BC Lake Stewardship and Monitoring Program

New Lake 2009 - 2011

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

The Importance of New 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 (MOE), 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 provides the 2009 - 2011 results of a Level II program for New Lake.

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.

New Lake is located in the East Kootenays region of BC, approximately 6 km west of Cranbrook. The lake has a perimeter of 2.5 km and lies at an elevation of 1192 m. Its surface area is 27.6 hectares, its maximum depth is 10.4 m, and its mean depth is 3.4 m (Habitat Wizard, 2013).

New Lake does not have any defined inflows. And is fed solely by groundwater and precipitation Volunteers report that in the 1950s, Ducks Unlimited installed a dam with a low level gate on the lake. The lake level has not yet reached the height of the gate however if/when it does the water would flow from the south end of the lake into Angus Creek (Passey 2013, Pers. Comm.). The lake has one main outflow, East Angus Creek, which flows from New Lake into Jimsmith Lake (Passey 2013, Pers. Comm.). The lake contains rainbow trout, brook trout, and cutthroat trout. In the past 5 years, the lake has been stocked with rainbow trout annually (Munro , 2013).

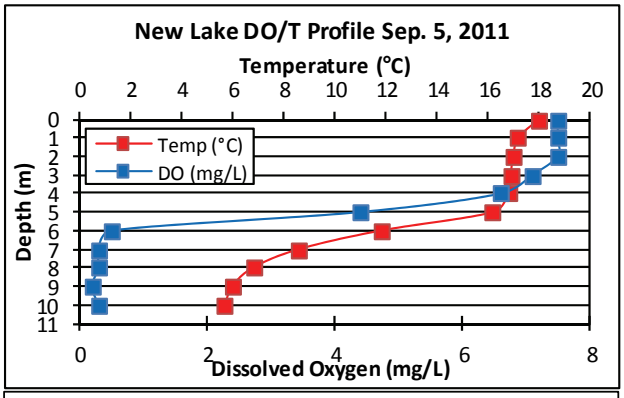
New Lake has one licensed water withdrawal pipe located at the northeast side of the lake, which takes water to a private residence approximately 5 km to the east (Passey, 2010). The flushing rate, another factor that affects water quality, is the rate of water replacement in a lake and depends on the amount of inflow and outflow of a lake. The higher the flushing rate, the more quickly excess nutrients can be removed from the system. The flushing rate for New Lake is currently unknown.

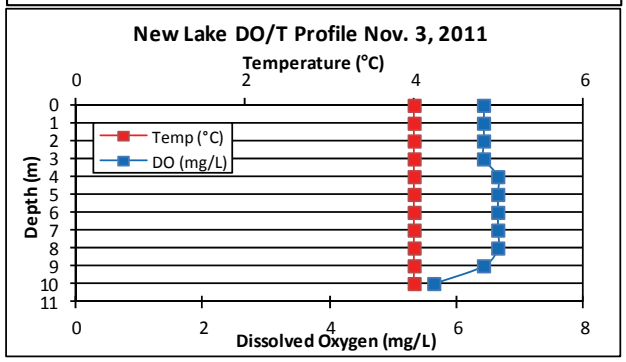
What's Going on Inside New Lake?

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 more dense, 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. New Lake is classified as 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 global warming is affecting our lakes. Volunteers have not been collecting ice-on/ice-off data for New Lake due to difficulty with accessing the lake in winter.



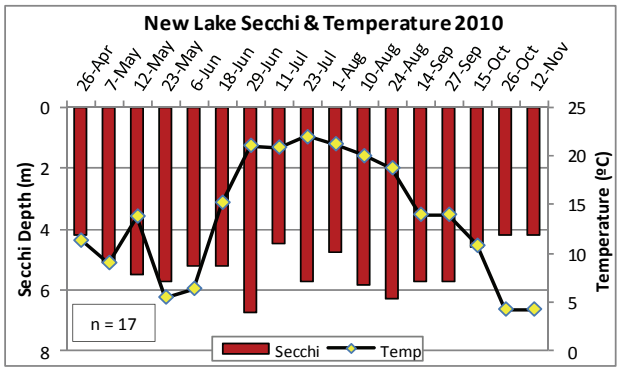


Surface temperature readings serve as an important ecological indicator. By measuring surface temperature, we can record and compare readings from season to season and year to year. Surface temperature helps to determine much of the seasonal oxygen, phosphorus, and algal conditions.

Dissolved oxygen (DO) and temperature (T) data were collected approximately every 2 weeks at 1 m intervals at the Deep site (see p. 3 for sample site location) on New Lake in 2011 between Jun 19 - Nov 3. Data collected indicate that the lake was stratified between Jun 19 & Oct 10 and was experiencing fall overturn on the Oct 24 & Nov 3 sample dates. The upper adjacent graph shows the DO/T profile from Sep. 5/11 and is representative of profiles collected from Jun 19 - Sep 5. These data show that DO levels are significantly depleted in the bottom waters during stratification. The lower adjacent graph illustrates the DO/T profile for New Lake on Nov 3, which shows that the DO and T were relatively constant throughout the depths sampled, indicating that the lake was mixed. In productive lakes, oxygen in the isolated bottom layer may deplete rapidly (often to anoxia), forcing fish to move into the upper layer where T may be too warm. Salmonids are stressed when oxygen levels fall below about 20% saturation which varies with water T and elevation. For comparison, 20% saturation at the 6 m depth for the T sampled on Sep 5 (11.8°C) would be approximately 2 mg/L. The measured value was 0.5 mg/L, which would likely have resulted in fish moving into the upper depths of New Lake. Fish kills can occur when decomposing or respiring algae use up the oxygen. In the summer, this can happen on calm nights after an algal bloom, but most fish kills occur during late winter or at initial spring mixing because oxygen has been depleted under winter ice. New Lake frequently experiences winter fish-kills due to anoxic conditions (Heidt 2014, Pers. Comm).

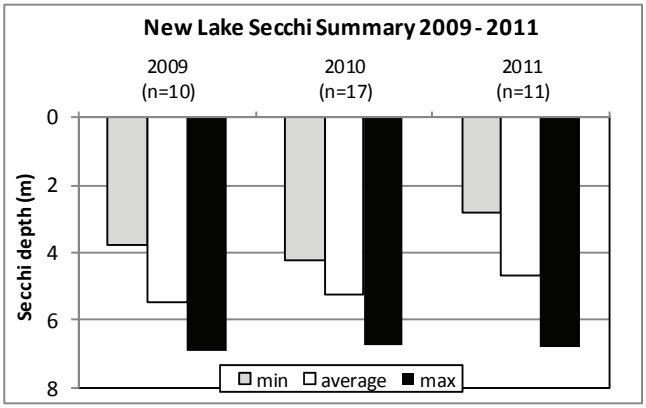
Trophic Status and Water Clarity

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 could lead to nuisance algal blooms and decreased water clarity. Total phosphorus (TP) in a lake can be greatly influenced by human activities.



Lakes of low productivity are referred to as ***oligotrophic***, meaning they are typically clear water lakes with low nutrient levels, sparse plant life and low fish production. Lakes of high productivity are ***eutrophic***. They have abundant plant life because of higher nutrient levels. Lakes with an intermediate productivity are called ***mesotrophic*** and generally combine the qualities of oligotrophic and eutrophic lakes.

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.

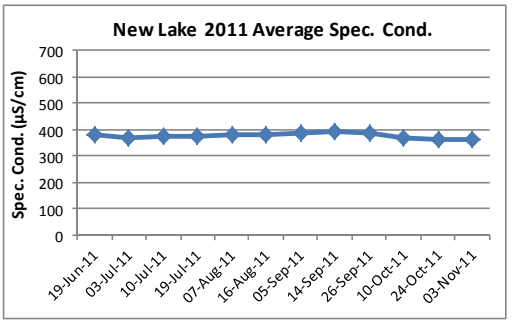


Surface T and Secchi depth were measured at the Deep site on New Lake from 2009-2011. Secchi and T readings met the minimum data requirements in 2010 and fell slightly short in 2009 & 2011. The third graph on this page shows the 2010 Secchi and T data for New Lake, and the number of readings (n). The maximum surface temperature was 22.0°C (Jul 23) and the minimum surface temperature was 4.3°C (Oct 26 & Nov 12). The maximum surface temperatures measured in 2009 & 2011 were 22.5°C (Jul 24) & 22.1°C (Jul 19), respectively. Minimum surface temperatures were 4.3°C (Oct 30) & 4.0°C (Nov 3) in 2009 & 2011, respectively.

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 apparent in the New Lake data.

The bottom graph on the previous page shows the minimum, average and maximum Secchi readings from 2009-2011. The maximum reading for all sampling years was 6.9 m and occurred on Sep 27/09. The lowest Secchi depth measured over the 3-year sampling period was 2.8 m, on Oct 24/11. The average Secchi values ranged between 4.7 m (2011) and 5.5 m (2010) throughout the 3 years sampled. Based on the average summer Secchi values from 2009-2011, New Lake was exhibiting mesotrophic (3-6 m) conditions (Nordin, 1985).

Additional Parameters Monitored



In addition to dissolved oxygen, temperature, and Secchi readings, pH and specific conductivity (spec. cond.) data were collected in profile with a YSI handheld meter at 1 m depths on 12 dates in 2011, from Jun 19-Nov 3.

Spec. cond.is generally found to be a good measure of the concentration of total dissolved solids (TDS) and salinity. The more TDS that are present in the water, the higher the conductance of the water. Values of spec. cond. can differ greatly from system to system because the composition of inflowing tributaries reflects the geology of their watersheds. Additionally, there are anthropogenic sources of these materials such as road salt and non-point source pollution (ourlake.org, 2013). The aesthetic objective established for TDS in drinking water is ≤ 500 mg/L (Health Canada, 1991). As shown in the adjacent graph, the average spec. cond. for New Lake ranged from 361-390 µS/cm, which converts to approximately 186-201 mg/L TDS, falling well below Health Canada's aesthetic objective. Seasonal data for spec. cond. showed that values were slightly higher at lower depths when the lake was stratified but didn't vary from top to bottom when the lake was mixed.

pH is the measurement of the hydrogen-ion concentration in the water. A pH below 7 is acidic and a pH above 7 (maximum of 14) is basic. A decrease of 1 full unit represents an increase in acidity of 10 times. Natural fresh waters have a pH range from 4.0 to 10.0 although most lakes in BC have a pH of 7.0 or greater. (MOE, 1998) The water quality guideline for pH for aquatic life is 6.5-9.0 and for drinking water is 6.5-8.5 (Government of BC, 2006). The average pH ranged from 7.8-8.1 for New Lake.

Land Use and Pollution Sources

New Lake is surrounded by crown forest except for a privately owned 40 acre lot near the northeast corner of the lake (Passey, 2013). According to local volunteers, anthropomorphic sources of pollution are minimal: road salt is not used anywhere near the lake and historically a sawmill was located near the boat launch which was dismantled in the 1940s (Passey, 2014). The lake has a very small watershed area, which makes it vulnerable to non-point source pollution impacts, such as forestry and agriculture.

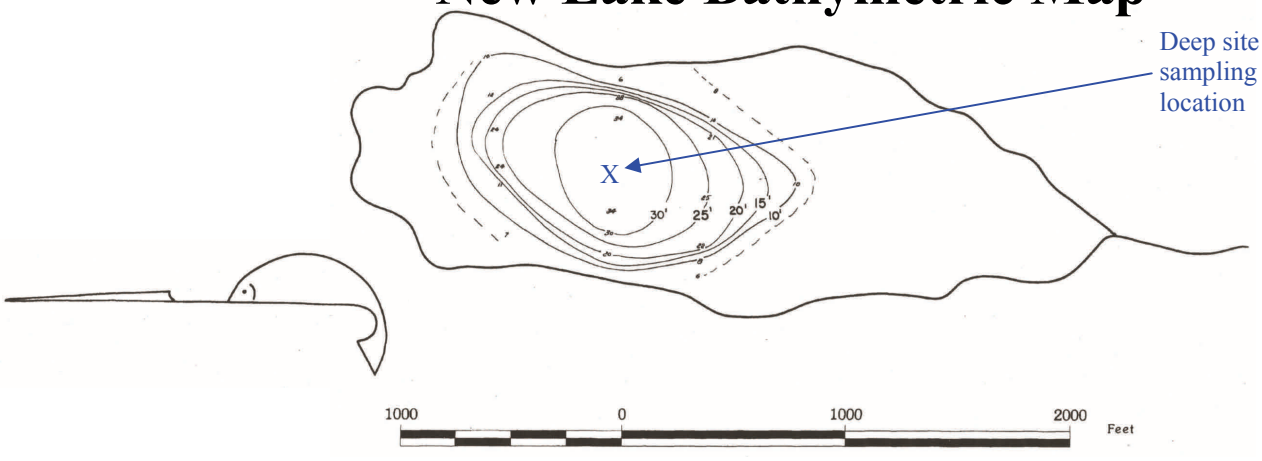
Local residents and recreational users who visit New Lake are encouraged to ensure they are following good environmental practices and that their boats and equipment are properly maintained. Further information on keeping New Lake healthy can be found on the following page.

Should Further Monitoring Be Done on New Lake?

Based on average summer Secchi data from 2009-2011, New Lake was exhibiting mesotrophic conditions. Average spec. cond. values fell below Health Canada's aesthetic objective of ≤ 500 mg/L. Average pH values fell within the BC water quality guidelines ranges for aquatic life and drinking water. The data collected on New Lake indicate that the water quality has remained stable, therefore further monitoring is not necessary at this time. However, if volunteers are able to continue monitoring at a Level 1 (minimum of 12 evenly spaced Secchi and surface temperature readings from ice-off through ice-on), the data would be valuable in identifying early warning signs should there be a deterioration in water quality.

Long-term collection of temperature and ice-on/ice-off data is also valuable for monitoring climate change over time. Due to difficulty in reaching the lake over snow-covered roads, volunteers have not been collecting data on freeze-up and break-up of ice on New Lake. All residents, recreational users and land developers within the watershed are advised to continue to practice good land management so that nutrient migration to the lake and its tributaries are minimized.

New Lake Bathymetric Map



Map obtained from FISS (lake surveyed 1960)

Tips to Keep New Lake Healthy

Onsite Sewage Systems (campers & RVs at campsites)

- Inspect your system yearly and have the septic tank pumped every 2-5 years by a septic service company. Regular pumping is less expensive than having to rebuild a drainage field.
- Use phosphate-free soaps and detergents.
- Be responsible and dispose of RV wastewater at designated RV dumping sites. Do not dump grey water tank at the lakeshore.
- Do not put toxic chemicals or harmful cleaners down the drain, as they can contaminate waterbodies.
- Conserve water: run the washing machine and dishwasher only when full and use only low-flow showerheads and toilets.

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. If you have to use them, 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 ladybugs, as well as pests.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.
- Pick up after your pets, as pet 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.
- Check for and remove all aquatic plant fragments from boats and trailers before entering or leaving a lake.
- 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 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.

Who to Contact for More Information

Jimsmith Lake Community Association

Brian Passey numscull@shaw.ca
4283 Lakeview Drive, Cranbrook, BC V1C 6W4

Ministry of Environment - Nelson

401 - 333 Victoria Street Phone: 250.354.6333
Nelson, BC V1L 4K3 Fax: 250.354.6332

BC Lake Stewardship Society

206 - 1889 Springfield Rd.
Kelowna, BC V1Y 5V5

Phone: 250.717.1212 Toll free: 1.877.BC LAKES
Fax: 250.717.1226
Email: info@bclss.org Website: www.bclss.org

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Volunteer Monitoring by: Greg Ross, Don Jenstad, Sylvia Jensted, John Reith, Brian Passey, Dave Haley and Martin Blackwell

Data Compiling by:
Kristi Carter (BCLSS)

Brochure Produced by:
Kristi Carter (BCLSS)

Report Reviewed by:
Jolene Raggett (MOE)

Photo Credit:
Greg Ross

Bathymetric Map:
Fisheries Information Summary System (FISS)

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