THE ALBERTA LAKE MANAGEMENT SOCIETY
VOLUNTEER LAKE MONITORING PROGRAM

2013 Pine Lake Report

COMPLETED WITH SUPPORT FROM:

Alberta Government

Alberta Lake Management Society's LakeWatch Program

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. LakeWatch Reports are designed to summarize basic lake data in understandable terms for a lay audience and are not meant to be a complete synopsis of information about specific lakes. Additional information is available for many lakes that have been included in LakeWatch and readers requiring more information are encouraged to seek those sources.

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

Acknowledgements

The LakeWatch program is made possible through the dedication of its volunteers. We would like to thank Ed Lawrence, Jackson Woren, and Rod Woren. We would also like to thank Jared Ellenor, Nicole Meyers, and Elynne Murray who were summer technicians with ALMS in 2013. Program Coordinator Bradley Peter was instrumental in planning and organizing the field program. Technologists Chris Ware and Sarah Hustins were involved in the training aspects of the program. Lisa Reinbolt was responsible for data management. This report was prepared by Bradley Peter and Arin Dyer. Alberta Environment and the Beaver River Watershed Alliance (BRWA) were major sponsors of the program.

PINE LAKE:

Pine Lake (Figure 1) is a small eutrophic lake southeast of Red Deer, Alberta. Pine Lake is subject to cyanobacterial blooms and public concern over deteriorating water quality prompted the Alberta government to initiate a lake restoration program in 1991. The Pine Lake Restoration Program was designed as a pilot project for future lake and watershed projects in Alberta.

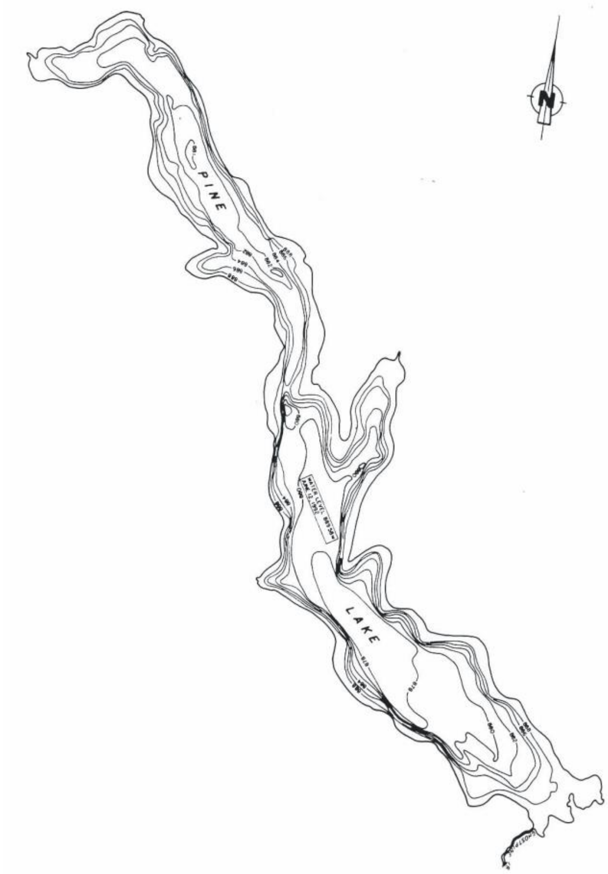

Figure 1 – Bathymetric map of Pine Lake[1].

An advisory committee that represented all members of the community directed early planning and problem diagnosis by the Alberta government. A diagnostic study in 1992 determined that approximately 61% of the total phosphorus (TP) loading was from sediment release and other internal sources, while about 36% was from surface runoff. Monitoring of Pine Lake determined that algal growth was mainly limited by the supply of phosphorus[1]. Four critical areas for watershed restoration were identified on four streams affected by livestock operations and sewage release. These streams contributed 72% of the phosphorus loading from streams in 1992.

The advisory committee later formed the Pine Lake Restoration Society, a non-profit organization with representatives from all stakeholders which raised funds and worked with technical advisors from the Alberta government. The Pine Lake Restoration Society implemented a four-year work plan in 1995 that addressed phosphorus loading from all sources. The main objective of the restoration program was to restore Pine Lake to a 'natural' level of algal productivity (as determined by paleolimnology). The Pine Lake Restoration Society and other individuals in the basin completed beneficial management practice (BMP) projects at various agricultural sites. Other organizations also improved wastewater treatment at a resort and two camps near the shoreline of Pine Lake.

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[1] Sosiak, A. J and D.O. Trew. 1996. Pine Lake restoration project. Diagnostic Study (1992). Obtained from: http://environment.gov.ab.ca/info/library/7764.pdf

Following an evaluation of the different alternatives to remove or treat phosphorus released from lake sediments, hypolimnetic withdrawal was selected as the preferred method of treatment. Hypolimnetic withdrawal has been successfully used to reduce TP concentration in various lakes, mainly in Europe, but had never been attempted in Alberta.

The hypolimnetic withdrawal system at Pine Lake, installed in 1998, consists of a weir that regulates lake levels, and a gravity-fed pipeline that withdraws cool, phosphorus-rich water from near the bottom of the lake (the hypolimnion) of the south basin and discharges it through a vault with control valves to a stilling basin on Ghostpine Creek.

WATER QUANTITY:

There are many factors influencing water quantity. Some of these factors include the size of the lakes drainage basin, precipitation, evaporation, water consumption, ground water influences, and the efficiency of the outlet channel structure at removing water from the lake. Requests for water quantity monitoring should go through Environment and Sustainable Resource Developments Monitoring and Science division.

Water levels at Pine Lake have been monitored since 1965 (Figure 2). Under the approval to operate the hypolimnetic withdrawal system, the Pine Lake Restoration Society tries to maintain water levels within a range that was recommended in the engineering report for the system. The weir operator for the Society accomplishes this by adding or removing boards to the weir at the lake outfall and by operating control valves. Overall, lake levels have fluctuated very little and are maintained around 889.5 meters above sea level.

WATER QUANTITY GRAPH CURRENTLY NOT AVAILABLE. SEE FUTURE REPORT.

WATER CLARITY AND SECCHI DEPTH:

Water clarity is influenced by suspended materials, both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring but then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi disk depth.

Secchi disk depth fluctuated greatly throughout the summer at Pine Lake. Secchi disk depth ranged from a maximum of 4.00 m on June 12th to a minimum of 0.95 m on August 14th. Due to a late spring, water clarity in June appeared much improved compared to previous years (personal communication). On average, Secchi disk depth measured 1.94 m (Table 1). This average is higher than averages observed in recent years – however, a missing September sample may skew results slightly.

WATER TEMPERATURE AND DISSOLVED OXYGEN:

Water temperature and dissolved oxygen profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

Surface water temperatures ranged between a minimum of 15.58 °C on June 12th to a maximum of 22.30 °C on July 4th (Figure 3a). In 2013, thermal stratification was present only in July – by August, water temperatures were relatively uniform suggesting there was a mixing of the water column. It is possible that intermittent periods of stratification are established in calm, hot weather, as sampling in previous years has revealed weak stratification events in August.

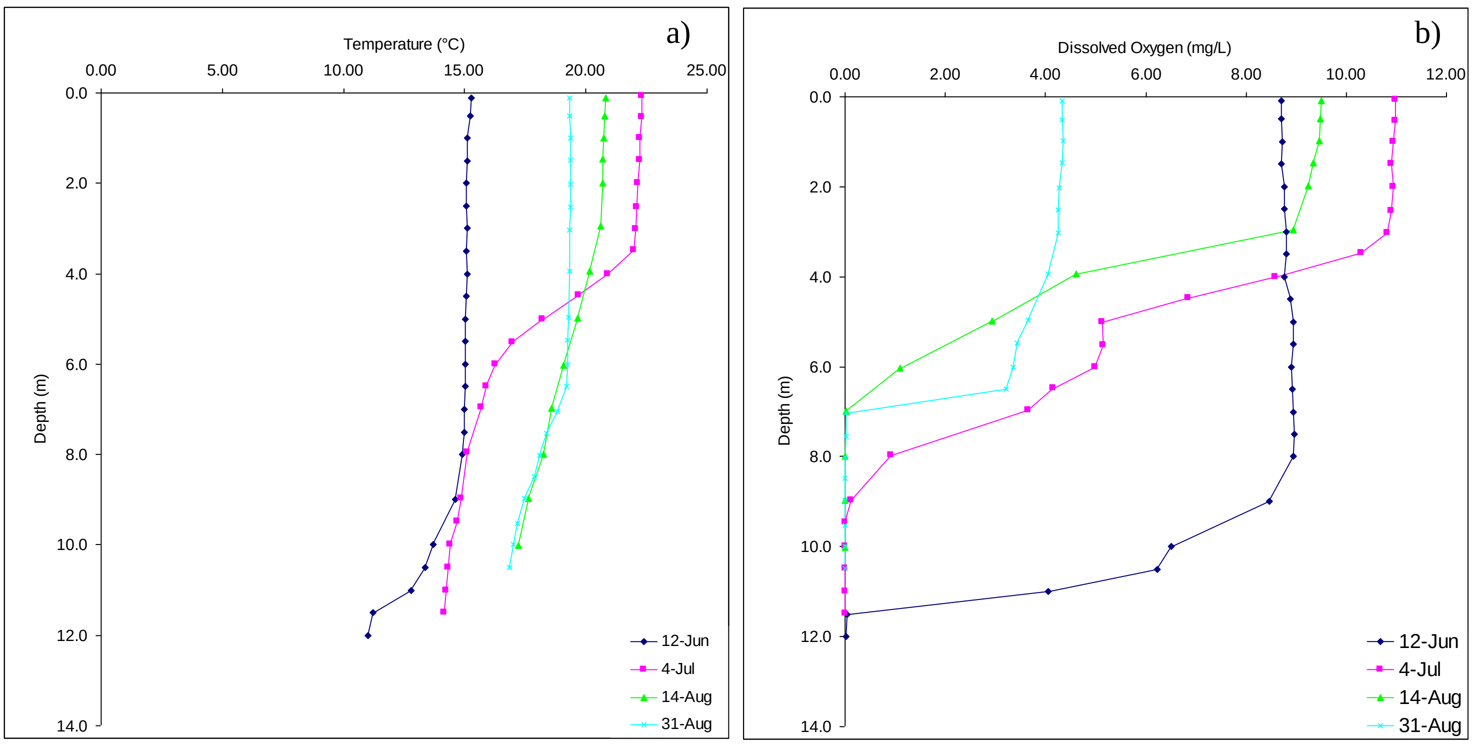

Figure 2 - a) Surface water temperature (°C) and b) dissolved oxygen concentrations (mg/L) measured four times over the course of the summer at Pine Lake.

Dissolved oxygen concentrations in Pine Lake ranged from supersaturated due to photosynthesis on July 4th to depleted on August 31st (Figure 3b) On August 31st, the entire water column fell below the Canadian Council for Ministers of the Environment guidelines for the Protection of Aquatic Life of 6.5 mg/L. At these concentrations, fish are likely being stressed. Intermittent periods of stratification will exacerbate oxygen gradients between surface and bottom waters. The decomposition of algae/cyanobacteria on the lakebed is an oxygen consuming process which will drive down oxygen concentrations.

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 1 for a complete list of parameters.

Average Total Phosphorus (TP) measured 72.8 μg/L in 2013 (Table 1). This is the lowest average measured since 2005, though still falls into the eutrophic, or nutrient rich, classification. Throughout the summer, TP concentration ranged from a minimum of 62 μg/L on August 14th to a maximum of 83 μg/L on July 4th (Figure 5). A late fall with an extremely short spring run-off period may help to explain the reduced nutrient concentrations observed in 2013.

Chlorophyll-*a* concentration is closely tied to TP concentration at Pine Lake (Figure 6). Similar to TP, average chlorophyll-*a* concentration was the lowest observed since 2005. On average, chlorophyll-*a* concentration measured 17.82 μg/L, which falls into the eutrophic classification (Table 1). Throughout the summer chlorophyll-*a* concentration ranged from a minimum of 5.69 μg/L on June 12th to a maximum of 28.2 μg/L on August 14th (Figure 5).

Finally, TKN measured an average of 1678 μg/L in 2013 (Table 1). This value falls into the hypereutrophic, or extremely productive, classification. Similar to TP and chlorophyll-*a*, this is the lowest average recorded since 2003.

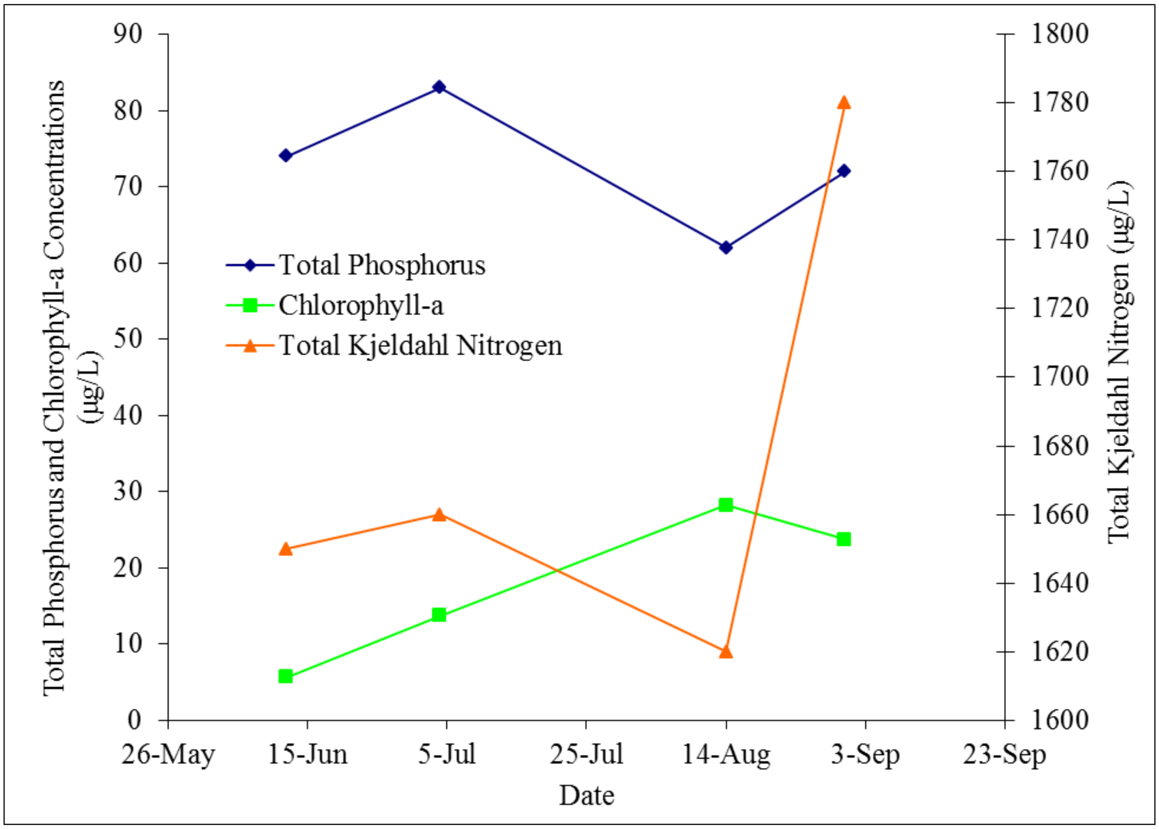

Figure 5 – Total phosphorus (µg/L), total Kjeldahl nitrogen (µg/L), and chlorophyll-*a* concentration (µg/L) measured at Pine Lake during the summer of 2013.

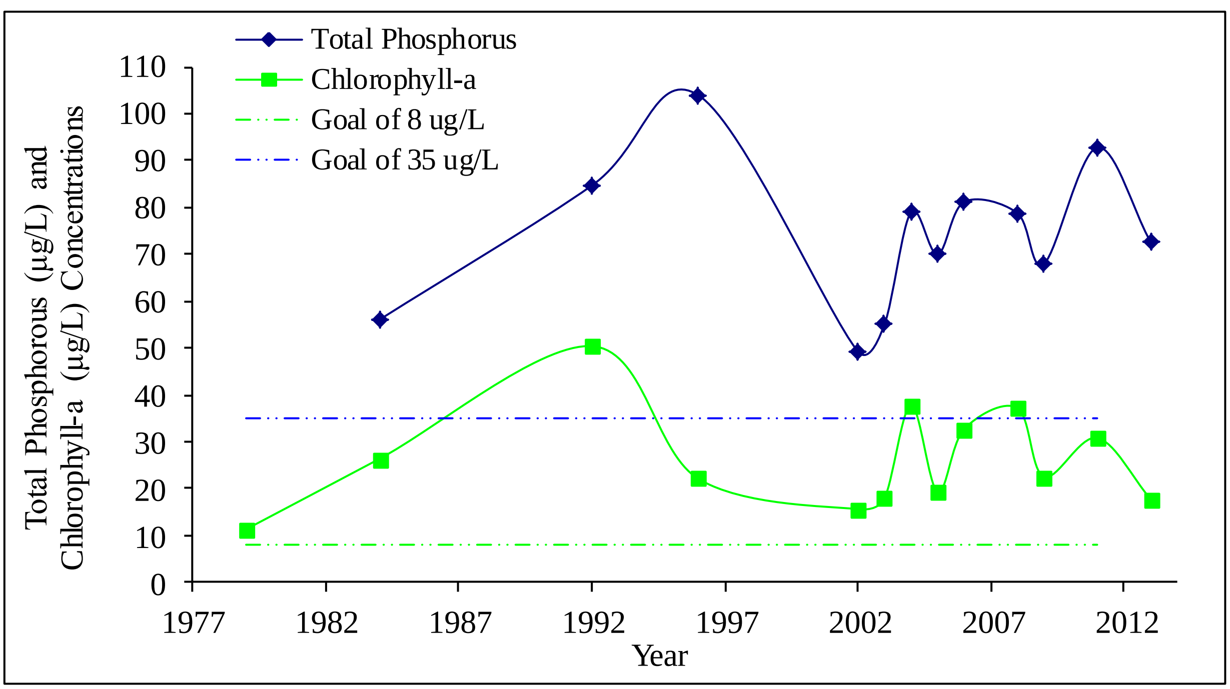

Figure 6 – Historical values of total phosphorus (µg/L) and chlorophyll-*a* concentration (µg/L) measured at Pine Lake. Goal concentrations described in Sosiak 2002 are provided for comparison.[1]

Average pH measured at Pine Lake in 2013 was 8.630, which is well above neutral. High alkalinity (293 mg/L $CaCO_3$) and high bicarbonate concentration (331 mg/L HCO_3) likely help to buffer the lake against changes to pH (Table 1). Dominant ions in the lake included sodium (90.5 mg/L) and sulphate (62.5 mg/L).

Microcystins, liver toxins produced by cyanobacteria, were monitored on each sampling trip. Microcystin concentrations never exceeded 1.0 µg/L, and the average concentration of microcystin at Pine Lake in 2013 measured 0.24 µg/L (Table 1). This value falls well below the recreational water quality guidelines of 20 µg/L. Though microcystins were not detected in high concentrations, other cyanobacterial toxins which were not sampled for may still be present and pose a threat to health. Caution should be observed when recreating in lakes with cyanobacterial blooms. Metals were sampled for once throughout the summer and all concentrations fell within their respective guidelines (Table 2).

INVASIVE SPECIES:

Quagga and Zebra mussels are invasive species which, if introduced to our lakes, will have significant negative ecological, economical, and recreational impacts. ALMS collects water samples which are analyzed for mussel veligers (juveniles) and monitors substrates for adult mussels. In order to prevent the spread of invasive mussels, always clean, drain, and dry your boat between lakes. To report mussel sightings or mussel-fouled boats, call the confidential Alberta hotline at 1-855-336-BOAT.

In 2013, no zebra or quagga mussels were detected in Pine Lake.

Table 1 – Average Secchi disk depth and water chemistry values for Pine Lake. Previous years averages are provided for comparison.

Parameter	**1979**	**1984**	**1992**	**1996**	**2002**	**2003**	**2004**	**2005**	**2006**	**2008**	**2009**	**2011**	**2013**
TP (µg/L)	/	56	84.7	104	49.3	55	79	70	81.2	78.8	68	92.8	72.75
TDP (µg/L)	/	/	38.6	57.9	18.4	26.2	26.2	33.3	32.4	33.8	34.5	31.4	42.25
Chlorophyll-*a* (µg/L)	11.3	26.3	50.4	22.1	15.6	17.9	37.8	19.3	32.7	37.2	22.5	30.8	17.82
Secchi depth (m)	3.4	1.8	1.8	2.1	1.7	3.1	1.7	2.5	1.8	1.2	1.86	1.29	1.94
TKN (µg/L)	1293	1302	2052	1360	1442	1474	1880	1750	1856	1908	1760	1972	1677.5
NO_2 and NO_3 (µg/L)	13	<10	36	11	3	10	9.7	11	2	13	15.5	6.2	8.625
NH_3 (µg/L)	/	59	146	120	11	98	136	156	134	135	65	134	81.75
DOC (mg/L)	/	/	/	/	/	/	22.3	17.3	18.8	17.3	17.8	18.7	17.8
Ca (mg/L)	/	23	25	28	20	21	21.7	21	24	29.1	27.3	31.2	31
Mg (mg/L)	/	25	25	24	26	24	25	23	23	23.5	24.3	23.3	26.2
Na (mg/L)	/	108	99	103	112	124	132	129	128	109	115.3	83.6	90.45
K (mg/L)	/	10	9	10	11.5	10	10	10	10.7	9.7	10.4	9.1	8.65
SO_4^{2-} (mg/L)	/	84	69	63	90	79	85	78	82.3	68.3	75.6	56	62.5
Cl^- (mg/L)	/	6	7	8	11	10	11	10	12	12.8	13.46	12.4	11.85
CO_3 (mg/L)	/	/	/	/	/	22.8	20.5	17.7	17	9.7	14.3	11.3	16.67
HCO_3 (mg/L)	/	/	/	/	/	/	374	381	387	370	371.6	334	331.75
pH	/	/	/	/	/	/	8.8	8.7	8.7	8.5	8.61	8.6	8.63
Conductivity (µS/cm)	/	/	/	/	/	/	787.75	764	786	729.3	754.7	659	697.25
Hardness (mg/L)	/	/	/	/	/	163	156	148.3	153.3	169.6	168	174	185
TDS (mg/L)	/	/	/	/	/	469	489	477.3	487.3	457.6	463.6	393	408.5
Microcystin (µg/L)	/	/	/	/	/	/	/	0.876	0.2925	0.4275	1.19	0.27	0.24
Total Alkalinity (mg/L $CaCO_3$)	/	319	308	313	321	331	341	342	346	319.7	328.3	293	293.25

Note: TP = total phosphorus, TDP = total dissolved phosphorus, Chl-*a* = chlorophyll-*a*, TKN = total Kjeldahl nitrogen. NO_{2+3} = nitrate+nitrite, NH_3 = ammonia, Ca = calcium, Mg = magnesium, Na = sodium, K = potassium, SO_4 = sulphate, Cl = chloride, CO_3 = carbonate, HCO_3 = bicarbonate. A forward slash (/) indicates an absence of data.

Table 2 - Concentrations of metals measured in Pine Lake on August 14th. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	2003	2004	2013	Guidelines
Aluminum µg/L	24.9	30.55	26.2	100[a]
Antimony µg/L	0.056667	0.078	0.0915	6[e]
Arsenic µg/L	1.136667	1.145	1.37	5
Barium µg/L	56.23333	58.6	59.7	1000[e]
Beryllium µg/L	0.166667	0.00225	0.0015	100[d,f]
Bismuth µg/L	0.0065	0.00115	0.115	/
Boron µg/L	67.66667	80.3	85.8	5000[ef]
Cadmium µg/L	0.01	0.0037	0.0039	0.085[b]
Chromium µg/L	0.36	0.334	0.402	/
Cobalt µg/L	0.064667	0.063	0.115	1000[f]
Copper µg/L	0.83	1.57	0.468	4[c]
Iron µg/L	/	9	36.2	300
Lead µg/L	0.165	0.12665	0.0544	7[c]
Lithium µg/L	34.8	43.55	35.5	2500[g]
Manganese µg/L	10.86	10.475	7.42	200[g]
Molybdenum µg/L	0.683333	0.7	0.835	73[d]
Nickel µg/L	0.044667	0.195	0.527	150[c]
Selenium µg/L	0.35	0.05	0.177	1
Silver µg/L	0.0025	0.00025	0.0277	0.1
Strontium µg/L	255.6667	283.5	284	/
Thallium µg/L	0.033333	0.0007	0.0005	0.8
Thorium µg/L	0.0015	0.00555	0.0966	/
Tin µg/L	0.05	0.015	0.0352	/
Titanium µg/L	1.7	1.32	0.95	/
Uranium µg/L	0.711667	0.7565	1.25	100[e]
Vanadium µg/L	0.396667	0.3755	0.573	100[f,g]
Zinc µg/L	4.36	7.69	0.772	30

Values represent means of total recoverable metal concentrations.

[a] Based on pH ≥ 6.5; calcium ion concentrations $[Ca^{+2}]$ ≥ 4 mg/L; and dissolved organic carbon concentration [DOC] ≥ 2 mg/L.

[b] Based on water Hardness of 300 mg/L (as $CaCO_3$)

[c] Based on water hardness > 180mg/L (as $CaCO_3$)

[d] CCME interim value.

[e] Based on Canadian Drinking Water Quality guideline values.

[f] Based on CCME Guidelines for Agricultural use (Livestock Watering).

[g] Based on CCME Guidelines for Agricultural Use (Irrigation).

A forward slash (/) indicates an absence of data or guidelines.

A BRIEF INTRODUCTION TO LIMNOLOGY

INDICATORS OF WATER QUALITY:

Water samples are collected in LakeWatch to determine the chemical characteristics that characterize general water quality. Though not all encompassing, the variables collected in LakeWatch are sensitive to human activities in watersheds that can cause degraded water quality. For example, nutrients such as phosphorus and nitrogen are important determinants of lake productivity. The concentrations of these nutrients in a lake are impacted (typically elevated) by land use changes such as increased crop production or livestock grazing. Elevated nutrient concentrations can cause increases in undesirable algae blooms resulting in low dissolved oxygen concentrations, degraded habitat for fish and noxious smells. A large increase in nutrients over time may also indicate sewage inputs which in turn may result in other human health concerns associated with bacteria or the protozoan *Cryptosporidium*.

TEMPERATURE AND MIXING:

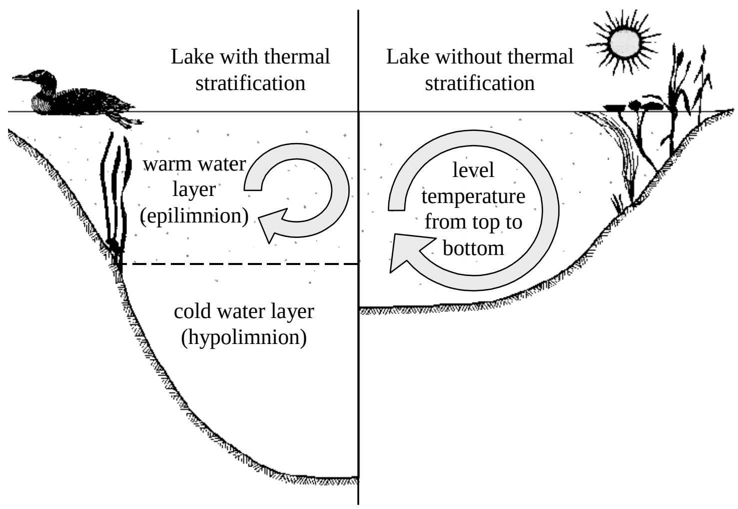

Figure A: Difference in the circulation of the water column depending on thermal stratification.

Water temperature in a lake dictates the behavior of many chemical parameters responsible for water quality. Heat is transferred to a lake at its surface and slowly moves downward depending on water circulation in the lake. Lakes with a large surface area or a small volume tend to have greater mixing due to wind. In deeper lakes, circulation is not strong enough to move warm water to depths typically greater than 4 or 5 m and as a result cooler denser water remains at the bottom of the lake. As the difference in temperature between warm surface and cold deeper water increases, two distinct layers are formed. Limnologists call these layers of water the **epilimnion** at the surface and the **hypolimnion** at the bottom. The layers are separated by a transition layer known as the **metalimnion** which contains the effective wall separating top and bottom waters called a **thermocline**. A thermocline typically occurs when water temperature changes by more than one degree within one meter depth. The hypolimnion and epilimnion do not mix, nor do elements such as oxygen supplied at the surface move downward into the hypolimnion. In the fall, surface waters begin to cool and eventually reach the same temperature as hypolimnetic water. At this point the water mixes from top to bottom in what is often called a **turnover** event. Surface water cools further as ice forms and again a thermocline develops this time with 4° C water at the bottom and near 0° C water on the top.

In spring another turnover event occurs when surface waters warm to 4° C. Lakes with this mixing pattern of two stratification periods and two turnover events are called **dimictic** lakes. In shallower lakes, the water column may mix from top to bottom most of the ice-free season with occasional stratification during periods of calm warm conditions. Lakes that mix frequently are termed **polymictic** lakes. In our cold climate, many shallow lakes are **cold monomictic** meaning a thermocline develops every winter, there is one turnover event in spring but the remainder of the ice free season the lake is polymictic.

DISSOLVED OXYGEN:

Oxygen enters a lake at the lake surface and throughout the water column when produced by photosynthesizing plants, including algae, in the lake. Oxygen is consumed within the lake by respiration of living organisms and decomposition of organic material in the lake sediments. In lakes that stratify (see temperature above), oxygen that dissolves into the lake at the surface cannot mix downward into the hypolimnion. At the same time oxygen is depleted in the hypolimnion by decomposition. The result is that the hypolimnion of a lake can become **anoxic**, meaning it contains little or no dissolved oxygen. When a lake is frozen, the entire water column can become anoxic because the surface is sealed off from the atmosphere. Winter anoxic conditions can result in a fish-kill which is particularly common during harsh winters with extended ice-cover. Alberta Surface Water Quality Guidelines suggest dissolved oxygen concentrations (in the epilimnion) must not decline below 5 $mg \bullet L^{-1}$ and should not average less than 6.5 $mg \bullet L^{-1}$ over a seven-day period. However, the guidelines also require that dissolved oxygen concentrations remain above 9.5 $mg \bullet L^{-1}$ in areas where early life stages of aquatic biota, particularly fish, are present.

GENERAL WATER CHEMISTRY:

Water in lakes always contains substances that have been transported by rain and snow or have entered the lake in groundwater and inflow streams. These substances may be dissolved in the water or suspended as particles. Some of these substances are familiar minerals, such as sodium and chloride, which when combined form table salt, but when dissolved in water separate into the two electrically charged components called **ions**. Most dissolved substances in water are in ionic forms and are held in solution due to the polar nature of the water molecule. **Hydrophobic** (water-fearing) compounds such as oils contain little or no ionic character, are non-polar and for this reason do not readily dissolve in water. Although hydrophobic compounds do not readily dissolve, they can still be transported to lakes by flowing water. Within individual lakes, ion concentrations vary from year to year depending on the amount and mineral content of the water entering the lake. This mineral content can be influenced by the amount of precipitation and other climate variables as well as human activities such as fertilizer and road salt application.

PHOSPHORUS AND NITROGEN:

Phosphorus and nitrogen are important nutrients limiting the growth of algae in Alberta lakes. While nitrogen usually limits agricultural plants, phosphorus is usually in shortest supply in lakes. Even a slight increase of phosphorus in a lake can, given the right conditions, promote algal blooms causing the water to turn green in the summer and impair recreational uses. When pollution originating from livestock manure and human sewage enters lakes not only are the concentrations of phosphorus and nitrogen increased but nitrogen can become a limiting nutrient which is thought to cause blooms of toxic algae belonging to the cyanobacteria. Not all cyanobacteria are toxic, however, the blooms can form decomposing mats that smell and impair dissolved oxygen concentrations in the lake.

CHLOROPHYLL-*A*:

Chlorophyll *a* is a photosynthetic pigment that green plants, including algae, possess enabling them to convert the sun's energy to living material. Chlorophyll *a* can be easily extracted from algae in the laboratory. Consequently, chlorophyll *a* is a good estimate of the amount of algae in the water. Some highly productive lakes are dominated by larger aquatic plants rather than suspended algae. In these lakes, chlorophyll *a* and nutrient values taken from water samples do not include productivity from large aquatic plants. The result, in lakes like Chestermere which are dominated by larger plants known as macrophytes, can be a lower trophic state than if macrophyte biomass was included. Unfortunately, the productivity and nutrient cycling contributions of macrophytes are difficult to sample accurately and are therefore not typically included in trophic state indices.

SECCHI DISK TRANSPARENCY:

Lakes that are clear are more attractive for recreation, whereas those that are turbid or murky are considered by lake users to have poor water quality. A measure of the transparency or clarity of the water is performed with a Secchi disk with an alternating black and white pattern. To measure the clarity of the water, the Secchi disk is lowered down into the water column and the depth where the disk disappears is recorded. The Secchi depth in lakes with a lot of algal growth will be small while the Secchi depth in lakes with little algal growth can be very deep. However, low Secchi depths are not caused by algal growth alone. High concentrations of suspended sediments, particularly fine clays or glacial till, are common in plains or mountain reservoirs of Alberta. Mountain reservoirs may have exceedingly low Secchi depths despite low algal growth and nutrient concentrations.

The euphotic zone or the maximum depth that light can penetrate into the water column for actively growing plants is calculated as twice the Secchi depth. Murky waters, with shallow Secchi depths, can prevent aquatic plants from growing on the lake bottom. Conversely, aquatic plants can ensure lakes have clear water by reducing shoreline erosion and stabilizing lake bottom sediments. In Alberta, many lakes are shallow and bottom sediments contain high concentrations of nutrients. Without aquatic plants, water quality may decline in these lakes due to murky, sediment laden water and excessive algal blooms. Maintaining aquatic plants in certain areas of a lake is often essential for ensuring good water clarity and a healthy lake as many organisms, like aquatic invertebrates and insects, depend on aquatic plants for food and shelter.

TROPHIC STATE:

Trophic state is classification of lakes into four categories of fertility and is a useful index for rating and comparing lakes. From low to high nutrient and algal biomass (as chlorophyll) concentrations, the trophic states are; **oligotrophic**, **mesotrophic**, **eutrophic** and **hypereutrophic (Table 2)**.

A majority of lakes in Alberta contain naturally high levels of chlorophyll *a* (8 to 25 µg/L) due to our deep fertile soils. These lakes are usually considered fertile and are termed eutrophic. The nutrient and algal biomass concentrations that define these categories are shown in the following table, a figure of Alberta lakes compared by trophic state can be found on the ALMS website.

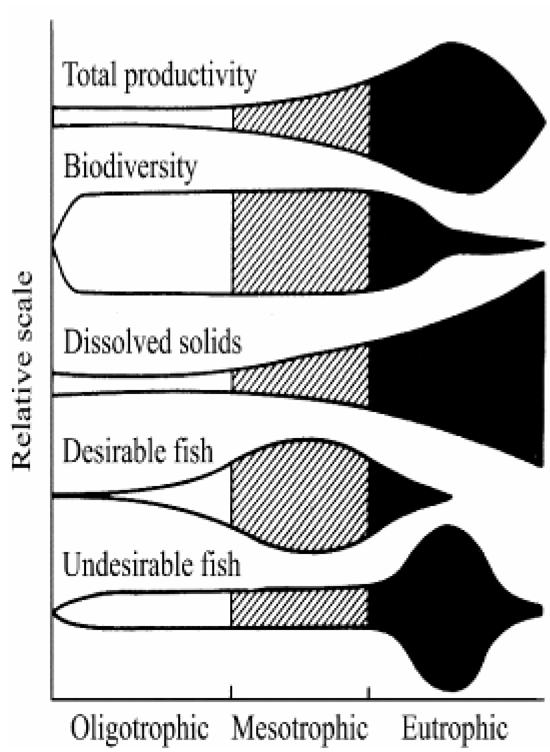

Figure B: Suggested changes in various lake characteristics with eutrophication. From “Ecological Effects of Wastewater”, 1980.

Table A - Trophic status classification based on lake water characteristics.

Trophic state	Total Phosphorus (µg•L^{-1})	Total Nitrogen (µg•L^{-1})	Chlorophyll a (µg•L^{-1})	Secchi Depth (m)
Oligotrophic	< 10	< 350	< 3.5	> 4
Mesotrophic	10 – 30	350 - 650	3.5 - 9	4 - 2
Eutrophic	30 – 100	650 - 1200	9 - 25	2 - 1
Hypereutrophic	> 100	> 1200	> 25	< 1