2023	2024	Guidelines
Aluminum (µg/L)	4.5	2.8	7.9	3.4	9.1	5.4	3.9	4.4	100[a]
Antimony (µg/L)	0.028	0.032	0.029	0.039	0.031	0.039	0.03	0.04	/
Arsenic (µg/L)	0.77	0.84	0.85	0.94	0.92	0.8	0.92	0.92	5
Barium (µg/L)	49.5	49.7	51.6	57.1	66.5	60.2	53.2	62.1	/
Beryllium (µg/L)	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	100[c,d]
Bismuth (µg/L)	0.0015	0.0015	0.0015	0.0015	0.004	0.0015	0.0015	0.004	/
Boron (µg/L)	96.5	94.6	93	88.9	97.7	109	89.2	90.6	1500
Cadmium (µg/L)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.36[b]
Chromium (µg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	/
Cobalt (µg/L)	0.039	0.017	0.041	0.04	0.065	0.03	0.054	0.032	500, 1000[c,d]
Copper (µg/L)	0.27	0.1	0.04	0.04	0.13	0.12	0.17	0.1	4[b]
Iron (µg/L)	3	2.3	16	9.9	5.4	4.5	5.6	4.9	300
Lead (µg/L)	0.014	0.005	0.009	0.005	0.014	0.014	0.01	0.033	7[b]
Lithium (µg/L)	31.6	29.6	27.2	25.7	30.8	27.8	25.1	26.7	2500[d]
Manganese (µg/L)	7.66	6.74	43.6	43.7	48.2	20.2	18.8	16.5	130[e]
Molybdenum (µg/L)	0.038	0.044	0.052	0.081	0.049	0.033	0.043	0.018	73
Nickel (µg/L)	0.08	0.08	0.11	0.13	0.18	0.15	0.09	0.08	150[b]
Selenium (µg/L)	0.1	0.2	0.4	0.3	0.3	0.1	0.1	0.3	1
Silver (µg/L)	5.00E-04	5.00E-04	5.00E-04	5.00E-04	5.00E-04	5.00E-04	5.00E-04	0.002	0.25
Strontium (µg/L)	183	197	204	202	226	212	197	214	/
Thallium (µg/L)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.8
Thorium (µg/L)	0.001	0.001	0.001	0.002	0.003	0.001	0.003	0.075	/
Tin (µg/L)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	/
Titanium (µg/L)	0.2	0.29	0.4	0.42	0.75	0.14	0.5	1.17	/
Uranium (µg/L)	0.22	0.228	0.211	0.217	0.189	0.176	0.159	0.163	15
Vanadium (µg/L)	0.171	0.144	0.171	0.221	0.103	0.089	0.064	0.247	100[c,d]
Zinc (µg/L)	0.4	0.2	0.4	0.4	1.2	0.8	1.2	0.5	30[f]

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on 2016 avg. water hardness (as $CaCO_3$) 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 2016 avg. water hardness (as $CaCO_3$) and avg. pH
[f] Based on 2016 avg. water hardness (as $CaCO_3$), avg. pH, and avg. DOC with CCME equation
A forward slash (/) indicates an absence of data or guidelines.

Table 6. Concentrations of metals measured in Skeleton Lake South Basin. 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 were not analyzed in 2023.

Metals	2008	2009	2010	2011	2012	2013	Guidelines
Aluminum (μg/L)	24.1	12.8	22.95	23.2	7.88	12.65	100[a]
Antimony (μg/L)	0.033	0.032	0.033	0.033	0.024	0.028	/
Arsenic (μg/L)	1.01	0.98	1.06	0.95	0.37	1.01	5
Barium (μg/L)	55.8	57.2	55.5	56.2	44	57.7	/
Beryllium (μg/L)	0.003	0.0015	0.0015	0.0048	0.0015	0.0015	100[c,d]
Bismuth (μg/L)	0.0035	0.004	0.002	0.0014	0.0057	0.0036	/
Boron (μg/L)	102.5	109.6	97	106	87.2	100.9	1500
Cadmium (μg/L)	0.001	0.002	0.007	0.004	0.004	0.002	0.36[b]
Chromium (μg/L)	0.1145	0.188	0.1395	0.15	0.106	0.196	/
Cobalt (μg/L)	0.0232	0.0203	0.01325	0.0171	0.0084	0.0285	500, 1000[c,d]
Copper (μg/L)	0.098	0.27	0.13	0.181	0.508	0.18	4[b]
Iron (μg/L)	49.2	70.4	41	53.4	48.5	40.2	300
Lead (μg/L)	0.028	0.028	0.025	0.033	0.013	0.027	7[b]
Lithium (μg/L)	30.6	36.1	28.05	33.2	21.9	29.15	2500[d]
Manganese (μg/L)	44.5	62.05	49.75	58.1	40.3	50.15	130[e]
Molybdenum (μg/L)	0.103	0.114	0.094	0.103	0.064	0.082	73
Nickel (μg/L)	0.002	0.202	0.002	0.002	0.002	0.162	150[b]
Selenium (μg/L)	0.097	0.095	0.076	0.138	0.05	0.05	1
Silver (μg/L)	0.0036	0.0069	0.0026	3e-04	0.0022	0.0273	0.25
Strontium (μg/L)	185	184.5	188	186	134	197.5	/
Thallium (μg/L)	0.0012	4e-04	0.001	0.001	1e-04	4e-04	0.8
Thorium (μg/L)	0.009	0.002	0.01	0.007	0.008	0.007	/
Tin (μg/L)	0.05	0.01	0.03	0.01	0.03	0.01	/
Titanium (μg/L)	1.211	0.762	0.904	1.1	0.26	1.43	/
Uranium (μg/L)	0.12	0.11	0.114	0.12	0.061	0.091	15
Vanadium (μg/L)	0.207	0.208	0.21	0.217	0.101	0.145	100[c,d]
Zinc (μg/L)	0.37	1	0.5	0.4	0.36	0.35	30[f]

Metals	2014	2017	2018	2020	2021	2022	2024	Guidelines
Aluminum (µg/L)	18.5	21.5	1.8	3.2	4.4	5.7	7.2	100[a]
Antimony (µg/L)	0.046	0.04	0.03	0.038	0.039	0.034	0.041	/
Arsenic (µg/L)	1.36	1.04	1.03	1.2	1.18	1.22	1.26	5
Barium (µg/L)	45.8	56.1	55.3	59.5	60.3	62.5	59.1	/
Beryllium (µg/L)	0.004	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	100[c,d]
Bismuth (µg/L)	5e-04	0.0015	0.0015	0.0015	0.006	0.0015	0.009	/
Boron (µg/L)	94.8	105	106	96.1	93	109	102	1500
Cadmium (µg/L)	0.008	0.005	0.005	0.005	0.01	0.005	0.005	0.36[b]
Chromium (µg/L)	0.215	0.05	0.05	0.05	0.05	0.05	0.05	/
Cobalt (µg/L)	0.022	0.042	0.019	0.023	0.028	0.025	0.029	500, 1000[c,d]
Copper (µg/L)	0.535	0.46	0.04	0.1	0.38	0.13	0.22	4[b]
Iron (µg/L)	13.45	28.4	18.2	20.9	15.5	13.6	16.5	300
Lead (µg/L)	0.027	0.029	0.002	0.008	0.054	0.011	0.033	7[b]
Lithium (µg/L)	39.7	33.8	32	27.2	28.5	26.7	29.9	2500[d]
Manganese (µg/L)	34.15	44.3	23.5	43.3	12.6	37.6	30.2	130[e]
Molybdenum (µg/L)	0.087	0.097	0.094	0.174	0.178	0.17	0.091	73
Nickel (µg/L)	0.06	0.18	0.09	0.1	0.18	0.17	0.144	150[b]
Selenium (µg/L)	0.07	0.1	0.1	0.1	0.2	0.1	0.2	1
Silver (µg/L)	0.001	0.002	0.001	5e-04	5e-04	5e-04	0.001	0.25
Strontium (µg/L)	208.5	190	211	200	210	214	212	/
Thallium (µg/L)	7e-04	0.001	0.001	0.001	0.01	0.001	0.001	0.8
Thorium (µg/L)	0.006	0.001	0.001	0.001	0.005	0.002	0.043	/
Tin (µg/L)	0.02	0.03	0.03	0.03	0.03	0.03	0.03	/
Titanium (µg/L)	0.985	1	0.88	0.54	0.64	0.12	0.77	/
Uranium (µg/L)	0.196	0.105	0.096	0.102	0.103	0.093	0.088	15
Vanadium (µg/L)	0.265	0.225	0.094	0.256	0.14	0.132	0.282	100[c,d]
Zinc (µg/L)	1.3	2.7	0.5	0.4	2.9	0.8	0.8	30[f]

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on 2016 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 2016 avg. water hardness (as CaCO3) and avg. pH
[f] Based on 2016 avg. water hardness (as CaCO3), avg. pH, and avg. DOC with CCME equation
A forward slash (/) indicates an absence of data or guidelines.

LONG TERM TRENDS

Trend analysis was conducted on the parameters total phosphorus (TP), chlorophyll-*a*, total dissolved solids (TDS), and Secchi depth to look for changes over time in both the North and South basins of Skeleton Lake. Both basins were first sampled through LakeWatch in 2005. The North basin was not sampled from 2006 through 2009, leaving a four-year gap in the North basin data. While trend analysis is still possible given this gap, inferences made from the data are less reliable. Data is presented below for the different parameters in each lake as both line and box-and-whisker plots. Secchi depth can be subjective and is sensitive to variation in weather; therefore, trend analysis must be interpreted with caution. Detailed methods are available in the ALMS Guide to Trend Analysis on Alberta Lakes.

In the North Basin, an increasing trend was detected in TP, chlorophyll-*a*, and TDS. A decreasing trend was detected in Secchi depth.

In the South Basin, an increasing trend was detected in chlorophyll-*a* and TDS. No trend was detected in TP and Secchi depth.

Table 7a. Summary table of trend analysis on Skeleton Lake North Basin data from 2005 to 2024.

Parameter	Date Range	Direction of Significant Change
Total Phosphorus	2005-2024	Increasing
Chlorophyll-*a*	2005-2024	Increasing
Total Dissolved Solids	2005-2024	Increasing
Secchi Depth	2005-2024	Decreasing

Table 7b. Summary table of trend analysis on Skeleton Lake South Basin data from 2005 to 2024.

Parameter	Date Range	Direction of Significant Change
Total Phosphorus	2005-2024	No Change
Chlorophyll-*a*	2005-2024	Increasing
Total Dissolved Solids	2005-2024	Increasing
Secchi Depth	2005-2024	No Change

Definitions

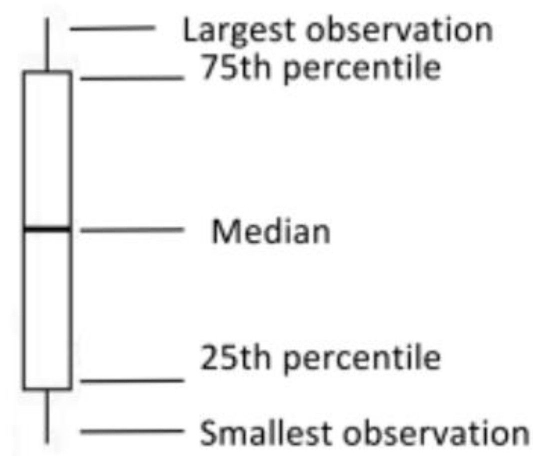
Median: the value in a range of ordered numbers that falls in the middle.

Trend: a general direction in which something is changing.

Monotonic trend: a gradual change in a single direction.

Statistically significant: The likelihood that a relationship between variables is caused by something other than random chance. This is indicated by a p-value of <0.05. Variability: the extent by which data is inconsistent or scattered.

Box and Whisker Plot: a box-and-whisker plot, or boxplot, is a way of displaying all of our annual data. The median splits the data in half. The 75th percentile is the upper quartile of the data, and the 25th percentile is the lower quartile of the data. The top and bottom points are the largest and smallest observations.



Total Phosphorus (TP) – North Basin

Trend analysis of TP over time suggests that it has significantly increased in Skeleton Lake North Basin since 2005 (Tau = 0.2987, p = 0.0018).

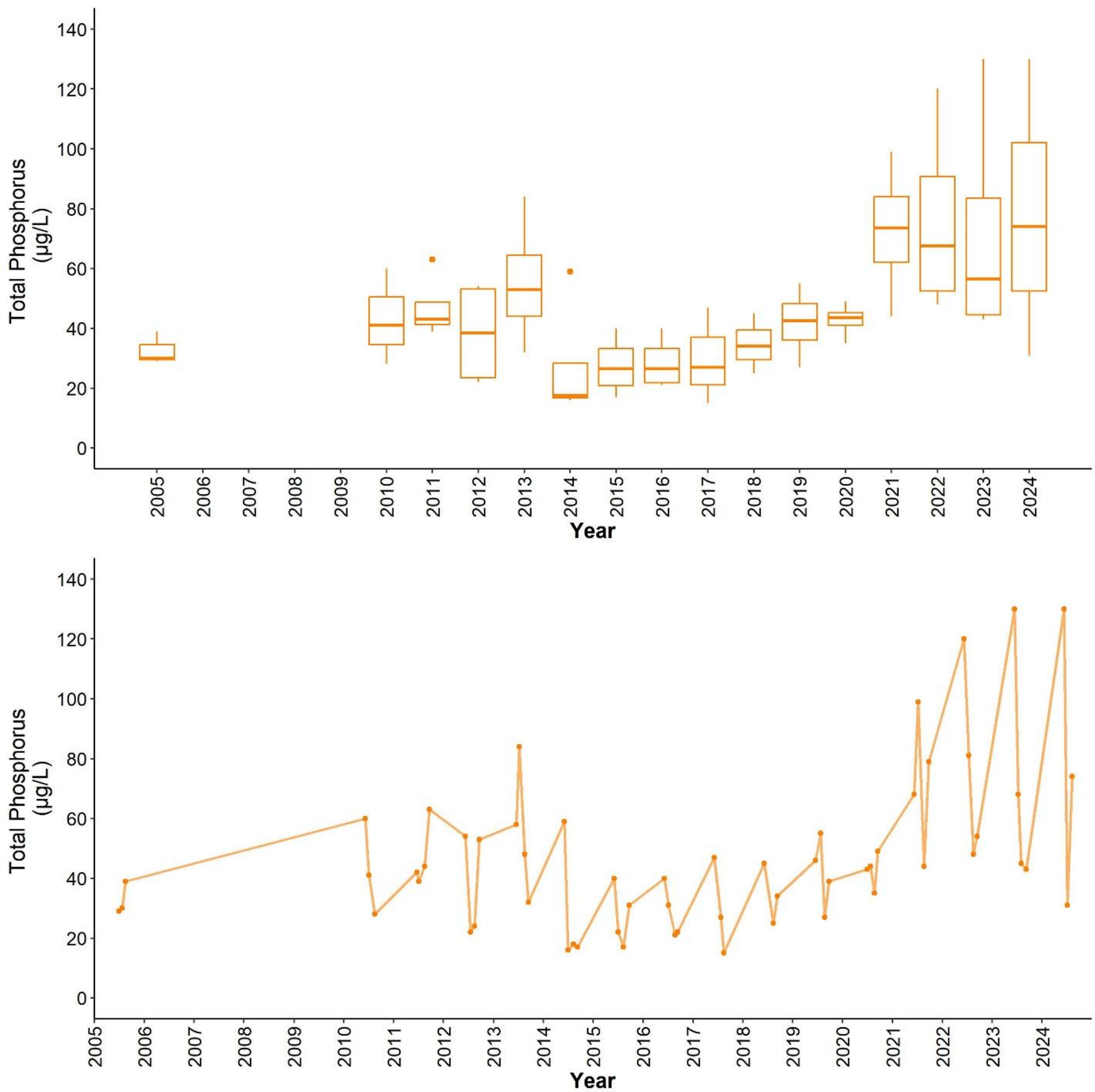
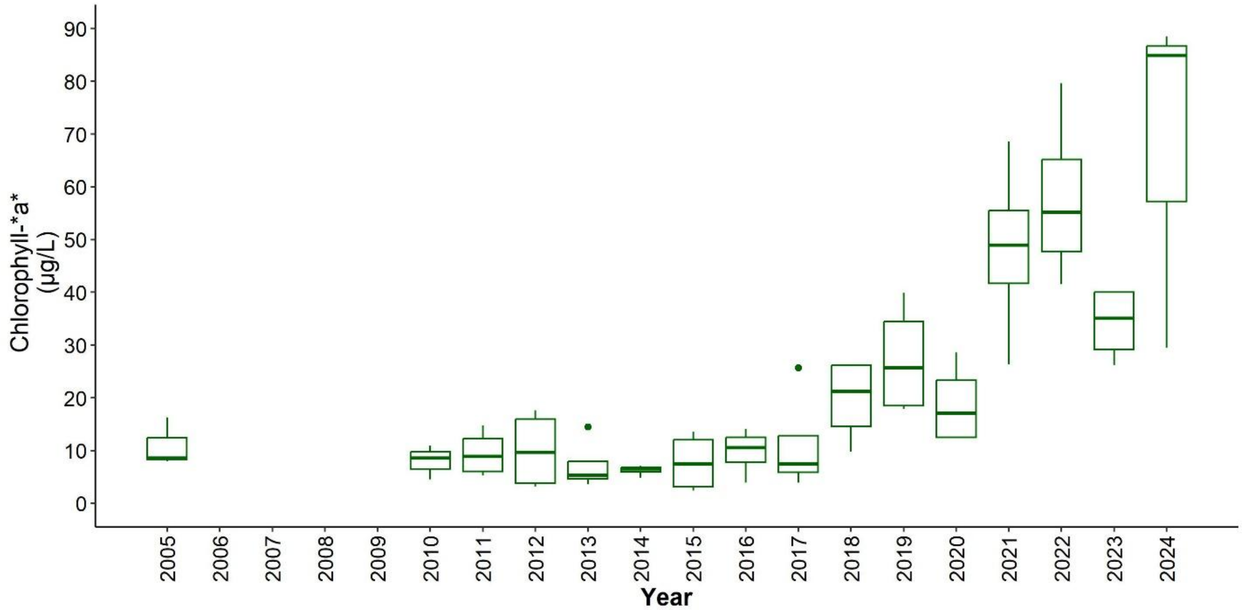


Figure 12. Monthly total phosphorus (TP) concentrations measured between June and September over the long term sampling dates between 2005 and 2024 (n = 59). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Chlorophyll-*a* – North Basin

Trend analysis of chlorophyll-*a* suggests it has significantly increased over time at Skeleton Lake North Basin (Tau = 0.5574, $p < 0.001$).



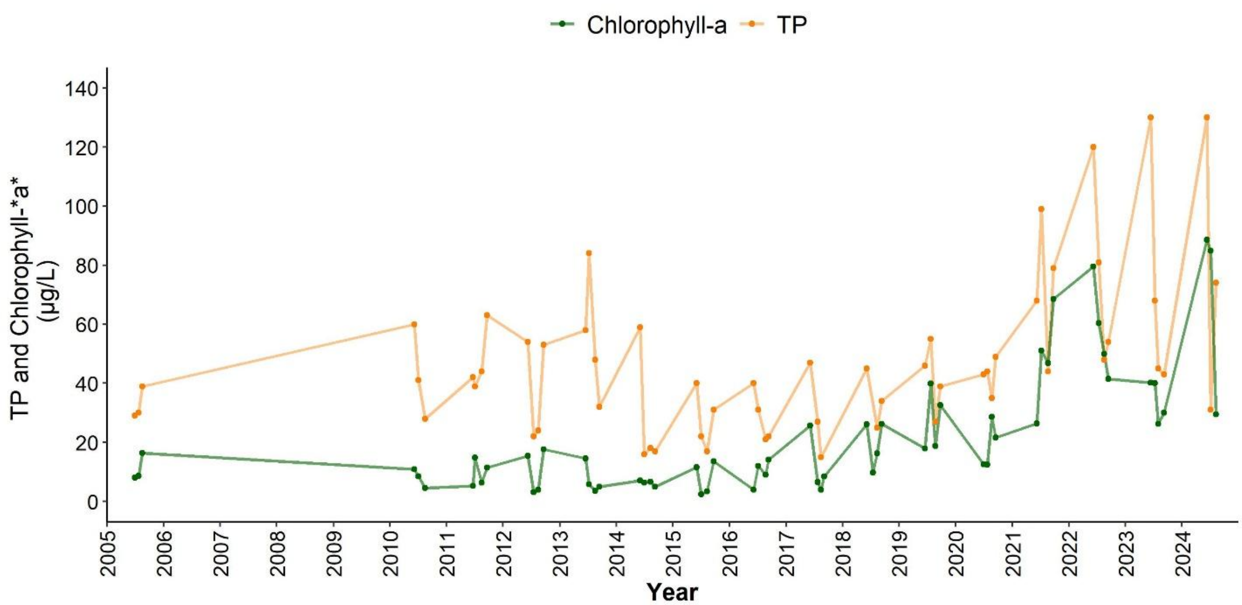


Figure 13. Monthly chlorophyll-*a* concentrations measured between June and September over the long term sampling dates between 2005 and 2024 (n = 61). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples. Line graph is overlain by TP concentrations.

Total Dissolved Solids (TDS) – North Basin

Trend analysis showed a significantly increasing trend in TDS in Skeleton Lake North Basin since 2005 (Tau = 0.6711, $p < 0.001$).

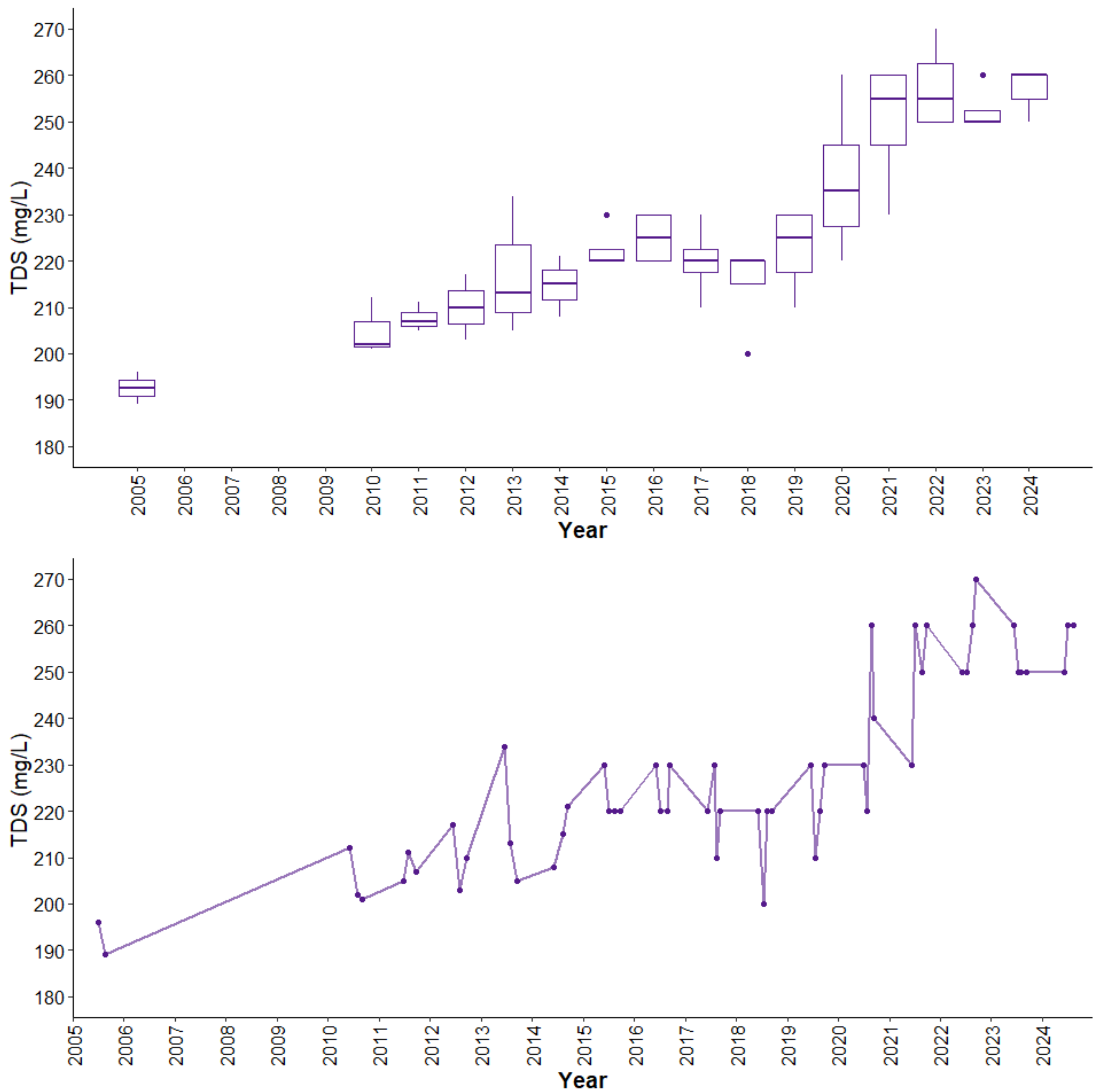


Figure 14. Monthly TDS values measured between June and September over the long term sampling dates between 2005 and 2024 (n = 56). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Due to the significant increasing trend of TDS in Skeleton Lake North Basin, exploring the specific major ions which may be driving this trend is important to determine.

Trend analysis of major ions at Skeleton Lake North Basin indicates that all ions with sufficient data are significantly increasing (Figure 15). Sulphate and alkalinity (bicarbonate and carbonate) are likely the key parameters that are driving the increase in TDS (Figure 14). These parameters display the greatest magnitude of change over time (slopes), at a rate of 0.94 mg/L per year and 1.0 mg./L per year, respectively. Magnesium and calcium had insufficient data for calculating a trend, indicated by "I.D.", insufficient data (collection began in 2015).

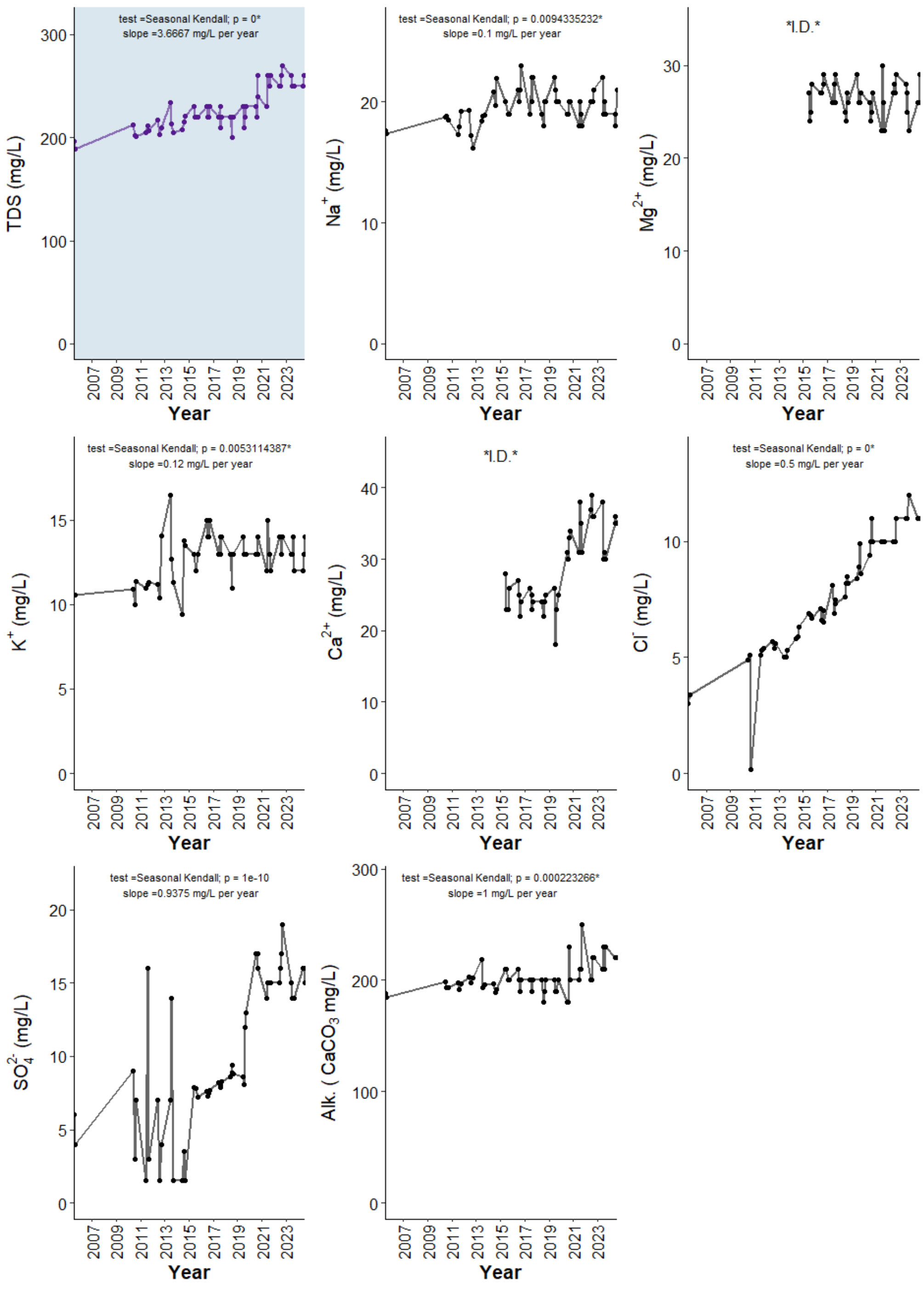


Figure 15. Concentrations of TDS (top left, blue panel), major ions (sodium = Na^{+}, magnesium = Mg^{2+}, potassium = K^{+}, calcium = Ca^{2+}, chloride = Cl^{-}, sulphate = SO_4^{2-}), and total alkalinity (Alk., as mg/L $CaCO_3$) measured monthly between June and September on sampling dates between 2005 and 2024. Also represented is the monotonic trend results for each parameter; test used (MK = Mann Kendall, SK = Seasonal Kendall), significance of test (*p*; assessed as significance when $p < 0.05$, marked with '*' if significant), and the slope of the trend. Test selection follows method outline in the ALMS Guide to Trend Analysis on Alberta Lakes. Note that some ions had insufficient data (I.D.) therefore trends were not calculated. The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Secchi Depth – North Basin

Water clarity measured as Secchi depth in Skeleton Lake North Basin has undergone a statistically significant decrease (the lake is becoming less clear) since 2005 (Tau = -0.6366, $p < 0.001$). The most recent five years have had both the lowest Secchi depth medians since 2005, and also some of the least variance.

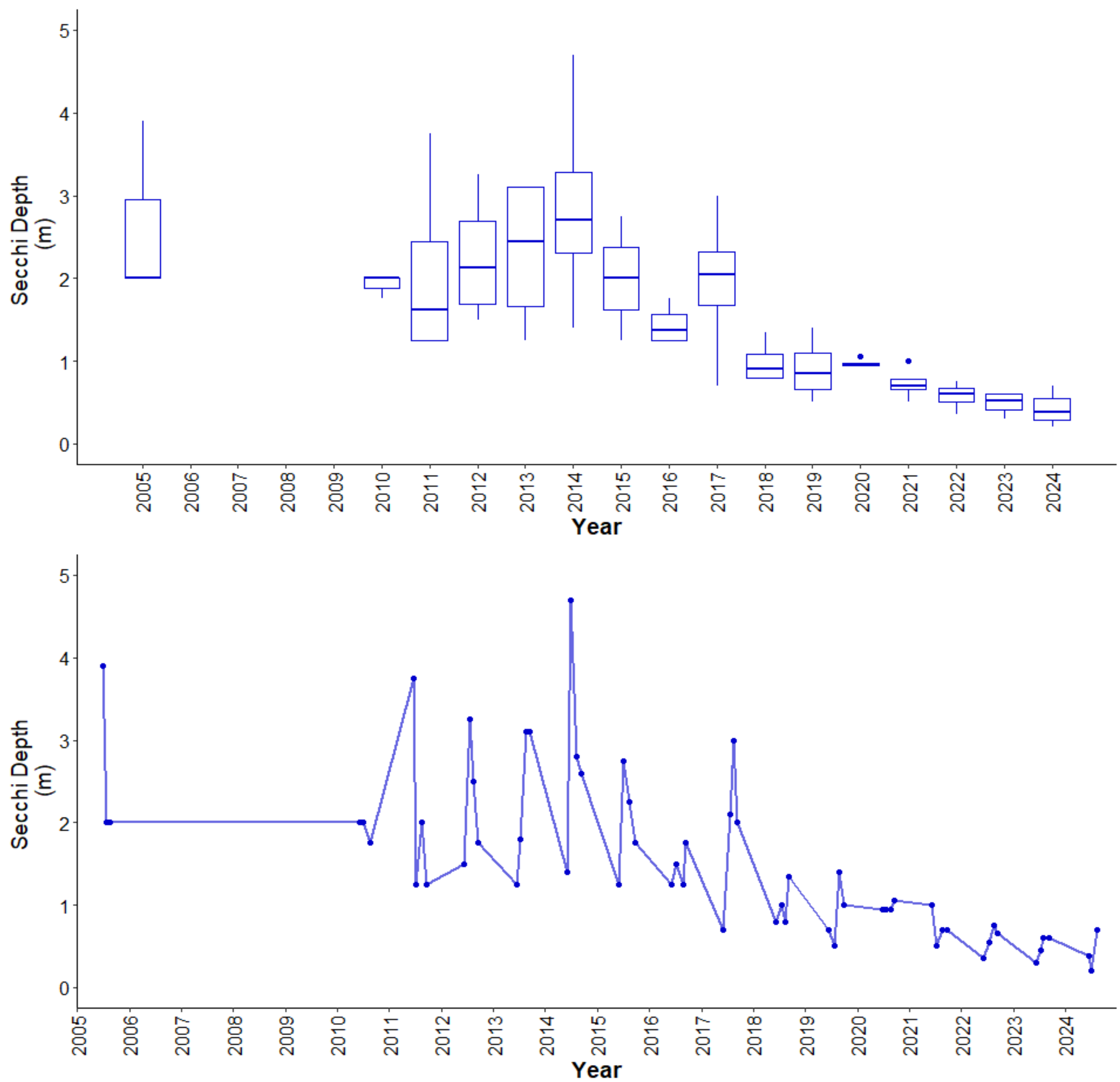


Figure 16. Monthly Secchi depth values measured between June and September over the long term sampling dates between 2005 and 2024 (n = 61). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

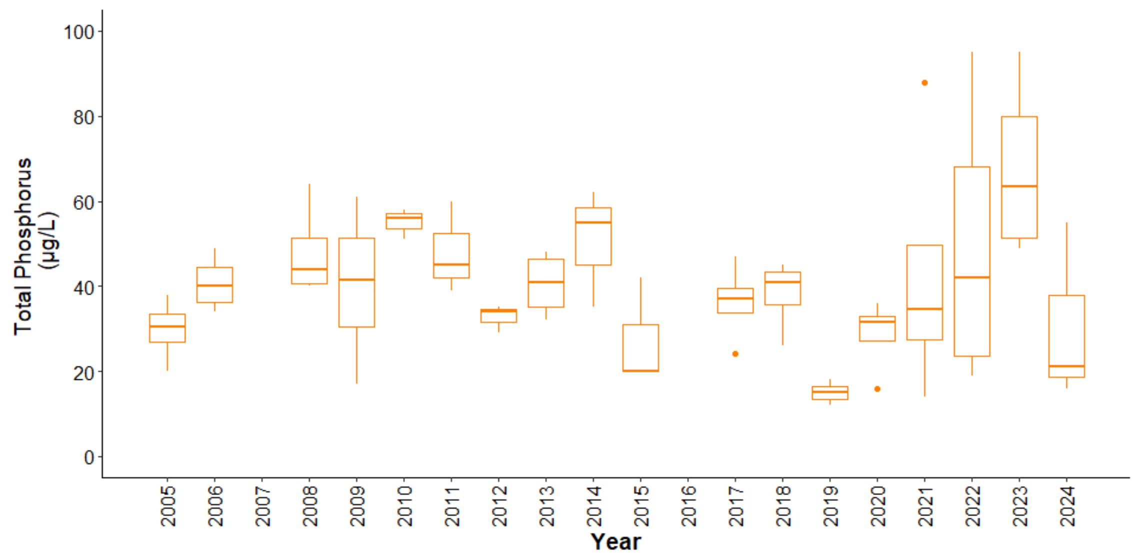
Table 8. Results of trend tests using total phosphorus (TP), chlorophyll-*a*, total dissolved solids (TDS), and Secchi depth data from June to September for sampled years from 2005-2024 on Skeleton Lake North Basin data.

Definition	Unit	Total Phosphorus (TP)	Chlorophyll-*a*	Total Dissolved Solids (TDS)	Secchi Depth
Statistical Method	-	Seasonal Kendall	Seasonal Kendall	Seasonal Kendall	Seasonal Kendall
The strength and direction (+ or -) of the trend between -1 and 1	Tau	0.2987	0.5574	0.6711	-0.6366
The extent of the trend	Slope (units per Year)	1.8	2.3029	3.6667	-0.1293
The statistic used to find significance of the trend	Z	3.1234	5.8349	6.7658	-6.6956
Number of samples included	n	59	61	56	61
The significance of the trend	*p*	0.0018*	5.4e-09*	< 0.001*	< 0.001*

*$p < 0.05$ is significant within 95%

Total Phosphorus (TP) – South Basin

Trend analysis of TP over time indicates that TP has not significantly changed in Skeleton Lake South Basin since 2005 (Tau = -0.0698, p = 0.3876). Two TP data points from 2014 were removed from the dataset as the samples exceeded laboratory hold times and were not considered reliable (see Skeleton Lake 2014 LakeWatch report for more details). Also note that 2019 data is only from June and July.



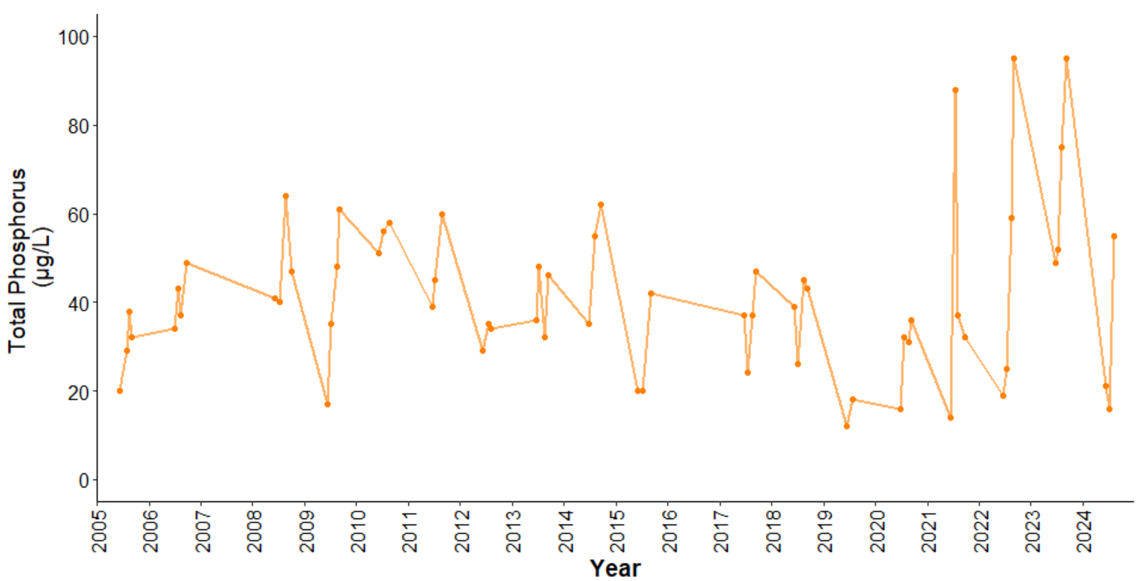
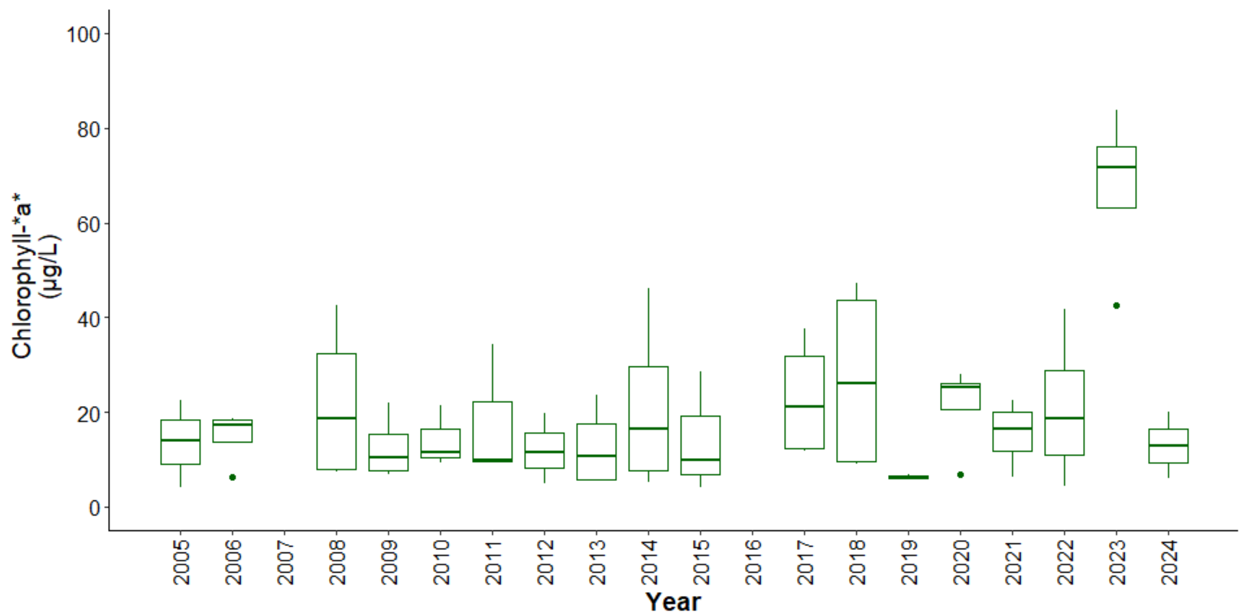


Figure 17. Monthly total phosphorus (TP) concentrations measured between June and September over the long term sampling dates between 2005 and 2024 (n = 64). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Chlorophyll-*a* – South Basin

Trend analysis of chlorophyll-*a* suggests it has significantly increased over time at Skeleton Lake South Basin (Tau = 0.2218, p = 0.0224). Note that 2019 data is only from June and July.



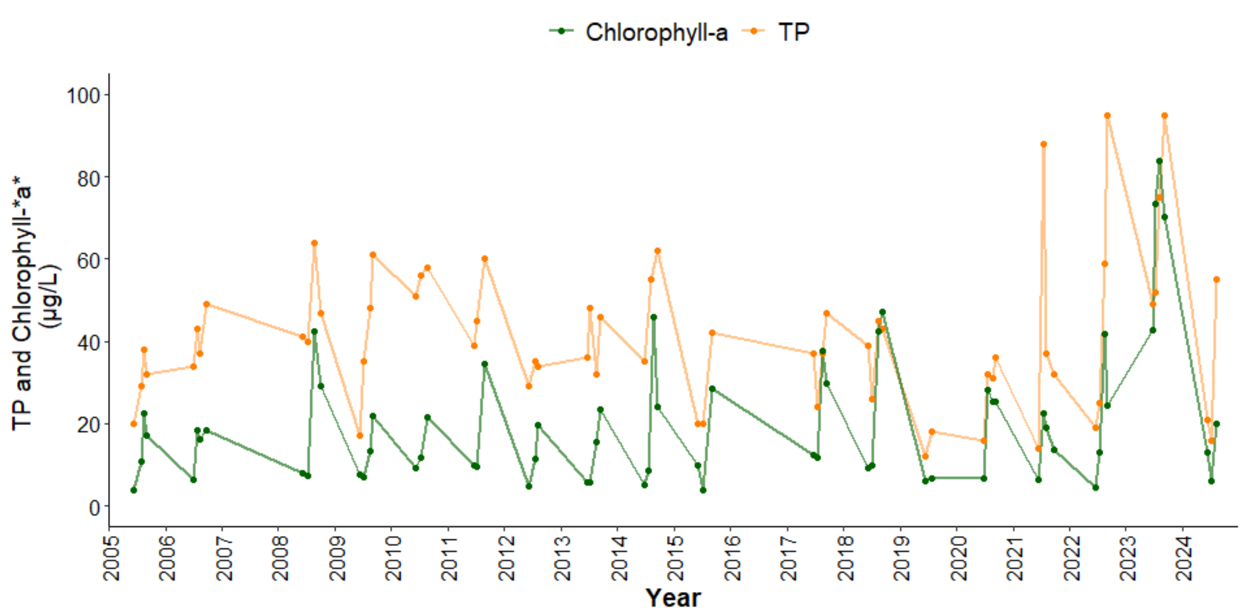
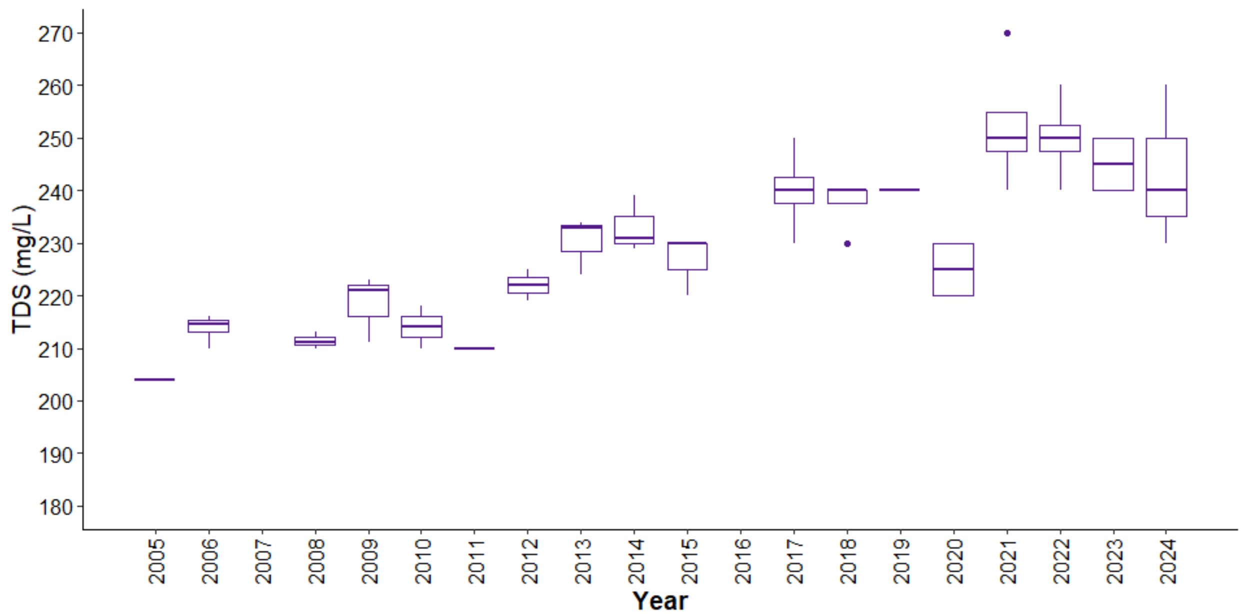


Figure 18. Monthly chlorophyll-*a* concentrations measured between June and September over the long term sampling dates between 2005 and 2024 (n = 65). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples. Line graph is overlain by TP concentrations.

Total Dissolved Solids (TDS) – South Basin

Trend analysis showed a significantly increasing trend in TDS in Skeleton Lake South Basin since 2005 (Tau = 0.662, $p < 0.001$). Note that 2019 data is only from June and July.



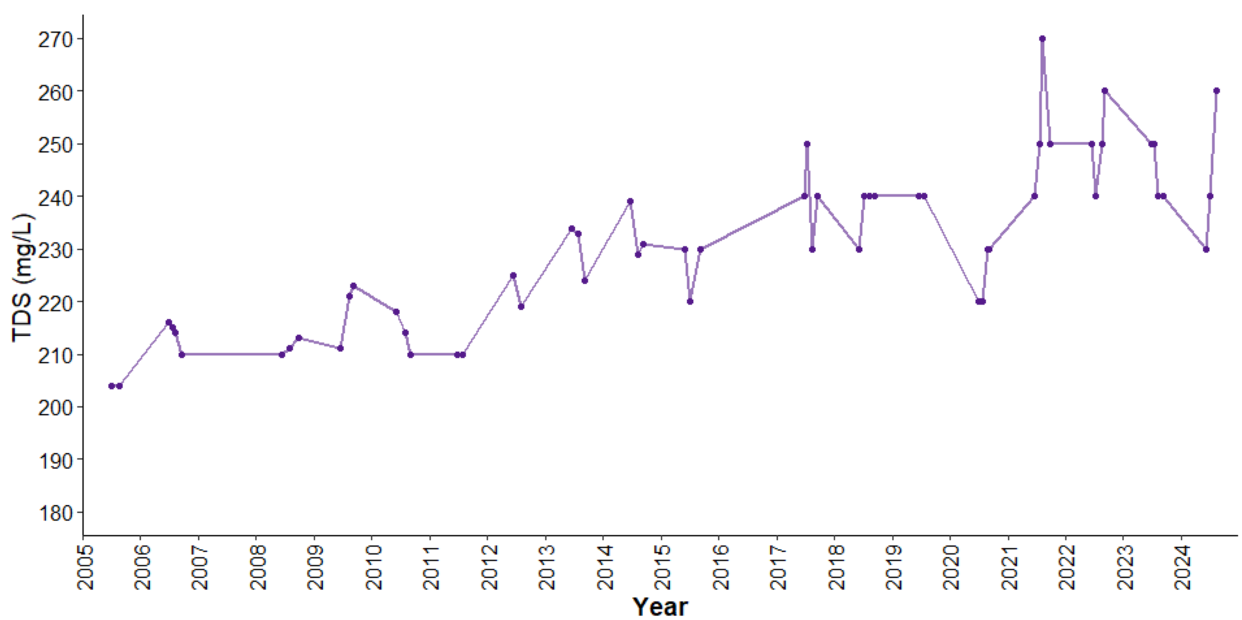


Figure 19. Monthly TDS values measured between June and September over the long term sampling dates between 2005 and 2024 (n = 57). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Due to the significant increasing trend of TDS in Skeleton Lake South Basin, exploring the specific major ions which may be driving this trend is important to determine.

Trend analysis of major ions at Skeleton Lake South Basin indicates that all ions with sufficient data are significantly increasing (Figure 20). Alkalinity (bicarbonate and carbonate) is the main parameter driving the increase in TDS over time at a rate of 1.07 mg/L per year. Magnesium and calcium had insufficient data for calculating a trend, indicated by "I.D.", insufficient data (collection began in 2015).

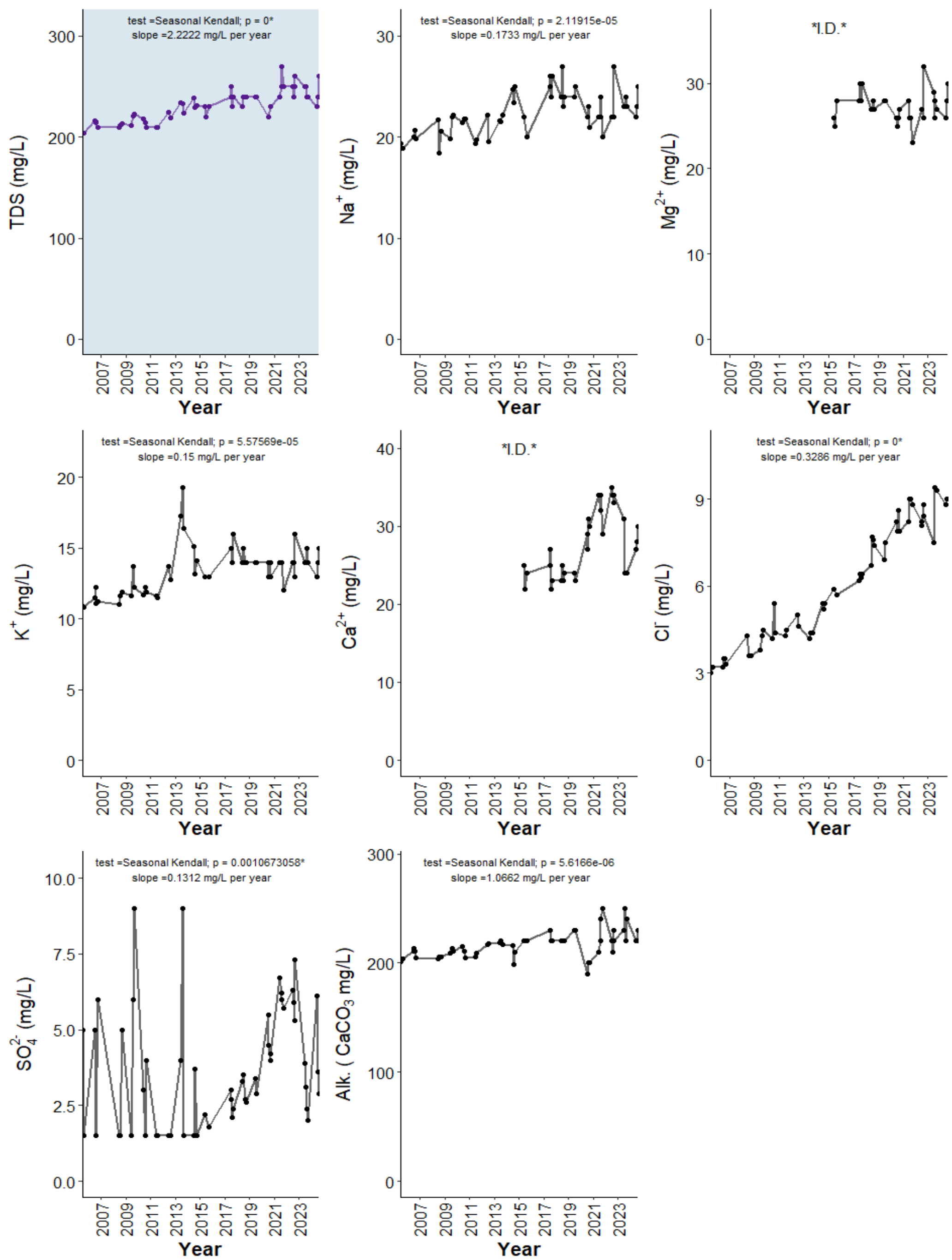
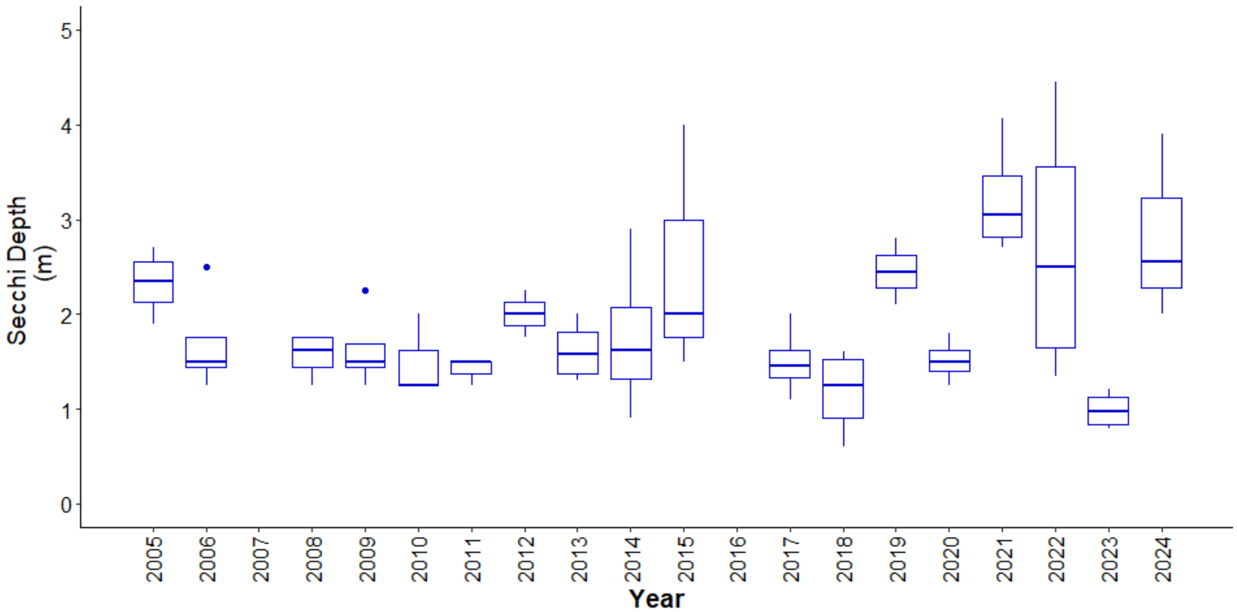


Figure 20. Concentrations of TDS (top left, blue panel), major ions (sodium = Na^+, magnesium = Mg^{2+}, potassium = K^+, calcium = Ca^{2+}, chloride = Cl^-, sulphate = SO_4^{2-}), and total alkalinity (Alk., as mg/L $CaCO_3$) measured monthly between June and September on sampling dates between 2005 and 2024. Also represented is the monotonic trend results for each parameter; test used (MK = Mann Kendall, SK = Seasonal Kendall), significance of test (p; assessed as significance when $p < 0.05$, marked with '*' if significant), and the slope of the trend. Test selection follows method outline in the ALMS Guide to Trend Analysis on Alberta Lakes. Note that some ions had insufficient data (I.D.) therefore trends were not calculated. The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Secchi Depth – South Basin

Water clarity measured as Secchi depth in Skeleton Lake South Basin has not significantly changed since 2005 (Tau = 0.0146, p = 0.7784). Note that 2019 data is only from June and July.



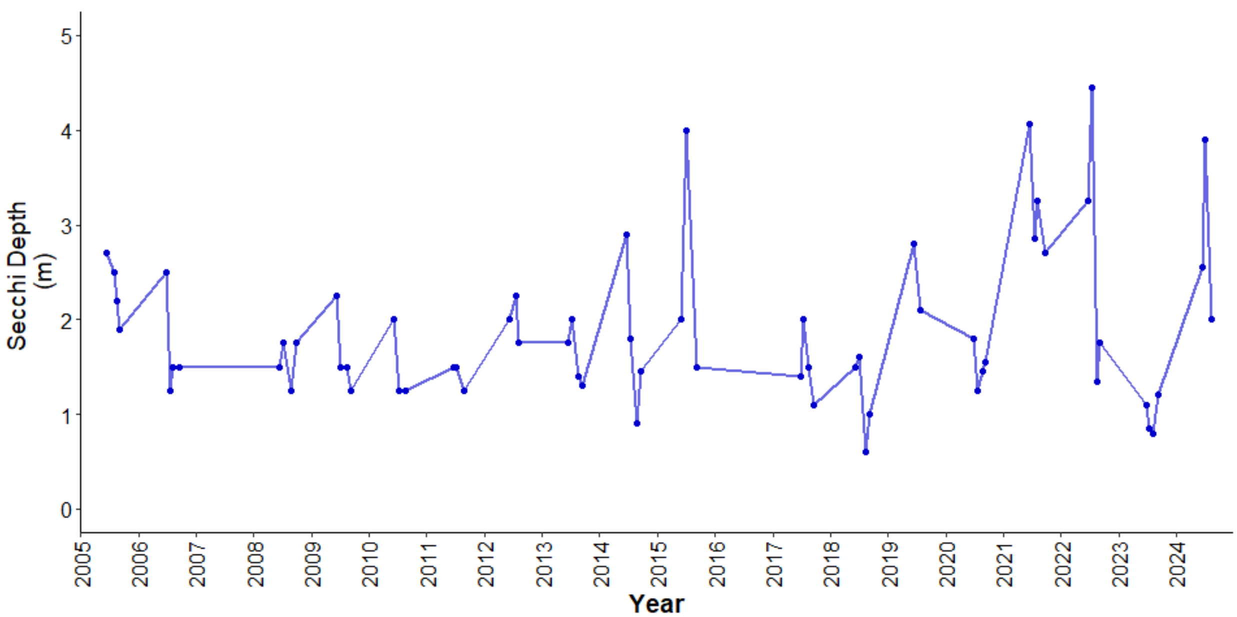


Figure 21. Monthly Secchi depth values measured between June and September over the long term sampling dates between 2005 and 2024 (n = 65). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Table 9. Results of trend tests using total phosphorus (TP), chlorophyll-*a*, total dissolved solids (TDS), and Secchi depth data from June to September for sampled years from 2005-2024 on Skeleton Lake South Basin data.

Definition	Unit	Total Phosphorus (TP)	Chlorophyll-*a*	Total Dissolved Solids (TDS)	Secchi Depth
Statistical Method	-	Seasonal Kendall	Seasonal Kendall	Seasonal Kendall	Seasonal Kendall
The strength and direction (+ or -) of the trend between -1 and 1	Tau	-0.0698	0.2218	0.662	0.0146
The extend of the trend	Slope (units per Year)	-0.25	0.2933	2.2222	0
The statistic used to find significance of the trend	Z	-0.864	2.2829	6.5965	0.2814
Number of samples included	n	64	65	57	65
The significance of the trend	*p*	0.3876	0.0224*	>0.001*	0.7785

*$p < 0.05$ is significant within 95%