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REPORT

Wizard Lake Watershed and Lake Stewardship Association

Water Quality Summary for Wizard Lake

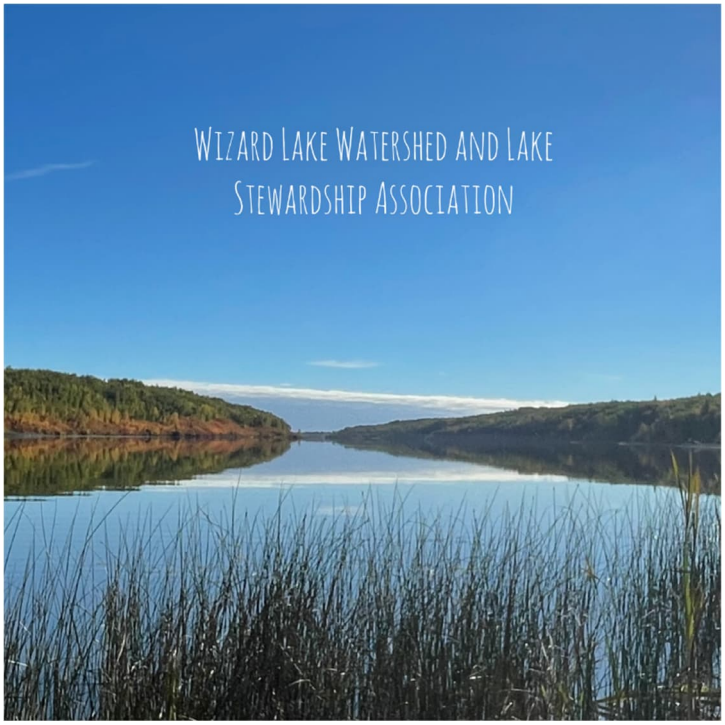

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TABLE OF CONTENTS

SECTION PAGE NO.
Table of Contents i
List of Tables i
List of Figures i
1 Introduction 1
2 Summary of Winter LakeKeepers and LakeWatch Data 2
2.1 What Was Measured 2
2.2 Water Quality Results for Wizard Lake 3
3 Tributary Sampling Program 6
3.1 What Sampling Was Completed 6
3.2 Sampling Locations 7
3.3 How Data in 2025 Compare to Previous Years 9
3.4 Flow Rates 12
4 Algae Data 13
4.1 What Was Collected and Why 13
4.2 Results 13
5 Summary and Recommendations 15
5.1 Winter LakeKeepers and LakeWatch 15
5.2 Tributaries 15
5.3 Algae 15
5.4 Summary 15
Closure
References
Appendix A – Wizard Lake Flyer

LIST OF TABLES

PAGE NO.
Table 3-1 Tributary Sampling Locations and Dates 6
Table 3-2 Parameters Tested in Tributaries 7
Table 3-3 Wizard Lake Flow Rates, April 9, 2025 13

LIST OF FIGURES

PAGE NO.
Figure 3-1 Watersheds for Tributary Sampling Locations 8
Figure 3-2 Total Phosphorus Concentrations in Wizard Lake Watershed 10
Figure 3-3 Dissolved Phosphorus Concentrations in Wizard Lake Watershed 10
Figure 3-4 Total Ammonia Concentrations in Wizard Lake Watershed 11
Figure 3-5 *E. coli* Concentrations in Wizard Lake Watershed 12
Figure 4-1 Cyanobacteria and Microcystin in Wizard Lake 2014–2024 14

1 INTRODUCTION

The Wizard Lake Watershed and Lake Stewardship Association (WLWLSA) was created in 2006 by community members living near Wizard Lake who were interested in stewardship of the lake. In 2021, the WLWLSA retained Associated Environmental Consultants Inc. (Associated) to summarize available information (up to 2020) to better understand the aquatic health of Wizard Lake and its associated watershed (Associated 2021). This information included scientific papers, reports, and the water quality data collected by WLWLSA and the Alberta Lake Management Society (ALMS). Included within ALMS is the Winter LakeKeepers and LakeWatch programs.[1] This exercise was repeated as more data became available, and in 2022, Associated issued a report on the aquatic health of Wizard Lake (Associated 2022). In that report, Associated made the following recommendations:[2]

- Collect another 2 years of water quality data from all sampling locations to better understand trends over time and various spring melt conditions.
- Consider testing water samples for an additional parameter, orthophosphate, which is the more bioavailable form of phosphorus.
- Tributary data showed that the area between sampling points Tributary A and Tributary B was contributing nutrients to Wizard Lake. If certain changes are made in this area, such as wetland restoration or erosion and sediment control, WLWLSA should collect additional samples at the same locations after making those changes to track potential improvements in water quality.
- Consider testing samples for *Enterococcus* during the warmer months (June through September), when people are more likely to be swimming in the lake and would therefore be exposed to fecal contamination.

In May 2025, WLWLSA again retained Associated to provide an update to the previous reports (Associated 2021, 2022), with the goal of evaluating the current aquatic health of Wizard Lake. The previous reports data (i.e., 2007–2022) was updated with new information acquired from 2022–2025.

In preparing this report, Associated completed the following:

- Summarized data from the recent Winter LakeKeepers (2022–2023 and 2023–2024) and LakeWatch program (2022 and 2024) reports as it pertains to Wizard Lake (**Section 2.0**);
- Analyzed and summarized existing water quality data for the tributaries of Wizard Lake (2007–2025), collected by WLWLSA (**Section 3.0**); and
- Evaluated how the water quality results in Wizard Lake relate to available information on algae (**Section 4.0**).

[1] The Winter LakeKeepers and LakeWatch programs are citizen-based volunteer programs led by ALMS to better understand ecology and lake health in the area.
[2] Associated made two additional recommendations for the Winter LakeKeepers data; however, because Winter LakeKeepers is not affiliated with the WLWLSA, those recommendations are not shown here. See Associated 2022 for further details.

2 SUMMARY OF WINTER LAKEKEEPERS AND LAKEWATCH DATA

2.1 What Was Measured

The Winter LakeKeepers and LakeWatch programs are run by ALMS, a non-governmental citizen science agency, who are supported by volunteers. The most recent Winter LakeKeepers reports were issued in 2023 (evaluating data from 2022–2023) and 2024 (evaluating data from 2023–2024). The most recent LakeWatch reports for Wizard Lake were issued in 2022 (evaluating data up to 2022) and 2024 (evaluating data up to 2024).

The Winter LakeKeepers program involves measuring dissolved oxygen and water temperature at several depths of the lake, from the surface to the lake bottom. In the past, water samples were collected at a single depth in two locations: one in the east basin of Wizard Lake (or Jubilee Park Beach, where ALMS usually collects summer data for the LakeWatch program; see **Section 2.2**) and one in the West Basin. Based on available information, the West End location was not sampled for water quality before 2022, as it is considered an open-water wetland and is accessible only by canoe in the summer. WLWLSA wants to gain a better understanding of water quality in the West End wetland area of Wizard Lake, which receives runoff from the western portion of the watershed. In this program, water quality samples are collected by volunteers (using equipment provided by ALMS). The samples are submitted to a laboratory for analysis of nutrients (total nitrogen, ammonia, total Kjeldahl nitrogen, and total and dissolved phosphorus), chlorophyll-*a*, conductivity, chloride, dissolved organic carbon, and pH.[3] Eight sampling events in the winter were included in this program:

- December 11, 2022;
- January 8, 2023;
- February 12, 2023;
- March 12, 2023;
- December 17, 2023;
- January 21, 2024;
- February 19, 2024; and
- March 10, 2024.

The LakeWatch program involves water sampling in the summer. Wizard Lake was included in the LakeWatch program starting in 1999 and was sampled roughly every 2 years since then. Wizard Lake was sampled in 2022 and 2024 but not in 2023. In this program, water quality data are collected using provincial standard methods and are tested for a more comprehensive suite of parameters than the Winter LakeKeepers program. Vertical water quality data is collected at the historically deepest point of Wizard Lake, known as the Centre location. ALMS issued a lake-specific annual report for the LakeWatch program in Wizard Lake in June 2023, wherein the first trend analysis report (presenting trends over time in Wizard Lake water quality) was included. The trend analysis report included roughly 10 years of data to complete the statistical analysis.

The Winter LakeKeepers and LakeWatch programs evaluate the health of numerous lakes in Alberta, and Associated has summarized the results from both programs specific to Wizard Lake in **Section 2.2**. This report discusses information that pertains to the results only from 2022 to 2024. Data before 2022 for both programs can be found in annual reports on the ALMS website (ALMS 2025), and a previous report (Associated 2022) contains a more focused

[3] Sulphate was also tested during one sampling event in 2001.

summary of that information, specifically on Wizard Lake. However, any key long-term trends were included here, where they inform about ongoing changes at Wizard Lake.

2.2 Water Quality Results for Wizard Lake

2.2.1 Chlorophyll-a

Winter chlorophyll-*a* data were collected by LakeKeepers in December 2022 and 2023, and in January, February, and March 2023 and 2024. The results from that sampling showed elevated concentrations of chlorophyll-*a* at the West Basin and Jubilee sampling locations in December in both 2022 and 2023 (LakeKeepers 2023, 2024). At both sampling locations, a decrease in chlorophyll-*a* was noted in January 2023 (compared to December 2022), and concentrations remained low and relatively consistent from January to March. Results in 2024 were slightly different: concentrations fluctuated between each sampling event (between January and March) and each sampling location. Regardless, winter chlorophyll-*a* concentrations at the Jubilee and West Basin sampling locations were similar to one another and between sampling years. The average chlorophyll-*a* concentrations at the Jubilee sampling location were 35.1 µg/L in 2022–2023 (ranging from 8.2–81.5 µg/L) and 39.9 µg/L in 2023–2024 (ranging from 12.5–65.1 µg/L). The average chlorophyll-a concentrations at the West Basin sampling location were 25.5 µg/L in 2022–2023 (ranging from 8.3–67.6 µg/L) and 35.3 µg/L in 2023–2024 (ranging from 9.3–66.0 µg/L).

Summer chlorophyll-*a* data were evaluated by LakeWatch in June, July, August, and September 2022, and in June, July, and August 2024. In 2022, chlorophyll-*a* concentrations steadily increased from June to September (LakeWatch 2023). The results were similar in 2024, in that June showed the lowest chlorophyll-*a* concentrations and August the highest (LakeWatch 2024). The average chlorophyll-a concentrations in summer were similar to those in winter, at 31.3 µg/L and 40.3 µg/L for the 2022–2023 and 2023–2024 sampling periods, respectively.

These average chlorophyll-*a* concentrations are higher than the recreational guideline of 33 µg/L, which is the threshold that indicates the potential for an algal bloom (Health Canada 2022). Overall, Wizard Lake was considered hypereutrophic[4] in 2022 and 2024 based on the observed chlorophyll-*a* concentrations in winter and summer.

2.2.2 Phosphorus

Phosphorus is the main limiting nutrient that affects algal growth (and chlorophyll-*a* concentrations) in most lakes of Alberta, including Wizard Lake. In both sampling periods, total phosphorus concentrations were generally higher at the Jubilee sampling location (2022–2023: average of 46 µg/L, ranging from 16–62 µg/L; 2023–2024: average of 42 µg/L, ranging from 18–55 µg/L) compared to the West Basin location (2022–2023: average of 25 µg/L, ranging from 11–36 µg/L; 2023–2024: average of 27 µg/L, ranging from 17–35 µg/L). During the 2022–2023 winter sampling event, total phosphorus concentrations were highest in December and lowest in February at both sampling locations. The 2023–2024 season did not follow the same trend: the highest total phosphorus concentrations at the Jubilee and West Basin sampling locations were slightly later in the year (in January and February, respectively) (LakeKeepers 2023, 2024).

Dissolved phosphorus[5] showed a more consistent trend compared to total phosphorus. Winter concentrations at the West Basin sampling location (2022–2023: average 20 µg/L; 2023–2024: average 15 µg/L) were similar to those at the Jubilee location (2022–2023: average 19 µg/L; 2023–2024: average 13 µg/L). Although dissolved phosphorus concentrations remained relatively stable at Jubilee between 2022 and 2024, concentrations at West Basin were higher in February 2024 compared to the other sampling events that year.

[4] Hypereutrophic means the lake contains very high levels of nutrients and algae.
[5] Bureau Veritas labels this parameter as "total dissolved phosphorus," but for the purposes of this report, the term "dissolved phosphorus" is used to prevent confusion with total phosphorus.

During the summer, total phosphorus at the Centre sampling location in Wizard Lake was evaluated in 2022 and 2024, whereas dissolved phosphorus was evaluated only in 2024. Total phosphorus showed a similar trend to chlorophyll-*a*, in that concentrations increased from June to August in 2022 (24-53 µg/L) (LakeWatch 2023). This trend was also evident in 2024, with concentrations of total phosphorus being lower in June (28 µg/L) than in August (56 µg/L). This trend indicates a phosphorus release from sediments in summer, which is common in Alberta lakes. Dissolved phosphorus concentrations also rose throughout summer, increasing from 3 µg/L to 8 µg/L between June and August 2024. Increasing phosphorus concentrations coincided with increased chlorophyll-*a* concentrations in the lake, which was expected as phosphorus is the limiting nutrient for algal growth (LakeWatch 2024).

During both winter and summer seasons, Wizard Lake was considered eutrophic[6] based on the phosphorus concentrations present.

2.2.3 Ammonia and Other Nitrogen Compounds

Ammonia and other nitrogen compounds are nutrients that primary producers, such as algae, need to grow. They are generally not limiting nutrients like phosphorus, but in combination with excessive phosphorus, these nutrients can promote algal blooms. Unlike phosphorus, high concentrations of nitrogen-based compounds, specifically ammonia, can also directly affect aquatic life. Total ammonia, evaluated in the Winter LakeKeepers program in 2022–2023 and 2023–2024 (LakeKeepers 2023, 2024), peaked generally in January and decreased thereafter (the lowest concentrations were observed in March). Ammonia concentrations in 2023–2024 at both sampling locations were similar to those in the previous year (2022–2023), ranging from 19.0–140 µg/L at the Jubilee sampling location and from 44.0–190.0 µg/L at the West Basin location. Concentrations were lower in summer than in winter, with average of around 20 µg/L (while in winter, the maximum concentrations were up to 200 µg/L) (LakeWatch 2022, 2024). Ammonia concentrations were below the Alberta surface water guidelines (GoA 2018) in the winter and summer for water quality samples taken between 2022 and 2024,[7] suggesting low risk to aquatic life in Wizard Lake.

Nitrate + nitrite (evaluated as the sum of both parameters) in winter were generally lower at the start of the winter season (i.e., December) and increased afterward (i.e., higher in February or March). For instance, nitrate + nitrite concentrations ranged from 88 µg/L in December to 420 µg/L in February at the Jubilee sampling location in 2022–2023. At the West Basin sampling location, concentrations were 57 µg/L in December and 380 µg/L in March. A similar trend was evident in the 2023–2024 season: nitrate + nitrite was the lowest at both locations in December (approximately 110 µg/L) and highest in March (approximately 300 µg/L). Nitrate + nitrite concentrations were dramatically lower in summer than in winter, as concentrations at the Centre sampling location in Wizard Lake were 6.0 µg/L and 10.5 µg/L in 2022 and 2024, respectively.

Total Kjeldahl nitrogen (TKN), which represents the sum of organic forms of nitrogen, was generally stable throughout the winter in 2022–2023 and 2023–2024; concentrations ranged from 1.1–1.8 mg/L from December to March in both periods. While TKN concentrations in summer 2022 and 2024 were similar to those in winter (with an average concentration of 1.3 mg/L and 1.2 mg/L, respectively).

Wizard Lake was considered hypereutrophic in winter 2022–2023 and 2023–2024, as well as in summer 2022 and 2024 based on the elevated TKN concentrations. Overall, these results suggest that high levels of ammonia and other

[6] Eutrophic means the lake contains high levels of nutrients and algae.
[7] The Alberta Surface Water Quality Guideline for total ammonia is location specific and is calculated based on temperature and pH. The guideline range was 0.68–2.34 mg/L for Jubilee and 0.96–4.01 mg/L for West Basin.

nitrogen compounds in Wizard Lake could also be contributing to increased algal growth and potentially harmful algal blooms.

2.2.4 Dissolved Oxygen

Dissolved oxygen (DO) trends in winter 2022–2023 were similar between the Jubilee and West Basin sampling locations (LakeKeepers 2023). At both locations, DO was measured below the surface at 0.1 m, 0.5 m, and then at every subsequent metre to the bottom of the lake during all sampling months. In December 2022–2023, DO remained above 8 mg/L at all sampling depths and decreased steadily from January to March at the Jubilee sampling location. In February, DO levels at 5 m below the surface started to become concerning for aquatic life (under 3 mg/L); in March, depths 2 m below the surface crossed this threshold, and lower depths (4 m) neared hypoxic levels[8] (under 1 mg/L). Similarly, in 2023–2024, DO concentrations at the Jubilee sampling location in February and March were lower than in December and January (LakeKeepers 2024). Note that during the 2023–2024 sampling, DO was measured at different depths each month at the Jubilee location; the maximum depth ranged from 4 m in December to 6 m in February. In February, the lowest measured depth from the surface (i.e., 6 m) had concentrations near the level of concern for aquatic life (i.e., 3 mg/L).

At the West Basin sampling location, lake depths were much shallower, at 2.5 m in 2022–2023 and 2 m in 2023–2024. In December 2022, DO concentrations remained above 12 mg/L, at depths of up to 2 m. In January and February 2023, DO concentrations were much lower, as concentrations were below 3 mg/L at the lowest depth sampled (i.e., 2.5 m from the surface). However, DO concentrations at this location increased in March. Although concentrations were low at the sediment–water interface during the 2023–2024 sampling events, DO concentrations remained high near the surface at this location during all sampling months.

At the deeper Centre location[9] (as evaluated in summer), high DO concentrations (above 5 mg/L) were generally evident at the surface but decreased with increasing depth. For instance, in June 2022, hypoxic levels (under 1 mg/L) started near 10 m below the surface, while in July, August, and September 2022, DO concentrations near 0 mg/L were noted at 7.5 m, 6.5 m, and 8.5 m below the surface, respectively. The results were similar in 2024. Although DO concentrations in June 2024 were above 7 mg/L at all sampling depths, this was not evident in the other summer months. In July 2024, DO concentrations at 4 m from the surface were near concerning levels for aquatic life (i.e., 3 mg/L) and became hypoxic (i.e., under 1 mg/L) at 5 m below the surface. The water (at the lower depths) started to become more oxygenated in August 2024, when hypoxic levels started at 9.5 m below the surface; however, by September 2024, DO concentrations were above 5.5 mg/L at all measured depths.

DO is vital for the health of aquatic life in Wizard Lake. According to the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta 2018), DO levels should be at least 6.5 mg/L to protect aquatic life, such as fish. Generally, this guideline was met near the surface during the winter and summer; however, at lower water depth, DO levels appear to provide sub-optimal habitat for aquatic life such as fish. This is particularly concerning at the Jubilee sampling location (as sampled in winter) and the Centre sampling location (sampled in summer). The low DO concentrations at these times are likely related to primary productivity and nutrient enrichment, and highlight the potential negative consequences of eutrophication.

2.2.5 Conductivity

Conductivity is an indicator of various ions in the water; lower conductivity may indicate that fresh water enters the lake during melting events in warmer periods. In winter, conductivity ranged from 400–420 µS/cm at Jubilee and

[8] Hypoxic means that the dissolved oxygen levels are low (under 1 mg/L) which is harmful to aquatic life.
[9] DO was measured to a depth of 10.5 to 11.5 m from the surface from June to September 2022 and to 8.5 to 10 m from the surface in 2024 at the Centre sampling location (LakeWatch 2022, 2024).

400–440 µS/cm at West Basin (LakeKeepers 2023, 2024). In summer, conductivity was 355 µS/cm in 2022 and 370 µS/cm in 2024 (LakeWatch 2022, 2024). The slightly lower conductivity levels are likely related to freshwater entering the system from spring melt. These results underscore the importance of evaluating water quality from the tributaries of Wizard Lake (as discussed in **Section 3.0**), as they impact the water quality of the lake.

3 TRIBUTARY SAMPLING PROGRAM

3.1 What Sampling Was Completed

Volunteers of the WLWLSA have collected water samples since 2007 in several tributaries that flow into Wizard Lake (**Table 3-1**, **Figure 3-2**). This testing helps determine which areas contribute nutrients and other compounds (such as bacteria) to the lake and helps pinpoint areas to direct watershed stewardship activities. During each sampling year, volunteers collected water samples during times of high spring runoff, in March to June (i.e., late winter or spring), as this time of year represents the highest water inputs from tributaries into Wizard Lake. Furthermore, during the summer and fall, these tributaries are often dry, so samples cannot be collected.

Water samples are submitted to the Bureau Veritas laboratory for testing for nutrients, bacteria, and some physical parameters[10] (**Table 3-2**). Nutrients included phosphorus (total and dissolved) and nitrogen (including ammonia and total Kjeldahl nitrogen), as these are the primary contributors to algal growth. The bacterium *Enterococcus* was evaluated in 2022 at the recommendation of Alberta Health Services, but it has not been included since then due to logistical difficulties. Before 2022, water was tested for *E. coli*, which was easier to be analyzed, so the monitoring in 2023 focused on this parameter rather than *Enterococcus*. Water pH, temperature, and conductivity were also measured in the field using a Hach field meter.

Table 3-1 Tributary Sampling Locations and Dates

Location	2007	2010	2011	2018	2022	2023	2024	2025
Inflow 1	April 11	May 24	April 13	April 21	April 4	June 21	May 8	April 7
Inflow 2	April 16	-	April 26	April 21	April 7	June 21	May 8	April 9
Inflow 3	April 16	May 24	April 13	April 21	April 7	June 21	May 8	April 9
Inflow 4A	March 27	May 24	April 13	April 19	April 1	June 21	May 8	March 6
Inflow 4B	–	–	–	April 19	April 1	–	–	–
Tributary A	March 27	–	April 13	April 19	April 1	June 21	May 8	March 6
Tributary B	March 27	May 24	April 13	April 19	April 1	June 21	May 8	March 6
West End	–	–	–	–	April 4	June 21	May 8	April 7
WRP 11	–	–	–	–	–	–	May 8	March 6
WRP 12	–	–	–	–	–	–	–	April 7

[10] Volunteers collected water temperature and pH in the field instead of having the laboratory test for these parameters. Measuring these in the field allows for more accurate interpretation of the data, particularly when calculating the un-ionized ammonia concentration. Total ammonia is made up of ionized and un-ionized ammonia; un-ionized ammonia is more toxic to aquatic life, particularly fish.

Table 3-2 Parameters Tested in Tributaries

Parameter Group	Purpose for Testing	Parameters Tested
Nutrients	Nutrients (especially phosphorus) feed lake algae. If nutrients are present in excess, they can cause algal blooms. Elevated ammonia and nitrate levels can be toxic to aquatic life.	• Ammonia (as nitrogen) • Nitrate + nitrite (as nitrogen) • Total Kjeldahl nitrogen • Total phosphorus • Dissolved phosphorus
Bacteria[1]	Excessive fecal bacterial levels can cause digestive illness in swimmers.	• *Escherichia coli*
Physical	Physical parameters are important for fish habitat quality. Elevated temperature and pH can increase the toxicity of ammonia. Elevated pH can favour cyanobacteria growth over other algae growth.	• Total suspended solids • pH • Temperature • Specific conductance

[1] In 2022, Alberta Health Services recommended that *Enterococcus* be evaluated instead of *E. coli*; however, due to logistical issues, the WLWLSA reverted to evaluating *E. coli* for 2023, 2024, and 2025.

3.2 Sampling Locations

Since 2007, volunteers have generally collected six water samples from locations around Wizard Lake, including Inflows 1 to 4A, and Tributaries A and B (which are located along the ditch that flows into Inflow 4) (**Figure 3-1**). Inflow 4B was sampled only between 2018 and 2022, which makes it more challenging to compare parameters between the sampling years for this location. All sampling locations were on the south side of the lake, where most of the natural watershed drains into the lake. Tributary A is just downstream of a farm (a previous feedlot), and Tributary B is just upstream of the same farm. The purpose of these paired samples was to understand whether the farm runoff influences water quality. In 2022, a new sampling location (West End) was added at the west end of Wizard Lake to better understand water quality in that area. Additionally, two wetland restoration program locations, WRP 11 and WRP 12, were added in 2024 and 2025, respectively, to better understand water quality in the areas in which the WLWLSA hopes to restore wetlands on the landscape.

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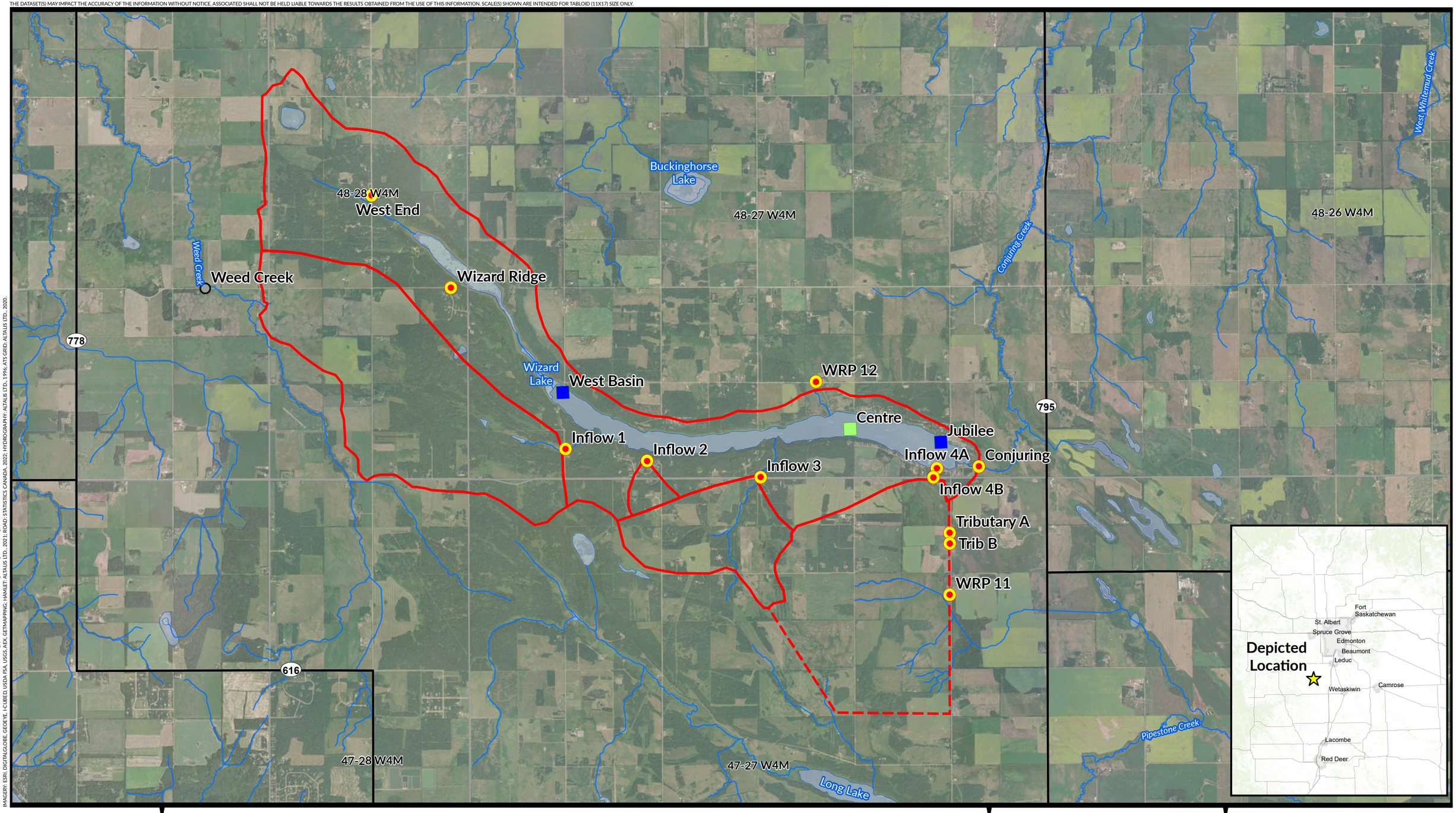

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LEGEND

- LakeKeepers Sample Site
- LakeWatch Sample Site
- Tributary Sample Site
- Wizard Lake South Boundary Of Watershed*
- Wizard Lake Watershed

Base Data

- Hamlet
- Highway
- Watercourse
- Water Body

*Approximate subwatershed created by drainage alterations on RR 271 (Stanley Associates Engineering 1989: Drainage Improvements in the Curilane Drive Area. Prepared for County of Wetaskiwin)

Flow was evaluated on April 9, 2025 at locations corresponding to the sampling locations of Inflow 1, Inflow 2, Inflow 3, Inflow 4, Wizard Ridge, Tributary A, West End and WRP 11 locations. The flow measurement location Inflow 4 corresponds to both Inflow 4A and Inflow 4B sampling locations.

N

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FIGURE 2-2
WATERSHED FOR TRIBUTARY SAMPLING LOCATIONS

WIZARD LAKE WATERSHED AND LAKE STEWARDSHIP ASSOCIATION

WIZARD LAKE 2025 DATA SUMMARY

3.3 How Data in 2025 Compare to Previous Years

Similar to past reports, this report focuses on nutrient (total and dissolved phosphorus) and bacteria (*E. coli*) concentrations in the tributaries and the resulting tributary water quality. Phosphorus and ammonia can cause eutrophic conditions, contributing to harmful algal blooms in the lake, and *E. coli* concentrations can indicate potential human health concerns related to the lake water. Understanding the main routes of influence that contribute to Wizard Lake water quality can help determine where to focus potential mitigation efforts to improve water quality in the lake. Data on other water quality parameters are also evaluated in the tributary sampling program, including nitrate, nitrite, nitrate + nitrite, total Kjeldahl nitrogen, pH, total suspended solids, specific conductance, and temperature.

3.3.1 Phosphorus (Total and Dissolved)

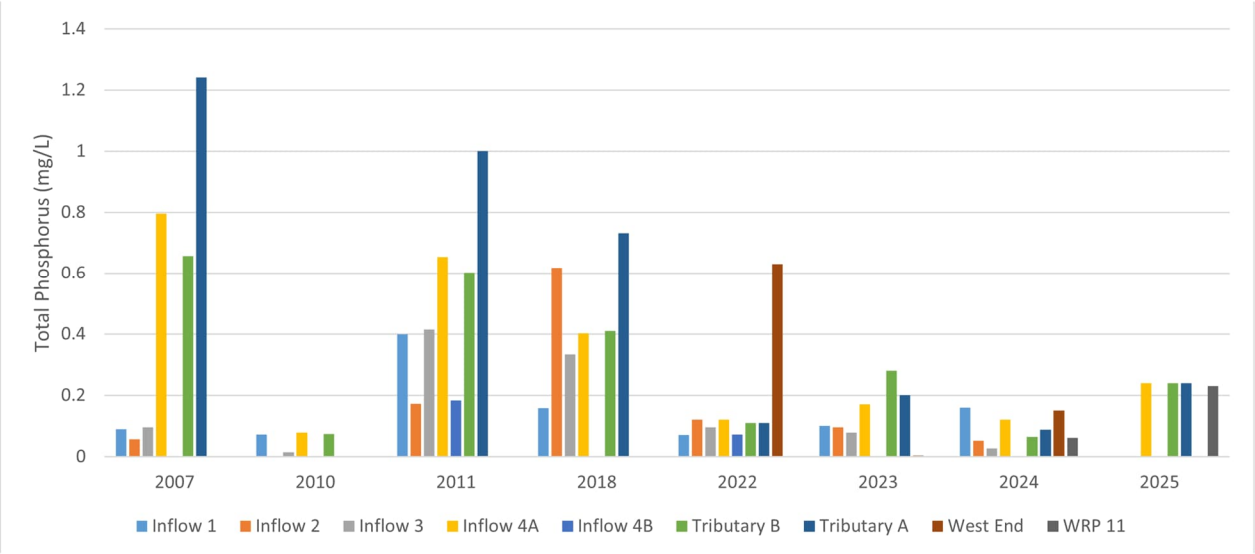
At most tributary locations in the Wizard Lake watershed, total phosphorus (**Figure 3-2**) and dissolved phosphorus concentrations (**Figure 3-3**) have generally decreased since 2007. Although a general decreasing trend since 2007 is evident, total and dissolved phosphorus concentrations at most sites were slightly elevated in 2025 compared to 2022, 2023, and 2024. As observed previously, these results correlate with measured flow rates in a nearby creek (Weed Creek at Thorsby, station name 05DF008), where historical peak flows in 2007 and 2018 resulted in high phosphorus concentrations, while years of low flow, such as 2010, 2023, and 2024, showed low phosphorus levels in the creeks. Flows in spring 2025 were intermediate, resulting in higher concentrations compared to recent years but lower concentrations compared to the historical peak flow years.

The highest levels of total phosphorus were observed in different sampling locations throughout the last 3 years (0.28 mg/L in Tributary B in 2023; 0.16 mg/L in Inflow 1 in 2024; and 0.24 mg/L in Inflow 4A, Tributary B, and Tributary A in 2025). All of these total phosphorus concentrations exceeded the high-risk category for nutrient aquatic ecosystem health impairment (0.13 mg/L) (Alberta Agriculture and Irrigation 2024).

In a previous report (Associated 2021), phosphorus results suggested that the farm area (i.e., near sampling location Tributary A) affected the water quality of Wizard Lake. However, this was not as evident in recent years, as concentrations upstream of the farm (i.e., Tributary B) and downstream of the farm (i.e., Tributary A) were largely similar. Differences between the years could be due to several factors, such as the timing of sampling and the implementation of revised farming practices in the area, as the feedlot, in this area, has not operated for a few years.[11] Regardless, the results from 2023 to 2025 indicate that total phosphorus is primarily made up of the more bioavailable form, dissolved phosphorus, which suggests that a large amount of the phosphorus in this system is available for uptake by aquatic life (such as algae).

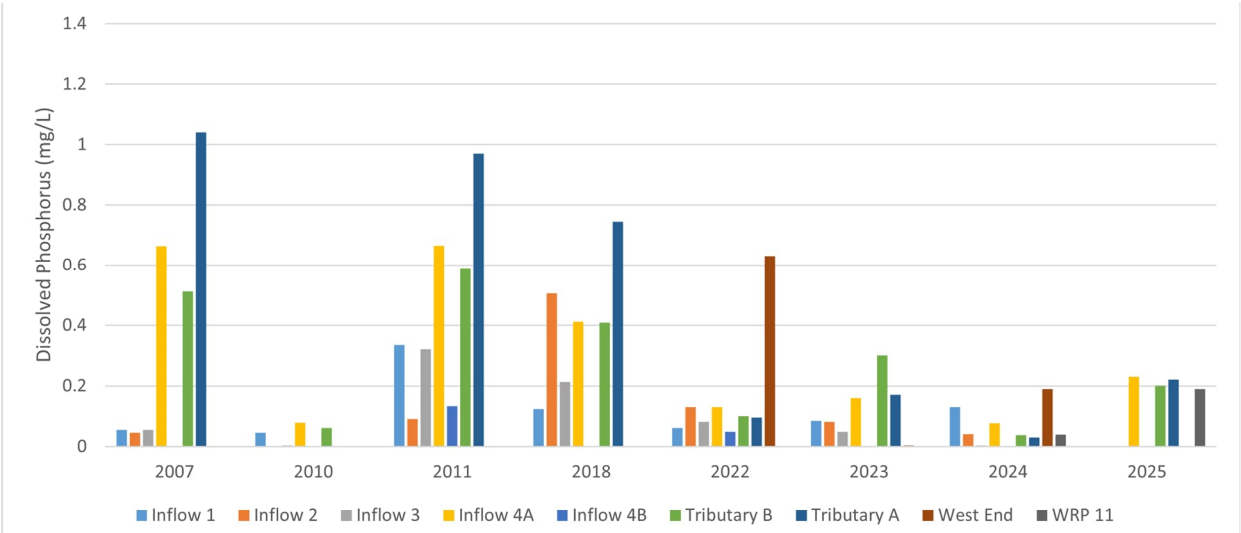
[11] Local community members confirmed that cattle were at this location in 2005 but have not been present since at least 2010 (although cattle are still present further upstream).

Figure 3-2 Total Phosphorus Concentrations in Wizard Lake Watershed



For all sampling years, locations that were evaluated for total phosphorus had one water sample collected on a date between March and June.

Figure 3-3 Dissolved Phosphorus Concentrations in Wizard Lake Watershed

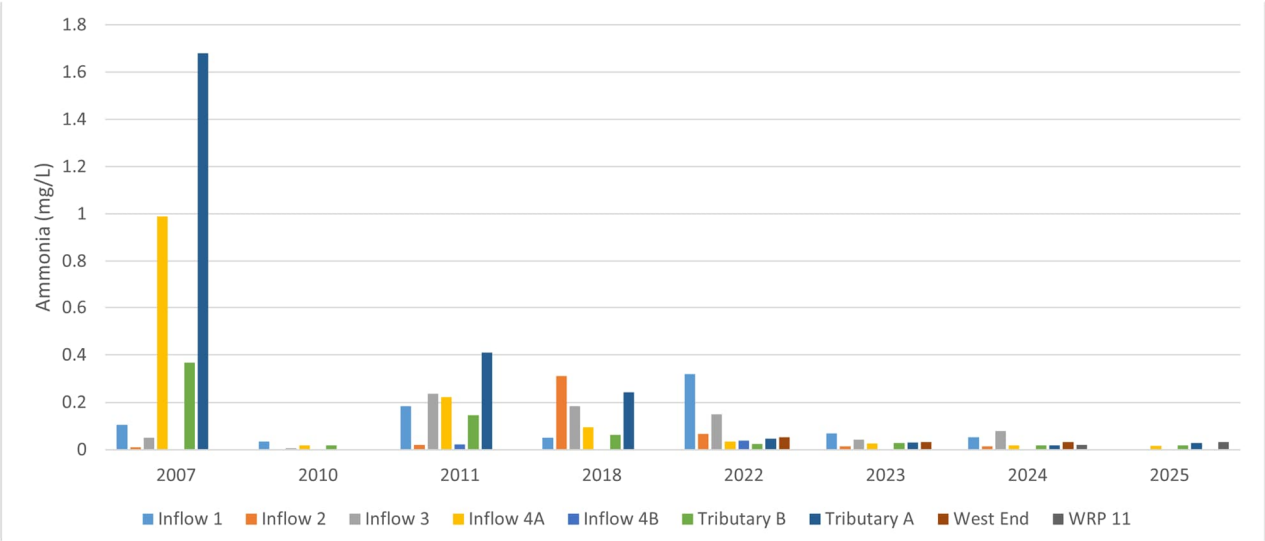


For all sampling years, locations that were evaluated for dissolved phosphorus had one water sample collected on a date between March and June.

3.3.2 Ammonia

Ammonia concentrations were substantially lower in the last 3 years (2023–2025) than in previous years (especially 2007). During this time frame, concentrations of total ammonia and un-ionized ammonia at all sampling locations (where ammonia was measured) were below the guideline for the protection of aquatic life (**Figure 3-4**).

Figure 3-4 Total Ammonia Concentrations in Wizard Lake Watershed



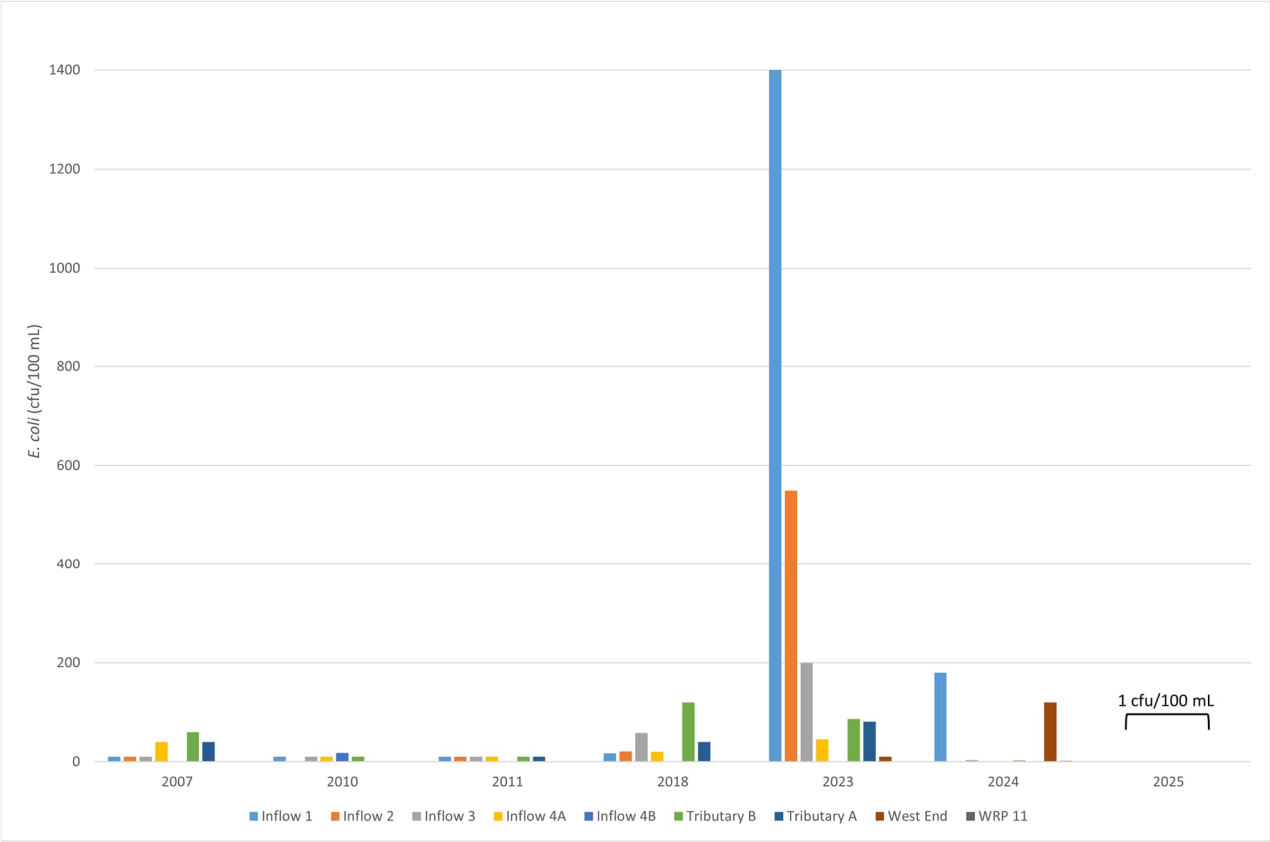
For all sampling years, locations that were evaluated for total ammonia had one water sample collected on a date between March and June.

3.3.3 Coliforms (Fecal and Total) and *E. Coli*

E. coli was evaluated in all sampling years (i.e., 2007–2025) (**Figure 3-5**). The Alberta recreational guideline for *E. coli* states that concentrations should remain below 100 colony-forming units (cfu) per 100 mL. Since 2007, only six of 42 samples have exceeded this guideline (ranging from 120 cfu/100 mL to 1,400 cfu/100 mL). Previously, Inflow 1 appeared to have the largest influence on *E. coli* concentrations; it was the only sampling location that exceeded the guideline in more than 1 year of sampling. The concentrations in 2025 were lower than in all previous years sampled, with concentrations below 1 cfu/100 mL, suggesting there is currently no risk associated with *E. coli* bacteria on human health.

Total coliforms are bacteria that are commonly found in various environmental sources, and fecal coliforms are specific to the feces of warm-blooded animals. Fecal coliform concentrations are a better indicator of potential health risk associated with water than total coliforms. For this reason, there is no Alberta water quality guideline for total coliforms, but there is a guideline for fecal coliforms (100 cfu/100 mL). Fecal coliforms in the tributaries were evaluated only from 2007–2018 and were below the guideline in all samples (data not shown). Total coliforms were evaluated from 2023–2025, but because fecal coliforms were not evaluated in the recent sampling years, it is not possible to evaluate how coliforms from the tributaries are affecting water quality in Wizard Lake.

Figure 3-5 *E. coli* Concentrations in Wizard Lake Watershed



For all sampling years, locations that were evaluated for *E. coli* had one water sample collected on a date between March and June.

3.4 Flow Rates

Flow rates at eight tributary sampling locations (**Figure 3-2** and **Table 3-3)** were evaluated by Alberta Environment and Protected Areas on April 9, 2025, and provided to WLWLSA. The highest total discharge was measured at the Tributary A sampling location (0.030 m^3/s), which was not unexpected, as this location was the widest (2.1 m) and the deepest (mean of 0.29 m) of the tributaries evaluated (even though the mean velocity was lower at this location than most other sampling locations [0.048 m/s]). The high discharge rates and corresponding elevated historical concentrations of nutrients at Tributary A (compared to other tributary sampling locations) suggest that this tributary is a significant contributor to most of the nutrients which enter the lake and therefore has the greatest influence on water quality in Wizard Lake. In the past evaluation, flow (especially in Tributary A) appeared to be linked to elevated concentrations of phosphorus, this link was not as strong in recent years; however, likely due to lower phosphorus concentrations entering Wizard Lake and lower spring melts (i.e., volume of water) in the area.

Table 3-3 Wizard Lake Flow Rates, April 9, 2025

Location	Total Width, m	Mean (Max.) Depth, m	Mean (Max.) Velocity, m/s	Total Discharge, m^3/s
Inflow 1	0.600	0.038 (0.080)	0.299 (0.372)	0.007
Inflow 2	0.400	0.060 (0.100)	0.185 (0.365)	0.004
Inflow 3	1.100	0.094 (0.150)	0.101 (0.203)	0.010
Inflow 4[1]	1.100	0.190 (0.270)	0.131 (0.323)	0.027
Wizard Ridge	0.700	0.100 (0.120)	0.043 (0.094)	0.003
Tributary A	2.100	0.294 (0.370)	0.048 (0.139)	0.030
West End	1.100	0.165 (0.240)	0.032 (0.059)	0.006
WRP 11	1.500	0.150 (0.220)	0.042 (0.089)	0.009

Flow rates were not measured at the Conjuring, Tributary B, and WRP 12 sampling locations in 2025. [1] The Inflow 4 flow rate location corresponds to Inflow 4A and Inflow 4B water quality sampling locations.

4 ALGAE DATA

4.1 What Was Collected and Why

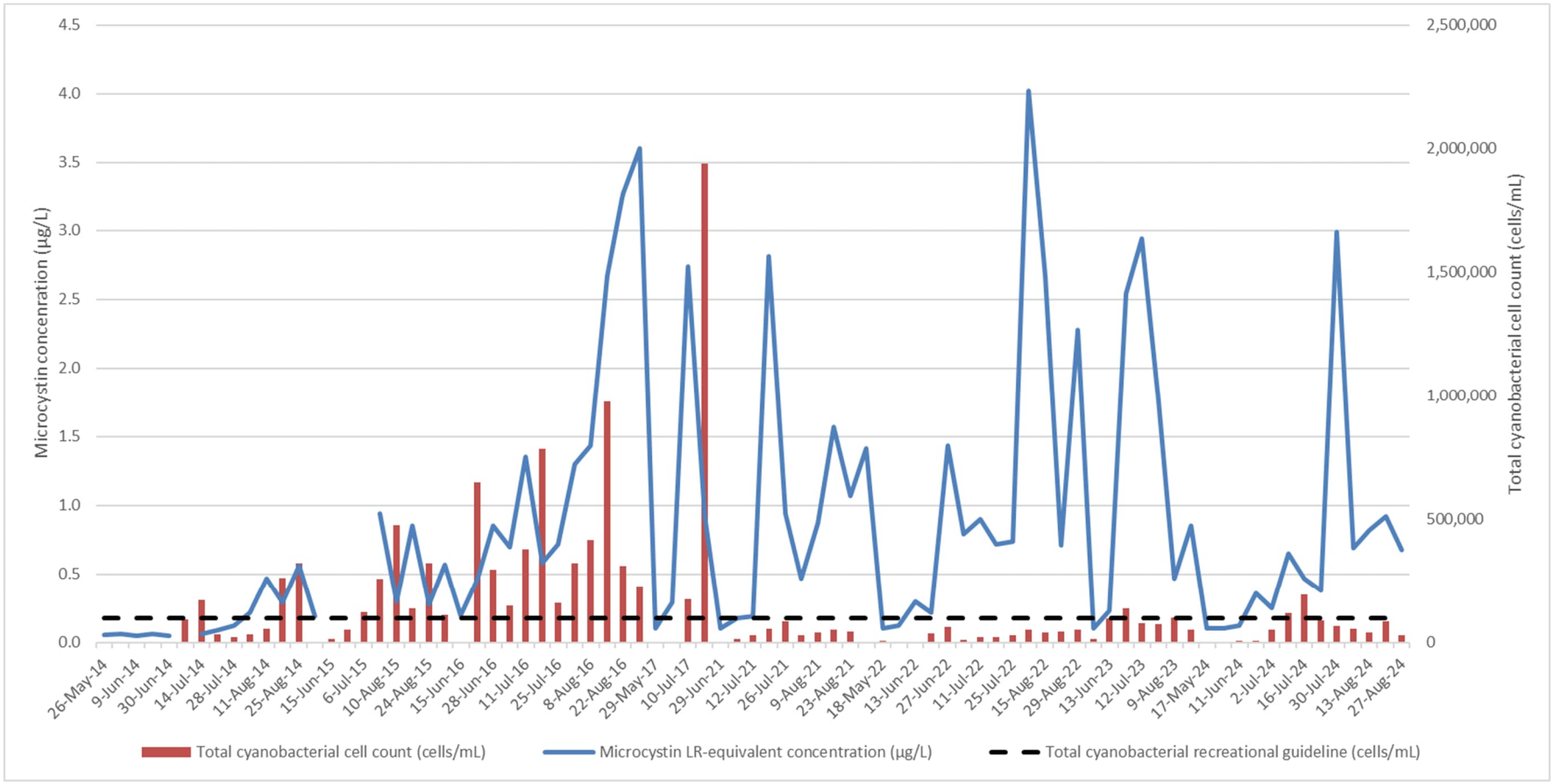
Alberta Health Services collects samples at priority lakes in Alberta and analyzes them for cyanobacteria (also called blue-green algae) and microcystin (the toxin that certain cyanobacteria produce) to understand the potential risk to humans and animals. Concentrations in Wizard Lake were compared to the Alberta surface water quality guideline for recreation and aesthetics for cyanobacteria (100,000 cells/mL) and for microcystin (20 µg/L) (Government of Alberta 2018).

4.2 Results

The total cyanobacterial cell counts in 2023 and 2024 at the Jubilee sampling location were generally below the applicable recreational guideline of 100,000 cells/mL for the 20 sampling events during that time frame (**Figure 4-1**), with only three exceptions: June 27, 2023 (137,991 cells/mL), July 9, 2024 (117,336 cells/mL), and July 16, 2024 (195,733 cells/mL). Between 2013 and 2022 (June to August sampling), cyanobacterial cell counts exceeded the guideline 24 times (out of 70 sampling events). The results for summer 2016 are noteworthy: 11 of the 12 sampling events exceeded the recreational guideline. In the other sampled years, guideline exceedances were less common, occurring generally in less than half of the sampling events. Nutrient concentrations were generally lower in 2023 and 2024 than in past years (see **Section 3.3**) in Wizard Lake, which could explain the lower frequency of cyanobacteria guideline exceedances compared to previous years.

The dominant cyanobacterial species groups in 2023 and 2024 were *Aphanothece* and *Aphanizomenon*. Both groups are known to produce toxins that can be harmful to aquatic and human life, so evaluating microcystin is also important. Microcystin concentrations from 2023 and 2024 were much lower than the recreational guideline of 20 µg/L (**Figure 4-1**). The average concentrations of microcystins in Wizard Lake were 1.27 and 0.66 µg/L in 2023 and 2024, respectively (the maximum concentrations were approximately 3 µg/L in both years). Overall, the low microcystin concentrations suggest that toxins associated with cyanobacteria present in Wizard Lake currently do not pose a human health concern.

Figure 4-1 Cyanobacteria and Microcystin in Wizard Lake 2014–2024



5 SUMMARY AND RECOMMENDATIONS

5.1 Winter LakeKeepers and LakeWatch

After reviewing the most recent Winter LakeKeepers (2022–2023 and 2023–2024) and LakeWatch program (2022 and 2024) reports (as discussed in **Section 2.0**), Associated makes the following conclusions:

- Nutrients (such as phosphorus and ammonia) and chlorophyll-*a* concentrations were higher in winter than in summer, showing a high biological activity under ice.
- Although ammonia concentrations are sometimes elevated (specifically in winter), they likely do not pose direct risk to aquatic life.
- Concentrations of dissolved oxygen at lower water depths appears to be at a low enough level to pose risks to aquatic biota and are, thus, likely unsuitable habitat for aquatic life.
- Nutrient and chlorophyll-*a* results suggest that Wizard Lake is hypereutrophic, meaning that it has very high levels of nutrients that promote increased algal growth.

5.2 Tributaries

After analyzing existing water quality data (2007–2025) for the tributaries of Wizard Lake (as discussed in **Section 3.0**), Associated makes the following conclusions:

- Concentrations of nutrients (such as phosphorus and ammonia) have generally decreased in tributaries since 2007, which may be at least partly due to lower spring flow in 2022–2025.
- *E. coli* concentrations were lower in 2025 than in past years and have largely been below the recreational guideline in all tributaries since 2007.
- Highest flow and the relatively high historical nutrient concentrations from Tributary A suggest this tributary has the greatest influence on water quality in Wizard Lake.
- Farming in the area (specifically near Tributary A) appears to be having less of an influence on Wizard Lake's water quality in recent years as compared to previous years (as upstream and downstream locations show similar results in recent years during that time frame).

5.3 Algae

Associated evaluated the water quality results for Wizard Lake related to available algae information (as discussed in **Section 4.0**), and makes the following conclusions:

- Total cyanobacterial cell counts in recent years (2023 and 2024) were lower than in previous years (2013–2022) and have generally been below the recreational guideline during that time frame.
- Microcystin concentrations were well below the recreational guideline in 2023 and 2024.
- Algae results suggest that there was no risk to human health in Wizard Lake in 2023 and 2024.

5.4 Summary

Overall, the results suggest that the Wizard Lake system is eutrophic (rich in nutrients and algae). Although phosphorus concentrations in tributaries were low between 2023 and 2025, concentrations were elevated in the past (especially in Tributary A). Therefore, Associated recommends the following:

- Explore the use of wetland creation and using other mitigation practices (such as buffer strips) near the tributaries.

- Review the additional water quality parameters that are available for the tributaries (see Section 3). This information would provide insight on other potential issues in Wizard Lake and may justify removing some parameters from the program).
- Discuss these results with the community. Associated has created a small flyer (Appendix A) that summarizes the results of this study and possible ways for improving water quality in Wizard Lake.

CLOSURE

This report was prepared for the Wizard Lake Watershed and Lake Stewardship Association to review the 2007–2025 tributary water quality, algae data, and Winter LakeKeepers and LakeWatch data for Wizard Lake, and to provide recommendations for future work.

The services provided by Associated Environmental Consultants Inc. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

Associated Environmental Consultants Inc.

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APPENDIX A – WIZARD LAKE FLYER

Have you noticed high algal growth in Wizard Lake?

What's being done:

- The Wizard Lake Watershed and Lake Stewardship Association has been evaluating water quality at the tributaries since 2007.
- Alberta Health Services has been collecting algae data at Jubilee since 2014.
- LakeKeepers and LakeWatch (via Alberta Lake Management Society) have evaluated lake water quality from 2019-2024 and 2006-2024, respectively.

Not all sampling locations from the programs are shown on this map.

Which water quality parameters are being evaluated and why?

- Phosphorus, nitrogen, ammonia (algae food)
- Chlorophyll-a (indicates algae amount)
- Dissolved oxygen (evaluation of fish habitat)
- Conductivity (indicates saltiness)
- Coliform bacteria (indicates fecal contamination)
- Cyanobacteria (toxic algae)

Key findings:

- Tributary A likely has the greatest influence on water quality in Wizard Lake.
- Wizard Lake is rich in nutrients that promote algal growth.
- Wizard Lake may sometimes provide unsuitable habitat for aquatic life.
- Water quality at Jubilee is generally slightly poorer than at West Basin.
- Tributary nutrient concentrations have declined in recent years, likely due to lower flow.

Why would a wetland help?

- **Nutrient filtration**: Wetlands trap and absorb phosphorus, reducing nutrient runoff into lakes.
- **Nutrient balance**: Wetlands help keep nutrients from building up, preventing harmful algal blooms.
- **Water purification**: Wetlands filter out pollutants, sediments, and pathogens.
- **Flood control**: Wetlands absorb and slowly release stormwater, reducing flood peaks.
- **Habitat support**: Wetlands provide critical habitat for various wildlife and aquatic species.
- **Carbon storage**: Wetlands capture carbon, helping mitigate climate change.