Wasa Lake

2004-2006, 2022-2024 Summary Report

Release Date

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Level of Study

Level 1 Enhanced

Volunteer Monitoring

Wasa Lake Land Improvement District (WLLID)

Data Compilation

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Photo 1 – Wasa Lake

The BC Lake Stewardship Society (BCLSS) and the Ministry of Environment and Parks (ENV) partner with local volunteers and stewardship groups to characterize lake water quality through the BC Lake Stewardship and Monitoring Program (BCLSMP).

The BCLSMP focuses on understanding water clarity, temperature, oxygen, and nutrients, as these provide a basic understanding of lake processes and influence biological productivity. Concerns about productivity are common, specifically because high productivity can affect recreation and drinking water due to harmful algal blooms and can also impact aquatic organisms, such as fish.

BRITISH COLUMBIA | BC Lake Stewardship and Monitoring Program

BCLSS

The Importance of Wasa Lake & its Watershed

Wasa Lake is located approximately 35 km east of Kimberley and 40 km north of Cranbrook in the East Kootenay region. Wasa Lake is a kettle lake, it was formed as a depression in glacial deposits and has no continuous inputs or outputs. It remains a lake because the depression it forms is lower than the surrounding water table; this means that fluctuations in the water table result in fluctuations in the lake level (McArthur, 2005). During freshet, it appears that the Kootenay River is the major contributing factor to the lake's level (Baker, 1987). Wasa Lake's depth changes throughout the summer following changes in the level of the Kootenay River. High water levels in the Kootenay River affect water table levels, which in turn affect the water level in Wasa Lake (McArthur, 2005).

Table 1. Physical Characteristics of Wasa Lake (BCLSS, 2009)

Lake Name	Wasa Lake
Elevation	722 m
Surface Area	1.1 km^2
Perimeter	6.98 km
Maximum Depth	15.8 m
Mean Depth	3.8 m

The lake is advertised as the warmest swimming lake in the Kootenays, which makes it a common vacation destination for families (BC Parks, 2023). There is also a provincial park with 104 campsites and a large day-use area on the lake (BC Parks, 2023).

In addition to Wasa Lake being popular for non-motorized recreation (swimming, paddle boarding, etc.), the lake has also become very popular with the motorized boating community, which has led to increasing community concerns about user safety, shoreline erosion, and water quality impacts (Berg, 2024). A Lake User Traffic Study was completed by Living Lakes Canada in 2023 at the request of the Regional District of East Kootenay (RDEK), with the aim to better understand the nature of the vessel/user traffic on Wasa Lake (LLC, 2024). Living Lakes Canada (LLC) conducted a basic vessel and user survey to quantify the volume, frequency and type of vessel/user traffic on Wasa Lake during the peak summer season. This report can also be accessed on the Wasa Lake Land Improvement District (WLLID) website. Volunteers indicate that the water clarity readings may be affected by the resuspension of bottom sediments from boat action in this relatively shallow lake (BCLSS, 2009; Berg, 2025). Residents also report odd smells that arise from the lake after days of substantial boat traffic (Berg, 2025)

Wasa Lake has contained brook trout (Salvelinus fontinalis), Burbot (Lota lota), lake chub (Couesius plumbeus), largemouth bass (Micropterus salmoides), largescale sucker (Catostomus macrocheilus), northern pikeminnow (Ptychocheilus oregonensis), peamouth chub (Mylocheilus caurinus), rainbow trout (Oncorhynchus mykiss), threespine stickleback (Gasterosteus aculeatus) and yellow perch (Perca flavescens) (BCLSS, 2009).

In addition to monitoring one site on Wasa Lake through a Level 1 Enhanced BC Lake Stewardship and Monitoring Program, the WLLID also partners with Interior Health to monitor E.coli through collection of water samples from six sites around the lake. The results of this testing are shared publicly on the Interior Health website. Additionally, the WLLID monitors and reports algae blooms on Wasa Lake to Algae Watch BC. The lake experienced two large blooms in 2023, one in April and one in October. Following consultation with BC Algae Watch, the Wasa Lake Land Improvement District (WLLID) concluded that those blooms were non-toxic (Berg, 2025).

The Wasa Lake community is unique in that only 32% of the homes are inhabited by full-time residents, and seasonal residents occupy the remaining 68% (Berg, 2025). Wasa Lake has approximately 107 residential waterfront lots around the lake (LLC, 2024) and approximately 400 residences in the Wasa Lake jurisdiction (Berg, 2025). There is no sewage system in the Wasa Lake community, and all residences are on septic systems (Berg, 2025); it is unknown if the septic systems have any impact on nutrient loading to Wasa Lake because no study has been completed. A Foreshore Inventory and Mapping Report was undertaken on Wasa Lake, which identified that 60% of the lake's foreshore area was found to be disturbed through anthropogenic (human-induced) modifications (McPherson et al., 2009). The report can be accessed through the Wasa Lake Land Improvement District's website.

The flushing rate of Wasa Lake is unknown; however, considering that there are no inflows or outflows, it is likely that Wasa Lake has a low ability to assimilate nutrients.

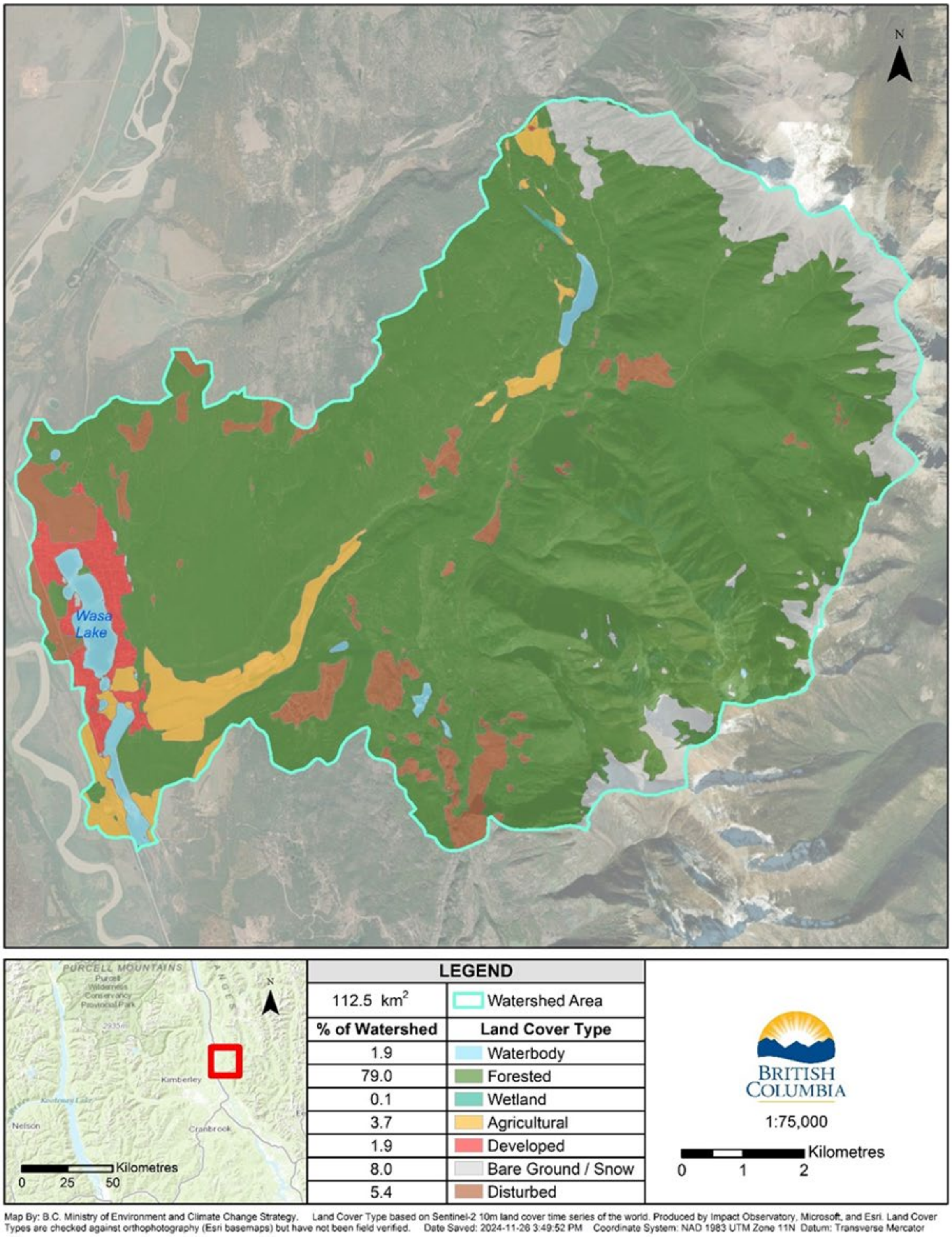


Figure 1. Map showing Wasa Lake watershed and associated land uses

Monitoring Approach

This report summarizes Level 1 Enhanced Study data collected by volunteers from the Wasa Lake Land Improvement District from 2022 to 2024. Volunteers also collected BCLSMP Study data between 2004 and 2006, which is referred to in this report where applicable for longer-term temporal comparison. A Level 1 Enhanced BCLSMP Study collects information from the lake location that best represents the entire lake, such as the centre or deepest point. It includes monitoring of surface temperature and water clarity (Secchi depth). In addition to surface temperature and clarity, volunteers were able to take temperature and dissolved oxygen profiles at depth intervals in Wasa Lake. Years that include full profiles from this program are 2022-2024. Information on these parameters is recommended to be collected at least twelve times during the open water season for three consecutive years to characterize the temporal variability typical of lake systems. This data provides valuable baseline and background information that helps in understanding what is happening in aquatic environments and helps in detecting long-term trends.

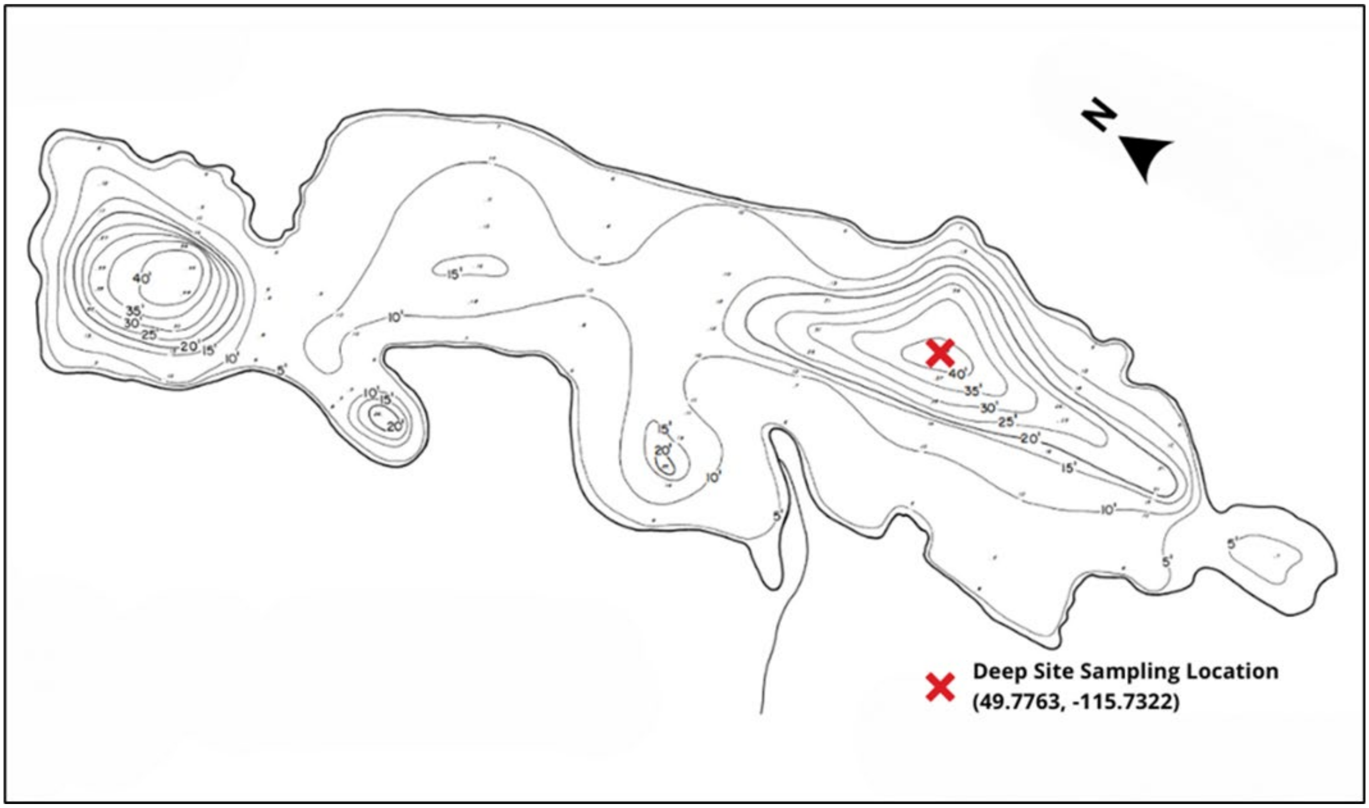
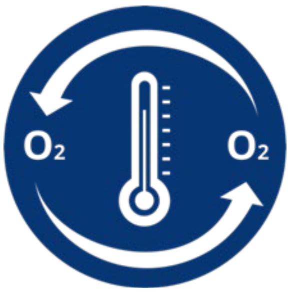


Figure 2. Bathymetric Map of Wasa Lake, including deep station sampling location

Level 1 Enhanced BCLSMP water quality information was collected from the Wasa Lake Deep Site between May and October during 20 sampling events in 2022 and 18 sampling events in

2023. In 2024, data was collected between June and September during 12 sampling events. Secchi depth, surface temperature, and full temperature and dissolved oxygen profiles (i.e., measured at 1 m intervals throughout the water column) were collected during sampling events.

Temperature and Dissolved Oxygen



Temperature and dissolved oxygen (DO) strongly influence physical, chemical, and biological processes in lakes. Annual temperature and oxygen patterns vary depending on local climate, lake shape, prevailing wind direction and lake depth (BCLSS, 2022). Water is most dense and, therefore, heaviest at 4°C and less dense (i.e., lighter) at both colder and warmer temperatures. During the summer, lakes more than 6 m deep usually experience a layering effect called stratification, with the warmer, less dense water sitting on top of the cooler and heavier water. Stratification keeps bottom cool water isolated from top warmer water, which traps nutrients released from bottom sediments until the layers mix in the fall. This mixing is also called lake overturn and can occur one (i.e., monomictic) to multiple times (i.e., polymictic) per year. During the mixing process, the bottom waters get recharged with oxygen, and nutrients are brought up to the surface.

Surface Temperature

Volunteers collected surface temperature readings throughout the 2004-2006 and 2022-2024 monitoring seasons. It should be noted that none of the early years met the minimum data requirements of 12 samples evenly spread between spring and fall. However, the current program has met or surpassed the minimum requirement of 12 readings each year. **Figure 3** displays the surface temperature summary statistics for 2004-2006 and 2022-2024. Though some surface temperature data is available for 2003 and 2007, it has been excluded from this figure due to the minimal number of readings during those years (n=2 in 2003, n=3 in 2007). The variation in the spread of the data (monitoring season) and the limited number of readings in the early years may significantly impact the comparisons of yearly mean and minimum surface temperatures between historical and current data. Because of these limitations on the data, no conclusions about changes in surface temperatures can be drawn from this data set.

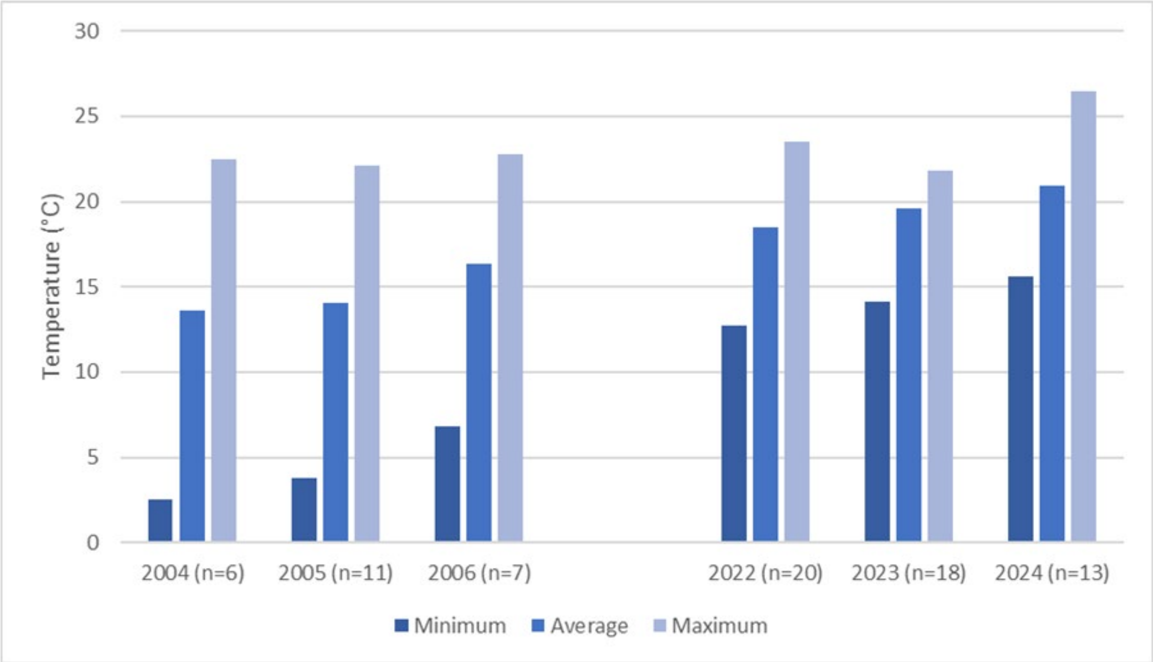


Figure 3. Surface Temperature Summary Statistics and the number of readings that year (n) for Wasa Lake 2004-2006 and 2022-2004

The minimum surface temperature readings appear lower in the early years (2004-2006) than during the current monitoring program (2022-2024). However, the monitoring seasons began earlier and extended later in the early years, reaching cooler temperature months like March, April and November. None of the current years have data in these months, as data collection occurred from May-October in 2022 and 2023, while the 2024 monitoring season ran from June – September. Averages also appear higher for current years; however, as mentioned above, a limited number of readings in early years and wider seasons would skew these averages and make them incomparable to current years.

The three years with the highest maximums are 2024 at 26.5 °C, 2023 at 22.5°C, and 2006 at 22.8 °C. The current program provides baseline data for comparison moving forward, and further monitoring of surface temperature is warranted.

Temperature Profiles

In addition to surface temperature, the volunteers collected temperature profiles during the current monitoring program. Historical years had some lower water column temperature data. However, it was only for an "upper" and "lower" depth, not a full profile. For this reason, the early data will not be graphed to compare to current profiles, though the historical report will be referenced when applicable. **Figure 4** displays temperature profiles collected during the current monitoring program (2022-2024).

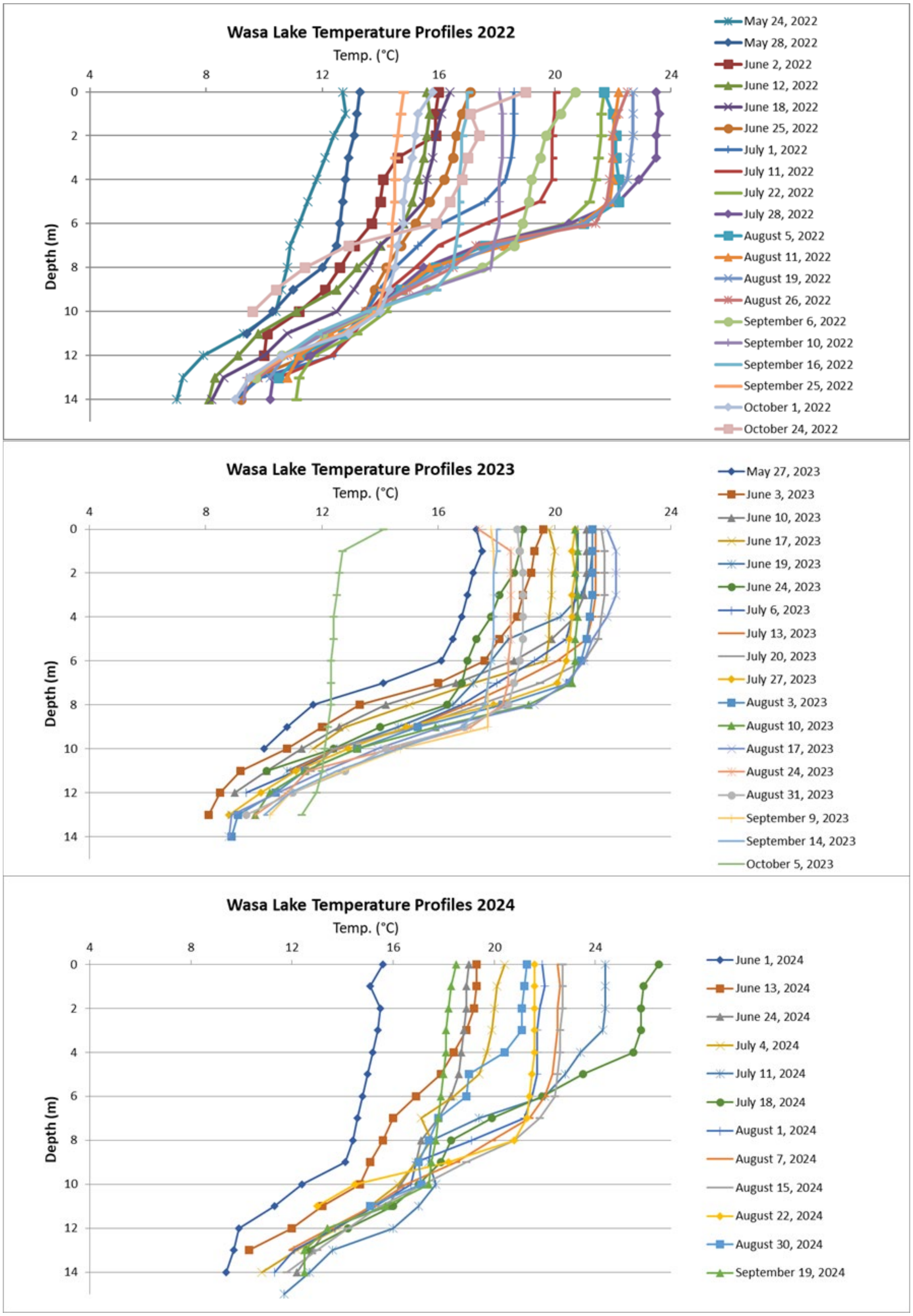


Figure 4. Wasa Lake Temperature Profiles 2022-2024

It is believed that Wasa Lake is dimictic (BCLSS, 2009). A dimictic lake experiences overturn twice per year and is the most common mixing regime in British Columbia (BCLSS, 2022). As surface waters cool in the fall and warm again in the spring, the density changes, gradually reducing the differences in temperature and density between the top and bottom of the lake. This makes it easier for wind and waves to mix the entire water column and results in overturn. However, in sheltered kettle lakes, spring warming can happen too quickly for the mixing process to fully take place (BCLSS, 2022). This characteristic may impact Wasa Lake; however, none of the current profiles occurred early enough in the season to capture spring turnover (uniform temperature and DO from top to bottom waters), so it is uncertain if Wasa Lake experienced spring turnover during the current monitoring period.

The profiles collected support that Wasa Lake stratifies throughout the summer, separating into layers: an epilimnion (top layer), thermocline (zone at least 1 °C change in temperature per vertical meter), and hypolimnion (bottom layer). The thermocline in Wasa Lake seems to move within the water column over the year and between years, sometimes being located fairly shallow (between 4-8 meters) and sometimes being located deeper (9-13 meters), while some profiles show two distinct thermoclines in the same profile. Occasionally, the thermocline extends right to the bottom of Wasa Lake (i.e. there is no distinct hypolimnion).

Though Wasa Lake is likely to have elevated water temperatures naturally due to no direct flow into the lake and it being relatively shallow, it is worth noting that the preferred temperature range for salmonid species (<18°C) is surpassed during the majority of the summer in the epilimnion. Many fish species, especially salmonids, show signs of stress at temperatures greater than 18ºC and dissolved oxygen concentrations less than 4 mg/L (Truelson, 1997). This temperature (>18 ºC) was surpassed down to seven meters depth during the August 11 and September 6, 2022 profiles, while it was surpassed down to eight meters depth during all profiles in August of 2023, and was surpassed down to nine meters depth during profiles collected in August of 2024. As climate change continues to warm lakes, heat may continue to penetrate deeper into the lake, which can have many implications for the physical, chemical, and biological characteristics of Wasa Lake, so this should be monitored going forward.

On one occasion in 2024 (July 18), the water in Wasa Lake surpassed 25°C down to four meters depth. If the entire water column warms in future years and surpasses 25 °C, the lethal temperature limit for many salmonid species will be reached (Ashley, 2024) and could result in a loss of these species if there are limited cool temperature refuges within the lake, while species that thrive in warm waters may flourish, such as largemouth bass. However, 2024 was the first and only year during this monitoring program to see surface waters surpass this threshold for sensitive salmonid species.

Fall turnover was not captured during this monitoring program. However, the October 5th profile from 2023 shows Wasa Lake was in the process of turning over. Because turnover was not captured, it cannot be determined if dissolved oxygen was replenished to the bottom waters of Wasa Lake before going into ice cover. The historic report identified fall overturn by comparing upper and lower depth samples for temperature and DO and concluded that overturn had occurred by the profiles taken on November 17 2004, October 18 2005, and October 31 2006 (BCLSS, 2009).

For subsequent years of data collection, it is recommended that profiles be conducted as soon as possible from ice-off and continue at least biweekly into fall. Capturing spring and fall overturn is important to establish more substantial baseline data on Wasa Lake's timing of turnover and compare to the limited historical data on fall overturn. Climate change may result in the earlier onset of stratification and longer periods in this stratified state. Because of this, it is important to collect strong baseline data for the timing of lake turnover in Wasa to compare to moving forward. Additionally, continued profiling through the stratified season will help track the available habitat within the water column at the Wasa Lake deep site for sensitive species such as salmonids. Lakes will vary in how they respond to a warmer climate, which supports the need to collect as much data as possible on Wasa Lake and other BC lakes.

Dissolved Oxygen

Dissolved oxygen (DO) is essential to aquatic life in lakes. Oxygen from the atmosphere dissolves and mixes into the water’s surface and is also released from plants and algae during photosynthesis. Oxygen is consumed by respiration of animals and plants, including the decomposition of dead organisms by bacteria. A great deal can be learned about the health of a lake by studying oxygen patterns and levels.

Generally, lakes with lower nutrients and algae production will have sufficient DO to support life at all depths throughout the year. As lakes become more nutrient and algae rich there is increased plant and animal respiration and decay, resulting in more oxygen consumption. This is especially true near the bottom of the lake, where dead organisms can accumulate, and oxygen is depleted more rapidly. Stratified lakes with low oxygen concentrations in the isolated bottom layer can impact the behaviours and locations of fish residing within the lake. As mentioned above, many fish species, especially salmonids, show signs of stress at temperatures greater than 18ºC and DO concentrations less than 4 mg/L and begin to move up the water column to areas with higher DO concentrations. Fish kills can occur when decomposing or respiring plants and algae use up the oxygen supply. In summer, this can happen on calm nights after an algal bloom, but most fish kills occur during late winter or at initial spring mixing.

Volunteers collected dissolved oxygen profiles during the current monitoring program (2022-2024). Some of the historical years (2004-2006) had limited dissolved oxygen data; however, it was only for an "upper" and "lower" depth, not a full profile. For this reason, the early data will not be graphed to compare to current profiles, but the historical report will be referenced as applicable.

Figure 5 shows that the bottom waters (hypolimnion) of Wasa Lake remained depleted in dissolved oxygen as compared to the epilimnion throughout the full monitoring seasons of 2022-2024, with anoxic conditions at and below 12 meters depth during much of the summer.

In 2022, the DO depletion begins increasing by the July 22 profile, with a maximum of 6 meters near the bottom of Wasa Lake containing less than 4mg/L of DO. As mentioned above, salmonids show signs of stress at temperatures greater than 18ºC and dissolved oxygen concentrations less than 4 mg/L (Truelson, 1997). It is important to note that the depth of the profiles varied throughout the monitoring season due to the natural fluctuation of the water levels in Wasa Lake. So, for analysis purposes, it is more important to refer to the shallowest depth at which DO levels drop below 4mg/L each year. In 2022, DO levels dropped below 4 mg/L to a depth of 9 meters and below (August 5, August 22, August 26, September 6, and September 10). In 2023, DO levels dropped below 4mg/L to a depth of 10 meters and below (August 31, September 9, and September 14), and in 2024, to a depth of 8 meters and below (August 7, August 15, and August 22).

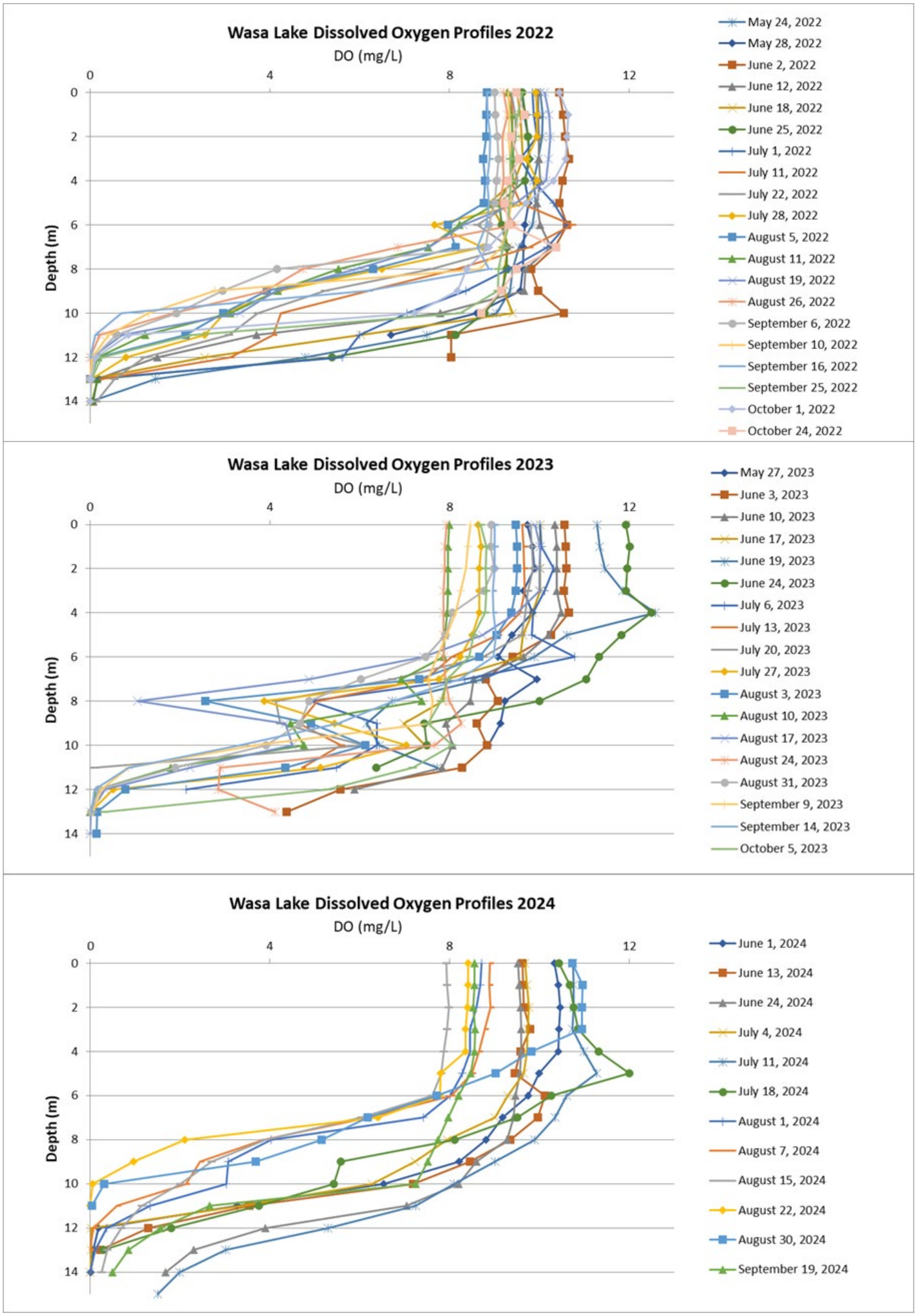


Figure 5. Wasa Lake Dissolved Oxygen Profiles 2022-2024

2024 saw the greatest heat penetration and most DO depletion (reaching the shallowest depth) out of all 3 years monitored at the Wasa Lake deep site. On occasion, the zone of comfortable conditions for salmonid species at the Wasa Lake deep site that was less than <18 °C and contained >4mg/L DO was eliminated within the water column in 2024. This occurred between the profiles conducted on August 1, 2024 – August 22, 2024. During the 2022 and 2023 monitoring seasons, there remained at least 1 meter within the water column that was less than 18°C and contained more than 4 mg/L DO.

It is clear that the most significant DO depletion occurs during the late summer stratified period, as is often the case with most lakes. This is due to the length of time that the epilimnion is separated from the hypolimnion, restricting oxygen exchange between the layers. Over time, oxygen is used up in the hypolimnion through decay and respiration, resulting in lower levels of DO as stratification persists. This is important to monitor going forward, as climate change may act to increase the length of time many lakes stay stratified, which will further reduce DO concentrations in hypolimnion during late stratified periods.

The depleted DO levels in the hypolimnion can have many implications for the chemical, physical, and biological characteristics of Wasa Lake. For example, under aerobic (oxygenated) conditions, much of the phosphorus in a lake is bound to iron, manganese and/or calcium contained in lake bottom sediments. When bottom waters become anoxic, chemical changes occur in the sediments that result in phosphorus being released into the water column. When the lake begins to turn over, the phosphorus is mixed into the photic zone where algae and plants can utilize it, sometimes resulting in blooms. This phenomenon is known as internal loading. Iron, manganese, and hydrogen sulphide (H2S) can also be released into the water during these anoxic periods (BCLSS, 2022).

Continued monitoring of DO is recommended going forward. For subsequent years of data collection, it is recommended that profiles be conducted as soon as possible from ice-off and continue at least biweekly into fall. Capturing spring and fall overturn is important to establish more substantial baseline data on Wasa Lake's timing of turnover and compare to the limited historical data on fall overturn. It is also important to determine whether oxygen is being replenished fully to the bottom of Wasa Lake in both the spring and the fall. Climate change may result in earlier onset of stratification and longer periods in this stratified state, which cause further depletion of DO levels in Wasa Lake late in the stratified period.

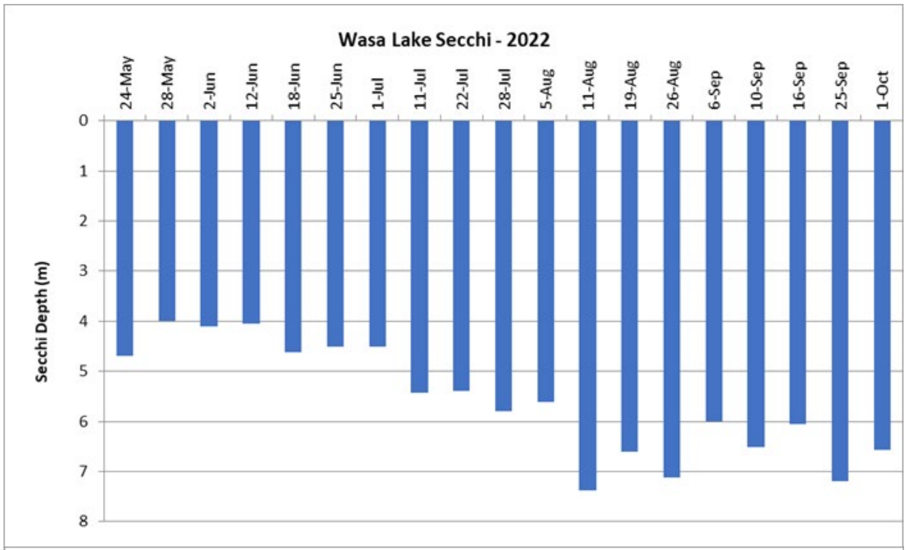
Water Clarity

Water clarity is an indicator of algae, suspended sediments, and other particles in the water. The clarity of the water can be evaluated by using a Secchi disk, a 20 cm diameter black and white disc that measures the depth of light penetration. Natural variation and trends in Secchi depth and temperature occur not only between years but also throughout one season. In general, as temperatures increase during the summer months, Secchi depth typically decreases. This is due to algal growth patterns; as the temperature of the lake increases, so do some species of algae. Due to the increase in algae, the water clarity can decrease. However, there can be other influences on Secchi readings, such as suspended solids from turbid inflowing streams.

Volunteers collected Secchi readings at the Wasa Lake deep site through both current and historical monitoring programs. It should be noted again that none of the early years met the minimum data requirements of 12 samples evenly spread between spring and fall. However, the current program has met or surpassed the minimum requirement of 12 readings each year and the results for those years are displayed in **Figure 6**. The 2009 Wasa Lake BCLMSP report discussed that water clarity readings may be affected by the resuspension of bottom sediments in this relatively shallow lake. Additionally, the previous BCLSS report noted that volunteer monitors witnessed the churning of bottom sediments by boat propellers when the water levels in the lake were low (BCLSS, 2009; Berg, 2025). These are important characteristics of Wasa Lake that may impact Secchi readings and should be considered during analysis.

Figure 6 supports that the clarity of Wasa Lake varies throughout the monitoring season. Spring tends to have some of the lower Secchi readings from the year, which may overlap with snowmelt bringing sediments into the lake or a spurring of algal growth after spring overturn. August saw some of the deeper Secchi readings in Wasa during the 2022 and 2023 monitoring seasons, while in 2024, August had some of the lowest readings of the year. These low readings in August of 2024 happened during the time when Wasa Lake had the greatest heat penetration, and most DO depletion (< 4 mg/L DO reaching the shallowest depth) out of all 3 years monitored at the Wasa Lake deep site. This could point to algae potentially being the cause of these low August readings in 2024. However, the resuspension of bottom sediments due to high boating activity cannot be ruled out. It is recommended that in future years, volunteers make notes and observations on the colour of the water as well as notes about any visible suspended sediment and amount of boat traffic while monitoring. These observations will be beneficial for determining if low Secchi readings are caused by increasing algal growth or by suspended sediment.

Because Wasa Lake has suffered significant algal blooms in recent years (Berg, 2025), a chlorophyll-*a* monitoring program is recommended. Though Secchi is often a useful indicator for algae growth, Wasa Lake may experience substantial suspended sediment impacts, so chlorophyll-*a* monitoring would better advise current primary productivity rates in Wasa Lake.


Wasa Lake Secchi - 2022
24-May
28-May
2-Jun
12-Jun
18-Jun
25-Jun
1-Jul
11-Jul
22-Jul
28-Jul
5-Aug
11-Aug
19-Aug
26-Aug
6-Sep
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Secchi Depth (m)
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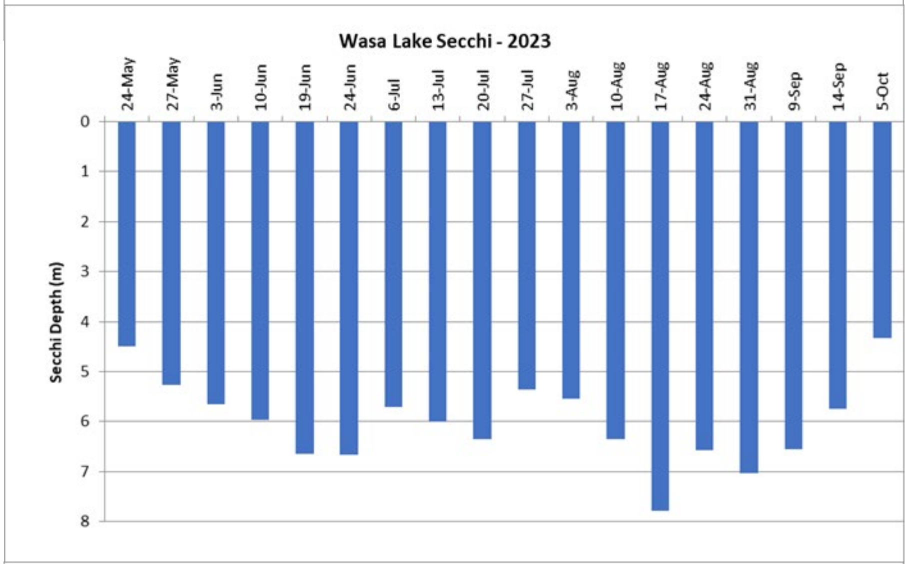
Wasa Lake Secchi - 2023
24-May
27-May
3-Jun
10-Jun
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20-Jul
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3-Aug
10-Aug
17-Aug
24-Aug
31-Aug
9-Sep
14-Sep
5-Oct
Secchi Depth (m)
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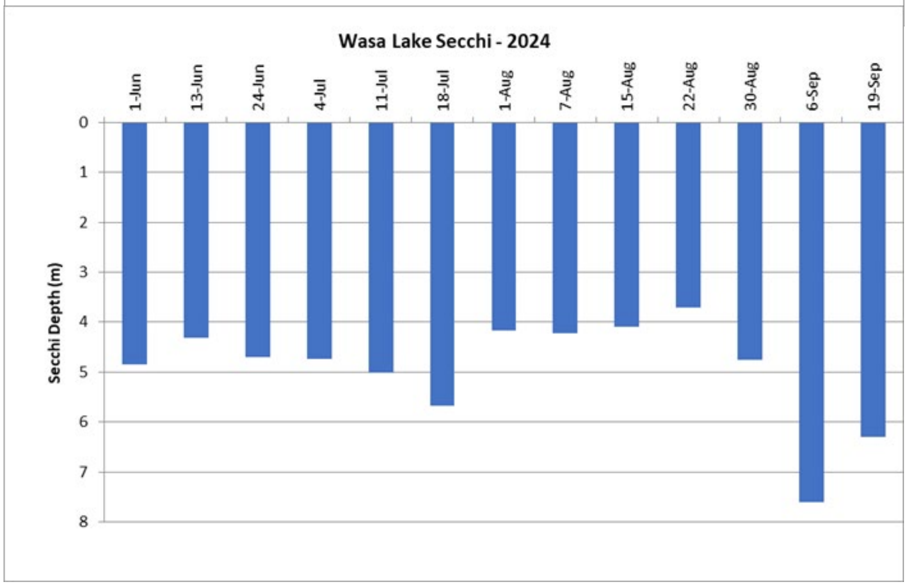
Wasa Lake Secchi - 2024
1-Jun
13-Jun
24-Jun
4-Jul
11-Jul
18-Jul
1-Aug
7-Aug
15-Aug
22-Aug
30-Aug
6-Sep
19-Sep
Secchi Depth (m)
0
1
2
3
4
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6
7
8

Figure 7 displays the Secchi summary statistics for 2004-2006 and 2022-2024. Though some Secchi data is available for 2003 and 2007, it has been excluded from this figure due to the very limited number of readings during those years (n=2 in 2003, n=3 in 2007). The variation in the spread of the data (monitoring season) and the limited number of readings in the early years may significantly impact the comparisons of summary statistics between historical and current data. The early years of monitoring have readings earlier in the season than the current monitoring program, which is when most of the years saw their minimum readings. Additionally, the early years of data collection often did not follow the ideal Secchi reading timeframe of monitoring between 10:00am-2:00pm. Many of the monitoring visits were outside this timeframe, which can impact Secchi readings due to the angle of the sun and the ability of light to penetrate through the water column.

Though it appears that clarity may have increased in Wasa since the previous monitoring program, because of the limitations in the data, no conclusions about changes in Secchi summary statistics can be drawn from this data set. However, the current monitoring program has set a stronger baseline to compare to moving forward by surpassing minimum data requirements. It is recommended that going forward, the volunteers continue to monitor Secchi but with an emphasis on evenly spaced readings between ice-off until turnover is captured in the fall.

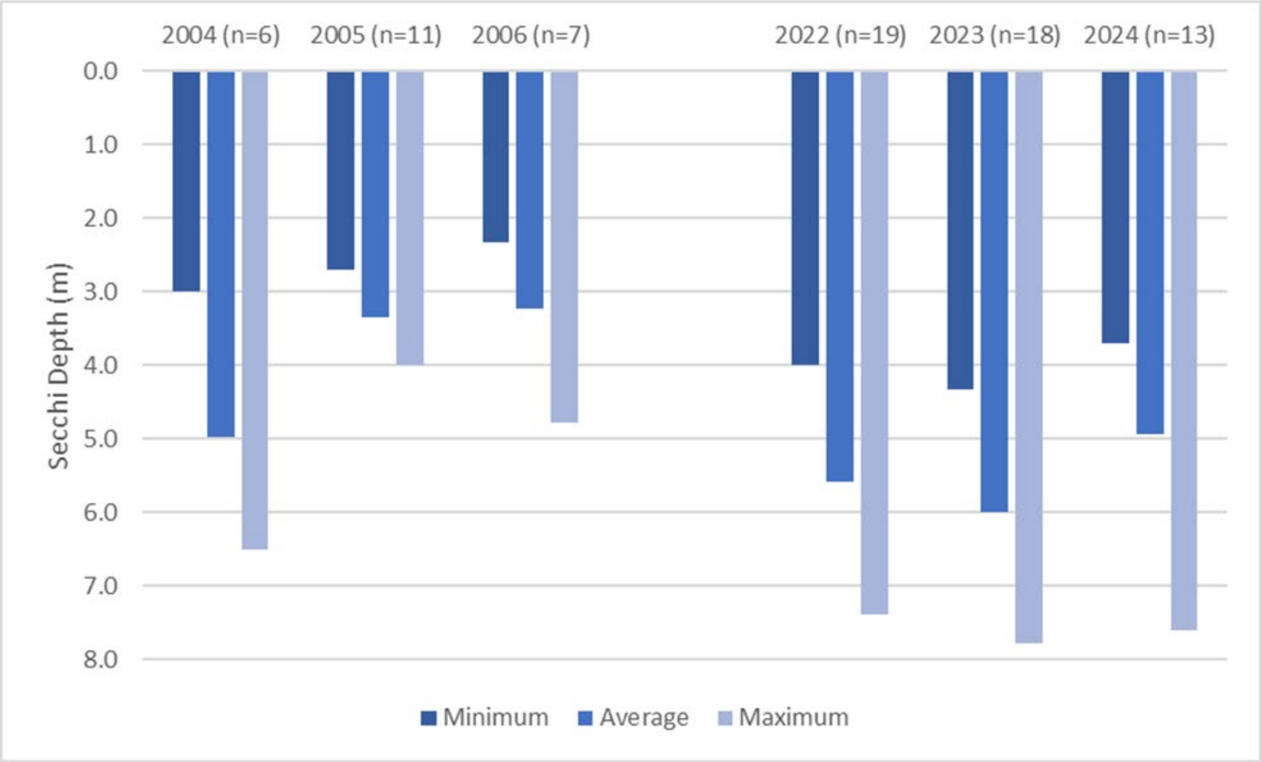

Figure 7. Wasa Lake Secchi Summary Statistics and number of observations (n) for 2004-2006 and 2022-2024

Trophic Status

Trophic status describes the level of biological productivity within a water body and is measured using Secchi depth, chlorophyll-a, and total phosphorus concentrations (Nordin, 1985). Low-productivity lakes are called oligotrophic and tend to have clear water and sufficient oxygen for aquatic life throughout the year. Lakes with moderate productivity are called mesotrophic. Eutrophic lakes have high productivity and often have high densities of aquatic plants and/or algae. Algal blooms may occur in these lakes frequently, reducing recreational opportunities and potentially impacting aquatic habitats.

Based on the average of total phosphorus data collected during fall overturn[1] from 2003-2005 and for 2007, BCLSS (2009) determined that Wasa Lake was exhibiting oligotrophic conditions. Historical Secchi data indicated mesotrophic conditions; however, BCLSS (2009) concluded that

[1] Because there was limited data collected during spring overturn, the 2009 BCLSMP report opted to use total phosphorus data collected during fall overturn data instead as an indicator of trophic status (BCLSS, 2009)

the total phosphorus data was a more reliable indicator of trophic status due to the potential impacts of sediment resuspension on Wasa Lake clarity readings.

Current Secchi readings place Wasa Lake in the mesotrophic category; however, like the 2009 report, Secchi data should not be relied on as a sole indicator for determining the current trophic status of Wasa Lake. Dissolved oxygen depletion levels in the lake are more indicative of a mesotrophic or eutrophic lake. When considering this, coupled with the large algal blooms that Wasa has experienced in recent years, a Level 3 BCLSM program is recommended to provide more insight into the current trophic status of Wasa Lake.

Table 2. Wasa Lake trophic indicator results (as per Nordin, 1985).

Parameters	**Trophic Categories**			**Wasa Lake**			
	Oligotrophic	Mesotrophic	Eutrophic		Historical BCLSMP Program (years indicated in columns below)		Level 1+ BCLSMP (2022-2024)
Chlorophyll-a (µg/L)	0 - 2	2 - 7	>7				
Secchi Depth (m)[1]	>6.0	3.0 - 6.0	<3.0		**3.9** (2004-2006)		**5.5**
Total phosphorus (µg/L)[2]	1 - 10	10 - 30	>30		**5.4** (2003- 2005, 2007)		

[1] Average of all years' average Secchi depth, [2] Average of 4 samples taken over 2003-5 and 2007 during "fall mixed conditions" (taken from BCLSS, 2007)

A Level 3 BCLSM Program includes bi-weekly monitoring of multi-depth water chemistry and biological sampling conducted by volunteers. This program would provide current data on Wasa Lake's chlorophyll-*a* and total phosphorus levels throughout the monitoring season. In addition to this, it is recommended that volunteers and residents on Wasa Lake continue to report all algal blooms to Algae Watch BC, and if the bloom is suspected to be cyanobacteria, it should also be reported to Interior Health and people/animals should stay away from the water. All blooms should be regarded with appropriate caution due to the potential toxicity of cyanobacteria. Learn more about cyanobacteria in this article – Cyanobacteria Blooms: Be Cautious of Potential Toxicity.

Summary

Wasa Lake is a small, shallow kettle lake with substantial shoreline development. The lake is advertised as the warmest swimming lake in the Kootenays, which makes it a common vacation destination for families (BC Parks, 2023). Wasa Lake has also become very popular with the motorized boating community, which has led to community concerns about user safety, shoreline erosion, and bottom sediment resuspension (Berg, 2024). Wasa Lake was monitored under a Level 1 enhanced BCLSM Program by the Wasa Lake Land Improvement District between 2022 and 2024. There is also some limited historical data available through a past BCLSM Program conducted between 2004-2006.

Data collected through the current program showed warm surface water temperatures, surpassing the preferred range for salmonid species (>18 ℃) deeper into the water column through each of the current years of monitoring. On one occasion in 2024 (July 18) the water in Wasa Lake surpassed 25°C down to four meters depth. If the entire water column warms in future years and surpasses 25 °C, the lethal temperature limit for many salmonid species will be reached (Ashley, 2024). Though Wasa Lake is likely to have naturally elevated surface water temperatures due to its physical characteristics, if increased heat penetration is a pattern in the Lake, it could have many implications for the physical, chemical, and biological characteristics of Wasa Lake, so this should be monitored going forward.

Dissolved oxygen depletion in the hypolimnion was evident throughout the monitoring season each year, as spring or fall turnover was not captured through this program. On occasion, the zone of comfortable conditions for salmonid species at the Wasa Lake deep site that was less than <18 ℃ and contained >4mg/L DO was eliminated within the water column in 2024. This occurred between the profiles conducted on August 1, 2024 – August 22, 2024.

Current Secchi data indicates that Wasa is experiencing mesotrophic conditions; however, Secchi should not be relied on as a sole indicator of trophic status for Wasa Lake due to sediment resuspension likely impacting readings. The historic Wasa Lake report used fall turnover phosphorus data to determine that Wasa Lake was exhibiting oligotrophic conditions during the 2003-2007 monitoring period. However, current dissolved oxygen depletion levels in the lake are more indicative of a mesotrophic or eutrophic lake. When considering this, coupled with the large algal blooms that Wasa has experienced in recent years, a Level 3 program is recommended to provide more insight into the current trophic status of Wasa Lake.

Going Forward

There is strong evidence that climate change is exacerbating existing issues in lakes that are already experiencing problems. One climate change impact already observed in many northern hemisphere lakes is earlier onset and longer periods of stratification, which may make internal nutrient loading more problematic

(Woolway et al., 2020). Wasa Lake is a small, moderately shallow lake with a highly developed shoreline and likely a low flushing rate, which makes it susceptible to impacts from both climate change and the accumulation of pollutants.

If there is volunteer interest and capacity, continued monitoring at a Level 1 enhanced program or at a Level 3 Program (bi-weekly monitoring of multi-depth water chemistry and biological sampling) at the Wasa Lake Deep site from early spring to fall overturn would be beneficial to help understand Wasa Lake's stratification pattern and give better insight into its productivity. These data are important for long-term lake condition records and will provide early warning signs of deterioration in water quality. It is also recommended that monitoring include ice-on and off dates.

In addition to the monitoring recommendations above, volunteers and residents on Wasa Lake should continue to report all algal blooms to Algae Watch BC, and if the bloom is suspected to be cyanobacteria, it should also be reported to Interior Health, and the beaches should be closed.

Keeping Wasa Lake Healthy

- The Wasa Lake Foreshore Inventory and Mapping Report found that 60% of the lake's foreshore area was disturbed through anthropogenic (human-induced) modifications (McPherson et al., 2009). Preventing the removal of riparian vegetation around Wasa Lake will help to protect the water quality of the lake. Adequate shoreline protections, including healthy riparian buffer zones, can mitigate development impacts on water quality and fish habitat (Dosskey et al., 2010). Emphasis on preserving and restoring native overhanging vegetation on the shoreline of Wasa Lake may also help to combat the high water temperatures. Riparian vegetation provides an important source of shading and temperature control for streams and lakes (B.C. Government, n.d).

- It is recommended that Wasa Lake residents learn more about algal blooms and stay vigilant. If you observe a bloom that you believe could be cyanobacteria and it is impacting drinking or recreational waters, it is important to contact the local health authority and stay away from the water. In addition, please submit your observations to Algae Watch BC. Algae Watch is an educational program for Citizen science data gathering with the goals to help people recognize and identify algae blooms and relies on citizen science to help water quality experts identify and better understand cyanobacteria and algal blooms in B.C.

  In addition to learning more and reporting possible blooms there are ways individuals can reduce their impacts on lakes to help reduce the likelihood of blooms including:
  - Maintaining healthy riparian areas
  - Reducing fertilizer applications

- Maintaining septic systems and ensuring they abide by regulations
- Using phosphate-free products
- Agricultural landowners should consider environmental farm planning. More information on Environmental Farm Plans is available here.

- Wasa Lake is popular with the motorized boating community, and wake boats have become a particular concern in the community (Berg, 2024). Large wake and prop wash from boats can erode shorelines, swamp habitats and nests and cause habitat disturbance and sediment resuspension in shallow waters. Sediment can be churned up by boats, which can disturb habitat, clog fish gills, smother vegetation, suffocate fish eggs, and release nutrients like phosphorus, which can promote weed growth and algal blooms (BCLSS, 2021). Mercier-Blais and Prairie (2014) found that energy produced by the wake boats they studied dissipated completely if the passage of the boat occurred 300 meters or more from shore. A study by Larratt Aquatic Consulting found that bottom sediments in water as deep as 8 m can be impacted by wake boats (Self, 2019). Wake boats are advised to stay away from shorelines and avoid shallow areas to protect Wasa Lake.

- A recreational carrying capacity study could be a good next step for Wasa Lake. The study could look at the impacts of boating and other forms of recreation on the lake and if there is any cause for concern regarding the safety and enjoyment of user groups or ecological impacts. There are examples of these studies from other lakes in BC, and one recent example is a Recreational Carrying Capacity Study that was done on Windermere Lake by the Lake Windermere Ambassadors, Ecoscape Environmental Consultants Ltd., and Laratt Aquatic Consulting Ltd. Once the results of this study are reported, a recreation management plan that includes all stakeholders would be a good step in ensuring community safety and limiting ecological damage to Wasa Lake.

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