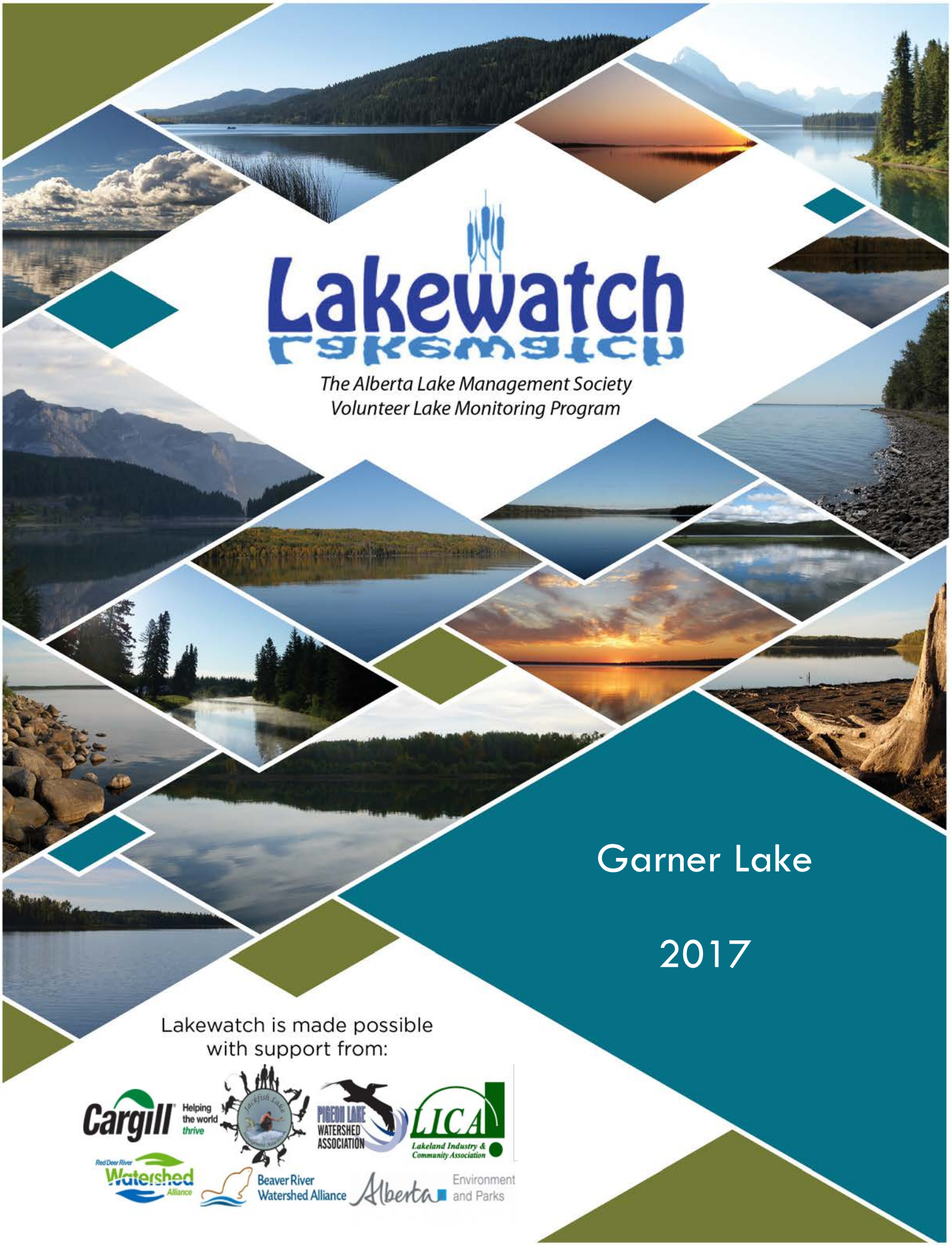

# Lakewatch

*The Alberta Lake Management Society*
*Volunteer Lake Monitoring Program*

## Garner Lake

## 2017

Lakewatch is made possible with support from:

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Red Deer River Watershed Alliance

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Alberta Environment and Parks

# 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.

ALMS is happy to discuss the results of this report with our stakeholders. If you would like information or a public presentation, contact us at info@alms.ca.

## ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Colin Hanusz for the time and energy put into sampling Garner Lake in 2017. We would also like to thank Elashia Young and Melissa Risto who were summer technicians in 2017. Executive Director Bradley Peter and LakeWatch Coordinator Laura Redmond was instrumental in planning and organizing the field program. This report was prepared by Laura Redmond and Bradley Peter. The Beaver River Watershed, the Lakeland Industry and Community Association, Environment Canada, and Alberta Environment and Parks are major sponsors of the LakeWatch program.

# Garner Lake

Garner Lake is a picturesque lake located 5 km north of Spedden, Alberta. Garner Lake Provincial Park is a popular place for camping, bird watching, berry picking and wildlife viewing. There is 5 km of hiking and biking trails in the summer and 6 km of ungroomed cross-country skiing trails in the winter at the Provincial Park. There is a boat launch at the park as well as a great beach for swimming. The lake supports sport fisheries for Northern pike, Perch and Walleye.

A calm day on Garner Lake, 2017 (Elashia Young)

Garner Lake is located in the boreal forest in the Dry Mixedwood/ Central Mixedwood subregion region. Native vegetation in this region consist of trembling aspen as well as balsam poplar, birch, white spruce, alder and willow. The watershed is around 26 $km^2$ and the watershed:lake ratio is around 4:1 (Atlas of Alberta Lakes). Much of the watershed is cleared for agriculture, with grazing activity near the shoreline. External loading of phosphorus into Garner Lake is historically high and predominantly sourced from agricultural runoff (Atlas of Alberta Lakes).

Garner Lake is productive during the summer months and is often issued with blue-green algae (cyanobacteria) advisories by Alberta Health Services during peak bloom season.
The lake was named after George C. Garner in 1904 after he began homesteading nearby. Traditionally, the lake is named Hollow Lake by local First Nations (Alta. Rec. Parks n.d.). Soon after the arrival of the Garner family, the town of Spedden was established in 1912. The Alberta government reserved a large area for public recreation, and in 1953, the reserve became Garner Lake Provincial Park (Alta. Mun. Aff. 1982).

University of Alberta - Atlas of Alberta Lakes. "Garner Lake". Archived from the original on 2009-05-23. Retrieved 2017-10-31.

Alberta Recreation and Parks. N.d. Unpublished data. Edmonton.

Alberta Municipal Affairs. 1982. Garner Lake management study. Prep. for Co. St. Paul and Co. Smoky Lake by Alta. Mun. Aff., Plan. Serv. Div., Plan. Br., Edmonton.

# METHODS

***Profiles:*** Profile data is measured at the deepest spot in the main basin of the lake. At the profile site, temperature, dissolved oxygen, pH, conductivity and redox potential are measured at 0.5- 1.0 m intervals. Additionally, Secchi depth is measured at the profile site and used to calculate the euphotic zone. On one visit per season, metals are collected at the profile site by hand grab from the surface and at some lakes, 1 m off bottom using a Kemmerer.

***Composite samples:*** At 10-sites across the lake, water is collected from the euphotic zone and combined across sites into one composite sample. This water is collected for analysis of water chemistry, chlorophyll-a, nutrients and microcystin. Quality control (QC) data for total phosphorus was taken as a duplicate true split on one sampling date. ALMS uses the following accredited labs for analysis: Routine water chemistry and nutrients are analyzed by Maxxam Analytics, chlorophyll-*a* and metals are analyzed by Alberta Innovates Technology Futures (AITF), and microcystin is analyzed by the Alberta Centre for Toxicology (ACTF). In lakes where mercury samples are taken, they are analyzed by the Biogeochemical Analytical Service Laboratory (BASL).

***Invasive Species:*** Monitoring for invasive quagga and zebra mussels involved two components: monitoring for juvenile mussel veligers using a 63 µm plankton net at three sample sites and monitoring for attached adult mussels using substrates installed at each lake.

***Data Storage and Analysis:*** Data is stored in the Water Data System (WDS), a module of the Environmental Management System (EMS) run by Alberta Environment and Parks (AEP). Data goes through a complete validation process by ALMS and AEP. Users should use caution when comparing historical data, as sampling and laboratory techniques have changed over time (e.g. detection limits). For more information on data storage, see AEP Surface Water Quality Data Reports at aep.alberta.ca/water.

Data analysis is done using the program R.[1] Data is reconfigured using packages tidyr [2] and dplyr [3] and figures are produced using the package ggplot2 [4]. Trophic status for each lake is classified based on lake water characteristics using values from Nurnberg (1996)[5]. The Canadian Council for Ministers of the Environment (CCME) guidelines for the Protection of Aquatic Life are used to compare heavy metals and dissolved oxygen measurements. Pearson's Correlation tests are used to examine relationships between TP, chlorophyll-*a,* TKN and Secchi depth, providing a correlation coefficient (r) to show the strength (0-1) and a p-value to assess significance of the relationship.

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[1] R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

[2] Wickman, H. and Henry, L. (2017). tidyr: Easily Tidy Data with 'spread ( )' and 'gather ( )' Functions. R package version 0.7.2. https://CRAN.R-project.org/package=tidyr.

[3] Wickman, H., Francois, R., Henry, L. and Muller, K. (2017). dplyr: A Grammar of Data Manipulation. R package version 0.7.4. http://CRAN.R-project.org/package=dplyr.

[4] Wickham, H. (2009). ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York.

[5] Nurnberg, G.K. (1996). Trophic state of clear and colored, soft- and hardwater lakes with special consideration of nutrients, anoxia, phytoplankton and fish. Lake and Reservoir Management 12: 432-447.

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 Garner Lake was 113 µg/L (Table 2), falling into the hypereutrophic, or very productive trophic classification. TP was highest on July 27, with a concentration of 130 µg/L. Since only two sampling trips were conducted and both were during the warmest period of summer, averages may be skewed high.

Average chlorophyll-*a* concentration in 2017 was 88.4 µg/L (Table 2), also putting Garner Lake into the hypereutrophic classification. Chlorophyll-*a* concentration on July 27 was 120 µg/L.

Finally, average total Kjeldahl nitrogen (TKN) concentration was 3.15 mg/L (Table 2), and concentrations were highest on the first trip on July 27.

Average pH was measured as 9.21 in 2017, buffered by moderate-high alkalinity (650 mg/L $CaCO_3$) and bicarbonate (560 mg/L $HCO_3$). Sulphate and sodium were the dominant ions contributing to a high conductivity of 1400 µS/cm (Table 2).

# METALS

***Samples were analyzed for metals (Table 3). In total, 27 metals were sampled for. It should be noted that many metals are naturally present in aquatic environments due to the weathering of rocks and may only become toxic at higher levels.***

Metals were measured once at Garner Lake on August 29 at the surface. Arsenic was measured as above the recommended guideline measuring 25.9 µg/L. Aluminum and selenium also exceeded the CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life. In 2017, all other measured values fell within their respective guidelines (Table 3).

# 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 depth. Two times the Secchi depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.***

The average Secchi depth of Garner Lake in 2017 was 1.0 m (Table 2). Water clarity measured as Secchi depth was only measured twice, but may have been shallow given the high algal biomass on those sampling visits.

# 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.***

Temperatures of lakes vary throughout the summer, and Garner Lake had a maximum temperature of 22.5 °C measured at the surface on July 27 (Figure 1a). The lake was stratified on both sampling visits.

Garner Lake remained well oxygenated at the surface on both sampling visits, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 1b). During thermal stratification, oxygen levels decreased near the bottom due to separation from atmospheric oxygen that is circulated at the lake's surface. On July 27, the surface water was supersaturated with oxygen, likely due to increased photosynthetic activity by algae blooms.

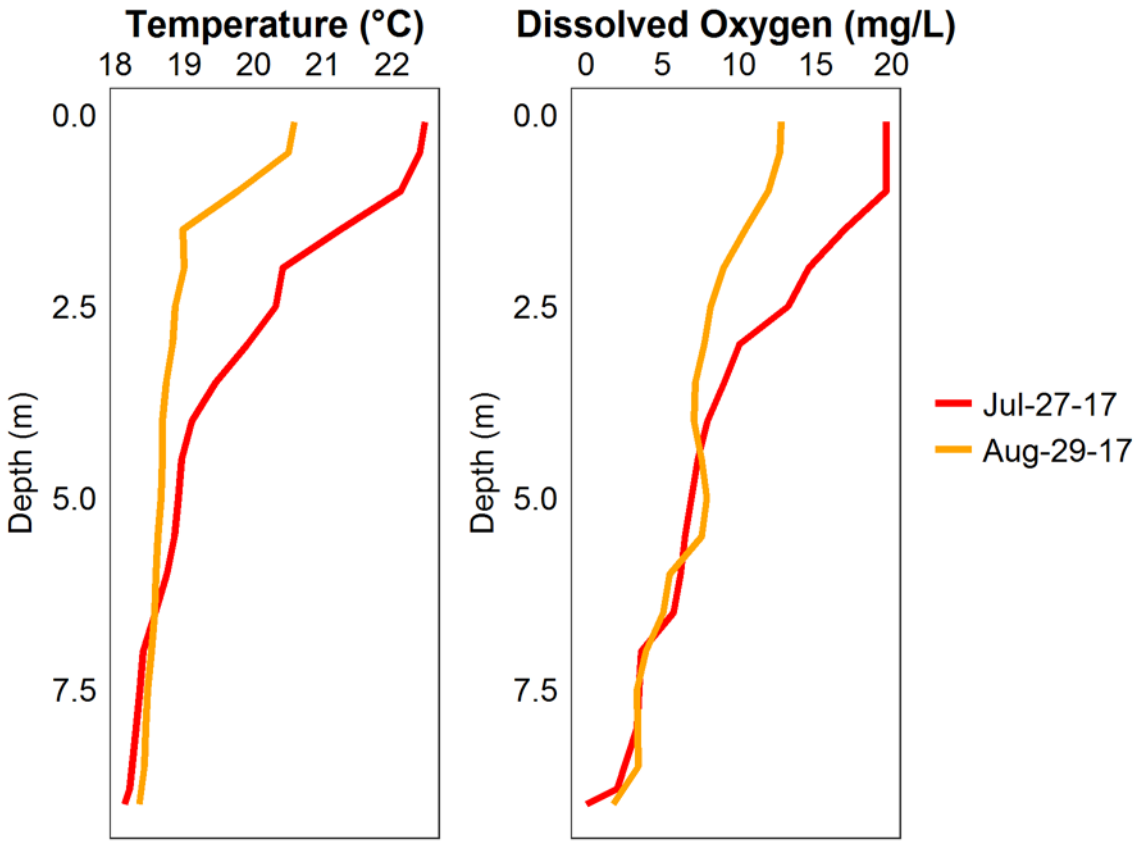


Figure 1– a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Garner Lake measured two times over the course of the summer of 2017

# MICROCYSTIN

***Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested, can cause severe liver damage. Microcystins are produced by many species of cyanobacteria which are common to Alberta's Lakes, and are thought to be the one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 20 µg/L. 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 Garner Lake exceeded the recreational guideline of 20 µg/L on August 29, and was high on July 27 (Table 1).

Table 1 – Microcystin concentrations measured two times at Garner Lake in 2017.

| Date | Microcystin Concentration (µg/L) |
|---|---|
| **Jul-27** | 13.09 |
| **Aug-29** | 24.97 |
| **Average** | 19.03 |

# INVASIVE SPECIES MONITORING

***Dreissenid mussels pose a significant concern for Alberta because they impair the function of water conveyance infrastructure and adversely impact the aquatic environment. These invasive mussels have been linked to creating toxic algae blooms, decreasing the amount of nutrients needed for fish and other native species, and causing millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities.***

Monitoring involved two components: monitoring for juvenile mussel veligers using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. No mussels have been detected in Garner Lake.

# 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. Up to date water levels data is not available for Garner Lake. Requests for water quantity monitoring should go through Alberta Environment and Parks Monitoring and Science division.***

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

| Parameter | Trip 1 | Trip 2 | Average |
|---|---|---|---|
| TP (µg/L) | 130 | 96 | 113 |
| TDP (µg/L) | 21 | 22 | 21.5 |
| Chlorophyll-*a* (µg/L) | 120 | 56.7 | 88.4 |
| Secchi depth (m) | 1.0 | 1.0 | 1.0 |
| TKN (mg/L) | 3.4 | 2.9 | 3.15 |
| $NO_2$-N and $NO_3$-N (µg/L) | 2.2 | 2.2 | 2.2 |
| $NH_3$-N (µg/L) | 69 | 79 | 74 |
| DOC (mg/L) | 33 | 33 | 33 |
| Ca (mg/L) | 18 | 20 | 19 |
| Mg (mg/L) | 110 | 120 | 115 |
| Na (mg/L) | 140 | 140 | 140 |
| K (mg/L) | 47 | 47 | 47 |
| $SO_4^{2-}$ (mg/L) | 180 | 180 | 180 |
| $Cl^-$ (mg/L) | 13 | 13 | 13 |
| $CO_3$ (mg/L) | 110 | 120 | 115 |
| $HCO_3$ (mg/L) | 570 | 550 | 560 |
| pH | 9.16 | 9.25 | 9.21 |
| Conductivity (µS/cm) | 1400 | 1400 | 1400 |
| Hardness (mg/L) | 510 | 530 | 520 |
| TDS (mg/L) | 910 | 920 | 915 |
| Microcystin (µg/L) | 13.09 | 24.97 | 19.03 |
| Total Alkalinity (mg/L $CaCO_3$) | 650 | 650 | 650 |

Table 3: Concentrations of metals measured in Garner Lake on Aug 29. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

| Metals (Total Recoverable) | 2017 | Guidelines |
|---|---|---|
| Aluminum µg/L | 122 | 100[a] |
| Antimony µg/L | 1.29 | / |
| Arsenic µg/L | 25.9 | 5 |
| Barium µg/L | 441 | / |
| Beryllium µg/L | 0.0055 | 100[c,d] |
| Bismuth µg/L | 0.0055 | / |
| Boron µg/L | 1130 | 1500 |
| Cadmium µg/L | 0.025 | 0.26[b] |
| Chromium µg/L | 0.25 | / |
| Cobalt µg/L | 0.976 | 1000[d] |
| Copper µg/L | 1.7 | 4[b] |
| Iron µg/L | 172 | 300 |
| Lead µg/L | 0.206 | 7[b] |
| Lithium µg/L | 589 | 2500[e] |
| Manganese µg/L | 26.9 | 200[e] |
| Molybdenum µg/L | 3.87 | 73[c] |
| Nickel µg/L | 3.3 | 150[b] |
| Selenium µg/L | 4.5 | 1 |
| Silver µg/L | 0.026 | 0.25 |
| Strontium µg/L | 2050 | / |
| Thallium µg/L | 0.005 | 0.8 |
| Thorium µg/L | 0.05 | / |
| Tin µg/L | 0.15 | / |
| Titanium µg/L | 10.1 | / |
| Uranium µg/L | 13.1 | 15 |
| Vanadium µg/L | 9.05 | 100[d,e] |
| Zinc µg/L | 8.1 | 30 |

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness > 180mg/L (as CaCO3 )
[c] CCME interim value.
[d] Based on CCME Guidelines for Agricultural use (Livestock Watering).
[e] Based on CCME Guidelines for Agricultural Use (Irrigation).
A forward slash (/) indicates an absence of data or guidelines.