



*The Alberta Lake Management Society
Volunteer Lake Monitoring Program*

Touchwood Lake Report 2022

Updated June 23, 2023

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 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 Lac La Biche County Staff for their commitment to collecting data at Pinehurst 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.

TOUCHWOOD LAKE

Touchwood Lake is a beautiful wilderness lake set in heavily forested, rolling hills. It is located in Lakeland County, 265 km northeast of Edmonton and 45 km east of the town of Lac La Biche, which is the closest large population centre. Touchwood Lake falls within the boundaries of the Lakeland Recreation Area, positioned between the Lakeland Provincial Park to the west and the Cold Lake Air Weapons Range to the east. It is a popular recreational lake for camping, fishing, and boating.

“Touchwood” refers to birch punk, which was used to start fires with flint and steel. The Cree called the lake Nameygos Sakahegan, which means Trout Lake, in reference to the abundant, large lake trout found there.¹ By the late 1920’s, however, the trout population was decimated by the commercial fishery industry. Today, walleye and northern pike are the main species caught by the popular sport fishery.

Concentrations of algae in Touchwood Lake are low throughout the open-water period, so the water is clear. The density of aquatic vegetation is sparse to moderate.



Touchwood Lake, at the campground beach
(Photo by Caleb Sinn, July 2022).

Touchwood Lake is one of the largest bodies of water in the Lakeland region (surface area = 29.0 km², mean depth = 15.0 m). It is separated into two basins by a large peninsula. The north basin, with a maximum depth of 40.0 m, is the deeper of the two. Touchwood Lake is a headwater lake. It drains quite a large area (111 km²), but the drainage basin is less than four times the size of the lake. The outlet stream flows to Pinehurst Lake, six km to the south, and eventually to the Beaver River via Punk Creek and Sand River. The drainage basin is part of the Boreal Mixwood Ecoregion.² The dominant trees are an association of trembling aspen, balsam poplar, and lodgepole pine on moderately well-drained Gray Luvisols. Other species present are jack pine, white spruce, black spruce, willows, and sedges.

The watershed area for Touchwood Lake is 112.45 km² and the lake area is 28.91 km². The lake to watershed ratio of Touchwood Lake is 1:4. A map of the Touchwood Lake watershed area can be found at <http://alms.ca/wp-content/uploads/2016/12/Touchwood.pdf>.

¹ Chipeniuk, R.C. (1975). Lakes of the Lac La Biche district. R.C. Chipeniuk, Lac La Biche.

² Strong, W.L. and K.R. Leggat. (1981). Ecoregions of Alberta. Alberta Energy and Natural Resources, Resource Evaluation and Planning Division. ENR Technical Report T/4. Map at 1:1,500,000.

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 Touchwood Lake was 8 µg/L (Table 2), falling into the oligotrophic, or low productivity trophic classification. This value below all previously observed historical averages going back to 1986 (Table 2). TP ranged from a minimum of <3.0 µg/L on August 9th (a value of 1.5 µg/L is assigned for a result below detection limit, in order to calculate an average and to plot), to a maximum of 10 µg/L on July 7th (Figure 1).

Average chlorophyll-*a* concentration in 2022 was 3.0 µg/L (Table 2), falling into the oligotrophic, or low productivity trophic classification. Chlorophyll-*a* was highest during the September 7th sampling event at 3.5 µg/L, and lowest at 2.6 µg/L on July 7th.

The average TKN concentration was 0.5 mg/L (Table 2), and was consistent through the season (Figure 1).

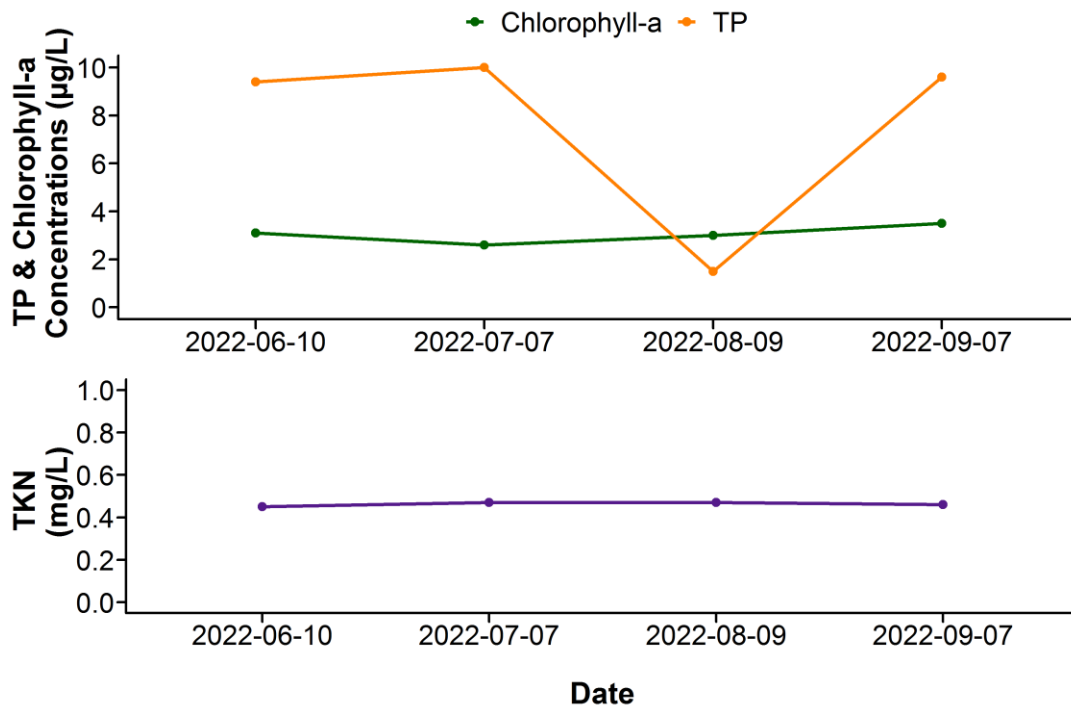


Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Touchwood Lake.

Average pH was measured as 8.26 in 2022, buffered by moderate alkalinity (145 mg/L CaCO_3) and bicarbonate (178 mg/L HCO_3^-). Aside from bicarbonate, calcium, magnesium, and sodium were in highest abundance, and together contributed to a low conductivity of 278 $\mu\text{S}/\text{cm}$ (Figure 2, top; Table 2). Touchwood Lake is in the low range of ion levels, compared to other LakeWatch lakes sampled in 2022. (Figure 2, bottom).

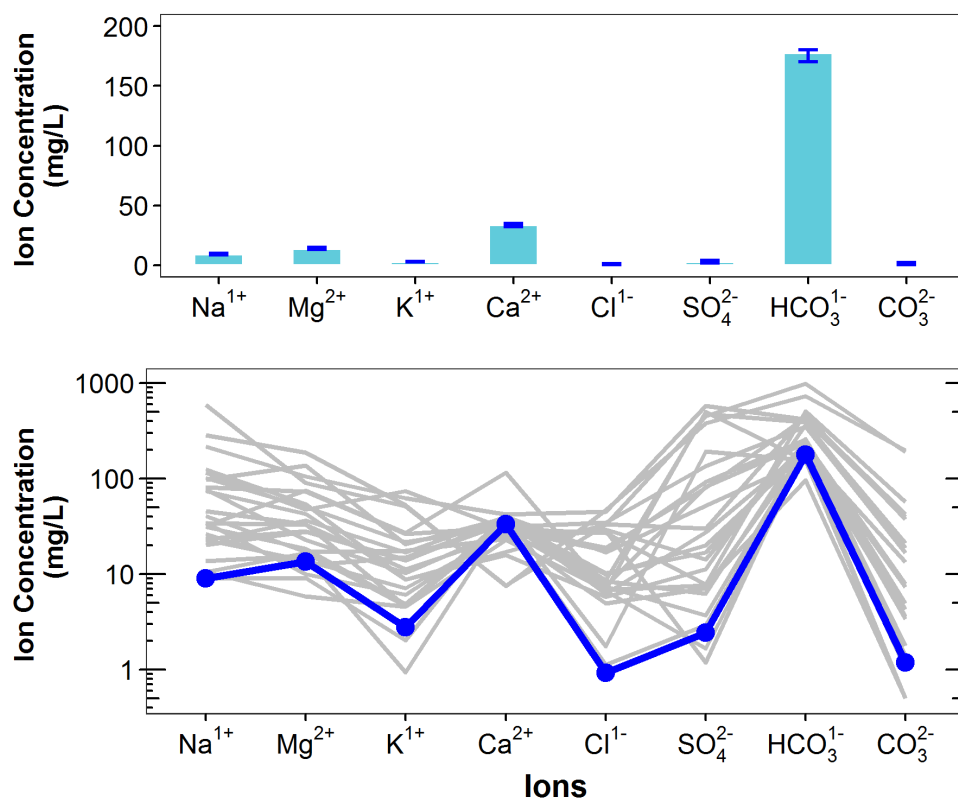


Figure 2. Average levels of cations (sodium = Na^+ , magnesium = Mg^{2+} , potassium = K^+ , calcium = Ca^{2+}) and anions (chloride = Cl^- , sulphate = SO_4^{2-} , bicarbonate = HCO_3^- , carbonate = CO_3^{2-}) from four measurements over the course of the summer at Touchwood Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Touchwood Lake (blue line) compared to 26 lake basins (gray lines) sampled through the LakeWatch program in 2022 (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 at Touchwood 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 Touchwood Lake in 2022 was 9.48 m, corresponding to an average Secchi depth of 4.74 m (Table 2). Euphotic depth varied over the season, ranging from as deep as 10.50 m on July 7th and August 9th, to 7.00 m on June 10th (Figure 3).

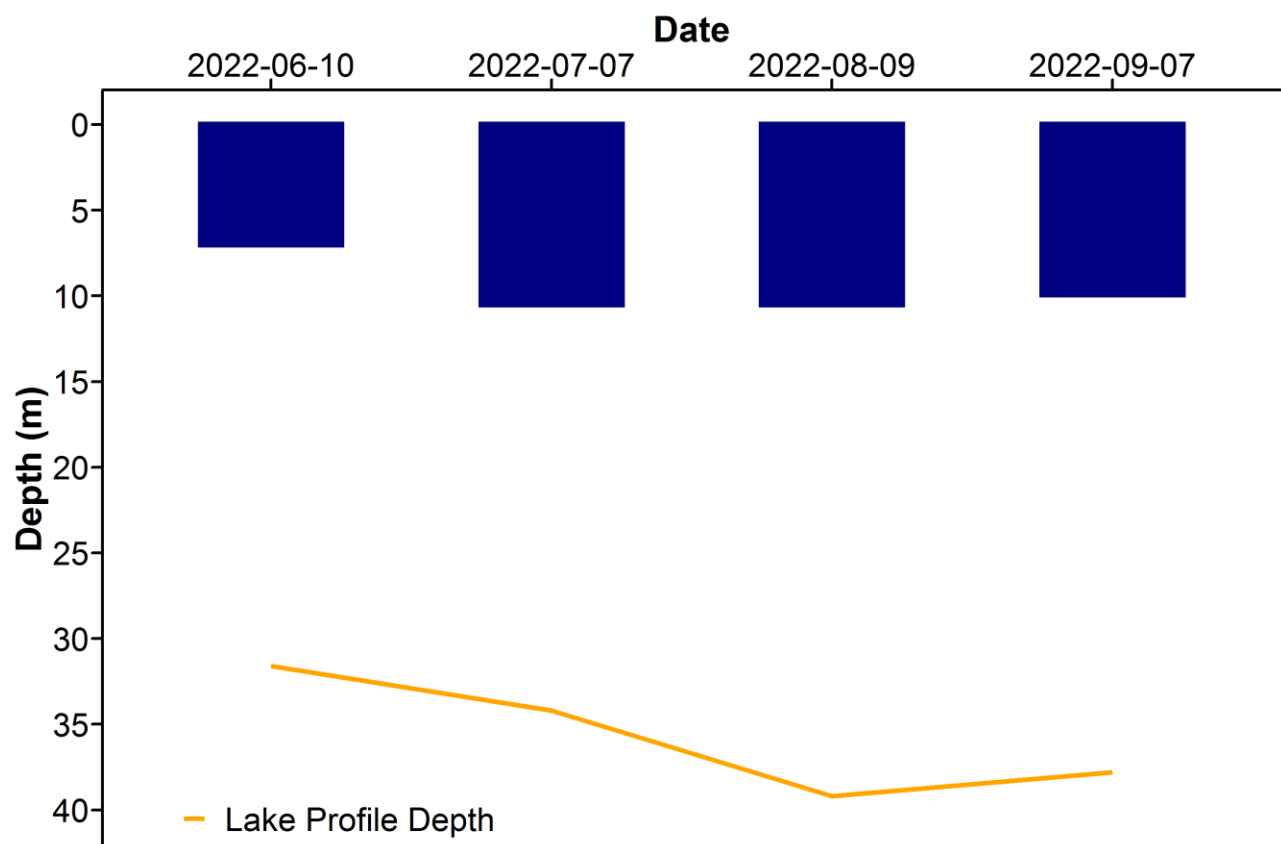


Figure 3. Euphotic depth values measured four times over the course of the summer at Touchwood Lake in 2022.

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 water temperatures of Touchwood Lake varied throughout the summer, with the September 7th sampling date having the warmest temperatures at 18.8°C (Figure 4a). The lake was stratified during each sampling event, with the mixing depth (thermocline) decreasing through the season, from as shallow as about 7 m in June to as deep as 10.5 m in September. Temperatures near the bottom warmed slightly through the summer, from 4.7°C to 5.9°C between June and September.

Touchwood 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). Oxygen levels in the surface mixed region of the lake decreased slightly through the season, and below the thermocline, decreased more appreciably. Anoxic levels (<1.0mg/L) were only detected during the September 7th sampling event, at 30 m and below. Interestingly, a slight increase in oxygen was detected at the thermocline during the June sampling event.

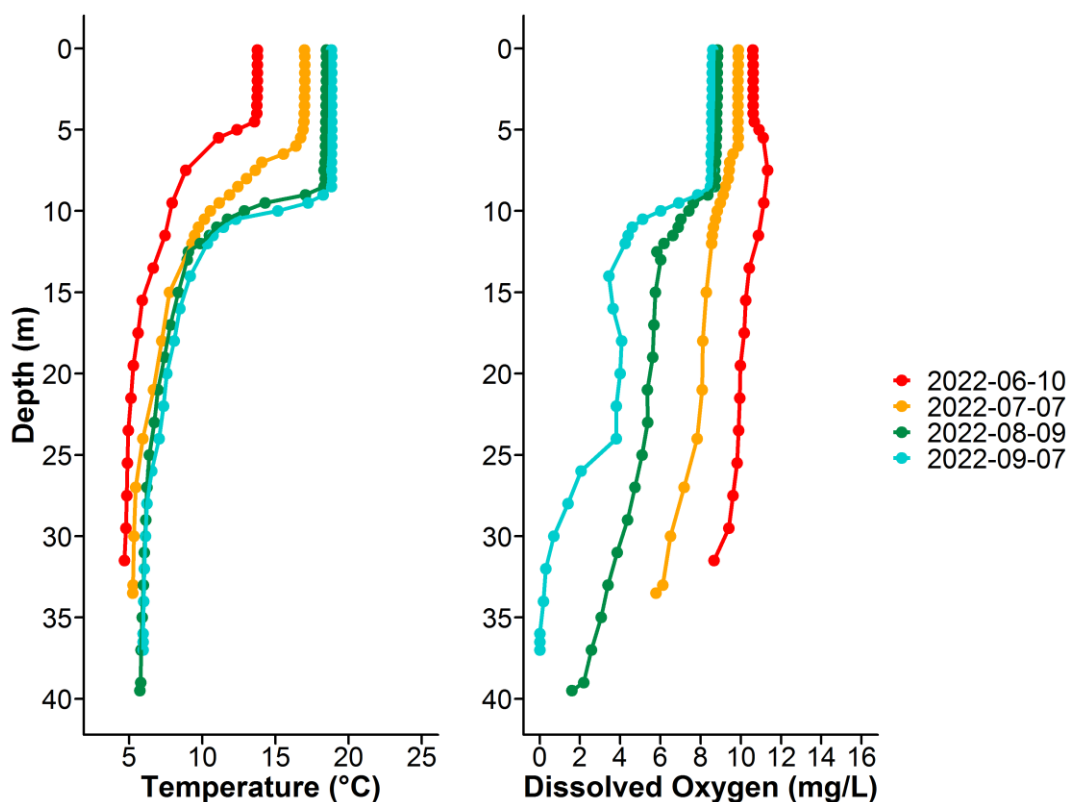


Figure 4. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Touchwood Lake measured four times over the course of the summer of 2022.



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 Touchwood Lake fell below the recreational guideline of 10 µg/L during every sampling event in 2022. In addition, microcystin levels from every sampling event was below the laboratory detection limit of 0.10 µg/L. A value of 0.05 µg/L is assigned when a value is below detection, in order to calculate an average.

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

Date	Microcystin Concentration (µg/L)
10-Jun-22	<0.1
7-Jul-22	<0.1
9-Aug-22	<0.1
7-Sep-22	<0.1
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 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 Touchwood 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.

A watermilfoil specimens was collected from Touchwood Lake on July 7th, and was confirmed to be the native Northern Watermilfoil, *Myriophyllum sibiricum*.

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 levels at Touchwood Lake in 2022 were slightly below the historical average (Figure 5). Historical data indicates that since the beginning of the record in 1969, levels increase gradually until a period of stability starting in the early 2000s. Then, levels began dropping in the mid-2010s.

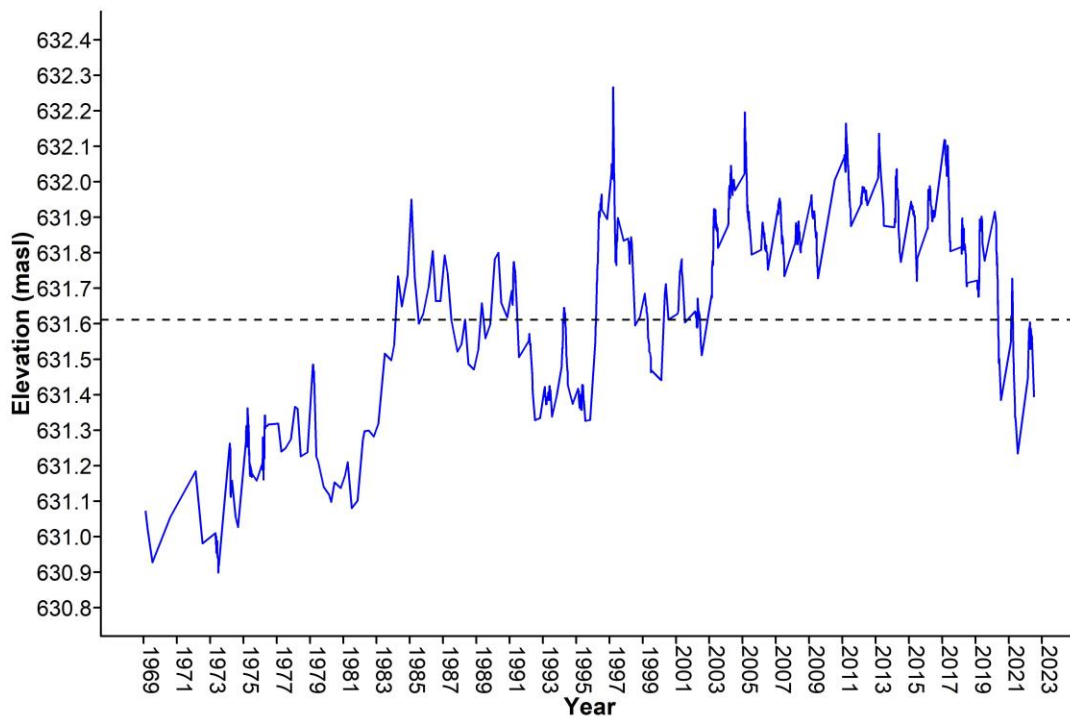


Figure 5. Water levels measured at Touchwood Lake in metres above sea level (masl) from 1969-2022. Data retrieved from Alberta Environment and Parks and/or Environment and Climate Change Canada. Black dashed line represents historical yearly average water level.

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.

Touchwood Lake experienced a warmer, drier, and less windy summer than normal (Figure 6). A prolonged and calm warm spell leading up to the September 7th sampling event likely led to the high observed water temperatures.

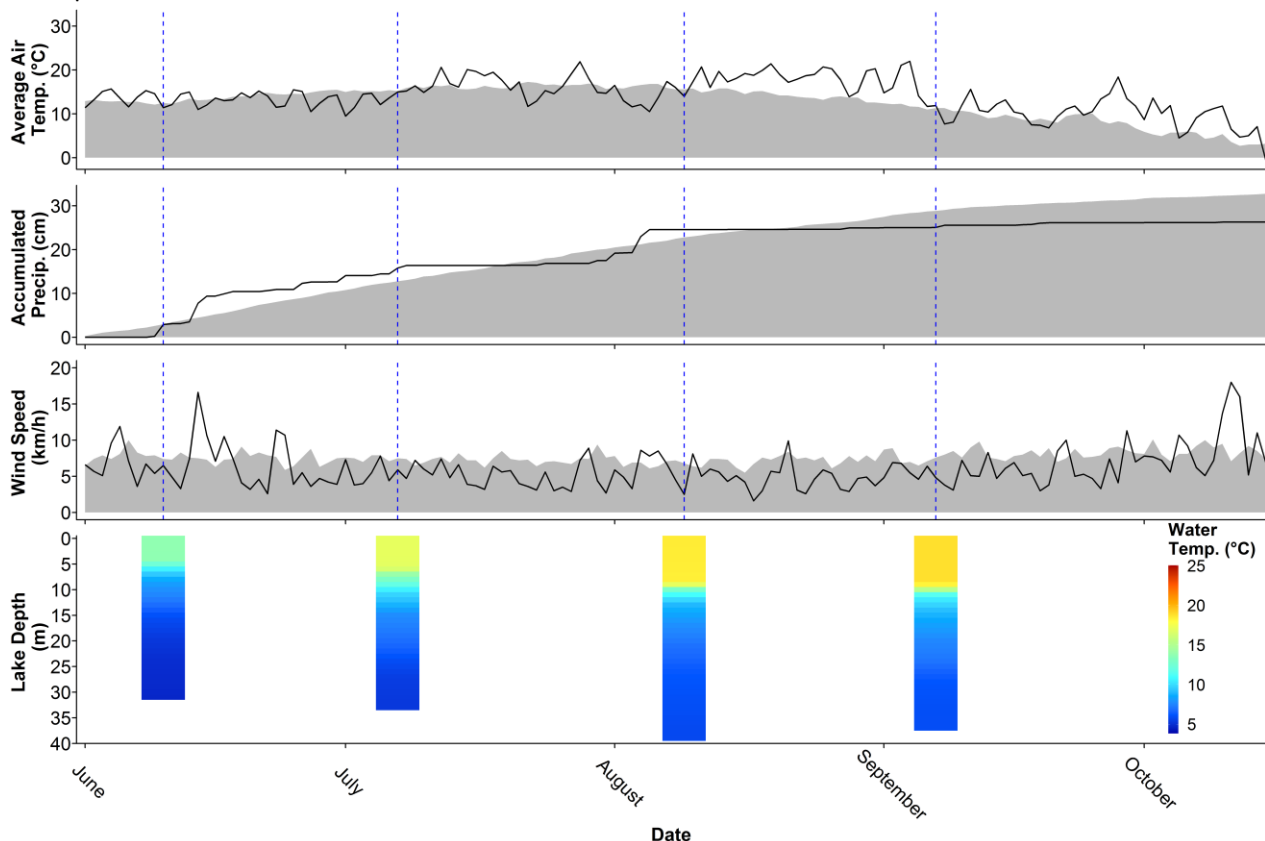


Figure 6. Average air temperature (°C) accumulated precipitation (cm), and wind speed (km/h) measured from 'Heart Lake Auto' weather station, as well as Touchwood Lake temperature profiles, interpolated (°C). Black lines indicate 2022 levels, gray indicates long-term normals, and blue lines indicate sampling dates for Touchwood 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). *Note that Solar Radiation is unavailable for the 'Heart Lake Auto' weather station.

Table 2. Average Secchi depth and water chemistry values for Touchwood Lake. Historical values are given for reference.
Number of sample trips are inconsistent between years.

Parameter	1986	1995	1996	1997	1998	2000	2001	2003	2004	2010	2014	2016	2017	2022
TP ($\mu\text{g/L}$)	22	19	18	16	19	16	17	15	14	17	14	11	14	8
TDP ($\mu\text{g/L}$)	11	8	/	/	/	/	/	7	7	8	6	3	5	3
Chlorophyll- <i>a</i> ($\mu\text{g/L}$)	4.6	3.2	3.2	2.9	4.4	1.7	2.8	3.7	3.6	1.9	1.9	3.4	3.5	3.0
Secchi depth (m)	6.24	3.92	3.60	3.49	3.60	4.64	4.62	3.62	4.56	4.65	5.55	4.25	4.65	4.74
TKN (mg/L)	0.8	0.6	/	/	/	/	/	0.6	0.6	0.7	0.6	0.5	0.6	0.5
NO ₂ -N and NO ₃ -N ($\mu\text{g/L}$)	10	2	/	/	/	/	3	10	3	4	28	2	2	5
NH ₃ -N ($\mu\text{g/L}$)	26	7	/	/	/	/	/	18	9	15	17	25	8	6
DOC (mg/L)	11	10	/	/	/	/	/	/	10	11	19	9	10	12
Ca (mg/L)	33	/	30	32	31	31	33	/	31	27	30	32	33	33
Mg (mg/L)	11	/	12	12	13	12	13	/	12	14	13	14	15	14
Na (mg/L)	7	8	8	8	9	8	8	15	8	9	10	10	10	9
K (mg/L)	3	3	3	3	3	3	3	8	3	3	3	3	3	3
SO ₄ ²⁻ (mg/L)	2	2	2	/	2	5	4	32	2	7	2	1	1	2
Cl ⁻ (mg/L)	0	/	/	1	/	1	0	1	0	1	0	0	0	1
CO ₃ (mg/L)	2.5	4.3	0.2	1.5	3.2	2.5	2.5	5.2	5.5	1.8	0.5	2.8	2.3	1.2
HCO ₃ (mg/L)	170	161	168	166	167	174	170	165	166	176	175	172	175	178
pH	8.34	8.51	8.10	8.20	8.16	8.35	8.30	8.57	8.45	8.35	8.21	8.49	8.42	8.26
Conductivity ($\mu\text{S/cm}$)	268	254	262	264	269	280	280	/	270	272	269	275	270	278
Hardness (mg/L)	128	123	126	131	130	127	135	122	128	124	128	140	142	138
TDS (mg/L)	146	139	137	141	144	146	145	184	144	148	145	150	152	152
Microcystin ($\mu\text{g/L}$)	/	/	/	/	/	/	/	/	/	0.05	0.07	0.05	0.06	0.05
Total Alkalinity (mg/L CaCO ₃)	143	140	/	/	/	145	140	144	146	146	143	148	150	145

Table 3. Concentrations of metals measured in Touchwood 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)	2003	2004	2010	2014	2016	2017	2022	Guidelines
Aluminum µg/L	15	29	21	15	15	4	4	100 ^a
Antimony µg/L	0.007	0.029	0.021	0.024	0.029	0.025	0.027	/
Arsenic µg/L	1.06	0.60	0.64	0.65	0.68	0.63	0.64	5
Barium µg/L	33	36	36	36	35	35	36	/
Beryllium µg/L	0.073	0.002	0.006	0.004	0.004	0.002	0.015	100 ^{c,d}
Bismuth µg/L	0.0042	0.0005	0.0020	0.0005	0.0010	0.0015	0.0015	/
Boron µg/L	31	37	31	34	39	35	36	1500
Cadmium µg/L	0.010	0.003	0.003	0.003	0.003	0.005	0.005	0.21 ^b
Chromium µg/L	0.28	0.13	0.06	0.20	0.09	0.05	0.05	/
Cobalt µg/L	0.02	0.01	0.01	0.00	0.00	0.02	0.04	50,1000 ^{c,d}
Copper µg/L	0.59	0.26	0.21	0.36	0.58	0.31	0.24	3.1 ^b
Iron µg/L	15	22	21	10	13	12	7	300
Lead µg/L	0.23	0.05	0.02	0.03	0.12	0.02	0.01	4.8 ^b
Lithium µg/L	9	11	10	10	12	11	11	2500 ^d
Manganese µg/L	9.4	11.7	5.3	5.6	5.2	6.4	6.2	260 ^e
Molybdenum µg/L	0.11	0.11	0.11	0.09	0.11	0.13	0.16	73
Nickel µg/L	0.030	0.003	0.049	0.004	0.294	0.890	0.290	121.7 ^b
Selenium µg/L	0.65	0.09	0.05	0.03	0.13	0.10	0.10	1
Silver µg/L	0.0025	0.0011	0.0052	0.0020	0.0010	0.0010	0.0005	0.25
Strontium µg/L	126	131	126	130	130	126	131	/
Thallium µg/L	0.003	0.001	0.003	0.000	0.001	0.001	0.001	0.8
Thorium µg/L	0.004	0.004	0.006	0.015	0.003	0.009	0.001	/
Tin µg/L	0.05	0.04	0.02	0.01	0.04	0.03	0.03	/
Titanium µg/L	0.90	0.74	0.68	0.54	0.63	0.25	0.05	/
Uranium µg/L	0.10	0.10	0.13	0.12	0.13	0.13	0.22	15
Vanadium µg/L	0.15	0.16	0.14	0.13	0.13	0.10	0.13	100 ^{c,d}
Zinc µg/L	1.6	1.7	0.3	0.9	1.3	1.4	1.0	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#_aqf_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

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 Touchwood Lake. In sum, a significant increasing trend was observed in TDS, a significant decreasing trend was observed for TP, and no significant trends were detected for chlorophyll-*a* or Secchi depth. Secchi depth can be subjective and is sensitive to variation in weather; therefore, trend analysis must be interpreted with caution. Data is presented below as both line and box-and-whisker plots. Detailed methods are available in the *ALMS Guide to Trend Analysis on Alberta Lakes*.

Table 4. Summary table of trend analysis on Touchwood Lake data from 1986 to 2022.

Parameter	Date Range	Direction of Significant Trend
Total Phosphorus	1986-2022	Decreasing
Chlorophyll- <i>a</i>	1986-2022	No Change
Total Dissolved Solids	1986-2022	Increasing
Secchi Depth	1986-2022	No Change

Definitions:

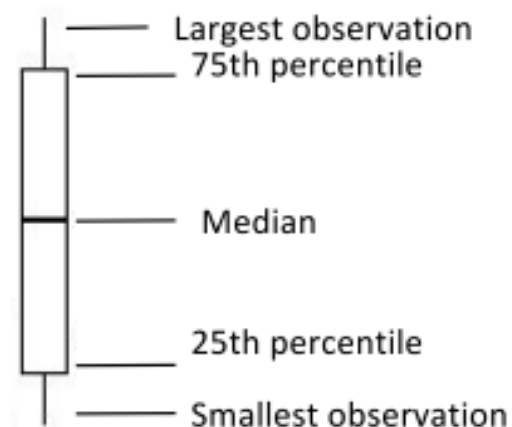
Median: the value in a range of ordered numbers that falls in the middle.

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)

Trend analysis of TP over time showed that it has significantly decreased in Touchwood Lake since 1986 (Tau = -0.33, $p = 0.004$).

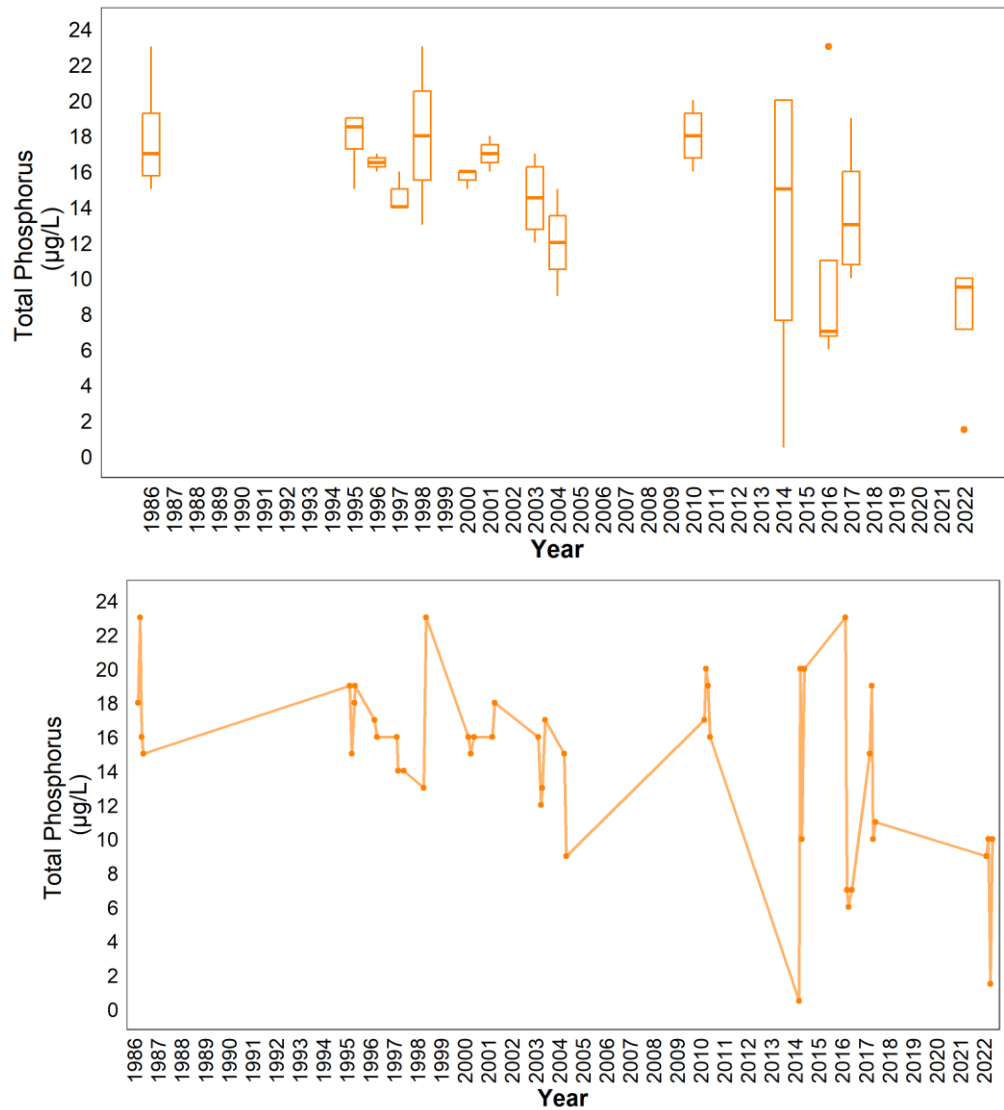


Figure 7. Monthly total phosphorus (TP) concentrations measured between June and September over the long term sampling dates between 1986 and 2022 ($n = 46$). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Chlorophyll-*a*

Trend analysis of chlorophyll-*a* over time showed that it has not significantly changed in Touchwood Lake since 1986 (Tau = 0.06, $p = 0.66$).

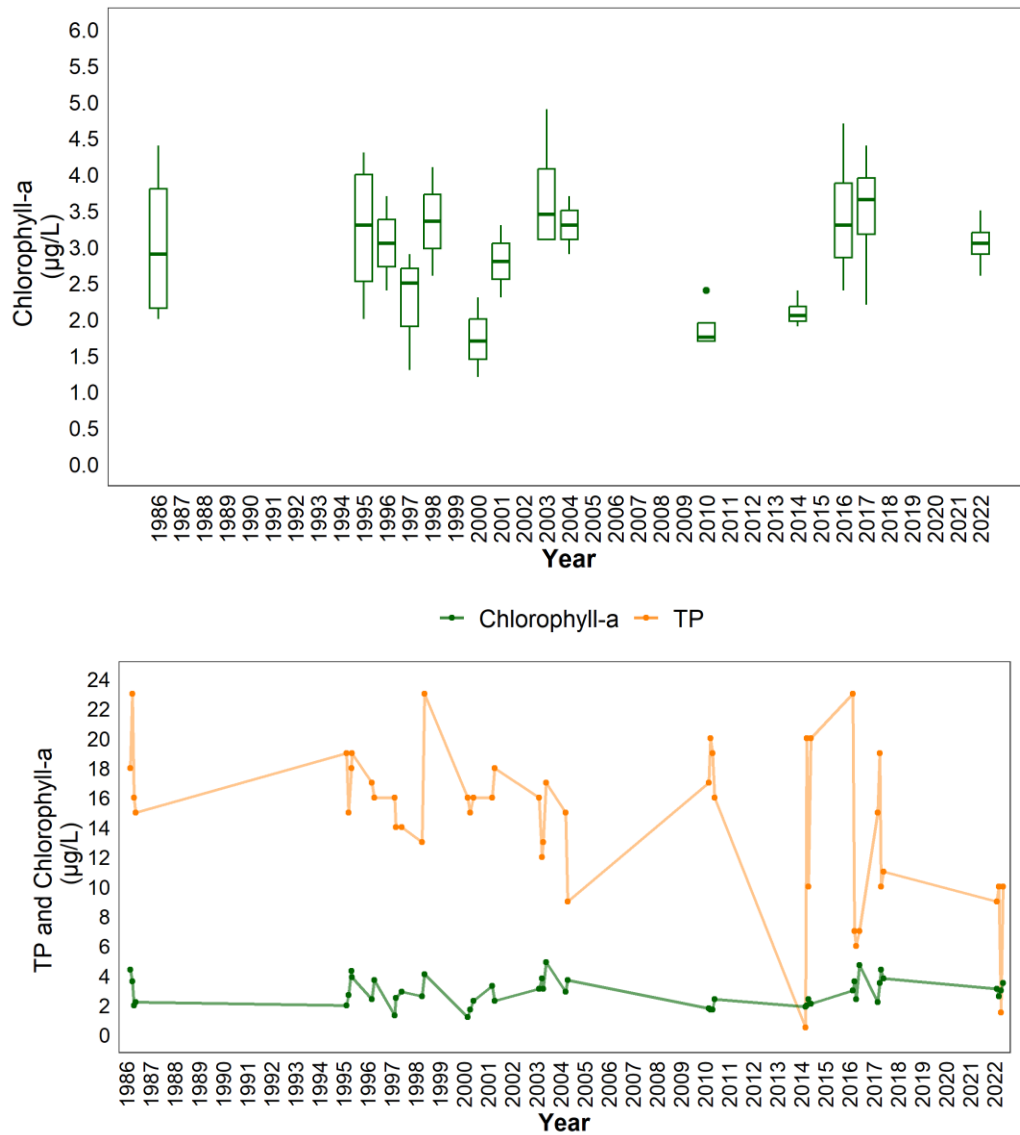


Figure 8. Monthly chlorophyll-*a* concentrations measured between June and September over the long term sampling dates between 1986 and 2022 ($n = 46$). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples. Line graph is overlain by TP concentrations.

Total Dissolved Solids (TDS)

Trend analysis showed a significant increasing trend in TDS between 1986 and 2022 (Tau = 0.52, $p = <0.001$) in Touchwood Lake (Figure 9).

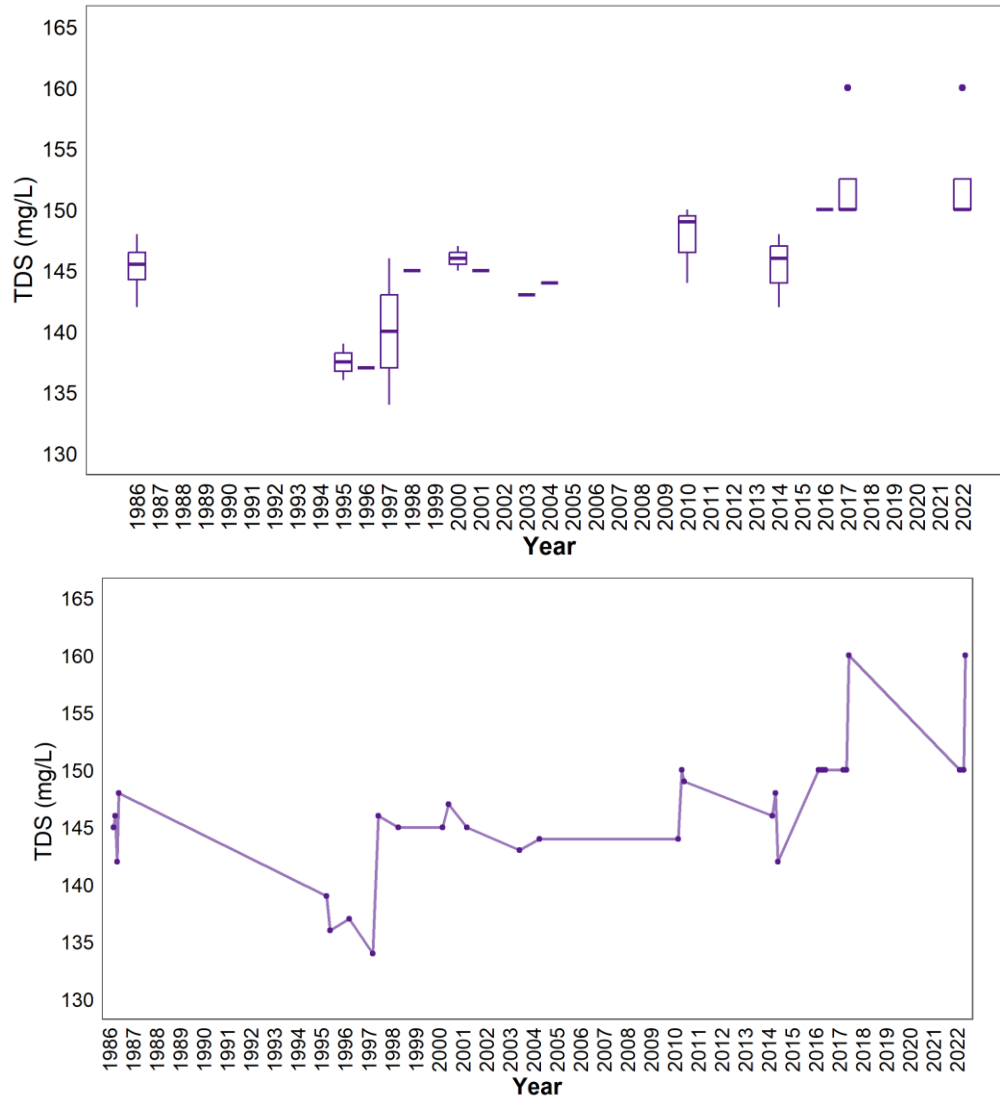


Figure 9. Monthly TDS values measured between June and September over the long term sampling dates between 1986 and 2022 ($n = 33$). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Due to the significant increasing trend of TDS in Touchwood Lake, exploring the specific major ions which may be driving this trend is important to determine. Trend analysis of major ions at Touchwood Lake indicates that alkalinity is the key parameter that is driving the increase in TDS (Figure 10). This parameter displays the greatest magnitude of change over time (slope), but also follows the trajectory of TDS. While the slopes of sodium and potassium are smaller, their increasing trends are also significant, and their trajectories also follow the trajectory of TDS over time.

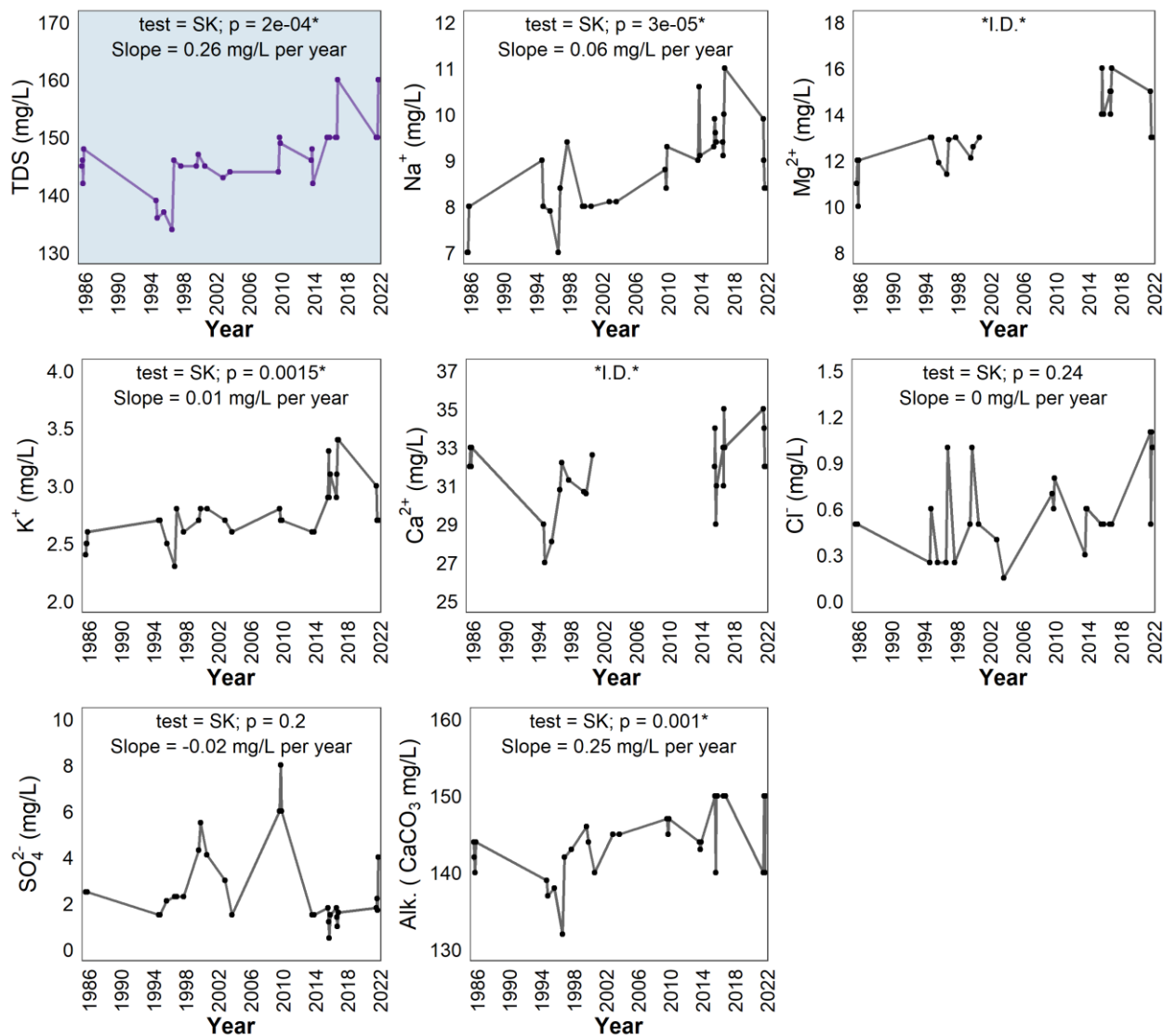


Figure 10. Concentrations of TDS (top left, blue panel), major ions (sodium = Na⁺, magnesium = Mg²⁺, potassium = K⁺, calcium = Ca²⁺, chloride = Cl⁻, sulphate = SO₄²⁻), and total alkalinity (Alk., as mg/L CaCO₃) measured monthly between June and September on sampling dates between 1986 and 2022. Also 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

Trend analysis of Secchi depth over time showed that it has not significantly changed in Touchwood Lake since 1986 ($\text{Tau} = 0.19$, $p = 0.07$).

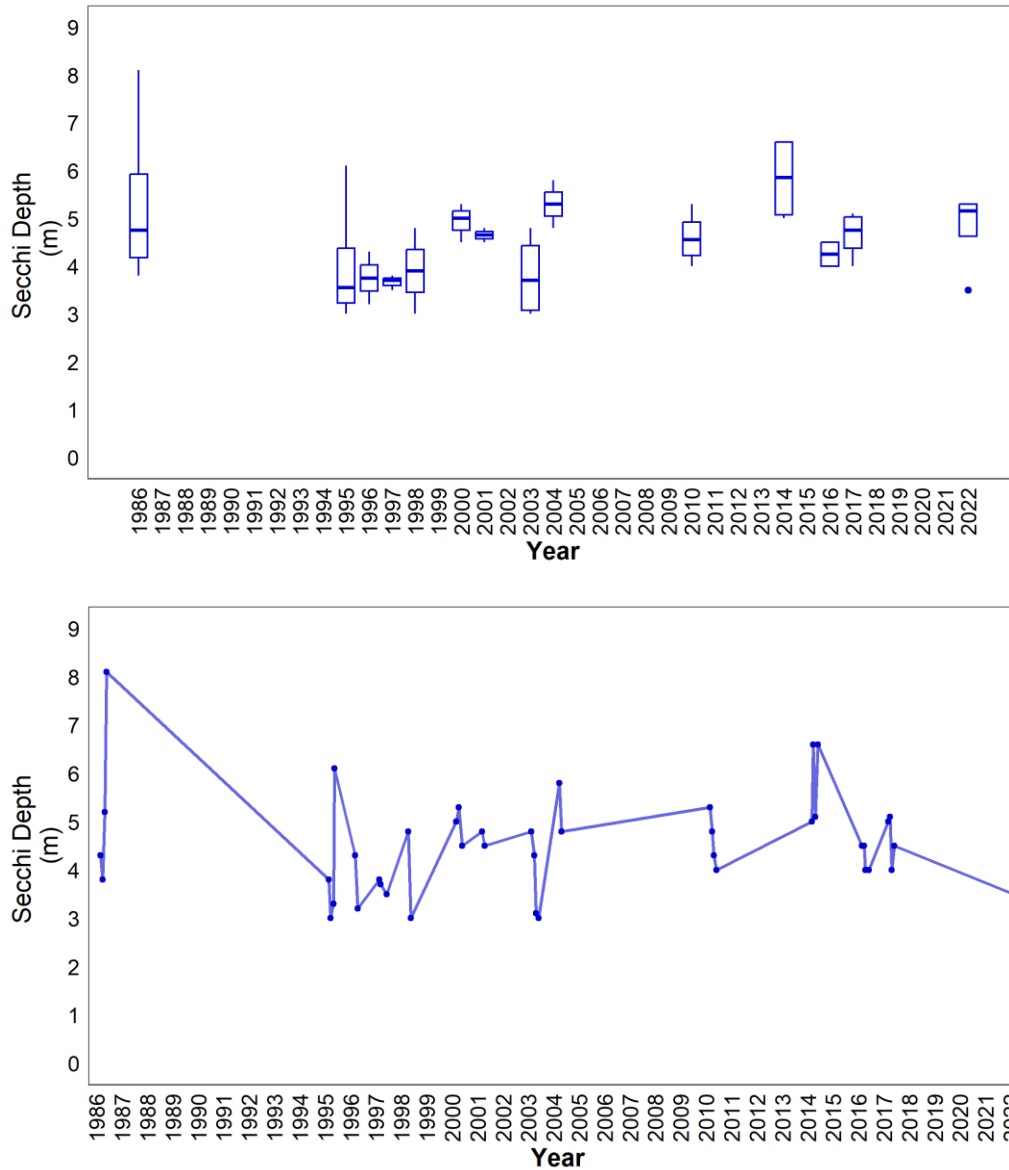


Figure 11. Monthly Secchi depth values measured between June and September on sampling dates between 1986 and 2022 ($n = 46$). The value closest to the 15th day of the month was chosen to represent the monthly value in cases with multiple monthly samples.

Table 5. 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 1986-2022 on Touchwood Lake 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	-0.33	0.06	0.52	0.19
The extent of the trend	Slope (units per Year)	-0.24	0.01	0.26	0.03
The statistic used to find significance of the trend	Z	-2.91	0.43	3.71	1.82
Number of samples included	n	46	46	33	46
The significance of the trend	<i>p</i>	$3.66 \times 10^{-3*}$	0.66	$2.04 \times 10^{-4*}$	0.07

**p* < 0.05 is significant within 95%