



BCLSS

BC Lake Stewardship and Monitoring Program

Heffley Lake 2005-2020

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



The Importance of Heffley 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 2005-2020 results of a Level I volunteer program for Heffley Lake. A previous report was written on Level II data collected from 2005-2008 and can be found in the BCLSS website [Library](#). Level I Secchi and temperature data were collected by volunteers with the Heffley Lake Community Association, who have provided a very thorough and consistent data set.



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. The watershed area of Heffley Lake is 52 km².

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.

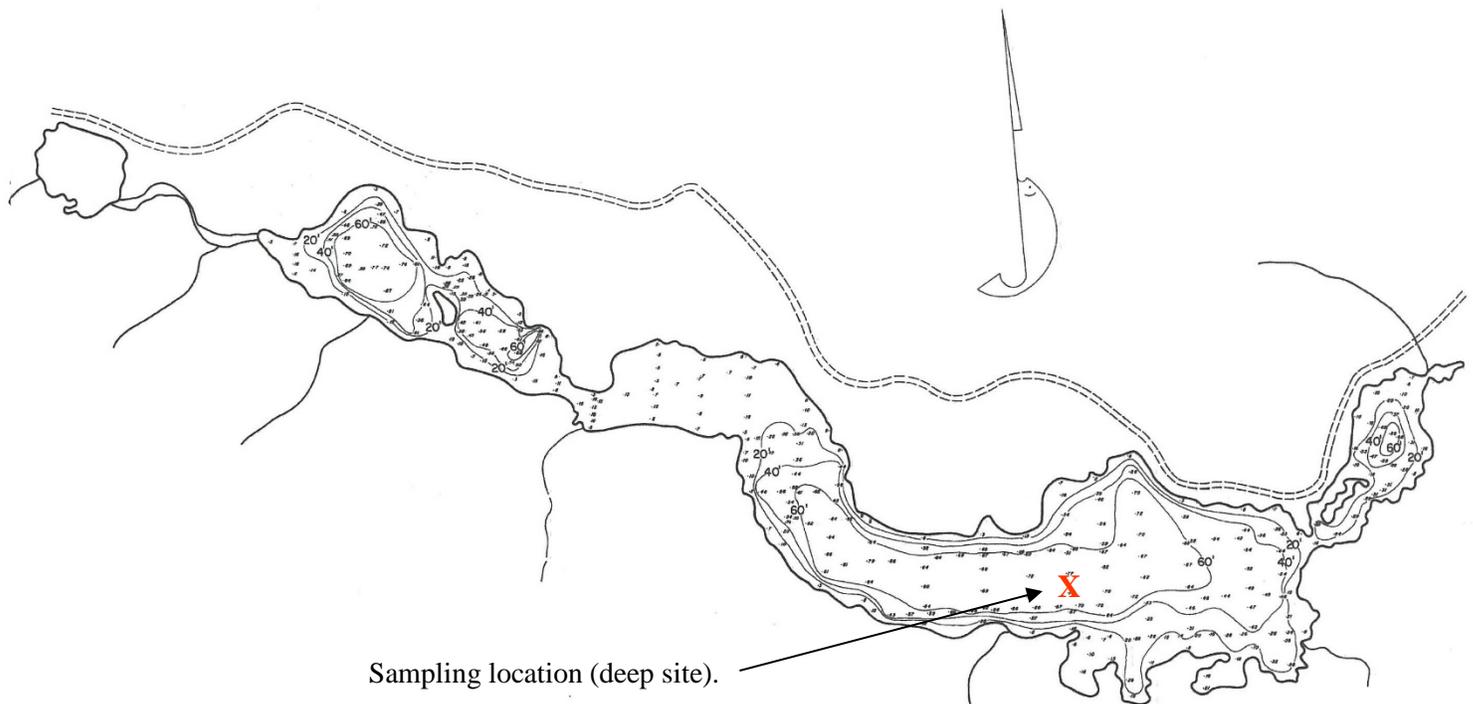
Heffley Lake is located approximately 44 km northeast of Kamloops, near Sun Peaks Resort. The lake sits at 944 m elevation and has a surface area of 2.02 km². The mean depth is 11 m and the maximum depth is 23.4 m. The lake perimeter is 15 km.

Armour Creek, a spawning creek for rainbow trout, flows into the southeast end of Heffley Lake. There are also five other smaller creeks that flow into the lake at various locations during freshet. At the west end of the lake, Heffley Creek flows out of the lake towards the small community of Heffley Creek, eventually draining into the North Thompson River. The outflow (Heffley Creek) is dammed for irrigation purposes and the water level fluctuates as local ranchers control the dam, and therefore the lake level, according to the downstream needs. The fluctuation depends on the water level at ice-on the previous winter plus the rise during the following freshet, and will be close to 1.5 m each year (Schmid, 2020).

Due to its vicinity to Kamloops and Sun Peaks, Heffley Lake is a popular recreational lake. Activities include boating, fishing, swimming, canoeing, kayaking, paddle boarding, camping, and ice fishing in the winter. Recent years have seen an increase in recreational usage of the lake (Strong, 2020).

Heffley Lake contains wild rainbow trout and is also restocked annually (Angler's Atlas, 2020). The lake was treated with toxaphene in 1957 to eradicate the coarse fish species (shiners and pea mouth chub) and create a rainbow trout fishery (Sidney, 2009).

Heffley Lake Bathymetric Map



Map obtained from FIDQ, 2020.
Not to be used for navigational purposes.

What's Going on Inside Heffley 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. Heffley Lake is a dimictic lake.

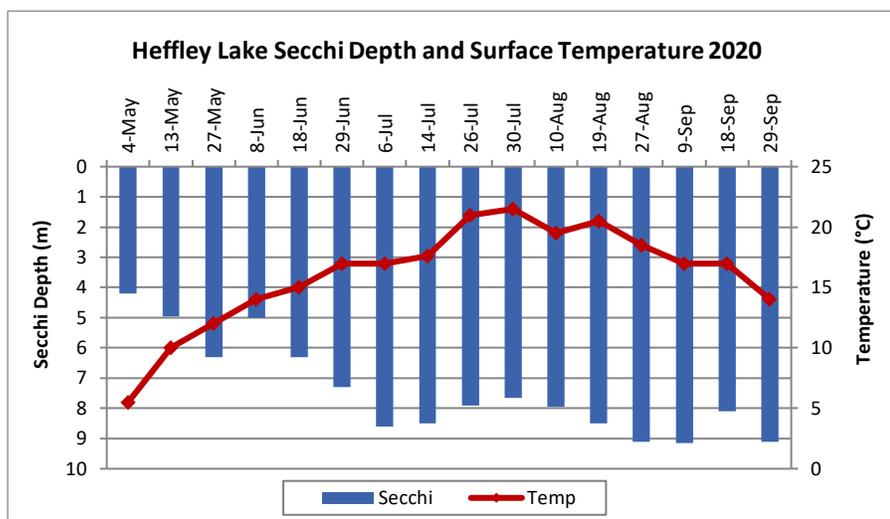
Coastal lakes in BC are more often termed warm monomictic lakes because they turn over once per year. These lakes have temperatures that do not fall below 4°C. Warm monomictic lakes generally do not freeze and circulate freely in the winter at or above 4°C and stratify only in the summer.

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. Heffley Lake freezes over from approximately December to April.

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 of lakes.

Surface temperature (T) and Secchi depth (water clarity) were measured by volunteers at Heffley Lake from 2005-2020 (site marked on map on page 2). The minimum data requirement of 12 samples was met for all years. The adjacent graph illustrates the 2020 Secchi depth and surface water temperature data from the sampling site. In 2020, the maximum surface water temperature measured was 21.5°C (July 30) and the minimum was 5.5°C (May 4).

The average surface temperature readings for Heffley Lake ranged from 13.6°C (2005) to 16.6°C (2013). The maximum surface temperature measured between 2005 to 2020 was 26°C (July 31, 2009) and the minimum surface temperature recorded was 2°C (May 23, 2012).



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 nutrient available for plant growth, including both floating algae (phytoplankton) and rooted plants (macrophytes). Algae are important to the overall ecology of a lake because they use nutrients to produce organic matter and are consumed by zooplankton, which in turn are food for other organisms, including fish. Macrophytes provide important habitat to many fish species and are the base of littoral zone (shallow water near shore) production.

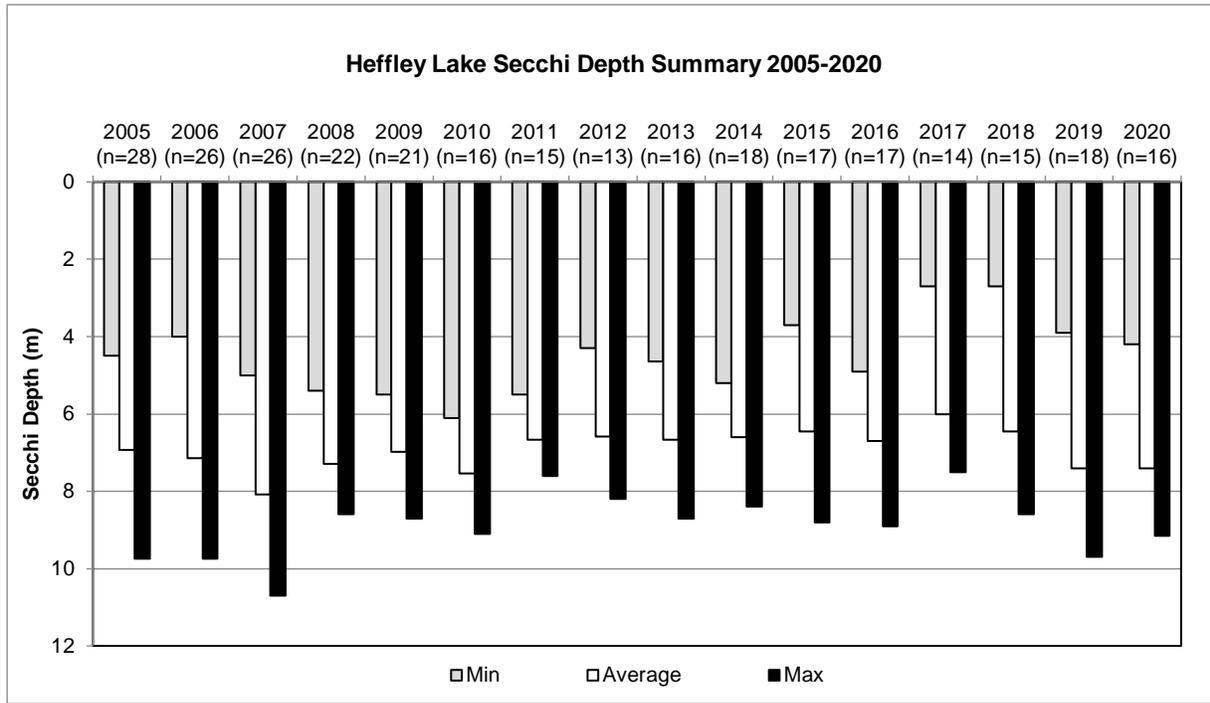
In most BC lakes, phosphorus is the nutrient in shortest supply relative to need and thus limits the production of aquatic life. When in excess, phosphorus accelerates growth and may artificially age a lake. Total phosphorus in a lake can be greatly influenced by human activities.

Lakes with low levels of phosphorus usually support limited biological production and, thus, contain low concentrations of the photosynthetic pigment chlorophyll *a*, which is found in both algae and aquatic plants. These lakes are called *oligotrophic* and tend to have clear water and sufficient oxygen throughout the year to support fish and other aquatic organisms. *Mesotrophic* lakes have moderate levels of phosphorus and support greater biological production and therefore contain greater concentrations of chlorophyll *a*. Water clarity in mesotrophic lakes is moderate, but there is an increased probability of oxygen depletion in the deepest areas. *Eutrophic* lakes contain even greater concentrations of phosphorus and chlorophyll *a* and can experience extended periods of poor water clarity and low oxygen levels.

Mesotrophic and eutrophic lakes experience higher densities of macrophytes and algae. Surface accumulations or 'blooms' of algae may occur during the warmest months, particularly in eutrophic lakes, where lack of water transparency can significantly reduce recreational activities. Mesotrophic to slightly eutrophic lakes support productive fisheries, so are desirable for those seeking good fishing lakes. As a result of higher productivity, these lakes also tend to draw in wildlife and waterfowl in larger numbers.

The trophic status of a lake can be determined by looking at concentrations of different chemical and biological variables. One measure of productivity is water clarity. This can be assessed 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, so does the algal community which causes the water clarity (as measured by the Secchi depth) to decrease.

The following figure shows the minimum, average, and maximum Secchi readings from 2005-2020 and the number of readings for each year (n). The maximum reading during these years was 10.7 m (July 2, 2007) and the minimum was 2.7 m (May 9, 2017 & May 11, 2018).



The average Secchi readings ranged from 6.0 m (2017) to 8.1m (2007). The overall water clarity remained relatively consistent during the sampling period. Based on these summer average Secchi values, Heffley Lake was exhibiting oligotrophic (average Secchi readings >6 m) 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. Flow data from 1911-1925 and 1946-1947 show the flushing rate for Heffley Lake was 5.5 years (BCLSS, 2010). The outflow dam on Heffley Creek may have an effect on the current flushing rate.

Land Use and Pollution Sources

Most of the Heffley Lake watershed is forested, with the most prominent land use being forestry, as well as some cattle grazing. There is also residential development along the north and southeast shorelines of Heffley Lake. A resort that operates year-round, a campsite, boat launch, and public access day use area are located at the east end of Heffley Lake. The south shore of Heffley Lake is undeveloped crown land.

An increased level of recreational usage, in addition to growth and development within the watershed, could present challenges to maintaining water quality. 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.

Should Further Monitoring be Done on Heffley Lake?

Generally, trophic status is based on a combination of parameters such as Secchi depth, nutrients, and chlorophyll a. Based on the Secchi data collected by volunteers on Heffley Lake from 2005-2020, 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. Previous Level II sampling at Heffley Lake from 2005-2009 indicated oligotrophic to marginally mesotrophic conditions based on phosphorus data and mesotrophic conditions based on nitrogen data. Spring overturn sampling was conducted by ENV in 2014 to compare to the previous Level II data. The results were very similar to the 2005-2009 samples and the trophic status of Heffley Lake remained the same, with no observable trend (Grace, 2014).

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. Volunteers are also encouraged to continue collecting ice on and ice off data for climate change studies. Heffley Lake Community Association has also been conducting bird counts since 2009. The group conducts bi-weekly bird counts from May until September in 6 zones of the lake and monitors the relative changes in populations. They also count Western Painted Turtles, an at-risk species. For detailed information about the bird and turtle counts, contact the Heffley Lake Community Association.

Tips to Keep Heffley Lake Healthy

Yard Maintenance, Landscaping, and Gardening

- 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.
- Use paving stones instead of pavement.
- 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.
- Hand pull weeds rather than using herbicides.
- 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 lady bugs, as well as pests.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.

Agriculture

- Winter feeding of cattle should be a minimum of 30 m from a watercourse and located where no direct run off to streams and lake will occur.
- Install barrier fencing to prevent livestock from grazing on streambanks and lakeshore.
- Maintain or create a buffer zone of vegetation along a streambank, rivers, or lakeshores.
- Ranchers are encouraged to have an Environmental Farm Plan for their operation (contact the Ministry of Agriculture).

Onsite Sewage Systems

- Inspect your system yearly, and have the septic tank pumped every 2 to 5 years by a septic service company. Regular pumping is cheaper than having to rebuild a drain-field.

- Use phosphate-free soaps and detergents.
- Do not put toxic chemicals (paints, varnishes, thinners, waste oils, photographic solutions, or pesticides) down the drain because they can kill the bacteria at work in your onsite sewage system and can contaminate waterbodies.
- Conserve water: run the washing machine and dishwasher only when full and use only low-flow showerheads and toilets.
- Use biodegradable household cleaners instead of bleach or other hazardous products (which will kill the good bacteria in your system).
- Avoid planting trees or shrubs near the drain field because their roots can damage or plug the pipes.

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.

Auto Maintenance

- Use a drop cloth if you fix problems yourself.
- Recycle used motor oil, antifreeze, and batteries.
- Use phosphate-free biodegradable products to clean your car. Wash your car over gravel or grassy areas, but not over sewage systems.

Boating

- Do not throw trash overboard or use lakes, other waterbodies, or shorelines as toilets.
- Watch your wake. Waves can increase shoreline erosion and churn up bottom sediment which decreases water clarity and can also reintroduce harmful nutrients.
- Use biodegradable, phosphate-free cleaners instead of harmful chemicals.
- Conduct major maintenance chores on land.
- Use absorbent bilge pads to soak up minor leaks or spills.
- Clean, Drain, Dry. Clean off all organic material and mud from boat and equipment (boots, waders, fishing gear). Drain onto land all items that can hold water (buckets, wells, bilge, and ballast). Dry all items completely before launching into another body of water (ISCBC, 2020)
- Leading by example is often the best method of improving practices - help educate fellow boaters.

Docks

- Do not use metal drums in dock construction. They rust, sink, and become unwanted debris. Use blue or pink closed-cell extruded polystyrene billets or washed plastic barrel floats.
- All floats should be labeled with the owner's name, phone number, and confirmation that barrels have been properly emptied and washed.
- Untreated cedar is the best choice for dock construction. In some places, pressure-treated wood is banned for waterfront use because it can leach chemicals into the environment.



Who to Contact for More Information

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