Clear Lake (Bain) Data Report

Gavin Vance

28/02/2024

Report Overview

Clear Lake (Bain)

STN 6954

Clear Lake (Bain) has been monitored by Lake Partners from 2004 to 2023. During this time, water samples were collected in the spring for total phosphorus levels. Water clarity is sampled monthly using a Secchi disk. Calcium and chloride were included in the Lake Partner Program (LPP) in 2008 and 2015, respectively, and were sampled along with total phosphorus in the spring.

Purpose of the Lake Report

This report provides background information on Ontario's LPP and summarizes each of the four water quality indicators monitored as part of the program (*total phosphorus, calcium, chloride, and water clarity*).

Please note that Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake health. If you would like to know about other lake water quality indicators, check out these additional resources:

- Healthy Shorelines & Lake Stewardship (FOCA): https://foca.on.ca/shorelines-stewardship/

How to navigate the Lake Data Report

This report consists of 6 sub-reports, which you can access from tabs at the side of this page (*Report Overview*, *Total Phosphorus*, *Calcium*, *Chloride*, *Water Clarity*, *Background Information*). Currently, you are reading the *Report Overview* tab. This tab provides an overview of the report.

Move to other sections by scrolling down. The indicator-specific sections (*Total Phosphorus*, *Calcium*, *Chloride*, *Water Clarity*) contain basic information and data visualizations for each indicator. The *Background Information* section provides links to further reading.

This section also contains a map which can be seen below. This map shows your lake, where it is sampled, and available in Appendix A there is a table that summarizes indicator averages for the most recent 5-year period (only sites with at least 5 years worth of consistent data were included in this map).

Clear Lake (Bain)'s monitoring location and recent indicator averages

Figure 1. A map showing Clear Lake (Bain) and the location of the Lake Partner Program sampling sites. Past six year averages of the parameters for each site can be found in Appendix A. Sites with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2017-2023.

Total Phosphorus

What is total phosphorus?

Phosphorus is an essential element for aquatic systems and the organisms that inhabit them. Phosphorus is one of the many factors that control the growth of algae in Ontario lakes. Increases in phosphorus concentrations may enhance algal growth, resulting in decreased water clarity, and reduced deep-water oxygen concentrations. Elevated phosphorus concentrations make algal blooms more frequent, including blooms that detract from the visual character of the lake, form toxins, and/or affect taste or odour of the water. Determining the causes of individual algal blooms is not straightforward; however, understanding the factors that influence bloom formation is a topic of ongoing research in Ontario.

In the LPP, we measure *total phosphorus* (TP, all forms of phosphorus in the water sample).

Clear Lake (Bain) is located within the Ontario Shield ecozone. In the LPP, these "on-Shield" lakes are sampled once in the spring for TP. Lakes can be placed into three broad categories according to their TP concentrations. These categories of "lake trophic status" summarize the lake's overall biological productivity, are related to phytoplankton, abundance and water clarity, and are defined as follows:

- Lakes with less than 10 micrograms per litre (μg/L) of TP are **oligotrophic**. These lakes have low biologically productivity and tend to be deep, cold lakes.
- Lakes with TP between 10 and 20 µg/L are termed **mesotrophic** and have a medium level of biological production.
- Lakes over 20 μg/L are **eutrophic** and may exhibit persistent algal blooms due to the high levels of biological production.

For more information visit https://www.alberta.ca/water-indicators-lake-trophic-status

Clear Lake (Bain)'s average total phosphorus concentration.

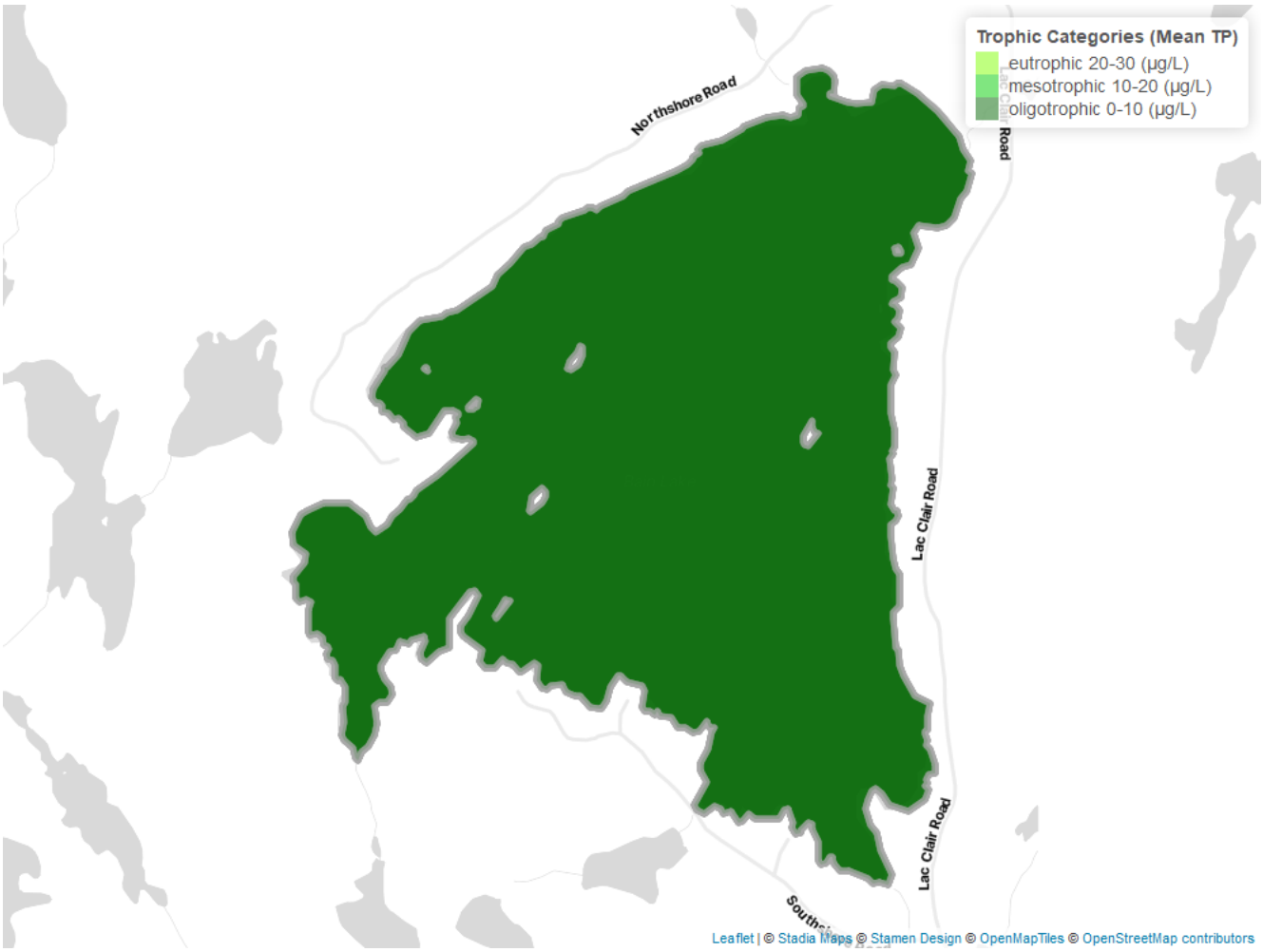

Figure 2. A map showing the trophic status of Clear Lake (Bain), which is colour coded according to trophic status (0-10 μg/L TP = oligotrophic; 10-20 μg/L = mesotrophic; and >20 μg/L = eutrophic). The TP concentrations represent ice-free averages from water samples taken in the spring and sampled within the last 10 years (2013-2023). Sites with insufficient data or with large gaps in data were excluded from analyses.

How does Clear Lake (Bain)'s TP compare to other on-Shield lakes in the LPP?

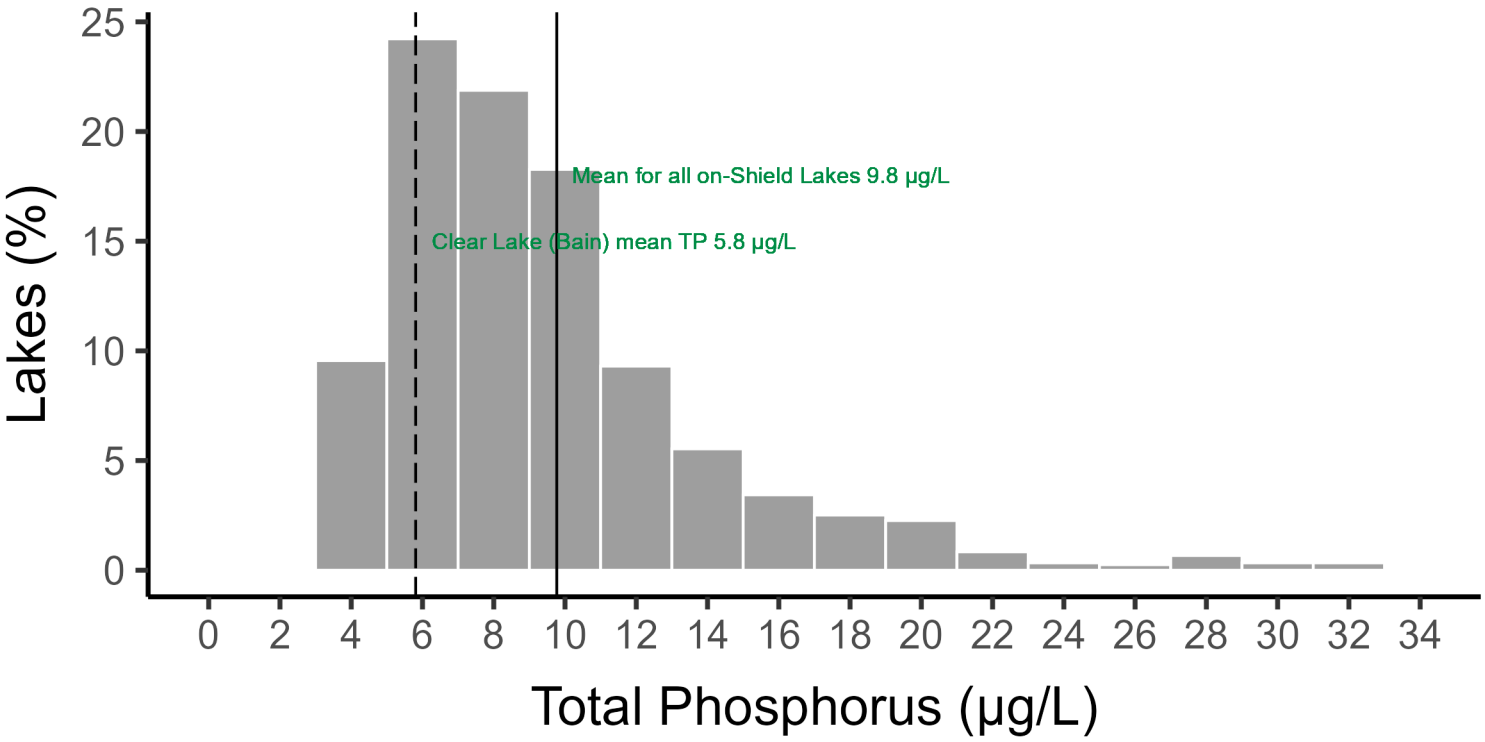

Figure 3. Histogram showing the distribution of average ice-free TP concentrations for 1200 lakes located on the Precambrian Shield, sampled as part of the Lake Partner Program between the years 2004-2023. The dashed line represents Clear Lake (Bain)'s spring average TP concentration for the years 2004-2023 (5.8 μg/L). The solid black line represents the ice-free spring average TP concentration of all LPP lakes located on the Precambrian Shield from 2002-2023 (9.8 μg/L). Most lakes are less than the Provincial Water Quality Objective of 20 μg/L. For more information on this objective please visit the link at the bottom of this page.

Summary: Clear Lake (Bain)'s compared to other on-Shield lakes

- The average TP concentrations for Clear Lake (Bain) between 2004 and 2023 is 5.8 μg/L.
- Clear Lake (Bain) falls into the seventeeth percentile of TP concentrations in on-Shield lakes monitored by LPP volunteers. This means that 83 percent of lakes have higher TP concentrations than Clear Lake (Bain).
- The mean TP concentration of Clear Lake (Bain) is below the Provincial Water Quality Objective of 20 μg/L.

What does Clear Lake (Bain)'s annual total phosphorus concentration look like over time?

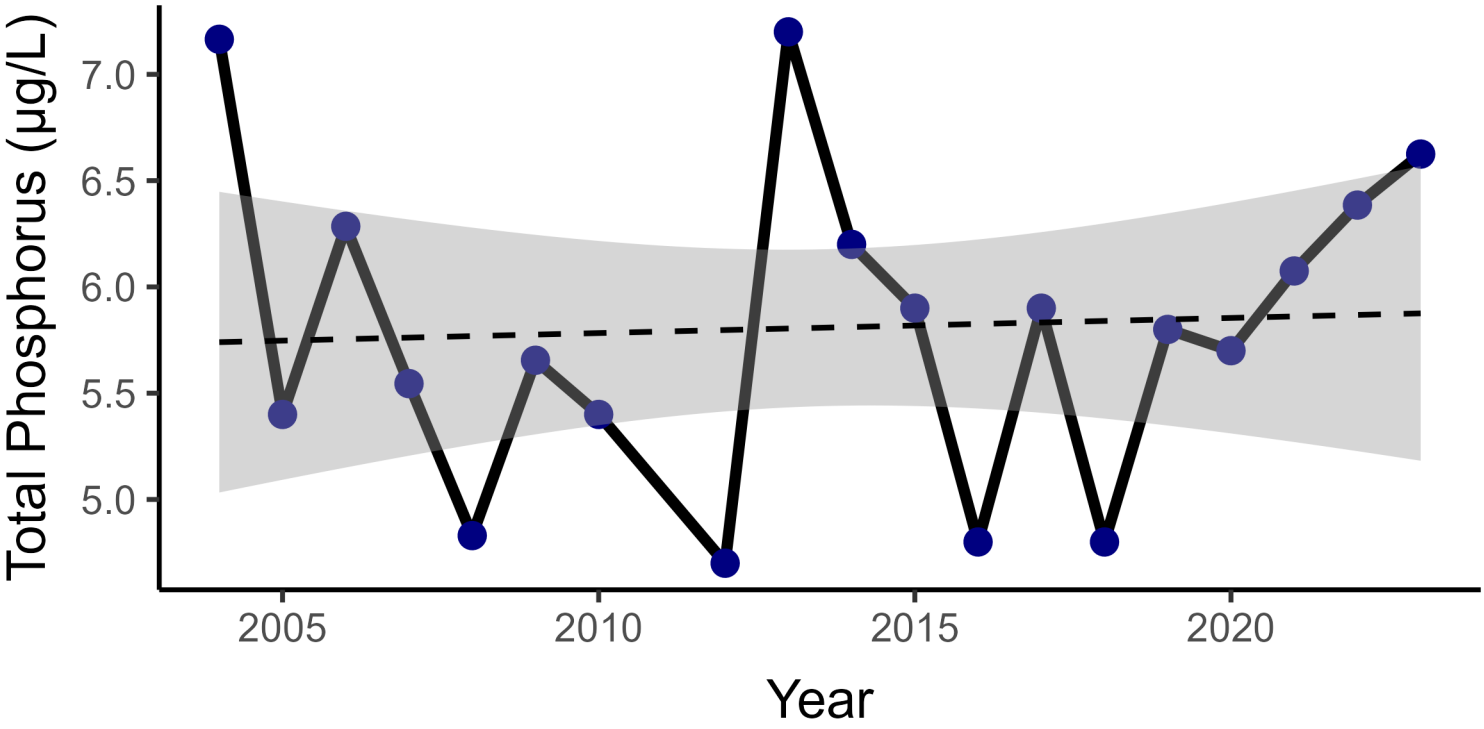

Figure 4. In general, the overall trend in TP concentrations of Clear Lake (Bain) have increased over time, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 0.5 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The blue points represent the average ice-free spring TP concentration for each year. The dotted line represents a linear model representing the overall trend over time. The shaded area represents the range of values within which we are 95% confident the true TP concentration lies. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the Lake Partner Program can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Clear Lake (Bain)'s total phosphorus trends over time

- This lake is a low production oligotrophic lake.
- Between 2004 and 2023 phosphorus concentrations in Clear Lake (Bain) had no significant statistical change.
- The approximate annual decrease was -0.03 μg/L. During this time TP concentrations fluctuated between 4.7 (μg/L) in 2012 to 7.2 (μg/L) in 2013.

Additional Information:

Provincial Water Quality Objective Information https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives

---

Calcium

What is calcium?

Calcium (Ca) occurs naturally in soils as a result of weathering of rocks and atmospheric deposition. Ca concentrations in many of Ontario's lakes within the Precambrian Shield have decreased over the last 40 years as a result of acid precipitation and deforestation, which have depleted watershed stores of Ca.

Ca is an important nutrient to many lake-dwelling organisms, such as mollusks, clams, amphipods, and crayfish. Daphnia, commonly referred to as water fleas, are an important food source for fish and are susceptible to decreasing calcium levels. Laboratory research has shown that the growth and reproduction of sensitive Daphnia species may be negatively affected at Ca concentrations below 1.5 mg/L.

The LPP began monitoring Ca concentrations in lake water samples in 2008 to observe trends and identify lakes that were experiencing changes in lake Ca concentrations.

Clear Lake (Bain)'s calcium concentrations compared to other on-Shield lakes

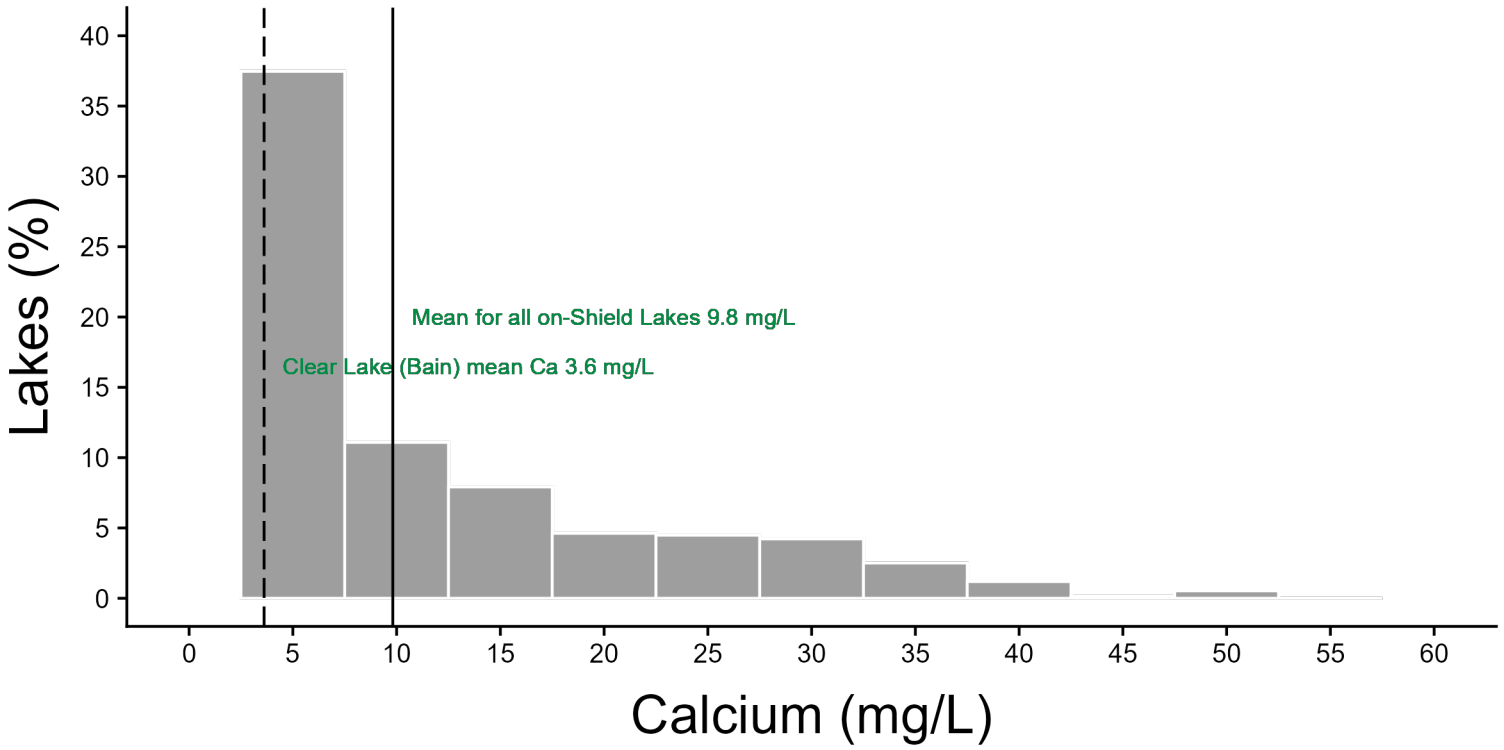

Figure 5. Histogram showing the distribution of ice-free spring average Ca concentrations for 762 lakes located on the Precambrian Shield sampled as part of the Lake Partner Program between the years 2015-2023 (3.6 mg/L). The solid black line represents the ice-free average calicum concetration of all LPP lakes located off the Precambrian Shield from 2008-2023 (9.8 mg/L). The level at which some aquatic animals (mainly, some Daphnia) become at risk of Ca deficiency is 1.5 mg/L.

Summary: Clear Lake (Bain)'s compared to other on-Shield lakes

- The average Ca concentration between 2015 and 2023 is 3.6 mg/L.
- Clear Lake (Bain) falls into the forty-second percentile of Ca concentrations in on-Shield lakes. This means that 58 percent of lakes have higher Ca concentrations than Clear Lake (Bain).
- Ca in Clear Lake (Bain) is well above the threshold in which sensitive aquatic species may be at risk (1.5 mg/L).

What do Clear Lake (Bain)'s calcium concentrations look like over time?

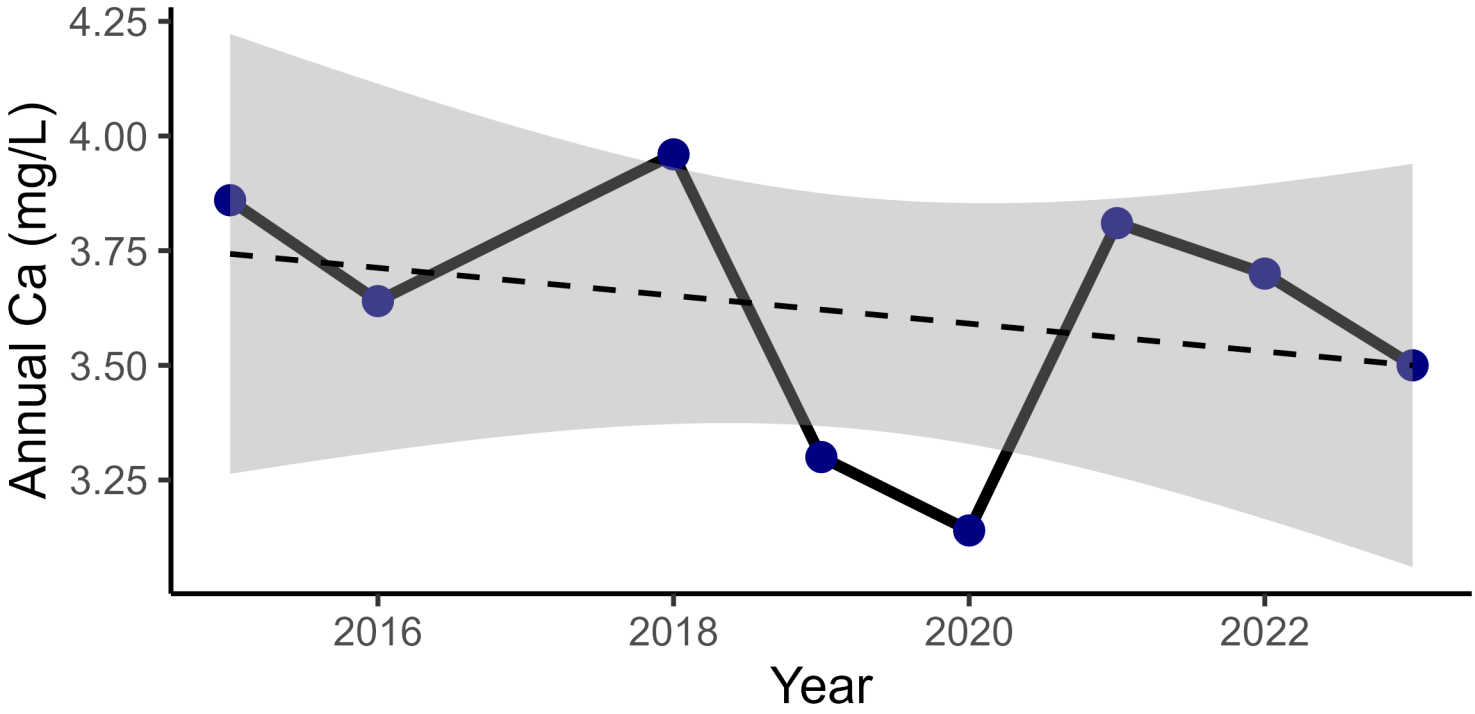

Figure 6. Ca concentrations in Clear Lake (Bain) decreased overtime, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 1.0 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The shaded area represents the range of values within which we are 95% confident the true total calcium lies. All samples were taken shortly after the ice-free period of each season. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Clear Lake (Bain)'s calcium trends over time

- Between 2015 and 2023 Ca concentrations in Clear Lake (Bain) had no significant statistical change.
- The approximate annual decrease was -0.04 mg/L. During this time Ca concentrations fluctuated between 3.1 mg/L in 2020 to 4.0 mg/L in 2018.

Chloride

What is chloride?

Freshwater lakes and rivers naturally contain low concentrations of dissolved salts including chloride (Cl). Cl is an essential element in freshwater lake ecosystems, but elevated concentrations are toxic to aquatic organisms. In North America, sodium chloride (NaCl) or magnesium chloride (MgCl) are salts often used to manage roads in the winter months. These molecules are highly soluble and mobile, meaning that they can easily enter lake watersheds and subsequently, lakes.

Cl concentrations have risen in recent years in Ontario lakes located near roads due to road salt, which is used to de-ice roads and other surfaces. Aquatic organisms, such as some types of zooplankton, are particularly sensitive to chloride.

The Canadian Council for Ministers of the Environment (CCME) have published a guideline of 120 mg/L for the protection of aquatic life to chronic Cl exposure. However, recent research has demonstrated that Cl levels well below 120 mg/L can have negative effects on sensitive organisms in freshwater lakes, specifically those with low nutrient and Ca levels (Arnott et al. (2020)).

Clear Lake (Bain)'s chloride concentrations compared to other on-Shield lakes?

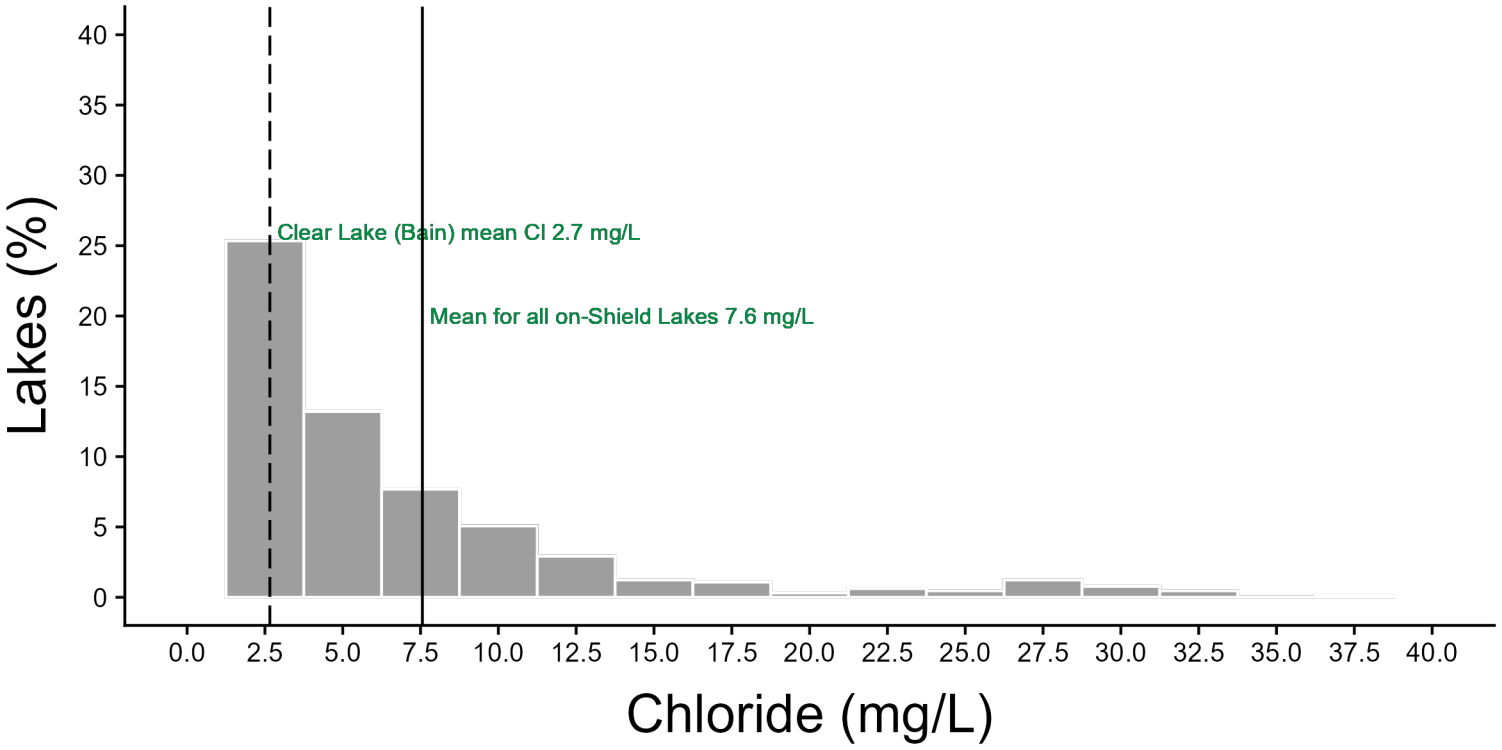

Figure 7. Histogram showing the distribution of ice-free spring average Cl concentrations for 675 lakes located on the Precambrian Shield sampled as part of the Lake Partner Program between the years 2016-2023. The dashed line represents Clear Lake (Bain)'s spring average ice-free Cl concentration for the years 2016 to 2023 (2.7 mg/L). The solid black line represents the ice-free average Cl concentrations of all LPP lakes located off the Precambrian Shield (7.6 mg/L). All lakes in this data set fall below the Canadian Water Quality Guideline for the Protection of Aquatic Life of 120 mg/L Cl.

Takeaways from Clear Lake (Bain)'s comparison to other on-Shield lakes:

- The average Cl concentration between 2016 and 2023 is 2.7 mg/L.
- Clear Lake (Bain) falls into the fifty-sixth percentile of Cl concentrations in on-Shield lakes. This means that 44 percent of lakes have higher Cl concentrations than Clear Lake (Bain).

What are Clear Lake (Bain)'s chloride concentrations look like over time?

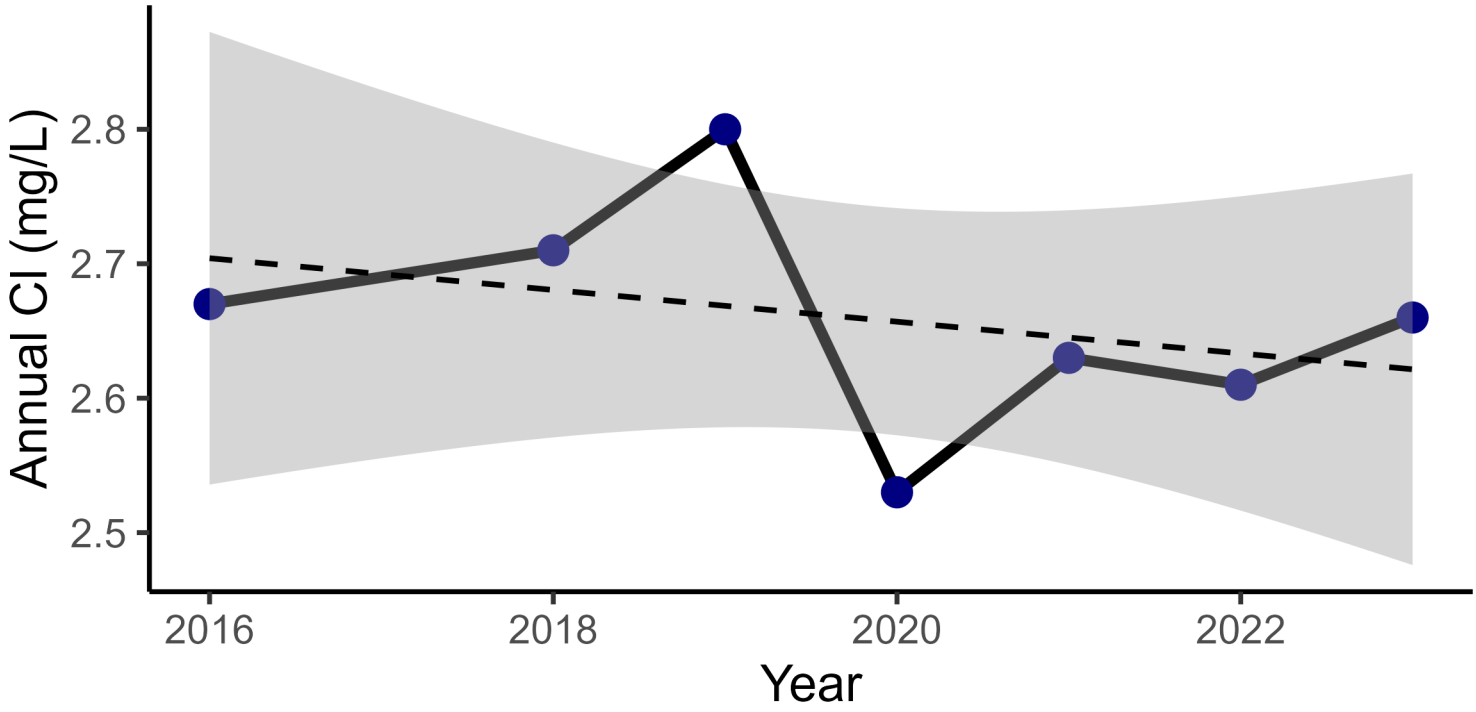

Figure 8. Cl concentrations in Clear Lake (Bain) decreased overtime, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 0.5 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The shaded area represents the range of values within which we are 95% confident the true total chloride lies. All samples were taken shortly after ice-off of each season. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Clear Lake (Bain)'s chloride trends over time

- Between 2016 and 2023 Cl concentrations in Clear Lake (Bain) had no significant statistical change.
- The approximate annual decrease was -0.001 mg/L. During this time Cl concentrations fluctuated between 2.5 mg/L in 2020 to 2.8 mg/L in 2019.

Arnott, S. E., Greco, D. A., Fournier, I. B., Schamp, B. S.(2021). Effects of chloride and nutrients on freshwater plankton communities. Limnology and Oceanography Letters, (8), 48-55. doi: 10.1002/lol2.10202

The LPP measures water quality in inland lakes across Ontario. The data are collected through volunteer monitoring efforts. You can download the data set used in this analysis by visiting the Ontario Open Data Catalog at https://data.ontario.ca/dataset/ontario-lake-partner

---

Water Clarity

What is Secchi Depth?

LPP volunteers track the water clarity of their lake by measuring how deep into the water a Secchi disk can be submerged before disappearing from sight. Light penetration into the lake can be controlled by dissolved organic carbon (DOC), biological turbidity (e.g. algae) and non-biological turbidity, which can influence the colour of the lake.

Water clarity readings with a Secchi disk are valuable for tracking change in lake transparency that may not be observed by monitoring TP concentrations alone. For example invasive species (e.g., zebra mussels) can alter water transparency, as can the presence of wetlands in a watershed.

Clear Lake (Bain)'s water clarity compared to other on-Shield lakes

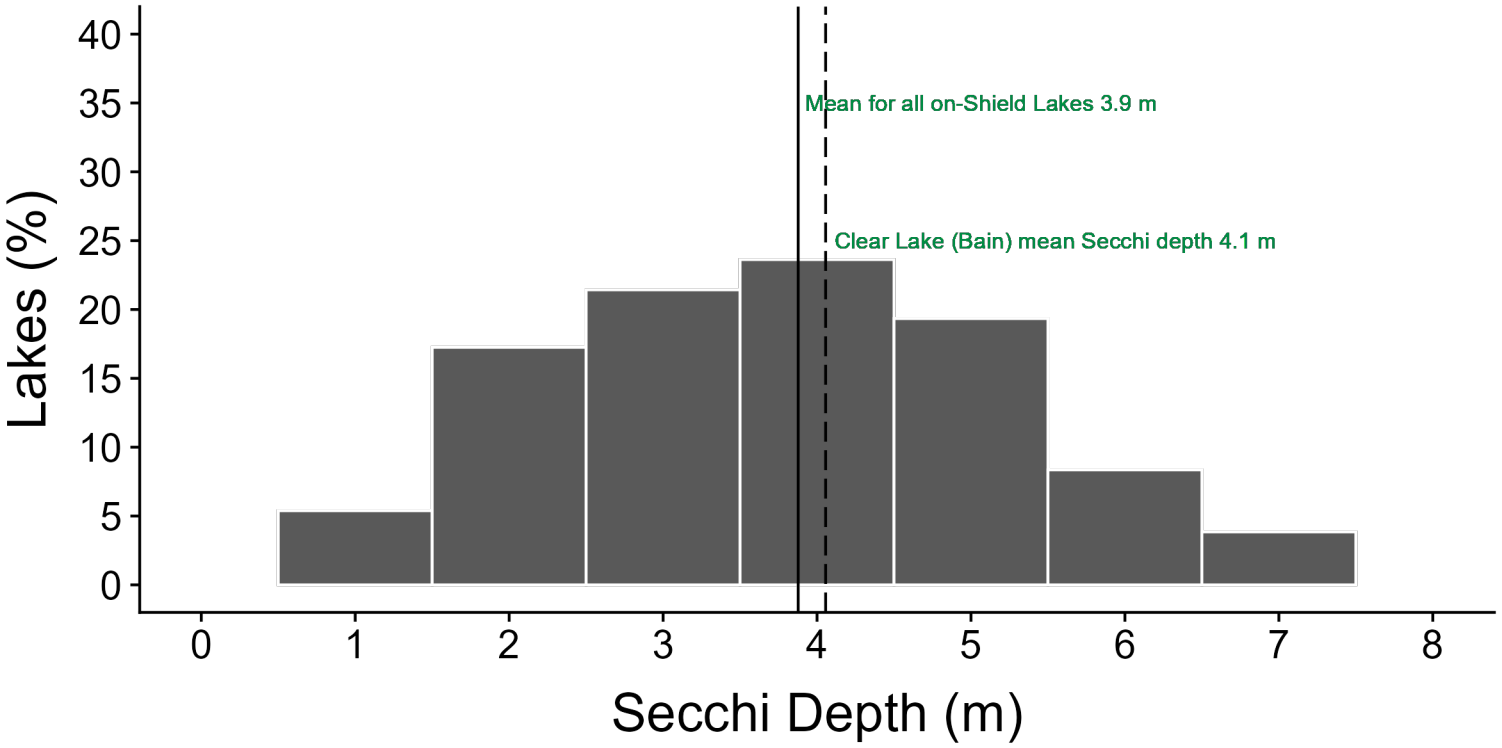

Figure 9. Histogram showing the distribution of Secchi depths (measured with a Secchi disk, Secchi depth is used as a representative of water clarity) for 923 Lake Partner Program Lakes for years 1998-2018 (4.1 m). The solid line represents the average Secchi depth of all LPP lakes located on the Precambrian Shield (3.9 m). Note that Secchi depth averages for each lake were calculated using data collected in July-September, as previous research has shown that these are the most stable months for inland lake water clarity and hence, are suitable for making comparisons among lakes (MECP, unpublished data; Bruhn & Soranno (2005)).

Summary: Clear Lake (Bain)'s water clarity compared to other on-Shield lakes

- The average Secchi depths between 1998 and 2018 is 4.1 m.
- Clear Lake (Bain) falls into the fifty-sixth percentile of Secchi depth on-Shield lakes in the LPP. This means that 44 percent of lakes have higher Secchi depth's than Clear Lake (Bain).

What does Clear Lake (Bain)'s Secch depth look like over time?

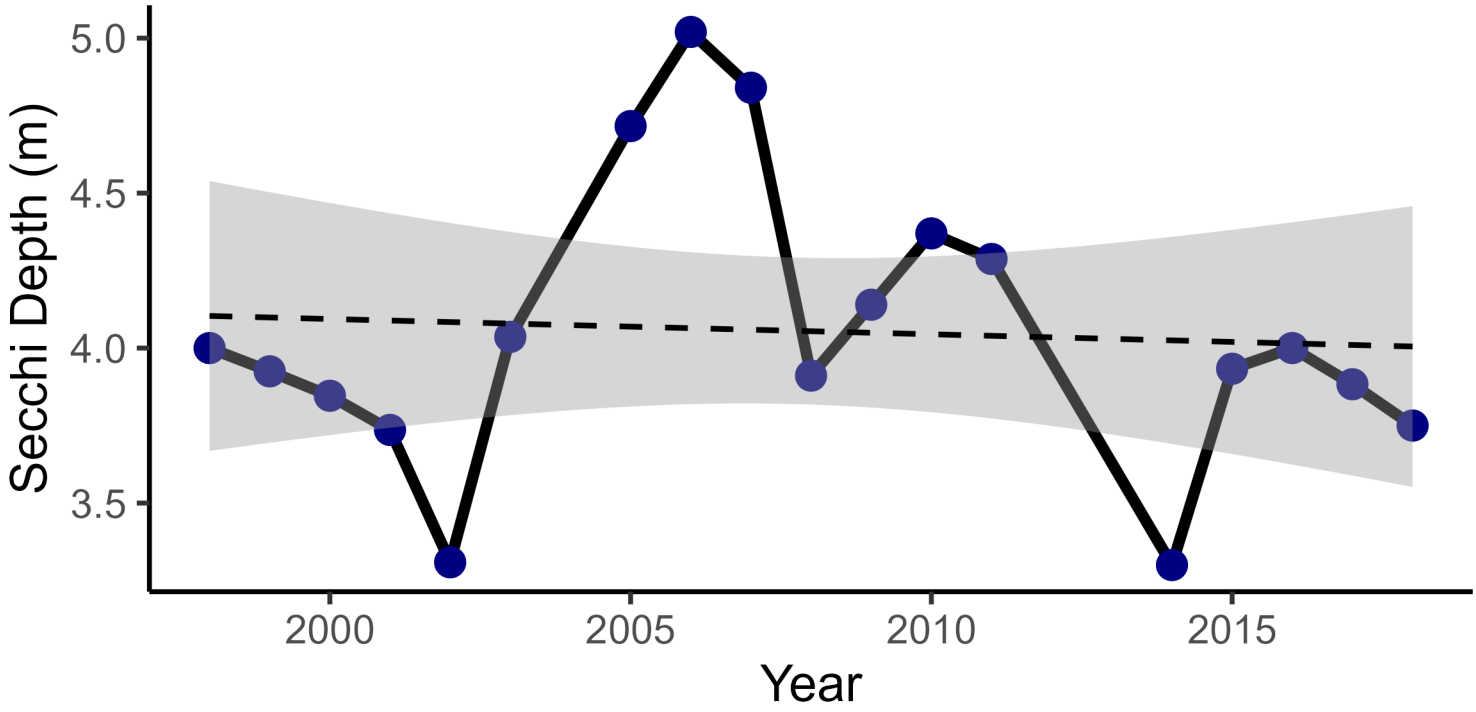

Figure 10. Water clarity (as measured with a Secchi disk) in Clear Lake (Bain) have increased over time, but this change was not significant. This was determined using a Mann-Kendall trend test, which provided a p-value of 0.8 (a p-value indicates the likelihood of a trend, with a p-value of less than 0.05 providing strong evidence that there is a trend). The blue points represent the average Secchi depths for July-September of each year. The dotted line represents a linear model representing the overall trend over time. The shaded area represents the range of values within which we are 95% confident the true Secchi depth lies. Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake health. All samples taken during ice-free season of each year (May-October). Please note: Ontario's inland lakes are complex ecosystems, and many factors beyond the indicators monitored by the LPP can affect lake water quality. The trends shown here are meant to provide general information only and may not capture the full complexity of the lake's water chemistry.

Summary: Trends in Clear Lake (Bain)'s annual water clarity:

- Between 1998 and 2018 water clarity levels in Clear Lake (Bain) had no significant statistical change.
- The approximate annual decrease was -0.01 m. During this time water clarity levels fluctuated between 3.3 m in 2014 to 5.0 m in 2006.

Bruhn, L. C., Soranno, P. A. (2005). Long Term (1974-2001) Volunteer Monitoring of Water Clarity Trends in Michigan Lakes and Their Relative Ecoregion and Land Use/Cover. Lake and Reservoir Management, 21, (10-23).

The LPP measures water quality in inland lakes across Ontario. The data are collected through volunteer monitoring efforts. You can download the data set used in this analysis by visiting the Ontario Open Data Catalog at https://data.ontario.ca/dataset/ontario-lake-partner

---

Background Info

History of the Lake Partner Program

The LPP is a volunteer-based, inland lakes water quality monitoring program in Ontario. The LPP enables lake stewards to monitor total phosphorus, calcium, chloride, and water clarity. LPP volunteers begin sampling each spring approximately two weeks after the lake ice has melted. Water samples are collected once per year for lakes located on the Precambrian Shield (representing about 90% of lakes in the program) and approximately six times per year for lakes located off the Precambrian Shield. Secchi disk measurements are made at least monthly throughout the sampling season (May-October). All data is posted online to the https://data.ontario.ca/dataset/ontario-lake-partner.

The LPP began in 1996. The program evolved from the Ministry's Self-Help Program, which collected information on chlorophyll and water clarity since the early 1970s. In 2002, the LPP relocated from Toronto to the Dorset Environmental Science Centre in Muskoka, where low-level total phosphorus analyses could be completed. The program continued to grow throughout the 2000s as the number of volunteers increased.

The LPP has partnered with the Federation of Ontario Cottagers' Associations (FOCA) since the start of the program in 1996. Through this partnership, FOCA's Lake Stewards are volunteer samplers, and FOCA provides outreach and stewardship to Ontario's lakefront communities and distributes water quality information to the public through their website, presentations, and email communications.

Federation of Ontario Cottagers' Associations

The Federation of Ontario Cottagers' Associations (FOCA) is a not-for-profit membership organization that has been the voice of the Ontario waterfront since 1963. Today, FOCA has over 525 lake, road and residents' association members, representing 50,000 waterfront property owning families across the province. FOCA's Lake Stewards contribute hundreds of water quality data points each year to the Lake Partner Program.

If you would like more information about what you can do, visit the FOCA webpage for resources on shoreline management, invasive species, and lake health management. Learn more: https://foca.on.ca/lake-partner-program/

Why water monitoring is crucial

None of the information or data in this report would be possible without the monitoring of fresh water lakes across Ontario by the volunteers in the LPP. Monitoring of freshwater lakes is a key to understanding lake health and maintaining healthy lakes across Ontario. To learn more about citizen science and the importance of water monitoring, download FOCA's Guide; visit this https://foca.on.ca/wp-content/uploads/2018/02/FOCA-Citizen-Science-Guide-PRINT-2021ADJ_REVfinal.pdf

How to contact us

For any questions about the report you can reach out to the lakepartner@ontario.ca email address or call us at 1-800-832-8700.

Other Resources

Smart about winter salt use: https://www.muskokawatershed.org/blog/reduce-road-salt/

Appendix A

Past six year averages of the parameters for each site on Clear Lake (Bain) can be seen in the table below. Sites with insufficient data were excluded from this analysis. All data were collected by Lake Partner volunteers from 2017-2023.

STN	Site	Lake Name	Shield	Total Phosphorus (g/L)	Calcium (mg/L)	Chloride (mg/L)	Secchi Depth (m)
6954	3	CLEAR LAKE (BAIN)	TRUE	5.9	3.57	2.66	NA