BC Lake Stewardship and Monitoring Program

Lac des Roches 1999, 2005-2013, and 2015-2020

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 Lac des Roches & 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 1999, 2005-2013, and 2015- 2020 results of a Level I volunteer program for Lac des Roches. A Level II report was written using data collected in 1999 and 2005-2009 and can be found in the BCLSS website Library. Level I Secchi depth and temperature data were collected by volunteers with the Lac des Roches Watershed Society, 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 Lac des Roches watershed is 48.6 km^2.

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 water quality is largely determined by a watershed's capacity to buffer impacts and absorb contaminants.

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.

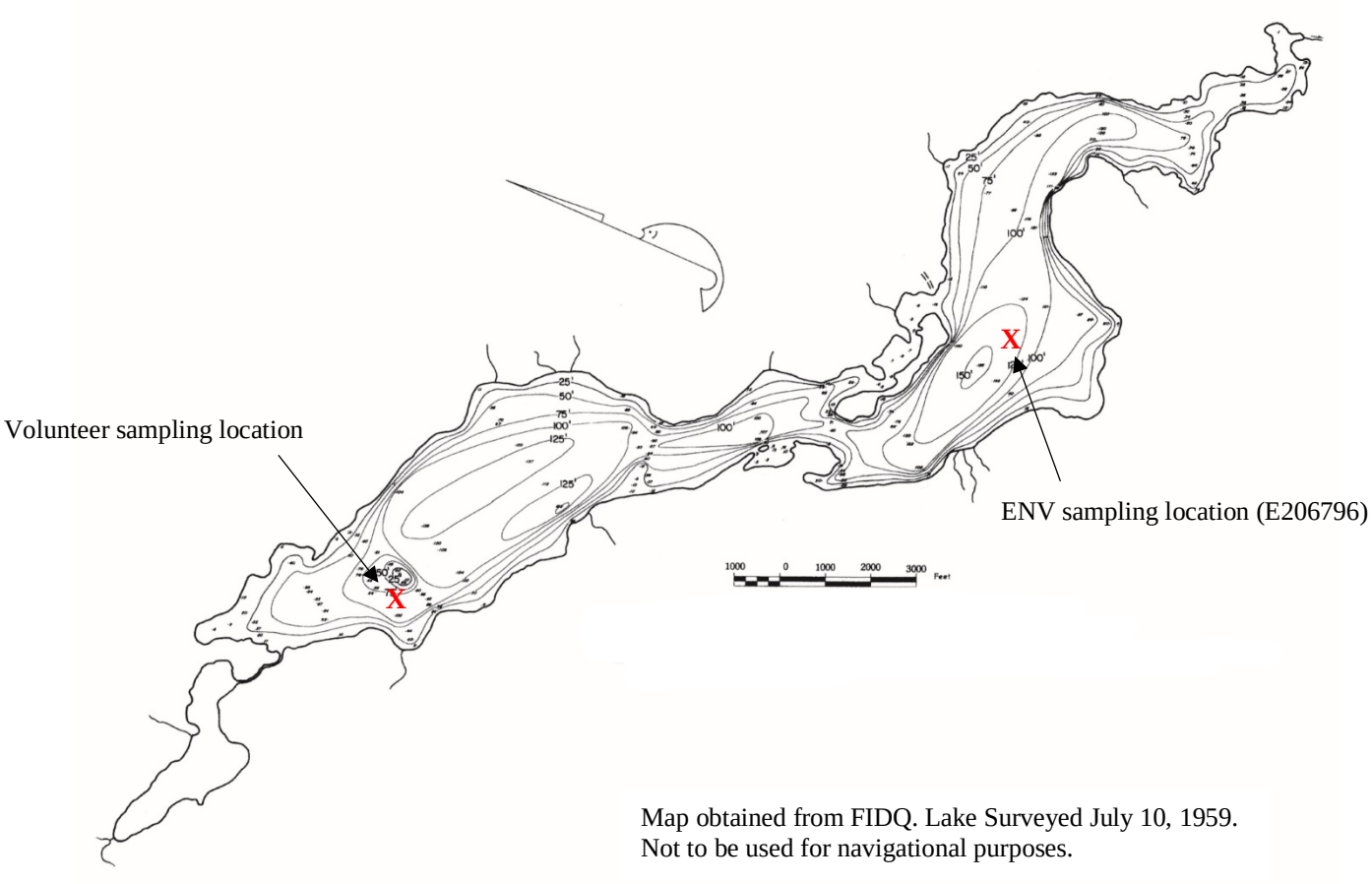
Human activities that impact water bodies range from small but widespread and numerous *non-point* sources throughout the watershed to large *point* sources of concentrated pollution (e.g., waste discharge outfalls, spills, etc.). Undisturbed watersheds have the ability to purify water and repair small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

Lac des Roches lies in the traditional territory of the Secwépemc. It is located approximately 32 km west of Little Fort on Highway 24, at an elevation of 1128 m. The lake has a maximum depth of 47.2 m and a mean depth of 22.0 m. Its surface area is 6.57 km2 and the shoreline perimeter is 24.7 km plus 1.92 km of island shoreline. It has 3 islands and many bays, peninsulas, narrows and shoals.

Little Lac des Roches drains into Lac des Roches at the north tip by a shallow channel. There are dozens of other small seasonal creeks that flow into the lake, the larger two of which are Goldpan Creek and Brown Creek. The only outflow, Deep Creek, is located at the southeast tip of Lac des Roches and flows into Birch Lake and eventually drains into the North Thompson River.

Lac des Roches contains rainbow trout (*Oncorhynchus mykiss*), burbot (*Lota lota*), redside shiner (*Richardsonius balteatus*), northern pikeminnow (*Ptychocheilus oregonensis*), peamouth chub (*Mylocheilus caurinus*), fine scale sucker *(Catostomus catostomus),* and large scale sucker (*Catostomus macrocheilus*). The lake is restocked with rainbow trout annually. Spawning channels and ladders have been installed at Lac des Roches to enhance the natural reproduction of trout in the lake; however, they are not currently maintained. The larger creeks, Brown and Goldpan, currently support spawning.

Lac des Roches Bathymetric Map



Map obtained from FIDQ. Lake Surveyed July 10, 1959.
Not to be used for navigational purposes.

What's Going on Inside Lac des Roches?

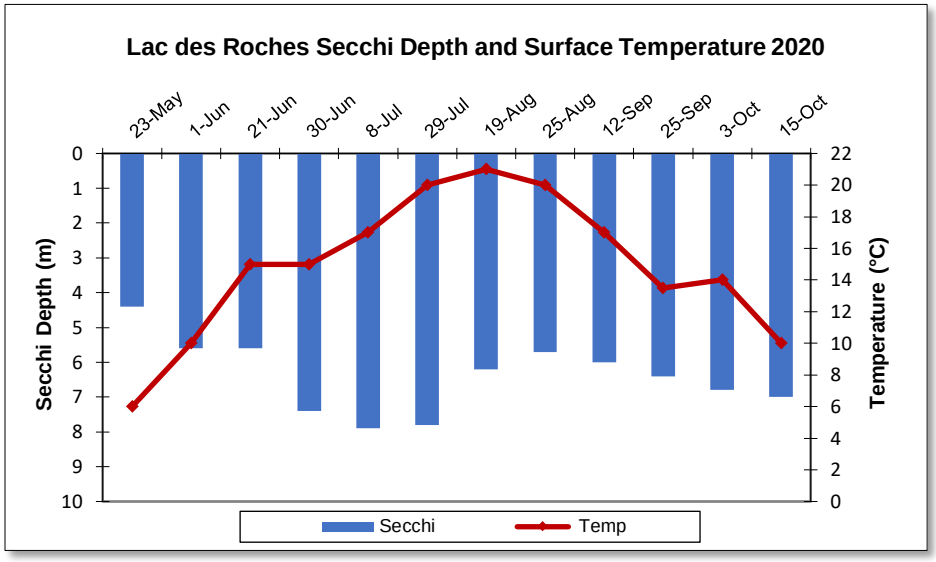
Temperature

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. Lac des Roches is a dimictic 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 lakes are being affected. Lac des Roches freezes over from approximately November to May.

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. When abundant, algae can create problems for most lake users.

Surface temperature (T) and Secchi depth (water clarity) were measured by volunteers at Lac des Roches in 1999 and from 2005-2013 and 2015-2020 (site marked on map on page 2). The minimum data requirement of 12 samples was not met for all years; however, the number of years of data and the even spread of measurements throughout the season for most years allows for good comparison in order to observe trends over time. 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°C (August 19) and the minimum was 6°C (May 23).



For all years, the average surface temperature readings for Lac des Roches ranged from 12°C (2011) to 16.5°C (2005). The maximum surface temperature measured was 22°C (July 17, 2007) and the minimum surface temperature recorded was 3.9°C (May 10, 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.

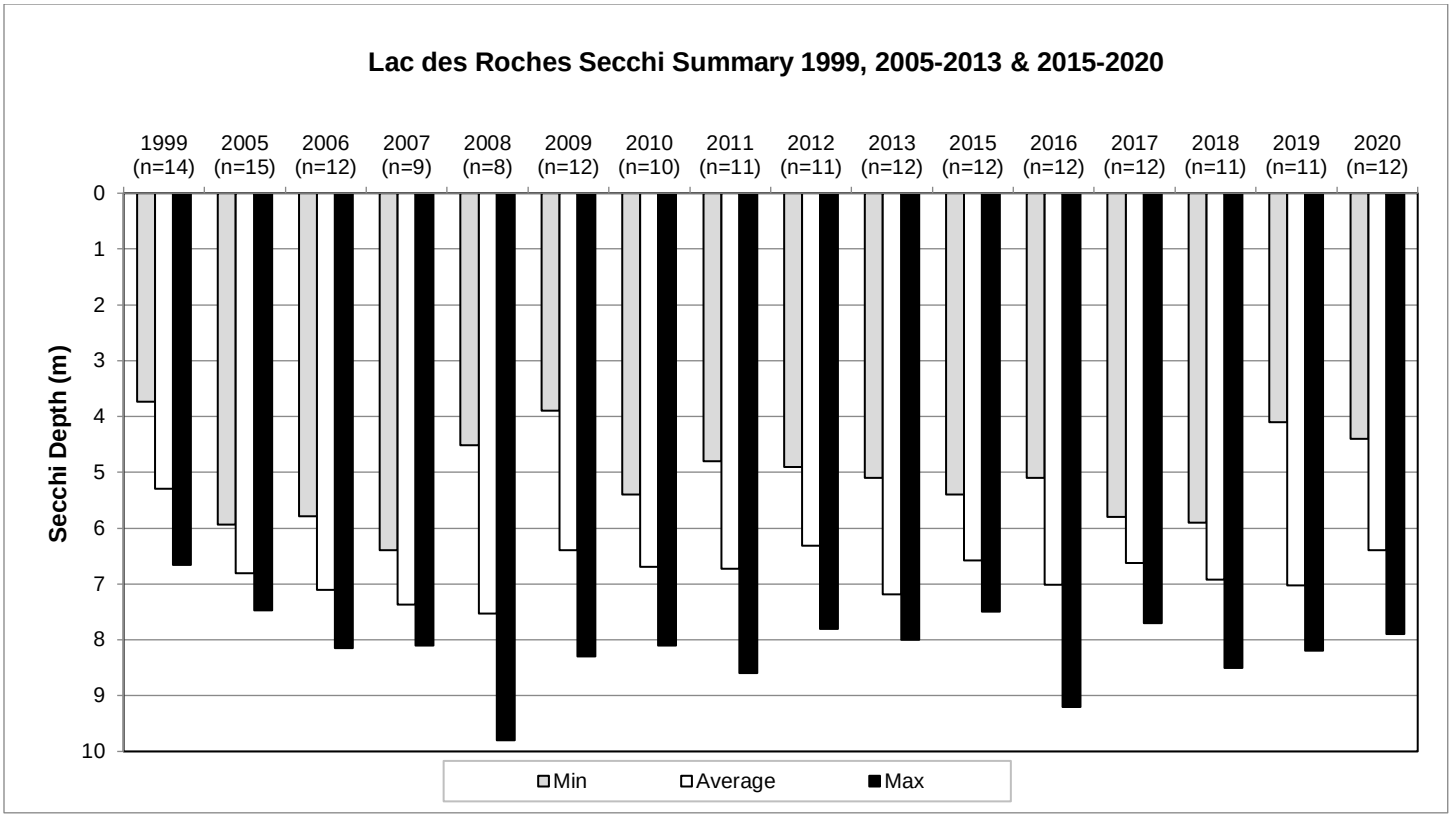
In most BC lakes, phosphorus is the nutrient in shortest supply relative to need and thus limits the production of aquatic life. When in excess, phosphorus accelerates growth and may artificially age a lake. Total phosphorus in a lake can be greatly influenced by human activities.

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 1999, 2005-2013, and 2015-2020 and the number of readings for each year (n). The maximum reading during these years was 9.8 m (July 20, 2008) and the minimum was 3.7 m (July 19, 1999).



The average Secchi readings ranged from 5.3 m (1999) to 7.5m (2008). The overall water clarity remained relatively consistent during the sampling period. Based on these summer average Secchi values, Lac des Roches was exhibiting oligotrophic (average Secchi readings >6 m) conditions with the exception of 1999 when mesotrophic (average Secchi readings 3-6 m) conditions were observed (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 of Lac des Roches is estimated to be 97.6 years (Cariboo Regional District, n.d.).

Land Use and Pollution Sources

Most of the Lac des Roches watershed is forested. The mix of spruce, pine, fir, and aspen trees have been affected by spruce bud worms, pine beetles, fir beetles, aspen leaf miners, and root rot. There has been an increase in tree mortality and timber harvesting on both public and private land in recent years. Residents are concerned that this could have an impact on local water bodies.

There is very limited agriculture in the area, with two grazing permits for cattle in the watershed. Private pastureland is now either unused or has been developed into residential lots.

Lac des Roches provides recreational opportunities such as boating, paddling, hiking, fishing, snowshoeing, cross-country skiing, ATVing, and snowmobiling. As recreational use grows in the watershed, there are local concerns about further foreshore development and erosion, an increase in the number and size of watercraft using the lake, and an expansion of use of land by Off-Road Vehicle (ORV) operators.

The south side of Lac des Roches is mainly forested crown land. It is undeveloped apart from an overgrown trapline trail and timber harvesting at both the east and west ends of the lake. The north side of Lac des Roches is developed with 199 properties, twenty of which are year-round residents.

There are also two resorts on Lac des Roches: Eagle Island Resort and Peaceful Cove Resort. Lac des Roches Resort is actually located on Little Lac des Roches, which is connected to Lac des Roches at the north end of the lake by a wide, shallow, 500-meter-long channel. Little Lac des Roches and Muddy Lake are within the Lac des Roches watershed and also have increased residential and recreational development, with further land development proposed. A Level 1 lake report for Little Lac des Roches is available on the BCLSS website.

Growth and development, timber harvesting, and increased recreation 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. Residents are encouraged to ensure their septic systems are up to standard and that their land use activities, including shoreline development, are following good environmental practices. Tips to Keep Lac des Roches Healthy can be found on the following page.

Marl Lakes

The climate, hydrology, and basin geology within a watershed help determine the chemistry of a lake. The chemical composition of the water helps determine the types of species that can survive there and the water's recreational and drinking water value. Human activity within the watershed can also have an impact on the chemical composition of a lake. Some lakes, such as hardwater lakes, have a natural way of combating problems such as acidification.

Hardwater lakes have a high pH level, which causes calcium carbonate to precipitate and remove phosphorus from the water column by adsorption of phosphorus to the calcium carbonate. One type of hardwater lake is a marl lake. Marl lakes are generally saturated with calcium and carbonate ions. The sediment of these lakes consists of marl, a soft-textured mixture of clay, sand, and limestone. When the calcium carbonate in these lakes begins to precipitate, phosphorus is effectively removed as a co-precipitate. Therefore, these lakes can reduce the impact of phosphorus loading from sources such as septic systems, livestock, domestic gardening, car washing, and agriculture. In other words, marl lakes are more resistant to eutrophication.

But how do we decide if a lake is a marl lake or not? There are a few qualities that we can use to determine this. The first is a visible shift from dark blue/green to extreme turquoise colour during periods of warmer temperatures. Tiny particles remain suspended in the water, refracting light and causing the lake to turn a light aquamarine (lake whitening). Another quality of a marl lake is high calcium concentrations in the sediment, especially in the shallower areas. These sediments are often lighter in colour due to the increased amount of limestone (calcium carbonate).

Since phosphate precipitates with calcium, marl lakes generally have low phosphorus levels and good water clarity. Calcium carbonate precipitates can be observed on vegetation and along the lake's edge. The presence of Chara species also indicates the possibility of a marl lake. Charophytes are a type of large, structurally complex green algae that attach to substrates. The

rhizoids that enable this attachment play an important role in the absorption of nutrients and extraction of calcium carbonate. Lac des Roches exhibits some of these marl lake characteristics including turquoise coloured water and Chara species. The qualities associated with a marl lake generally result in more stable water quality conditions.

Should Further Monitoring be Done on Lac des Roches?

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 Lac des Roches in 1999 and from 2005-2013 and 2014-2020, the water quality has remained relatively stable throughout the sampling years. Overall, the average annual Secchi readings suggest oligotrophic conditions. This classification is desirable from a recreational and drinking water supply water quality perspective.

The 2006-2008 phosphorus data from Lac des Roches indicate that the lake was exhibiting mesotrophic conditions. The relatively clear water for a lake with mesotrophic nutrient conditions could be the result of Lac des Roches being a marl lake; however, this would require further study to confirm. Spring overturn sampling was conducted by ENV in 2015 to compare to the previous data. The results were very similar to the 2006-2008 samples, with phosphorus indicating mesotrophic conditions.

Volunteer monitors could continue collecting Secchi depth and surface temperature readings, which can 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.

Tips to Keep Lac des Roches Healthy

Yard Maintenance, Landscaping, and Gardening

- Maintain or create a buffer zone of vegetation along a streambank, rivers, or lakeshores.
- 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

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

Lac des Roches Watershed Society
www.lacdesroches.org

Ministry of Environment and Climate Change Strategy
Kirsten McNeill, Aquatic Stewardship Coordinator
Public Feedback Welcomed
3rd Floor, 1011-4th Ave Prince George, BC, V2L 3H9
Email: volunteerlakes@gov.bc.ca
Website:https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/lake-monitoring/volunteer-lake-monitoring

Acknowledgements

Volunteer Monitoring by:
Wendy and Gordon Marshall

Photo Credit:
Daryl Llewellyn (Page 1)
Yvonne Llewellyn (Page 8)

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

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

References

Atherton, G. & S. Woloshyn. 2020. Email communication. Lac des Roches Land Use and Pollutions Sources. Lac des Roches residents. December 7, 2020.

Angler Atlas. 2020. Lac Des Roches. https://www.anglersatlas.com/place/100551/lac-des-roches. Accessed November 30, 2020.

BC Lake Stewardship Society. 2010. Lac des Roches 1999, 2005-2009. https://www.bclss.org/cms/wp-content/uploads/2017/05/lac_des_roches_1999_2005-09.pdf

Edwards, M. n.d. Lac des Roches Flushing Rate. Planning Aide. Cariboo Regional District. Accessed July 23, 2009.

Fish Inventories Data Queries (FIDQ). 2020. Lac des Roches Bathymetric Map. http://a100.gov.bc.ca/pub/fidq/searchBathymetricMaps.do. Accessed November 24, 2020.

Invasive Species Council of BC (ISCBC). 2020. Clean Drain Dry Program. Accessed April 15, 2020. https://www.bcinvasives.ca/resources/programs/clean-drain-dry/

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

Sidney, M. 2009. Email communication. Water Quality/Quantity Specialist. Ministry of Environment and Climate Chane Strategy. June 30, 2009.