BC Lake Stewardship and Monitoring Program

Tie Lake 2006 - 2009

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

The Importance of Tie 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, has designed a program, entitled *The BC Lake Stewardship and Monitoring Program* (BCLSMP), 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 2006 - 2009 results of a Level I program for Tie 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 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.

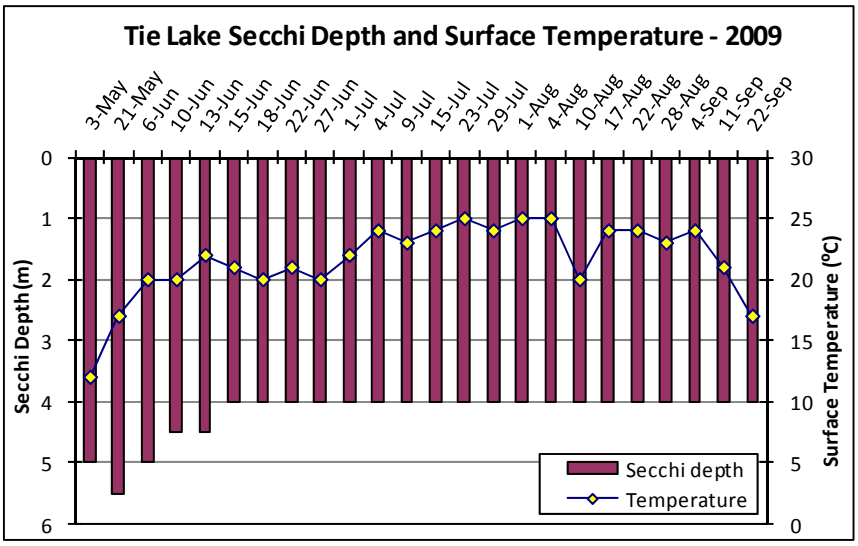
Tie Lake is located on the east side of the Kootenay River Trench in the shade of the Rocky Mountains, approximately 4 km north of Jaffray in the East Kootenay region. The lake has a surface area of 126.3 ha, lies at an elevation of 850 m and has average and maximum depths of 2.2 and 4.9 m, respectively. The water level of the lake is dependant on ground water (as no overland flows enter the lake) and one outflow, Tie Lake Creek. Fish species found in Tie Lake include yellow perch, brook trout, largemouth bass, longnose sucker, rainbow trout, redside shiner, and westslope (yellowstone) cutthroat trout. Tie Lake has been stocked periodically since 1926, and was stocked with rainbow trout within the last 5 years during the fall of 2005, 2006 & 2007. Stocking efforts have been met with marginal success because the lake is prone to periodic summer and winter die-offs (caused by lethal temperatures and oxygen depletion), and due to the establishment of illegally introduced non-native species such as yellow perch and largemouth bass (Bell 2010, Pers. Comm.).

In the 1880s, much of the land surrounding Tie Lake was acquired by the CP Railway. From that time through to the 1920s, Tie Lake was used to store and transport logs and railway ties. The lake got its name from the waterlogged railway ties that can still be seen on the bottom of the lake today. The lake is surrounded by approximately 150 residences, 25 of which are full-time residences. Other features of Tie Lake include: two boat launches, a private campsite, a day-use park with a public beach operated by the Regional District of East Kootenay, and small forestry campsite. To the north and west of the lake is the Pickering Hills grazing area. (Bacon 2010, Pers. Comm.)

What's Going on Inside Tie Lake?

Temperature

Lakes show a variety of annual temperature patterns based on their location and depth. Most interior lakes, such as Tie Lake, 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.



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.

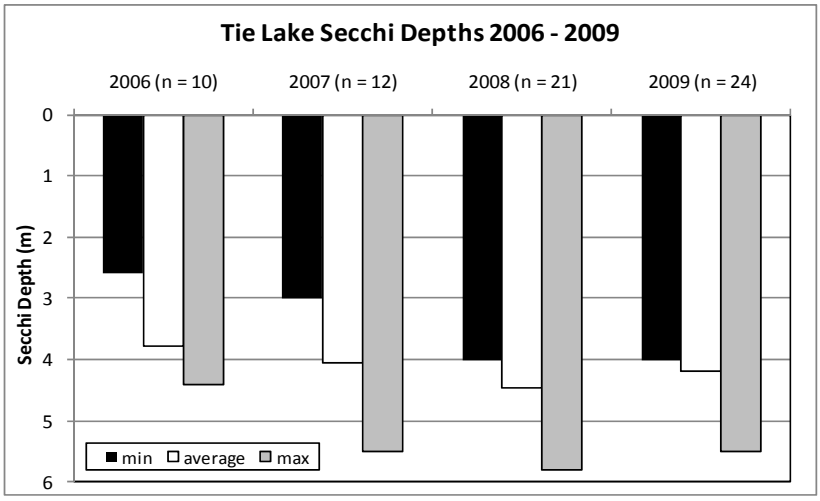
Ice-on and ice-off dates for BC lakes are important data for climate change research. Local residents have been recording and reporting ice-off dates for Tie Lake since 1979, and both ice-on and ice-off dates since 2005. Ice-on dates for 2005, 2006, 2007 and 2008 were November 30th, November 28th, November 21st and December 4th, respectively. Ice-off dates for 2006, 2007, 2008 and 2009 were April 10th, April 9th, April 24th and April 15th, respectively. By comparing these dates to climate change trends, we can examine how global warming is affecting our lakes.

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 and Secchi depth were measured at one location on Tie Lake. The graph above illustrates the Tie Lake Secchi depth and temperature for 2009. The maximum surface temperature was 25°C (Aug 1st & 4th) and the minimum surface temperature was 12°C (May 3rd). The maximum surface temperatures in 2006, 2007, and 2008 were 27°C, 29°C, and 25°C, respectively. All maximum temperatures recorded were below the 30°C maximum set in the BC Water Quality Guideline for Recreational Water Use (Science & Info Br., 2006). Consistent temperature readings will be important in the future for comparison to Guidelines for the Protection of Aquatic Life. The minimum surface temperatures in 2006, 2007, and 2008 were 19.5°C, 21°C, and 17°C, respectively, however the data from 2007 was collected in July and August only, therefore the minimum temperature is higher than in other years when sampling began in May.

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.



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 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. As the temperature of the lake increases, so do some species of algae. Due to the increase in algae, the water clarity decreases. This trend is not evident in the 2009 data (see top graph), perhaps due to the shallow depth of the lake. The 2009 data is comparable to the 2006, 2007 and

2008 data. The lower graph on the previous page shows the minimum, average, and maximum Secchi depths recorded on Tie Lake from 2006 to 2009, as well as the number of readings for each year (n). Average Secchi depths ranged from 3.8 m (2006) to 4.5 m (2008), indicating little change over the sampling years. The average Secchi depth over the 4 year sampling period is 4.1 m, indicating Tie lake is exhibiting mesotrophic conditions. The average Secchi depth of 4.1 m is well above the BC Water Quality Guidelines for Recreational Water Use, which sets a minimum at 1.2 m (Science & Info. Br. 2006).

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. McDonald (1984) estimated the water retention time for Tie Lake to be 2.4 - 4.5 years.

McDonald (1986) discussed the potential effects of diverting Little Sand Creek into Tie Lake in order to increase the flushing rate of the lake. McDonald concluded that the water from the creek would lower the alkalinity of the lake thereby reducing the frequency of marl formation occurrences. Marl formation events occur naturally in lakes with high pH levels. The high pH of the water causes calcium carbonate to precipitate and remove phosphorus from the water column, naturally controlling eutrophication.

Land Use and Pollution Sources

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

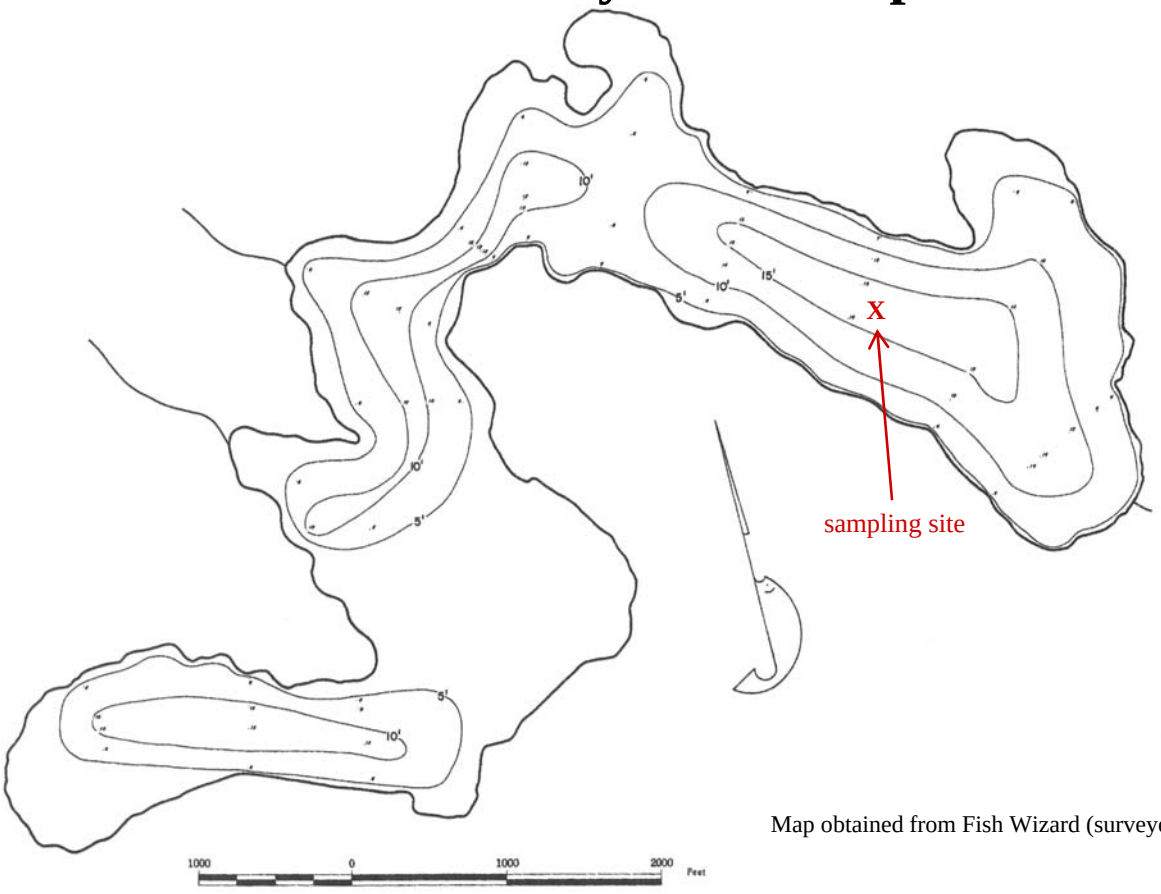
Land use surrounding Tie Lake is predominantly residential. Other land uses include a day-use provincial park, an overnight forestry campground, and grazing land (along the northwest shore). Local residents are encouraged to ensure their septic systems are up to standard and that their land use activities are following good environmental practices. Further information on keeping Tie Lake healthy can be found on the following page.

Should Further Monitoring be Done on Tie Lake?

The data collected on Tie Lake from 2006 - 2009 indicates the water quality has remained stable throughout the sampling period. Secchi results indicate the lake is mesotrophic. Continued collection of Secchi and surface temperature is not necessary at this time.

No water quality problems were identified through Level I sampling, nevertheless the Tie Lake Property Owners' Association is interested in a more comprehensive monitoring program, therefore Level III monitoring could be initiated on Tie Lake. Additionally, the BCLSS recommends that the Tie Lake Property Owners' Association hold a workshop to identify specific issues of concern, and with the aide of a qualified limnologist, determine their long term lake monitoring goals. A lake level gauge may also be helpful in documenting lake level fluctuations. Furthermore, ice-on and ice-off dates should continue to be recorded for climate change studies.

Tie Lake Bathymetric Map



Map obtained from Fish Wizard (surveyed June 19, 1959)

Tips to Keep Tie Lake Healthy

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.

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 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.

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.

Who to Contact for More Information

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Bathymetric Map: Fish Wizard (www.fishwizard.com)