Lazy Lake 2008, 2021-2023
BC Lake Stewardship and Monitoring Program
Summary Report

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's focus is on understanding water clarity, temperature, oxygen, and nutrients because these factors contribute to the basic understanding of lake processes which influence biological productivity. Concerns about productivity are common, specifically because high productivity can negatively impact recreation, drinking water and aquatic health due to harmful algal blooms. For more information about the BCLSMP please visit www.gov.bc.ca/lakestewardshipmonitoring.

Photo 1. Photo of Lazy Lake

Background

Lazy Lake (Rock Lake) is located approximately 10 km North-East of the town of Wasa in the East Kootenays. The lake is recorded to have a surface area of 31.57 ha, a perimeter of 3.9 km, and lies at an elevation of 909 m. The average depth of Lazy Lake is recorded as 5.3 m, and the deepest point is recorded as 10.7 m according to a bathymetric map from July 18, 1959, produced by the Fish and Wildlife Branch of the Department of Recreation and Travel (B.C. Gov, n.d). However, it is important to note that the water levels in Lazy Lake fluctuate by an estimated 1.5 meters throughout the year, as the

primary input into the lake is from a partial diversion of Lewis Creek (Williams, 2024). Residents have reported that the only other tributary into Lazy Lake is a tiny creek that they refer to as Diriet Creek (Williams, 2024).

The conditional water licenses (No. 41056 and No. 109117) governing the Lewis Creek diversion allow water to be diverted into Lazy Lake from May 15 to July 31 and from October 1 to November 30 each year. The Regional District of East Kootenay (RDEK) works with the community at Lazy Lake to control the water level during these months by diverting water from Lewis Creek. The RDEK website states that adjustments can only be made when there is enough water reaching the outfall structures of the diversion, so the lake level can only be adjusted when water levels in the creek are sufficient, and water cannot be diverted when the creek is too low (RDEK, n.d). Water diverted from Lewis Creek into Lazy Lake flows through a pipe, then through a shallow, open trench, the majority of the approximately 0.75 km path into the lake; see **Photo 2** (Williams, 2024). The diversion channel travels through private land in the Agricultural Land Reserve before it passes under the road and between two cabin properties to enter the lake (Williams, 2024).

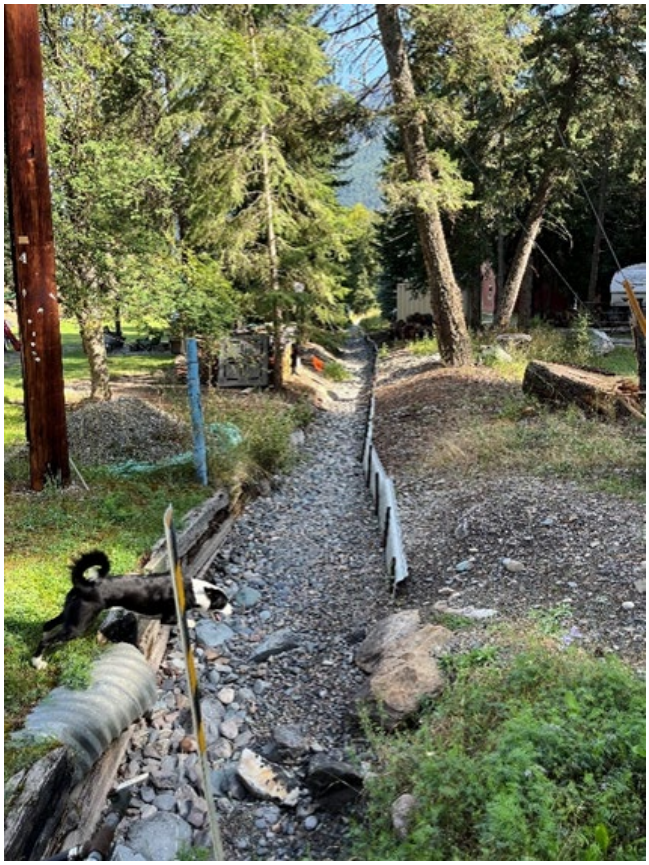

Photo 2. Photo of a section of the Lewis Creek diversion channel. Photo by Norma Williams (2024)

A portion of the Lewis Creek drainage experienced a severe forest fire in 2021, referred to as the Bill Nye Fire. Forest fires can have a wide array of impacts on freshwater ecosystems, including but not limited to, increasing the temperature of water due to a reduction in vegetation that would typically provide thermal shading, increased erosion and turbidity, as well as increased nutrient loading (Baxter & Ashley, 2023). A post-wildfire natural hazards risk analysis was completed in 2022 by SNT Geotechnical Ltd. who were retained by the Ministry of Forests Lands Natural Resource Operations (BC Wildfire Service). The report discusses the area impacted by the Bill Nye Fire and the potential consequences of the fire on the surrounding land. It is beyond the scope of this report to conduct an in-depth review of the Bill Nye fire risk analysis. To access the complete analysis, please visit the Regional District of East Kootenay Website.

Lazy Lake is a popular recreation destination for swimming, paddling and fishing. No gas-powered boats are allowed on the lake, but small electric motors are permitted. Lazy Lake was stocked with rainbow trout until 2004, and after that, it was stocked annually or twice annually with triploid (sterile) or all-female triploid rainbow trout (FFSBC, 2024). There is limited historical limnological information on Lazy Lake. However, a Kootenay Region Small Lakes Fisheries Assessments report cited a report by Balkwill from 1959 and included some information about Lazy Lake from 2012. The report focused on sampling fish and water chemistry to evaluate stocking rates and management regimes and includes some useful background about Lazy Lake. Worth noting from this information is that it is believed that Lazy Lake "was chemically rehabilitated with toxaphene in 1964 to eliminate nongame fish such as suckers, mountain whitefish and northern pikeminnow, though no paper records of this event were found" (Lamson, 2012).

At the north end of Lazy Lake is a campground with 14 sites that are managed by a host living onsite during the season (Williams, 2024). Additionally, there are 29 cabins directly adjacent to the lake and a popular day-use area on the West side of the lake (Williams, 2024). The East side of the lake borders a fairly steep mountain which restricts development along that shore. However, there is a small hiking trail along the northeast side that leads to a rope swing area. Much of the natural riparian vegetation seems to be intact around Lazy Lake, except for a few lawns to the water's edge and cleared recreation spots. A few cabins pull water from the lake for non-drinking purposes (Willaims, 2024). Though

residents report a general perception of high-quality water in Lazy Lake, concerns have been raised about the considerable amount of goose feces around the lakeshore during the summer months (Williams, 2024).

Lazy Lake contains extensive areas of white sediment, indicating a potential marl lake due to calcium carbonate deposition. Marl lakes are less sensitive to phosphorus inputs; however, no testing was conducted to determine if Lazy Lake is indeed a marl lake.

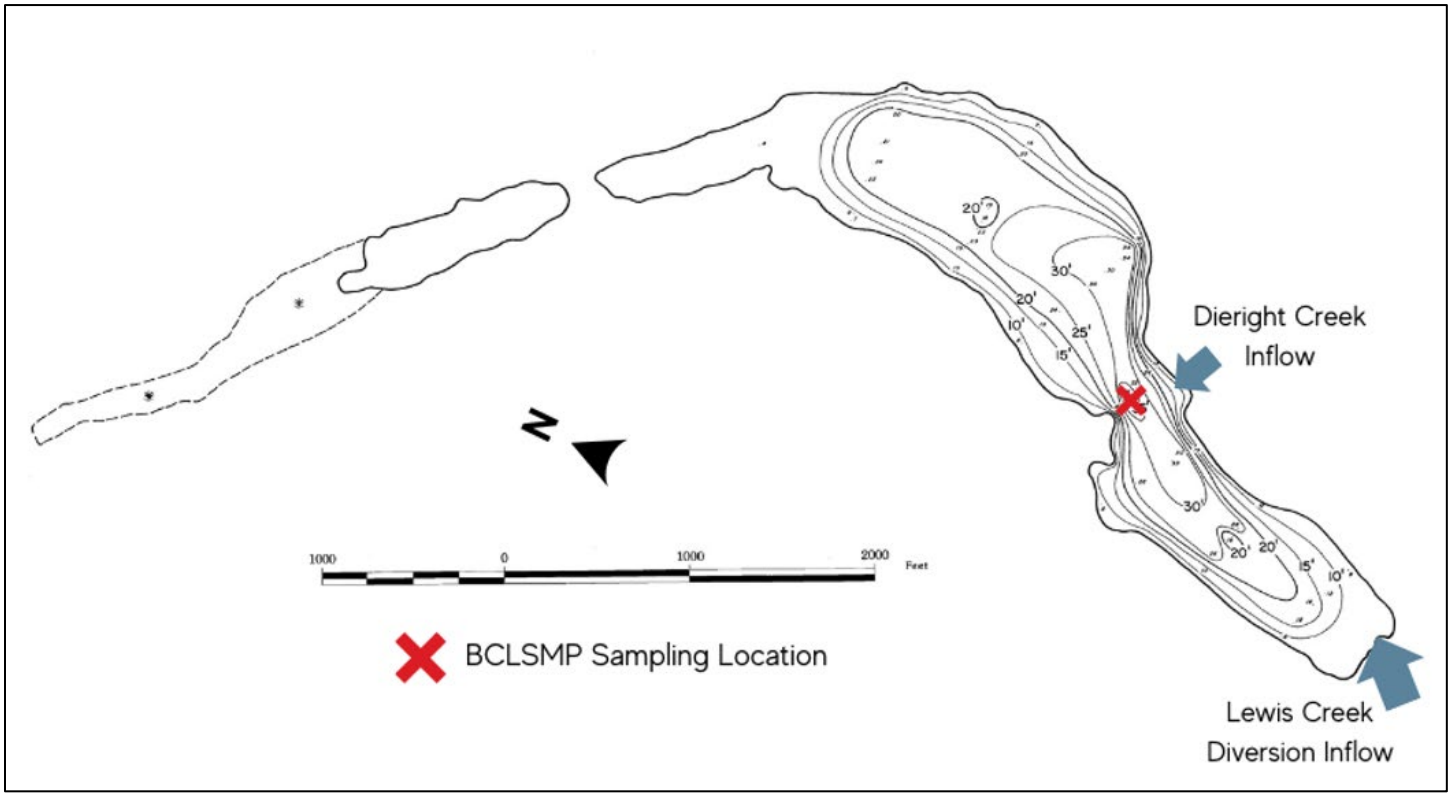

Figure 1. Bathymetric map of Lazy Lake, including BCLSMP Deep Station sampling site identified by the **red x**.

Monitoring Approach

This report summarizes Level 1 Study data collected by volunteers from the Lazy Lake Environmental Association (LLEA) from 2008 and 2021-2023. A Level 1 BCLSMP Study collects information from the lake location that best represents the entire lake, such as centre or deepest point, and includes monitoring surface temperature and water clarity (Secchi depth). In addition to surface temperature and clarity, in some years, volunteers were able to take temperature and dissolved oxygen profiles at depth intervals in Lazy Lake. The years that include profiles from this program are 2022 and 2023. 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 with understanding what is happening in aquatic environments and observing long-term trends.

Level 1 BCLSMP water quality information was collected from Lazy Lake Deep Station through July and August 2008 during 8 sampling events, which does not meet the minimum data requirements of 12 samples spread evenly throughout the ice-off to ice-on season, however the 2021-2023 data does meet the minimum data requirements. Data was collected

between April and October during 12 sampling events in 2021, 14 in 2022, and 12 in 2023. Secchi depth and surface temperature were collected at each outing, and full temperature and dissolved oxygen profiles (i.e., measured at 1 m intervals throughout the water column) were collected during some sampling events in 2022 and all sampling events in 2023.

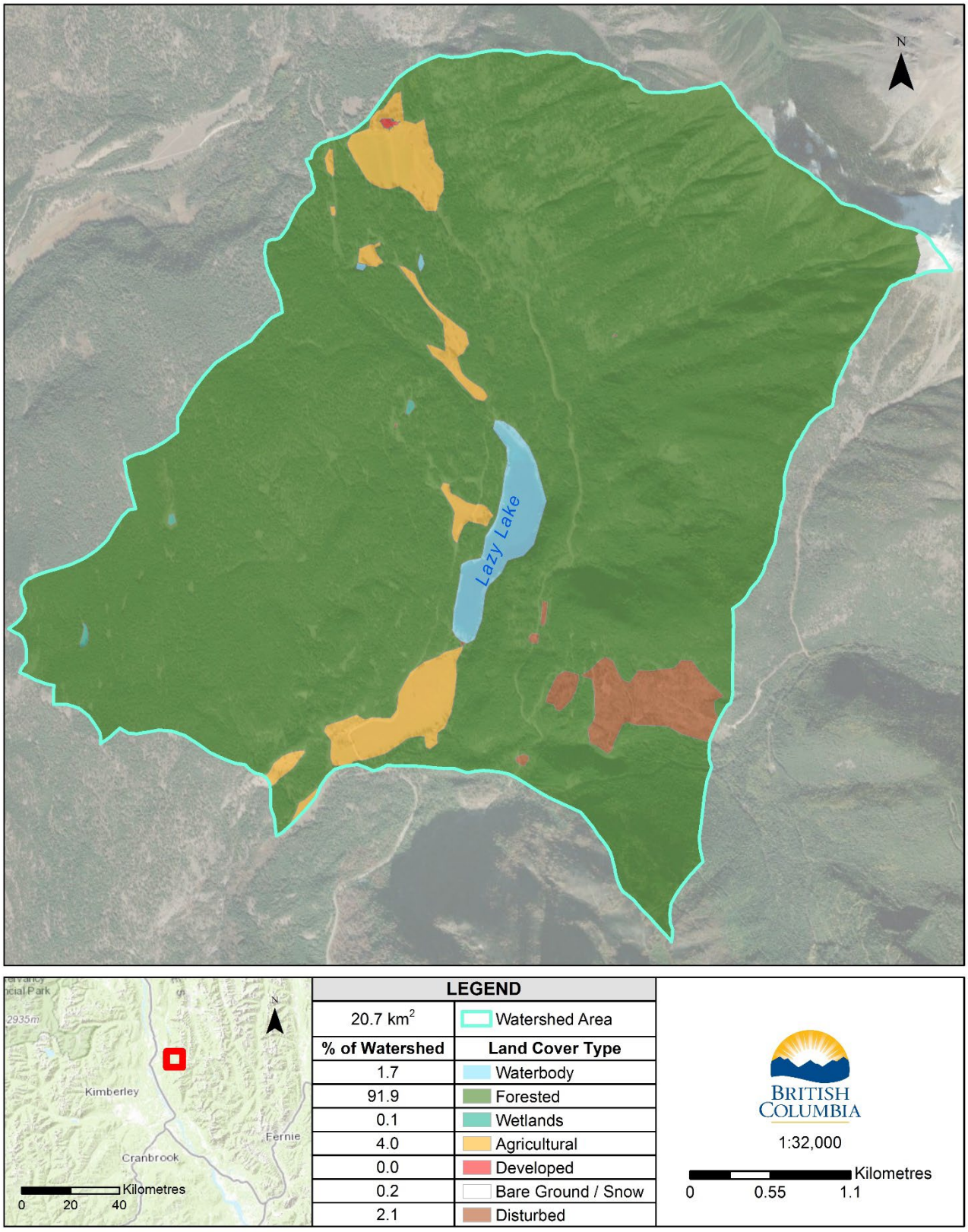

Figure 2. Lazy Lake watershed and associated land uses

Surface Temperature

Surface temperature readings serve as an important ecological indicator. By measuring surface temperature, we can record and compare readings from season to season and year to year. Surface temperature helps to determine much of the seasonal oxygen, phosphorus, and algal conditions. Volunteers collected surface temperature readings throughout the 2008 and 2021-2023 monitoring seasons. **Figure 3** shows the minimum, mean, and maximum surface temperature readings recorded at the monitoring site from 2008 and 2021-2023 and the number of readings each year (n). The minimum data requirement of 12 readings spread evenly throughout the sampling season was met for 2021-2023, but not for 2008. It is important to note that the 2008 readings only spanned from July through August. This difference in monitoring season between 2008 and the current years (2021-2023) may impact the overall summary statistics shown in **Figure 3**. To better assess the data for any potential changes, **Figure 4** shows summary statistics for surface temperature readings collected in just July and August for all years. **Figure 4**, showing readings only during the months of the 2008 readings (July and August), supports that the difference between historic (2008) surface temperatures and current (2021-2023) is not substantial as it appears to be in **Figure 3**.

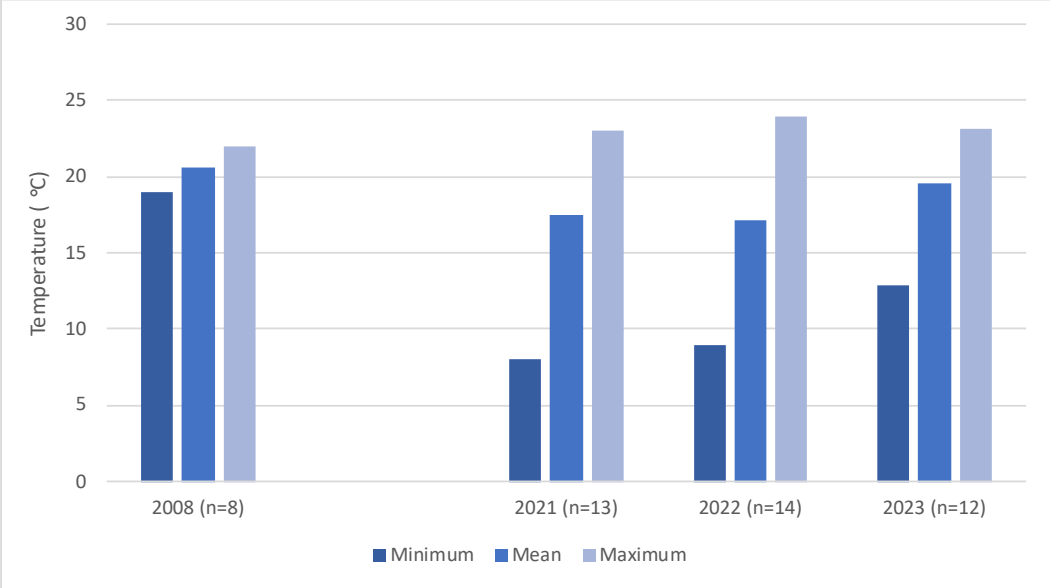

Figure 3 Lazy Lake Surface Temperature Summary 2008, 2021-2023

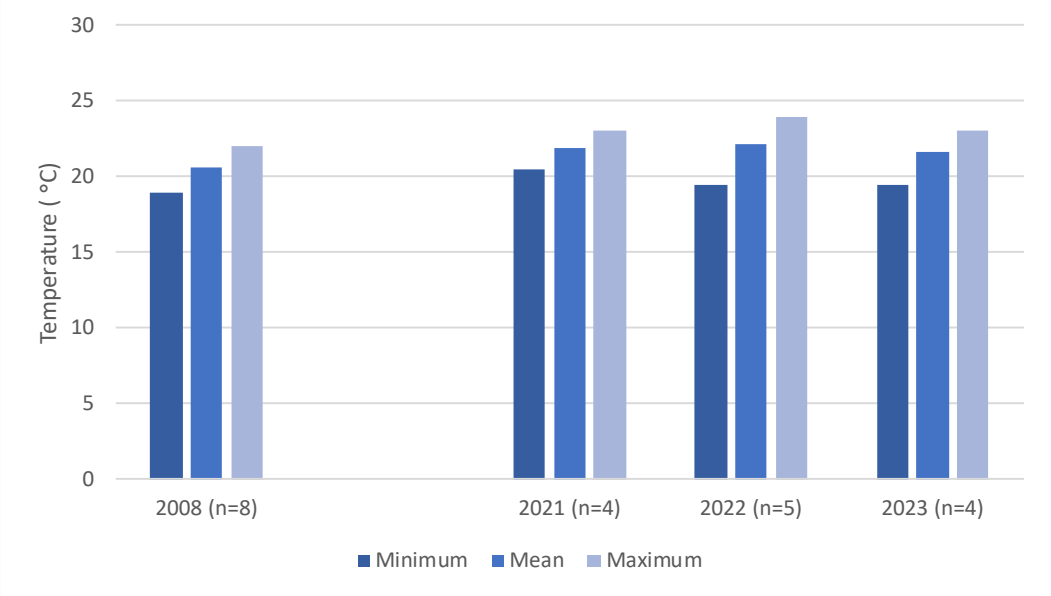

Figure 4 Lazy Lake Summer (July and August) Surface Temperature Summary 2008, 2021-2023

When considering **Figure 3**, it should be noted that the 2021 data collection started two weeks earlier (April 15, 2021) than in 2022 (April 30, 2022) or 2023 (May 1, 2023), which is when the year saw its lowest surface temperature, so the minimum temperature in 2023 appears elevated compared to the previous years. However, in 2023, data collection started the latest of all three years and ended the earliest. The shortened sampling season likely skewed the seasonal data resulting in an elevated minimum reading that should not be interpreted as a true increase to the minimum surface temperature of Lazy Lake.

The maximum surface temperature reading collected was 24.0°C (recorded on August 12, 2022). The minimum surface temperature recorded was 8°C (recorded on April 15, 2021). The average summer (July and August) surface temperature average of Lazy Lake ranged from 20.6 °C (2008) to 22.10°C (2022).

Temperature and Dissolved Oxygen

In addition to surface temperature, in 2022 and 2023 temperature and dissolved oxygen profiles (multiple depth measurements) were also collected from Lazy Lake. 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 heavier at 4°C and less dense (i.e., lighter) at both colder and warmer temperatures. During the summer, lakes usually experience a layering effect called stratification, with the warmer, less dense water sitting on top of the cooler and heavier water, separated by a thermocline. 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 to multiple times per year. During the mixing process, the bottom waters get recharged with oxygen, and nutrients are brought up to the surface. Lakes shallower than 6 meters may remain mixed throughout the summer, while lakes up to 9 meters deep may de-stratify for short periods during summer wind events, which can significantly influence nutrient cycling in such lakes (BCLSS, 2022).

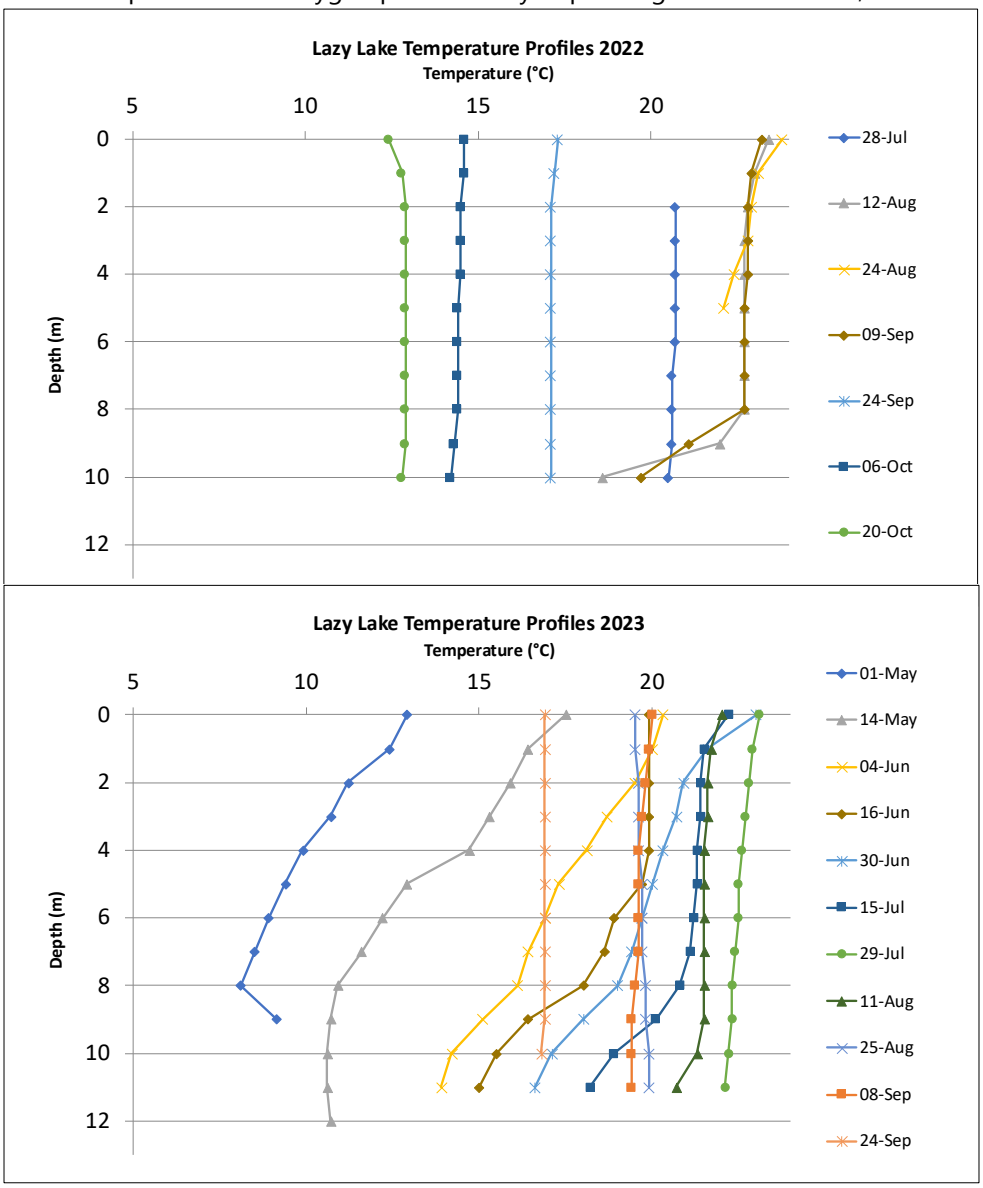

Figure 5 Lazy Lake Temperature Profiles 2022 and 2023

Temperature Profiles

The temperature profiles started at the end of July in 2022 due to the LLEA acquiring a field meter later in the summer, while 2023 had a more even spread of profiles throughout the sampling season. **Figure 5** shows temperature profiles taken during the 2022 and 2023 monitoring periods.

The 2023 profiles show how surface waters warm and the lake is stratifying in spring and early summer. However, the lake does not remain stratified long, and heat begins to penetrate the bottom waters (destratifying the lake). The lake is near isothermal by the July 29, 2023 profile, with the lake water warm from surface to bottom. The July 29, 2023 profile shows a surface water temperature of 23.1 °C while at 11 m deep, the water is only cooler by 1 degree at 22.1 °C. This is an uncommon behaviour in northern hemisphere lakes, as lakes deeper than 9 meters typically stratify throughout the summer (BCLSS, 2022). In 2022, it appears that Lazy Lake stratified in August and early September with cooler waters below the thermocline of around 8-10m indicating that the lake may move in and out of stratification depending on the year.

The warm water extending from surface to depth in Lazy Lake during the majority of the summer season likely has implications for the salmonid species that the lake contains. 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). Considering the monitoring site is located on the deepest part of the lake, there are likely few places with cooler temperature refuges for these sensitive species. In many lakes incoming tributaries may offer cool temperatures and high oxygen refuges, however Lazy Lake depends on water from a diversion of Lewis Creek that first passes through a very shallow, open trench (Williams, 2024). This may be causing warming of the water diverted from Lewis Creek during the summer when air temperatures are high, possibly resulting in water entering the lake at warmer than normal temperatures. Further research into the potential warming of Lewis Creek water between the diversion and the entrance to Lazy Lake is warranted to determine if it may be possible to slow the warming of Lazy Lake.

Lazy Lake appears to warm throughout the water column in 2023, avoiding the late summer stratification that may typically be expected of a lake this deep. 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 will likely result in a fish kill if there are limited cool temperature refuges for these sensitive species. The temperature profiles collected in 2022 and 2023 on Lazy Lake provide valuable information for comparison moving forward. For subsequent years of data collection it is recommended that profiles continue to be conducted as soon as possible from ice-off and continue at least biweekly into fall. This is important to determine if Lazy Lake is becoming warmer. Lakes will vary in how they respond to a warmer climate, which supports the need to collect as much data as possible on Lazy Lake and other BC lakes.

Dissolved Oxygen Profiles

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 concentration. 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.

From looking at the 2022 and 2023 profiles, Lazy Lake does not appear to stratify for long periods of time throughout the summers, which, as discussed above, can result in lower dissolved oxygen concentrations in bottom waters that are cut off from the atmosphere. Despite this, the lake may experience lower dissolved oxygen levels than many lakes throughout the water column due to the warm temperatures. This is because dissolved oxygen concentrations are also dependent on the temperature of the water, with the amount of dissolved oxygen greater in cooler than in warmer waters. Higher water temperatures result in increased molecular vibrations which reduces the amount of space available between the water molecules, while cooler water is more dense than warmer water and dissolved oxygen molecules stay trapped more readily in the water.

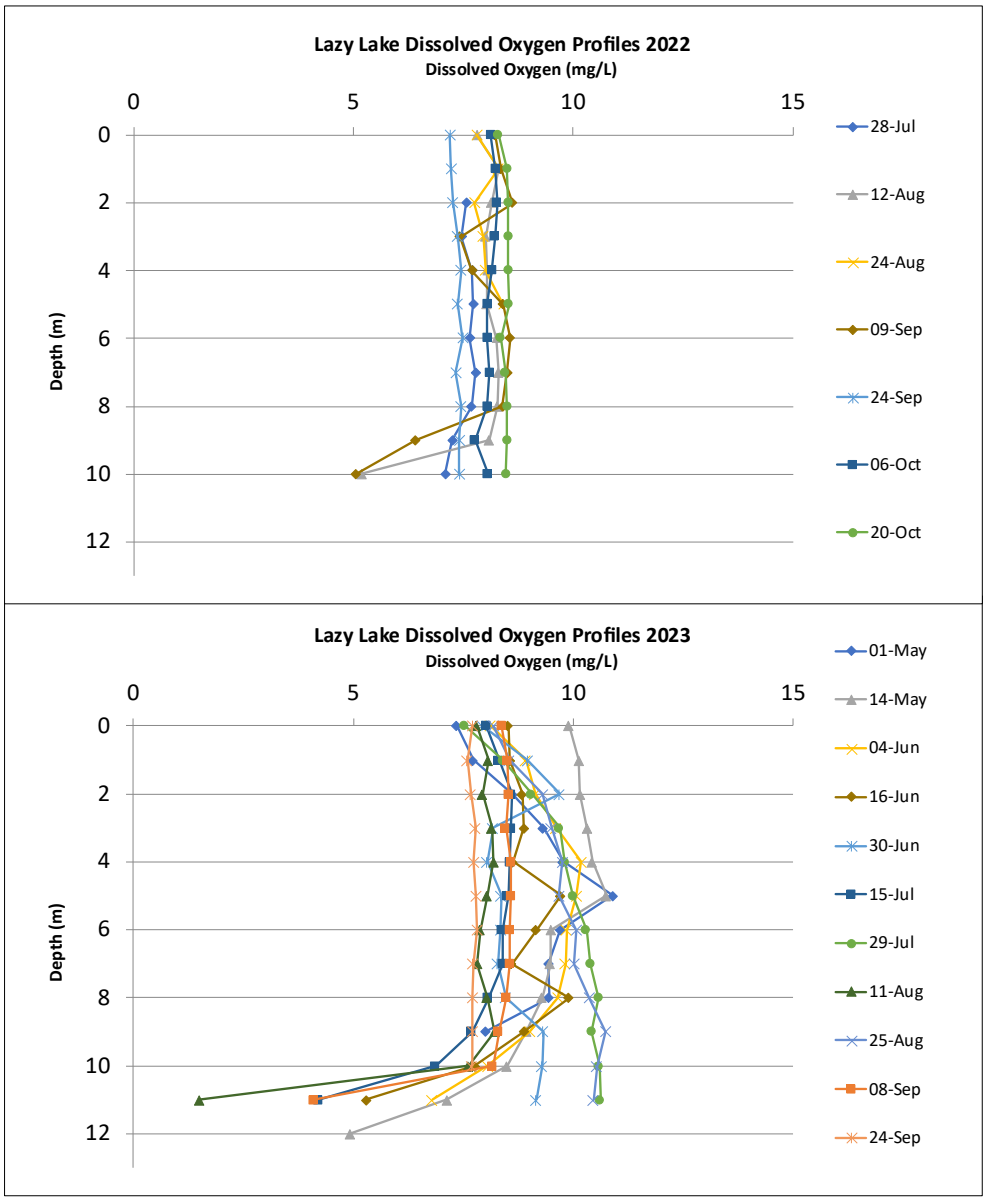

Figure 6 Lazy Lake Dissolved Oxygen Profiles 2022 and 2023

The profiles taken in 2022 indicate that the dissolved oxygen concentration in Lazy Lake appears to stay relatively constant from the first profile taken on July 28, 2022 to the last profile of the season taken on October 20, 2022. The exception to this is that there is a notable drop in dissolved oxygen below 8 m deep during the time the lake was stratified in August and early September. The September 9, 2022 dissolved oxygen profile coincides with a drop in temperature below 8m deep during the same monitoring outing. This profile also overlaps with a drop in Secchi depth from 8.75 on August 24, 2022, to 4.25 on September 9, 2022 (please refer to the water clarity section below).

The DO profiles in 2023 vary more from visit to visit than the profiles in 2022, with spring measurements indicating that the lake was beginning to stratify as a thermocline appeared between 4 and 5 meters deep during the May 14, 2023 profile. Dissolved oxygen readings during the spring of 2023 appeared to be highest around this thermocline at 5 meters, referred to as a positive heterograde curve (B.C. Ministry of Environment, 1997). As discussed above, as temperature decreases, the solubility of oxygen increases, making cooler waters able to store more dissolved oxygen when mixing occurs. A positive heterograde curve can occur when the thermocline lays within the photic zone and photosynthesis occurring in this area raises dissolved oxygen while the temperature gradient prevents mixing into the upper or lower waters. As the thermocline disappears and the lake begins to warm to the bottom, the high mid-water dissolved oxygen readings disappear as DO becomes relatively constant with depth, as seen in 2022. There are some depleted readings near the bottom in August and September when the lake stratified below 8m.

It should be noted that the YSI Pro20 probe that the LLEA acquired was likely giving inaccurate dissolved oxygen readings in 2023. A BCLSS staff member visited Lazy Lake to compare their YSI ProSolo to the readings the LLEA were getting with their field meter in 2023, and noted that the readings between probes varied by around 0.3-0.5 mg/L. Despite the variability in readings the data suggests that the water column at the Lazy Lake deep site contained sufficient dissolved oxygen levels throughout the monitoring period to comfortably support salmonid species.

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 disc, a 20 cm diameter black and white disc that measures the depth of light penetration. Natural variation and trends in Secchi depth and temperature not only occur 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.

Water clarity was measured at the Lazy Lake Deep Station in 2008 and from 2021-2023. The graphs in **Figure 7** show the Secchi readings collected by volunteers from 2021-2023. The minimum data requirement of 12 readings over the sampling season was met or exceeded each year from 2021-2023, and the spread of measurements was relatively evenly distributed from spring to fall. **Figure 7** shows that Lazy Lake generally seems to experience some of its lower Secchi readings towards the end of summer. This may be associated with late summer algal blooms that could last into the fall.

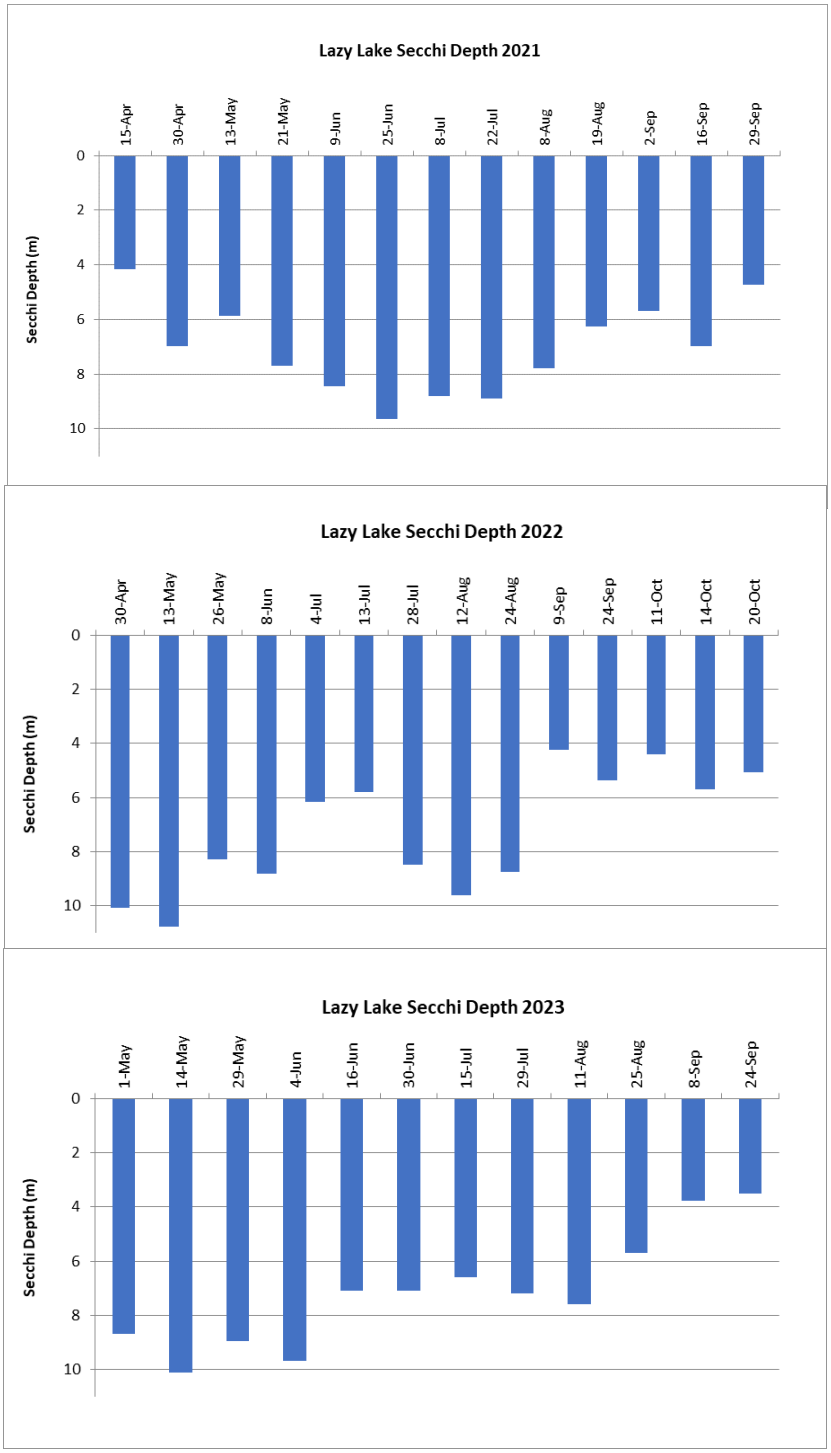

Figure 7 Lazy Lake Secchi Readings 2021-2023

Figure 8 shows the minimum, average, and maximum Secchi depths recorded at the monitoring site, as well as the number of readings each year (n). The minimum data requirement of 12 readings over the sampling season was not met in 2008 but was met for all recent years (2021-2023). Again, it is important to note that the spread of the 2008 measurements was limited to July and August which makes comparison to the current dataset difficult. To account for this difference in the spread of the data between historical and current years, **Figure 9** compares the summary statistics of readings taken only in July and August for all years. The data presented in **Figures 8 and 9** do not indicate any substantial changes in Secchi depth between the historical data (2008) and current data (2021-2023). However, more than one year of

historical data would be required to conclude whether significant changes occurred between the monitoring years. Most parameters, including Secchi readings, are prone to seasonal and yearly variations in lakes which is why the BCLMSP requires a minimum of 12 evenly spaced readings and 3 consecutive years of data to understand each lake's normal conditions. Based on the need for multiple years of data, and a seasonal spread of data from ice off to ice on, Lazy Lake now has baseline data for comparison going forward.

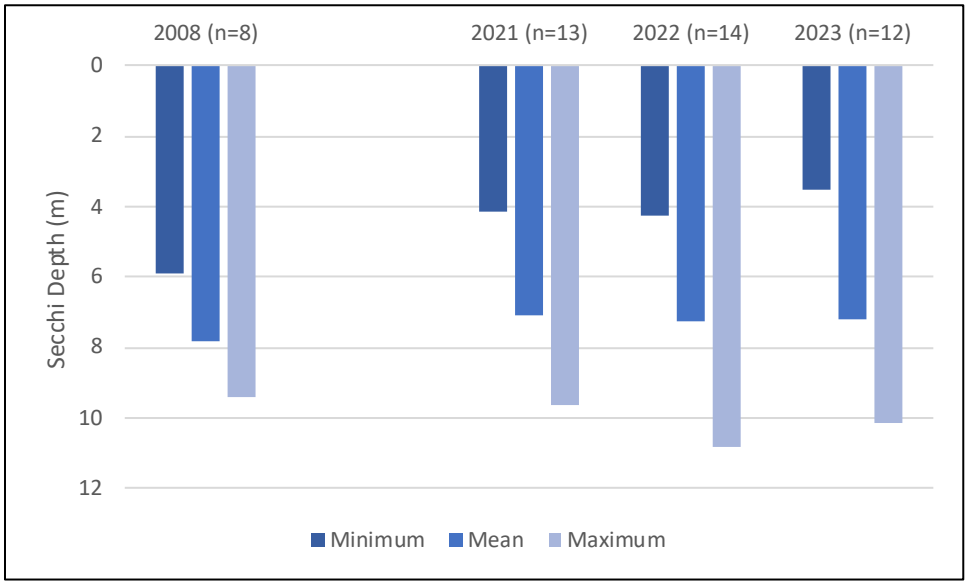

Figure 8 Lazy Lake Secchi Summary Statistics 2008, 2021-2023

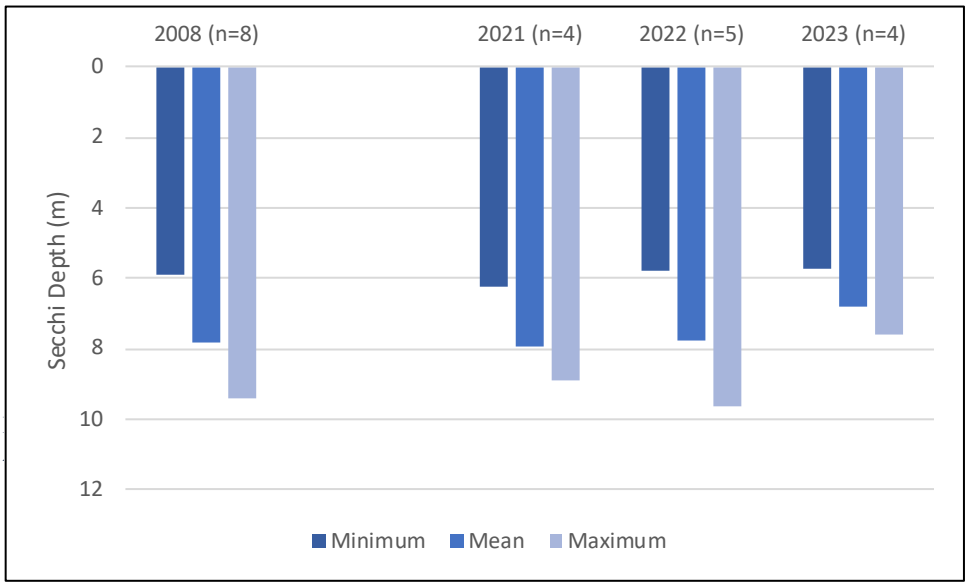

Figure 9 Lazy Lake Secchi Summary Statistics for July and August 2008, 2021-2023

Summary

Lazy Lake is a relatively small, warm lake. The lake is popular for paddling, swimming, and fishing. The Lazy Lake Environmental Association monitored the lake under the BCLSMP Level 1 program for three years, between 2021 and 2023. There is also a limited amount of data from 2008 that was collected through this program. In 2022 and 2023, the volunteers obtained dissolved oxygen (DO) and temperature profiles on Lazy Lake, indicating that Lazy Lake may not always stratify in the late summer and can experience significant warming throughout the water column. The entire water column at the Lazy Lake deep site in the late summer period of 2023 was warmer than the preferred temperatures for salmonid species. The July 29, 2023, profile shows that the entire water column at the Lazy Lake deep site ranged from 22.1°C to 23.1°C. If these temperatures surpass 25°C, it could result in a lake-wide fish kill of the sensitive salmonid species if there are no cold temperature refuges for the fish. Dissolved oxygen depletion does not appear to be a significant concern at present; however, it should continue to be monitored in the future.

Because of the limited amount of historical limnological data available for Lazy Lake, the data collected by the LLEA through this program has provided valuable baseline data for comparison going forward.

Going Forward

Due to the elevated temperatures throughout the water column in Lazy Lake, continued temperature profiling is highly recommended. Considering Lazy Lake is a popular fishery and is approaching the upper temperature tolerance for salmonid species, we recommend that a long-term management plan for the lake is completed in the coming years. There is strong evidence that climate change is exacerbating existing issues in lakes and creating issues where issues did not exist, whether expected or unexpected. This will make the management of BC's water resources more challenging. A long-term management plan for Lazy Lake could help address issues before they reach a critical level. All stakeholders should be consulted, including the Freshwater Fisheries Society of BC, which stocks Lazy Lake with rainbow trout.

If there is volunteer interest and capacity, continued monitoring should be done through an Enhanced Level 1 BCLSMP program: Secchi depth, dissolved oxygen (DO) and temperature profiles at Lazy Lake Deep Station from spring into fall is recommended. The Lazy Lake Environmental Association should consider upgrading to a newer probe, as their YSI Pro20 has caused them issues in the past and has been found to be less user friendly than newer models. BCLSS would recommend that the group purchase a YSI ProSolo to continue collecting dissolved oxygen and temperature profiles on Lazy Lake. These data are important for long-term lake condition records and will provide early warning signs of deterioration in water quality and if the water temperature in Lazy Lake approaches the lethal limit for salmonid species in the coming years.

It is also recommended that monitoring include ice-on and off dates which can be submitted online through BC Ice Reporting Tool (https://arcg.is/qy1e5).

Keeping Lazy Lake Healthy

1. A long term management plan could research options such as extending the water license on Lewis Creek later into the season to ensure flow into the lake through the warmest months and/or possibly keeping the lake deeper to induce stratification. However, both options will need to be thoroughly assessed before acting and the appropriate agencies would need to be consulted.

2. Research into the potential warming of Lewis Creek water between the diversion and the entrance to Lazy Lake is warranted. The channel that brings water from Lewis Creek into Lazy Lake is a shallow, open trench, which may be

subjecting the water to additional warming before entering Lazy Lake. The Lazy Lake Environmental Association may wish to set up HOBO temperature loggers at the diversion from Lewis Creek, as well in the diversion channel just before the entrance to Lazy Lake to determine if there is significant warming occurring within the channel. Temperature loggers are inexpensive and easy to use.

If the temperature of the diverted water is indeed warming significantly between where the water leaves Lewis Creek and where the water enters Lazy Lake, investigating channel modifications to shade or deepen the channel to attempt to minimize warming of the diverted water could be a potential step toward protecting the popular trout fishery in Lazy Lake as well as the water quality.

3. Emphasis on preserving and restoring overhanging vegetation along any portion of Lewis Creek that was burned in the 2021 Bill Nye fire (upstream of the diversion), along the diversion channel, and along the shoreline of Lazy Lake may 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). Additionally, having more native riparian vegetation versus open areas along Lazy Lake will deter geese (Maslo & Lewis, 2013), which will have the additional positive of combating the resident's concerns about goose feces along and in the lake.

4. Due to the large amount of agricultural land along the inlet stream, excess nutrient loading (nitrogen and phosphorus) could be an issue for the lake. It is recommended that agricultural landowners in the area consider environmental farm planning. More information on Environmental Farm Plans is available here.

Other Tips for Keeping Lazy Lake Healthy:

See link under Monitoring Resources on: www.gov.bc.ca/lakestewardshipmonitoring
BCLSS's LakeKeepers Manual: https://www.bclss.org/programs#lake-keepers-manual

Who to Contact for More Information

The Ministry of Environment and Parks	**The BC Lake Stewardship Society**
3rd Floor, 1011-4th Ave Prince George, BC V2L 3H9 Email: volunteerlakes@gov.bc.ca Website: www.gov.bc.ca/lakestewardshipmonitoring	Box 110, 5505 Jacobson Road, Big Lake Ranch, BC, V0L 1G0 Email: info@bclss.org Website: www.bclss.org

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Lake Report Production by: Amy Baxter (BCLSS)
Report Review: Norm Zirnhelt (BCLSS) and Kirsten McNeill (ENV)
Land Use Map by: Kim Klaczek (ENV)

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