BC Lake Stewardship and Monitoring Program

Cameron Lake 2016-18

A partnership between the BC Lake Stewardship Society and the BC Ministry of Environment and Climate Change Strategy

BCLSS

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

The Importance of Cameron Lake & its Watershed

British Columbians want lakes to provide good water quality, aesthetics, and recreational opportunities. When these features are not apparent in our local lakes, people begin to wonder why. Concerns often include whether the water quality is getting worse, if the lake has been impacted by land development or other human activities, and what conditions will result from more development within the watershed.

The BC Lake Stewardship Society (BCLSS), in collaboration with the Ministry of Environment and Climate Change Strategy (ENV), has designed a program, entitled *The BC Lake Stewardship and Monitoring Program*, to address these concerns. Through regular water sample collections, we can come to understand a lake's current water quality, identify the preferred uses for a given lake, and monitor water quality changes resulting from land development within the lake's watershed. There are different levels of lake monitoring and assessment. The level appropriate for a particular lake depends on the funding and human resources available. In some cases, data collected as part of a Level I or II program can point to the need for a more in-depth Level III program. This report gives the 2016-18 results of a Level I program for Cameron Lake. Data was collected by the Mount Arrowsmith Biosphere Region Research Institute (MABRRI).

The BCLSS can provide communities with both lake-specific monitoring results and educational materials on general lake protection issues. This useful information can help communities play a more active role in the protection of the lake resource. Finally, this program allows government to use its limited resources efficiently with the help of local volunteers and the BCLSS.

A **watershed** is defined as the entire area of land that moves the water it receives into a common waterbody. The term watershed is misused when describing only the land immediately around a waterbody or the waterbody itself. The true definition represents a much larger area than most people normally consider.

Watersheds are where much of the hydrologic cycle occurs and play a crucial role in the purification of water. Although no “new” water is ever made, it is continuously recycled as it moves through watersheds and other hydrologic compartments. The quality of the water resource is largely determined by a watershed’s capacity to buffer impacts and absorb pollution.
Every component of a watershed (vegetation, soil, wildlife, etc.) has an important function in maintaining good water quality and a healthy aquatic environment. It is a common misconception that detrimental land use practices will not impact water quality if they are kept away from the area immediately surrounding a waterbody. Poor land use practices in a watershed can eventually impact the water quality of the downstream environment.

Human activities that impact water bodies range from small but widespread and numerous *non-point* sources throughout the watershed to large *point* sources of concentrated pollution (e.g. waste discharge outfalls, spills, etc). Undisturbed watersheds have the ability to purify water and repair small amounts of damage from pollution and alterations. However, modifications to the landscape and increased levels of pollution impair this ability.

Cameron Lake is located on central Vancouver Island, approximately 15 km east of Port Alberni, on Highway 4. The south shore is incorporated in the Little Qualicum Falls Provincial Park and MacMillan Provincial Park encompasses the southwest shore. The lake has two day-use areas, the Beaufort and Cameron Lake Day Use Areas. There is also a private campground located on the east end of the lake. Cameron Lake has several beaches and provides recreational uses such as canoeing, fishing, swimming, waterskiing, windsurfing, and paddle boarding.

Cameron Lake lies at an elevation of 184 m, has a surface area of 4.77 km^2 (477 ha), a volume of 1.34 Mm^3, a mean depth of 28 m, and a maximum depth of 46 m. It has a perimeter of 14 km, is 6 km long, and averages 1 km in width (Turner, 1997).

The main inflow to Cameron Lake is the Cameron River and the main outlet is the Little Qualicum River. Cameron Lake's outlet into the Little Qualicum River has been controlled by a weir since 1978. The Little Qualicum River has been designated by the Ministry of Environment as a 'Sensitive Stream' that requires special management attention, under the Fisheries Protection Act, because of risk to fish populations due to inadequate water flows and other habitat concerns (Regional District of Nanaimo, 2019).

The lake contains rainbow trout, cutthroat trout, kokanee, brown trout, steelhead, and prickly sculpins (FIDQ, 2019).

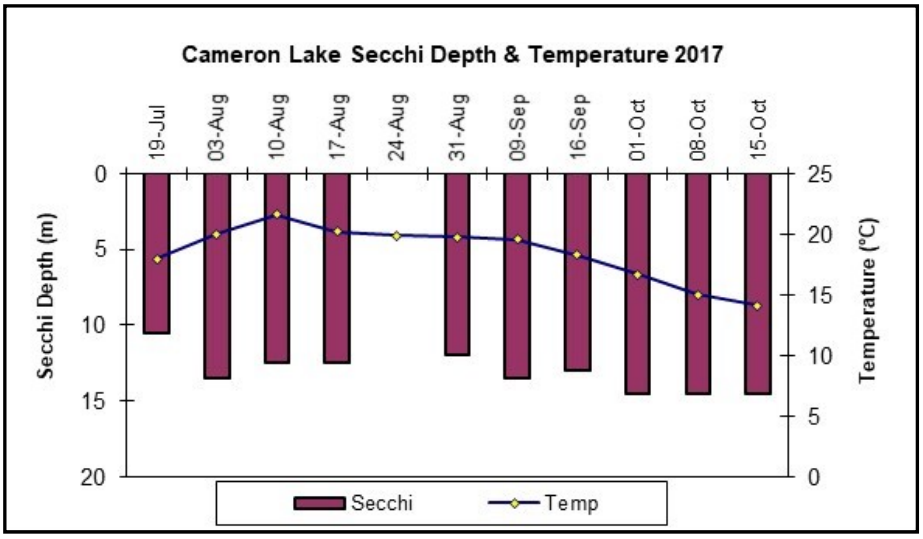
What's Going on Inside Cameron Lake?

Temperature

Lakes show a variety of annual temperature patterns based on their location and depth. Most interior lakes form layers (stratify), with the coldest water at the bottom. Because colder water is denser, it resists mixing into the warmer upper layer for much of the summer. In spring and fall, these lakes usually mix from top to bottom (overturn) as wind energy overcomes the reduced temperature and density differences between surface and bottom waters. In the winter, lakes re-stratify under ice with the densest water (4 °C) near the bottom. These lakes are called dimictic lakes because they turn over twice per year. They are the most common type of lake in British Columbia.

Coastal lakes in BC are more often termed warm monomictic lakes because they turn over once per year. These lakes have temperatures that do not fall below 4°C. Warm monomictic lakes generally do not freeze and circulate freely in the winter at or above 4°C, and stratify only in the summer. Cameron Lake is classified as a monomictic lake.

Ice-on and ice-off dates for BC lakes are important data for climate change research. By comparing these dates to climate change trends, we can examine how global warming is affecting our lakes. Cameron Lake does not freeze over.

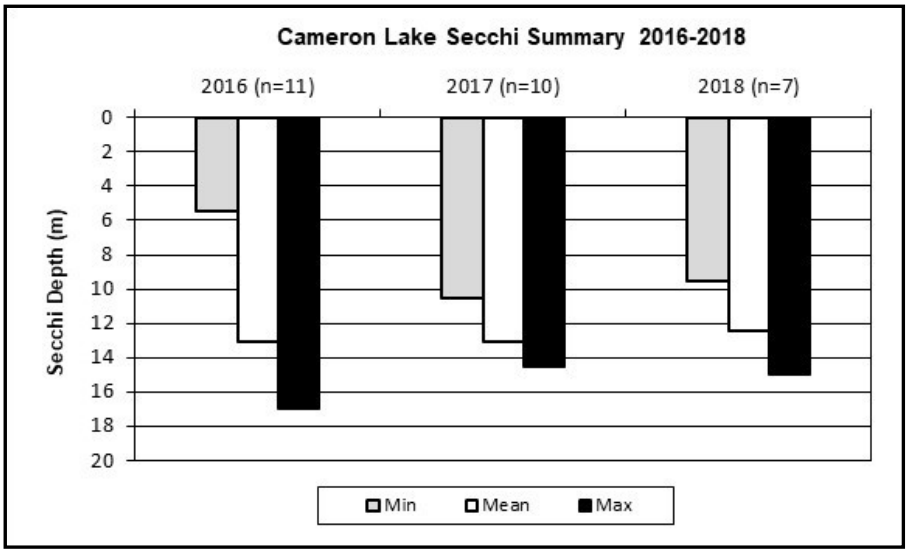


Surface temperature readings serve as an important ecological indicator. By measuring surface temperature, we can record and compare readings from season to season and year to year. Surface temperature helps to determine much of the seasonal oxygen, phosphorus, and algal conditions.

Surface temperature (T) and Secchi depth (water clarity) were measured at eastern end of Cameron Lake from 2016-18 (site marked on map on p. 3). Minimum data requirements of 12 samples were not met for all years. The adjacent graph illustrates the 2017 Secchi and surface temperature data from the sampling site. In 2017 the maximum temperature measured was 21.6°C (Aug 10) and the minimum was 14.1°C (Oct 15). The maximum surface temperatures measured in 2016 and 2018 were 21 °C (Aug 24) and 21.4 °C (Aug 9). Minimum surface temperatures were 12.2 °C (Oct 16) and 12.6 °C (Oct 11) in 2016 and 2018, respectively.

Trophic Status and Water Clarity

The term *trophic status* is used to describe a lake's level of productivity and depends on the amount of nutrients available for plant growth, including tiny floating algae called phytoplankton. Algae are important to the overall ecology of the lake because they are food for zooplankton, which in turn are food for other organisms, including fish. In most lakes, phosphorus is the nutrient in shortest supply and thus acts to limit the production of aquatic life. When in excess, phosphorus accelerates growth and may artificially age a lake. Total phosphorus (TP) in a lake can be greatly influenced by human activities.



One measure of productivity is water clarity. The more productive a lake, the higher the algal growth and, therefore, the less clear the water becomes. 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 decreases. As the temperature of the lake increases, so do some species of algae. Due to the increase in algae, the water clarity can decrease. This general trend is not strong in the data for Cameron Lake.

Readings were taken at a variety of locations throughout the monitoring period, however they were consistently collected near the deep site. The adjacent graph shows the minimum, average and maximum Secchi readings from 2016-18 and the number of readings for each year (n). The maximum reading during these years was 17.0 m (Aug 24, 2016) and the minimum was 5.5 m (Sep 29, 2016). This minimum reading is anomalous as the preceding and subsequent readings (Sep 26 and Oct 8) were 15 m and 16 m respectively. In 2017 and 2018, the September readings were 13-14 m. There were no reports of environmental events on Sep 29, 2016 that would influence the Secchi reading.

The average Secchi readings were 13.1 m, 13.1 m, and 12.4 m for 2016-18 respectively. The overall water clarity remained fairly con-

sistent during the sampling period. Based on these summer average Secchi values, Cameron Lake was exhibiting oligotrophic (>6 m Secchi depth) conditions (Nordin, 1985).

The flushing rate, another factor that affects water quality, is the rate of water replacement in a lake and depends on the amount of inflow and outflow. The higher the flushing rate, the more quickly excess nutrients can be removed from the system. The flushing rate for Cameron Lake is unknown.

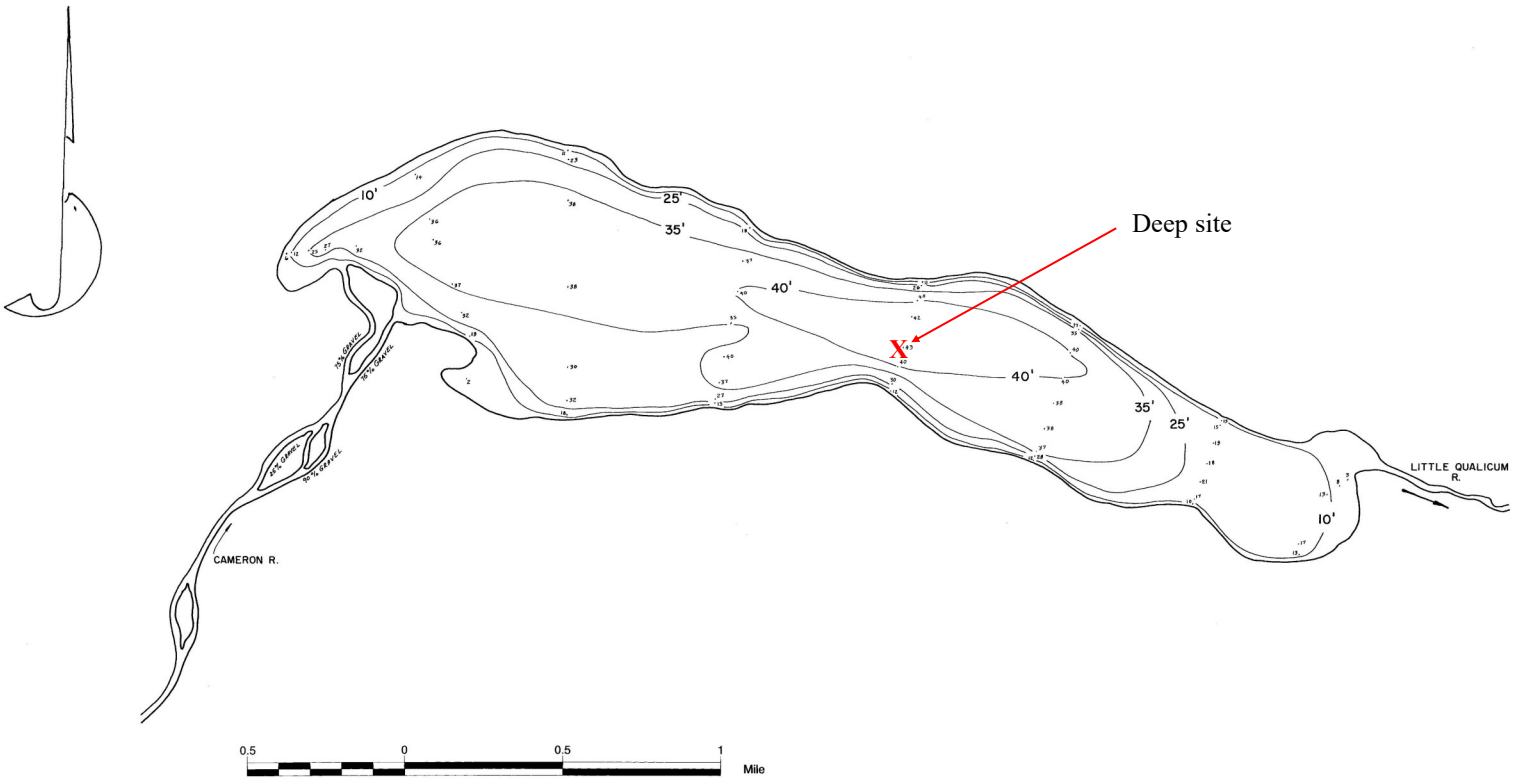
Land Use and Pollution Sources

There is little development on Cameron Lake, however forestry, gravel extraction, and residential development progress on surrounding lands. There are approximately 18 recreational leases with cabins on the north side of Cameron Lake (Turner, 1997). The private campground and day use areas receive the heaviest use in the summer months.

The Alberni Highway (Highway 4) runs alongside the south shore of Cameron Lake. This has the potential to introduce sediments and vehicle pollutants to the lake.

Growth and development within the watershed, in addition to an increased level of recreational use, could present challenges to maintaining water quality.

Cameron Lake Bathymetric Map



Caution: do not use this map for navigational purposes. Contours are in metres.

Lake surveyed July 4, 1951.

Should Further Monitoring be Done on Cameron Lake?

Generally, trophic status is based on a combination of parameters such as Secchi, nutrients, and chlorophyll *a*. Based on the Secchi data collected by volunteers on Cameron Lake from 2016-18, the water quality has remained stable throughout the sampling years. Average annual Secchi readings place the lake in the oligotrophic classification. This classification is desirable from a recreational and drinking water supply water quality perspective.

Mount Arrowsmith Biosphere Region Research Institute (MABRRI) volunteers also collected dissolved oxygen, turbidity, conductivity, and pH values, however those parameters are out of the scope of a Level 1 report.. This data could be used in a future, higher level assessment. Volunteer monitors are encouraged to continue collecting Secchi depth and surface temperature readings, which will provide valuable long term records and help identify early warning signs should there be a deterioration in water quality from its current state. A minimum of 12 evenly spaced samples taken at the deep site is recommended.

All recreational users and land developers within the watershed are advised to practice good land management so that nutrient migration to the lake and its tributaries are minimized.

Tips to Keep Cameron Lake Healthy

Camping and Recreation

- Ensure black and grey water are contained and disposed of at a sanitation station.
- When washing yourself or your dishes, dip water out of the lake using a clean container and move 30 m away.
- Dispose of used water by throwing it over a large area away from your site, the sites of others, and flowing or standing water.
- Use phosphate-free, biodegradable soaps.
- If you pack it in - pack it out. Remove all garbage including biodegradable soaps.
- Ensure all vehicles are well maintained and tuned to prevent fuel leaks.
- Pick up after your pets as their waste can lead to bacterial contamination of lake water.

Boating

- Do not throw trash overboard or use lakes or other water bodies as toilets.
- Use biodegradable, phosphate-free cleaners instead of harmful chemicals.
- Conduct major maintenance chores on land.
- Keep motors well maintained and tuned to prevent fuel and lubricant leaks.
- Use absorbent bilge pads for minor leaks or spills.
- Recycle used lubricating oil and left over paints.
- Clean off all aquatic plants, animals, and mud from boats and equipment before entering or leaving a lake.
- Do not use metal drums in dock construction. They rust, sink and become unwanted debris. Do not use non-encapsulated Styrofoam as this material often breaks up, litters beaches, and may be consumed by fish and other wildlife. All floats should be labelled with the owner's name, phone number, and confirmation that barrels have been properly maintained.
- Leading by example is often the best method of improving practices - help educate fellow boaters.

Land Maintenance

- Minimize the disturbance of shoreline areas by maintaining natural vegetation cover.
- Minimize high-maintenance grassed areas.
- Replant lakeside grassed areas with native vegetation. Do not import fine fill.
- Stop or limit the use of fertilizers and pesticides.
- Do not use fertilizers in areas where the potential for water contamination is high, such as sandy soils, steep slopes, or compacted soils.
- Do not apply fertilizers or pesticides before or during rain due to the likelihood of runoff.
- Use natural insecticides such as diatomaceous earth.
- Prune infested vegetation and use natural predators to keep pests in check. Pesticides can kill beneficial and desirable insects, such as ladybugs, as well as pests.
- Do not dispose of toxic chemicals (paints, varnishes, thinners, waste oils, or pesticides) on land or in waterbodies.

Who to Contact for More Information

Mount Arrowsmith Biosphere Region Research Institute
Vancouver Island University
900 Fifth Street, Nanaimo BC, V9R 5S5
Phone: 250-753-3245 local 2802
Website: http://mabrri.viu.ca/

Ministry of Environment and Climate Change Strategy
2080-A Labieux Rd, Nanaimo BC, V9T 6J9
Phone: 250-751-3100

The BC Lake Stewardship Society
1257 Erskine Street, Coquitlam, BC, V3B 6R3
Phone: 604-474-2441
Email: info@bclss.org
Website: www.bclss.org

Acknowledgements

Volunteer Monitoring by: Ryan Frederickson, Sarah Lumley Mike Anderson, Graham Sakaki, Kayla Harris, Nelson Lovestrom, Ashley Van Acken, Louise Frederickson, Allie Frederickson, Daryll Lawrence, Lauren Shaw, Maria Kawahara, Larissa Thelin, Nicole Frederickson, Haley Tomlin, Tom Frederickson, Roxanne Croxall, Brian Timmer, Kidston Short

Data Compiling and Brochure Produced by:
Dawn Roumieu (BCLSS)

Technical Review by:
Chris Swan (Ministry of Forests, Lands, Natural Resource Operations and Rural Development)

Photo Credit: Doug Wortley, Arrowsmith Media

Bathymetric Map: FIDQ (Fisheries Inventory Data Query)

References

FIDQ. 2018. Fisheries Inventory Data Query [online database]. http://a100.gov.bc.ca/pub/fidq/searchBathymetricMaps.do. Accessed Jan 29, 2019.

Habitat Wizard. 2019. http://www.env.gov.bc.ca/habwiz/. Accessed Jan 22, 2019.

Nordin, R. 1985. *Water Quality Criteria for Nutrients and Algae*. Water Quality Unit, Resource Quality Section. Ministry of Environment, Lands and Parks. Victoria, BC.

Pirani, Z. and G. Bryden. 1996. *Qualicum River Water Allocation Plan*. Ministry of Environment, Lands, and Parks Vancouver Island Region. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-planning/water_allocation_qualicum.pdf. Accessed Jan 29, 2019.

Regional District of Nanaimo. 2019. *Watershed 2: Little Qualicum River.* https://www.rdn.bc.ca/watershed-2-little-qualicum-river. Accessed Jan 29, 2019.

Tomlin, H. 2019. Personal Communication via email - Cameron Lake characteristics. Mount Arrowsmith Biosphere Region Research Institute.

Turner, M.H. 1997. *Little Qualicum Falls Provincial Park Management Plan.* http://www.env.gov.bc.ca/bcparks/planning/mgmtplns/littlequal/litqual_mp.pdf. Accessed January 29, 2019.

Wikipedia. 2018. *Cameron Lake.* https://en.wikipedia.org/wiki/Cameron_Lake_(British_Columbia). Accessed Jan 22, 2019.