*BC Lake Stewardship and Monitoring Program*

# Tatla Lake 1987, 2000 - 2006

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

## The Importance of Tatla Lake & its Watershed

British Columbians want lakes to provide good water quality, aesthetics and recreational opportunities. When these features are not apparent in recreational lakes, questions arise. People begin to wonder if the water quality is getting worse, if the lake has been affected by land development, and what conditions will result from more development within the watershed.

The BC Lake Stewardship Society, in partnership with the Ministry of Environment, has designed a program, entitled *The BC Lake Stewardship and Monitoring Program*, to help answer these questions. Through regular water sample collections, we can begin 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 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 1987 and 2000 - 2006 results of a Level II program for Tatla Lake.

Through regular status reports, this program can provide communities with monitoring results specific to their local lake and with educational material on lake protection issues in general. 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 thanks to the help of area volunteers and the BC Lake Stewardship Society.

The watershed area of Tatla Lake is over 686 $km^2$. A **watershed** is defined as the entire area of land that moves the water it receives to 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 ongoing hydrological cycle takes place 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 water body. Poor land-use practices anywhere in a watershed can eventually impact the water quality of the downstream environment.

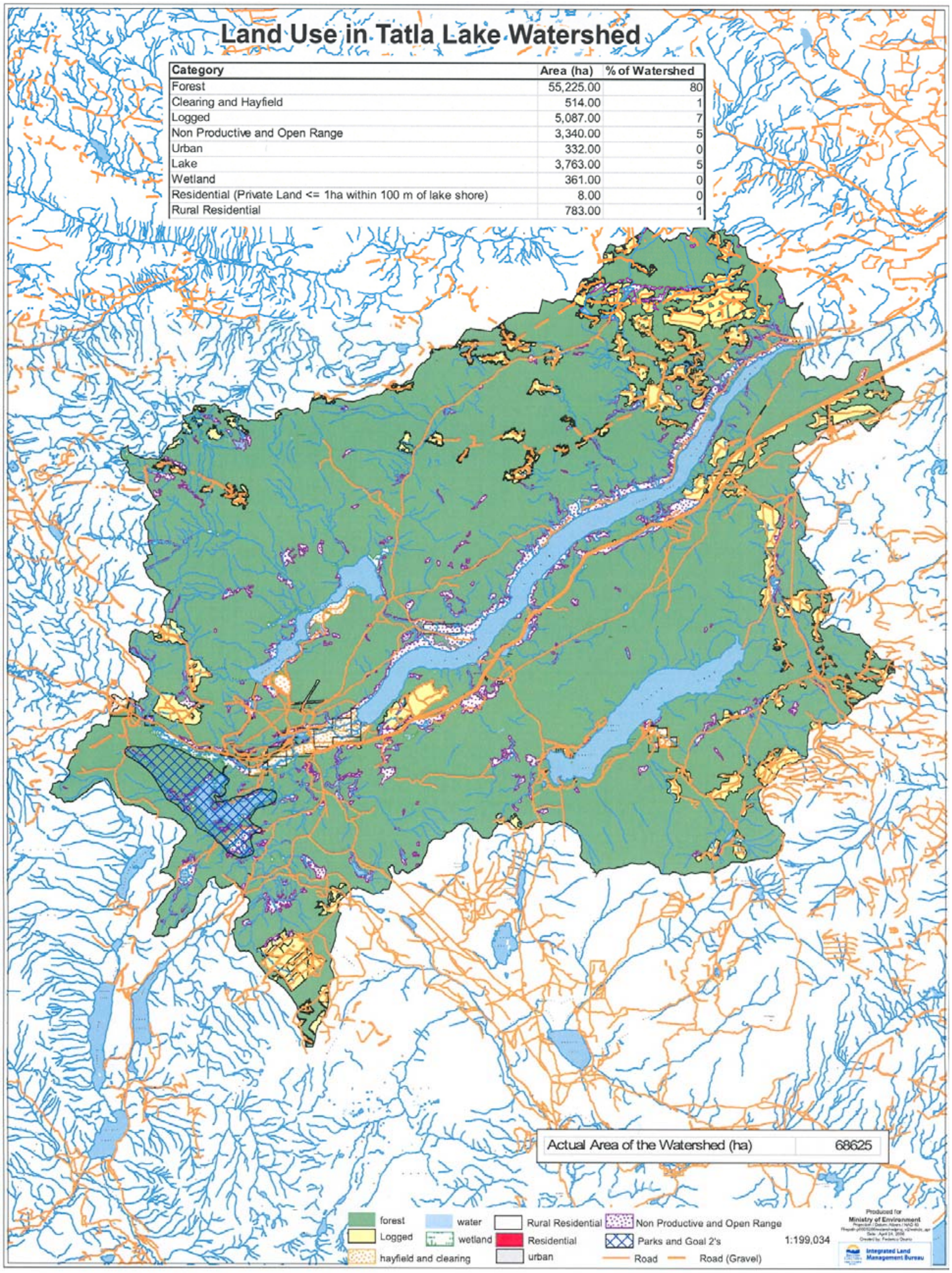
Human activities that impact water bodies range from small but widespread and numerous *non-point* sources throughout the watershed to large *point* sources of concentrated pollution (e.g. waste discharge outfalls, spills, etc). Undisturbed watersheds have the ability to purify water and repair small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

Tatla Lake is located approximately 210 km west of Williams Lake and lies at an elevation of 914 m. The lake has a maximum depth of 38.4 m and a mean depth of 10.4 m. Its surface area is 1816.29 hectares and the shoreline perimeter is 56 km. Tatla Lake contains Kokanee, Largescale Sucker, Longnose Sucker, Mountain Whitefish, Northern Pikeminnow (formerly N. Squawfish), Peamouth Chub and Redside Shiner.

The flushing rate is a measure of time that inflow replaces the lake water volume. It is important because the longer the retention time, the less the lake has the ability to assimilate additional nutrients, and therefore avoid unnatural eutrophication. The flushing rate of Tatla Lake is unknown.

Land use in the Tatla Lake watershed is predominately forest (80%), 7% logged, 5% non productive and open range, and 1% for both clearing/hayfield and rural residential. Information on non point source pollution is provided on the following page.

# Tatla Lake Watershed Map




| Category | Area (ha) | % of Watershed |
|---|---|---|
| Forest | 55,225.00 | 80 |
| Clearing and Hayfield | 514.00 | 1 |
| Logged | 5,087.00 | 7 |
| Non Productive and Open Range | 3,340.00 | 5 |
| Urban | 332.00 | 0 |
| Lake | 3,763.00 | 5 |
| Wetland | 361.00 | 0 |
| Residential (Private Land <= 1ha within 100 m of lake shore) | 8.00 | 0 |
| Rural Residential | 783.00 | 1 |

# Non-Point Source Pollution and Tatla Lake

Point source pollution originates from municipal or industrial effluent outfalls. Other pollution sources exist over broader areas and may be hard to isolate as distinct effluents. These are referred to as non-point sources of pollution (NPS). Shoreline modification, urban stormwater runoff, onsite septic systems, agriculture, and forestry are common contributors to NPS pollution. One of the most detrimental effects of NPS pollution is phosphorus loading to water bodies. The amount of total phosphorus (TP) in a lake can be greatly influenced by human activities. If local soils and vegetation do not retain this phosphorus, it will enter watercourses where it will become available for algal production.

The greatest challenge to Tatla Lake is phosphorus (nutrient) loading from chemical fertilizers and winter feeding areas situated too closely to the lake. This loading may promote summer algal blooms and the rapid growth of some aquatic plants species.

### *Agriculture*

Agriculture is economically and culturally important. When practices are improperly managed, however, there can be significant NPS impacts, such as nutrients and pathogens from manure and damage to shorelines from livestock access. Potential sources of nutrients include chemical fertilizers and improperly-situated winter feeding areas.

### *Onsite Septic Systems and Grey Water*

Onsite septic systems effectively treat human waste water and wash water (grey water) as long as they are properly located, designed, installed, and maintained. When these systems fail, they become significant sources of nutrients and pathogens. Poorly maintained pit privies, used for the disposal of human waste and grey water, can also be significant contributors.

### *Stormwater Runoff*

Over-fertilizing of lawns and gardens, oil and fuel leaks from vehicles , snowmobiles and boats, road salt, and litter are all washed by rain and snowmelt from our yards and streets. Pavement increases runoff of surface water and the amount of contaminants entering water bodies. Pavement collects contaminants during dry weather, and prevents water from soaking into the ground during storm events. Phosphorus and sediment are of greatest concern, providing nutrients and/or a rooting medium for aquatic plants and algae.

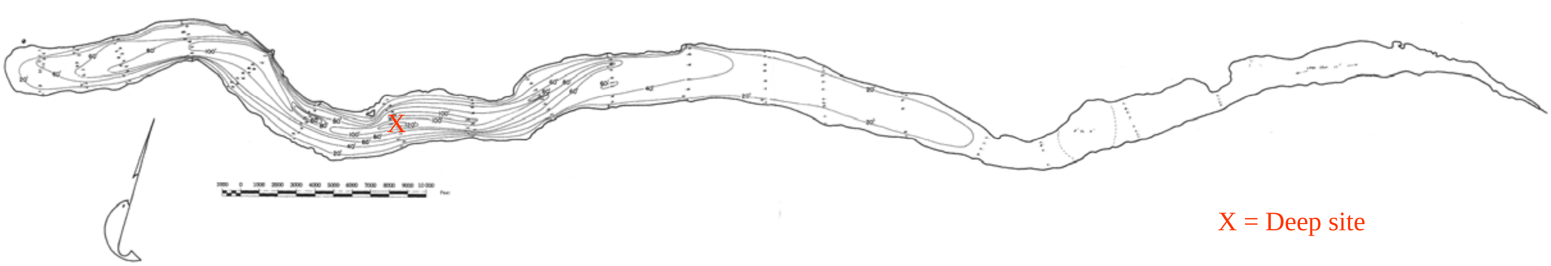
### *Forestry*

Forestry, which includes clear cutting, road building and other land disturbances is essential to the economy, however it can increase sediment and phosphorus, and alter water flow.

### *Boating*

Oil and fuel leaks are the main concerns of boat operation on small lakes. With larger boats, sewage and grey water discharges are issues. Other problems include the spread of aquatic plants and the dumping of litter. In shallow water operations, the churning up of bottom sediments and nutrients is a serious concern.

# Tatla Lake Bathymetric Map




Map obtained from www.fishwizard.com (2005).

# What's Going on Inside Tatla Lake?

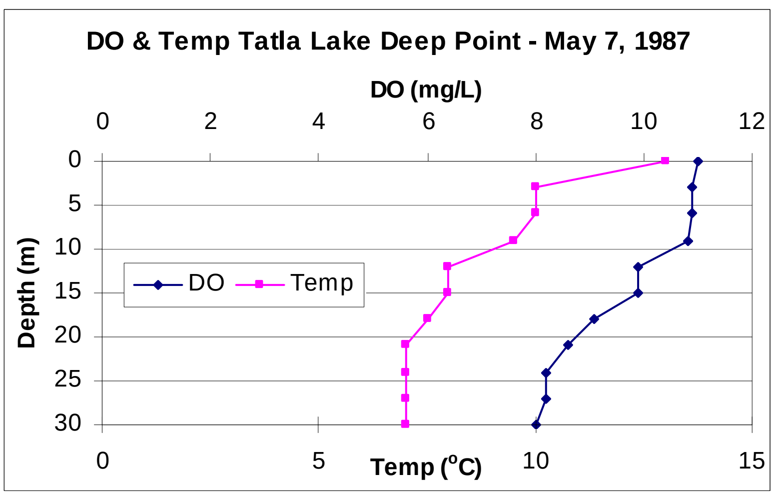
## *Temperature*

BC lakes can show a variety of annual temperature patterns based on their location and depth. Most interior lakes form layers (stratify), with the coldest water near the bottom. Because colder water is more dense, it resists mixing into the warmer, upper layer for much of the summer. When the warmer oxygen rich surface water distinctly separates from the cold oxygen poor water in the deeper parts of the lake, it is said to create a thermocline, a region of rapid temperature change between the two layers.

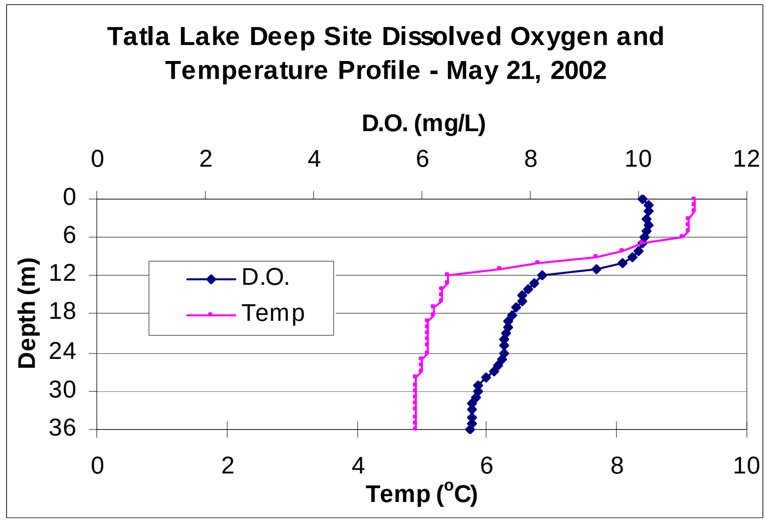
In spring and fall, these lakes usually mix from top to bottom (overturn) as wind energy overcomes the reduced temperature and density differences between surface and bottom waters. In the winter, lakes re-stratify under floating ice with the densest water (4°C) near the bottom. Because these types of lakes turn over twice per year, they are called dimictic lakes. This is the most common type of lake in British Columbia.

Coastal lakes in BC are more often termed warm monomictic lakes. These lakes turn over once per year. Warm monomictic lakes have temperatures that do not fall below 4°C in the winter and stratify in the summer.

The timing of freeze up and break up of BC lakes is important information for climate change research. BCLSS is interested in this information. If these dates have been recorded in the past, please send the information to BCLSS so that it can be incorporated into climate change studies.




Dissolved oxygen and temperature data was collected at 3 sites on Tatla Lake in 1987 and again from 2000 - 2003. The three sites included the deep site, the east end, and the west end. The above graph shows the dissolved oxygen and temperature data collected on May 7, 1987 at the deep site. The dissolved oxygen and temperature profiles show gradual gradients from surface to bottom, indicating the lake was sampled during or shortly after the lake underwent spring overturn. In this case thermal stratification is starting, but is still very weak. Data




collected on May 21, 2002 is shown in the graph above and displays the onset of thermal stratification with the formation of the thermocline between 6 and 12 m.

## *Dissolved Oxygen*

Oxygen is essential to life in lakes. It enters lake water from the air by wind action and also through plant photosynthesis. Oxygen is consumed by respiration animals and plants, including the decomposition of dead organisms by bacteria. A great deal can be learned about the health of a lake by studying oxygen patterns and levels.

Lakes that are less productive (oligotrophic) will have sufficient oxygen to support life at all depths throughout the year. But as lakes become more productive (eutrophic) and increasing quantities of plants and animals respire and decay, more oxygen consumption occurs, especially near the bottom where dead organisms accumulate. In productive lakes, oxygen in the isolated bottom layer may deplete rapidly (often to anoxia), forcing fish to move into the upper layer (salmonids are stressed when oxygen levels fall below about 20% saturation) where temperatures may be too warm. 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.

As mentioned, spring overturn is illustrated in the previous graphs. Spring overturn is a good time to get a representative sample because the water is well mixed. Nutrient concentrations can be compared each spring to determine trends.

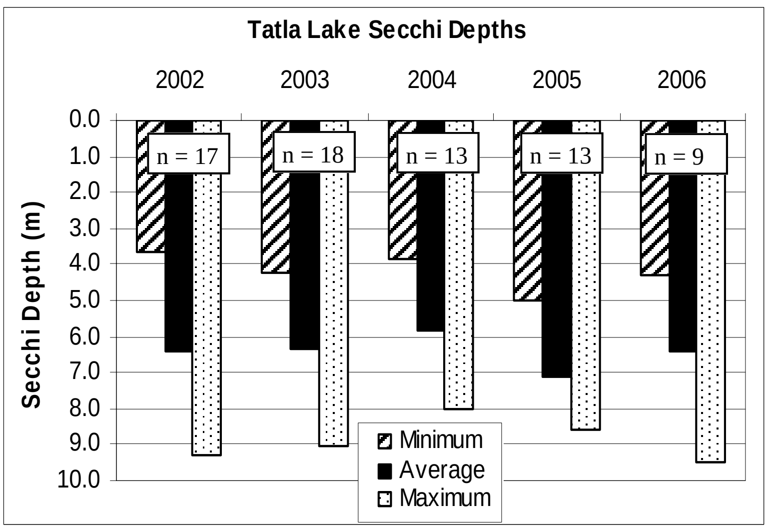
## *Trophic Status*

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. Trophic status is often determined by measuring levels of phosphorus, algal chlorophyll *a* (the green photosynthetic pigment), and water clarity. Establishing the trophic condition of a lake allows inter-lake comparisons and general biological and chemical attributes of a lake to be estimated.

Lakes of low productivity are referred to as ***oligotrophic***, meaning they are typically clear water lakes with low nutrient levels (1-10 *u*g/L TP), sparse plant life and low fish production. Lakes of high productivity are ***eutrophic***. They have abundant plant life including algae, because of higher nutrient levels (>30 *u*g/L TP). Lakes with an intermediate productivity are called ***mesotrophic*** (10-30 *u*g/L TP ) and generally combine the qualities of oligotrophic and eutrophic lakes.

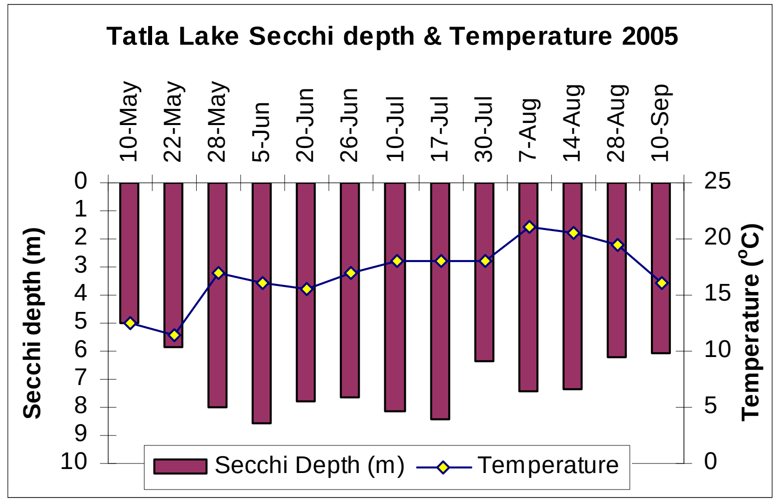
## *Water Clarity*

One method of determining productivity is by measuring water clarity. The more productive a lake is, 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 disk, a black and white disk that measures the depth of light penetration. The greater the Secchi depth the greater the water clarity.




The graph above shows the minimum, average and maximum secchi depths recorded on Tatla Lake from 2002 to 2006, as well as the number of readings for each year (n). From 2002 to 2006 the average Secchi depth measurements ranged from 5.8 m (2004) to 7.1 m (2005), indicating relatively little change has occurred over the 2002 - 2006 sampling period. Based on these Secchi values Tatla Lake was exhibiting oligotrophic conditions.

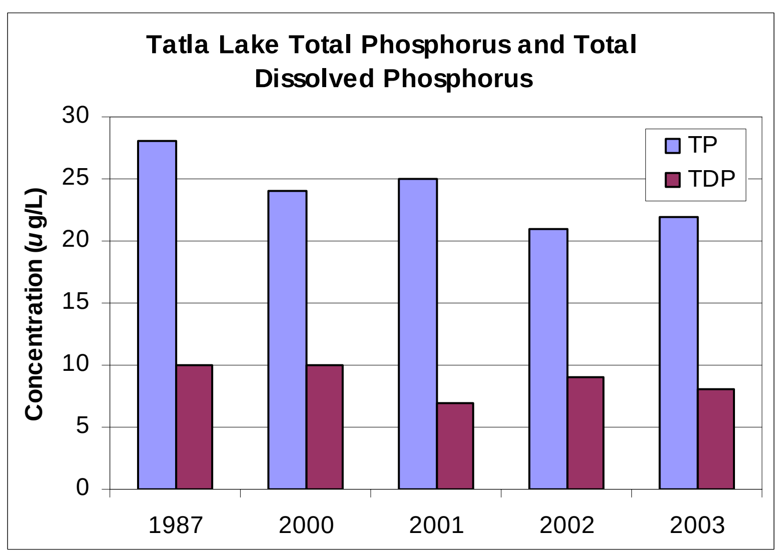
Natural variation and trends in Secchi depth and temperature not only occur between years, but also throughout one season. The Secchi depth and surface temperature for Tatla lake are shown in the following graph. In general as temperature increases during the summer months, the Secchi depth decreases. As temperature increases, so do some species of algae. When there is an increase in algae, the water clarity decreases and the Secchi depth decreases. Although this pattern is not strongly evident in the 2005 Tatla Lake data, generally the lake experiences a peak Secchi depth in June with minimum readings in July and August averaging about 2.5 m shallower.




## *Phosphorus*

As mentioned previously, productivity can also determined by measuring phosphorus levels. Phosphorus concentrations measured during spring overturn can be used to predict summer algal productivity. Productivity is dependant on the amount of nutrients (phosphorus and nitrogen) in a lake, which are essential for plant growth, including algae. Algae are important to the overall ecology of a lake because they are the food for zooplankton, which in turn are the 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, however, phosphorus accelerates growth and artificially ages a lake. Total phosphorus (TP) in a lake can be greatly influenced by human activities.

Lake sediments can themselves be a major source of phosphorus. If deep-water oxygen becomes depleted, a chemical shift occurs in bottom sediments. This shift causes sediment to release phosphorus to overlying waters. This *internal loading* of phosphorus can be natural but is often the result of phosphorus



pollution. Lakes displaying internal loading have elevated algal levels and generally lack recreational appeal.

Although nutrient sampling in 2002 and 2003 did not capture spring overturn conditions, an average of all results were used to calculate the mean values. It is assumed that these results accurately represent overturn values.

The average spring surface TP in 2003 was 22 *u*g/L, down from 28 *u*g/L in 1987 and 24 *u*g/L in 2000. In 2002 and 2001, the averages were 21 *u*g/L and 25 *u*g/L, respectively. From the previous graph and data collected it appears that total phosphorus and dissolved phosphorus levels have not changed significantly from 1987 to 2003. Based on the phosphorus data for the sampling years, the lake is classified as a mesotrophic lake, although the Secchi readings indicated Tatla Lake fell within the oligotrophic classification.

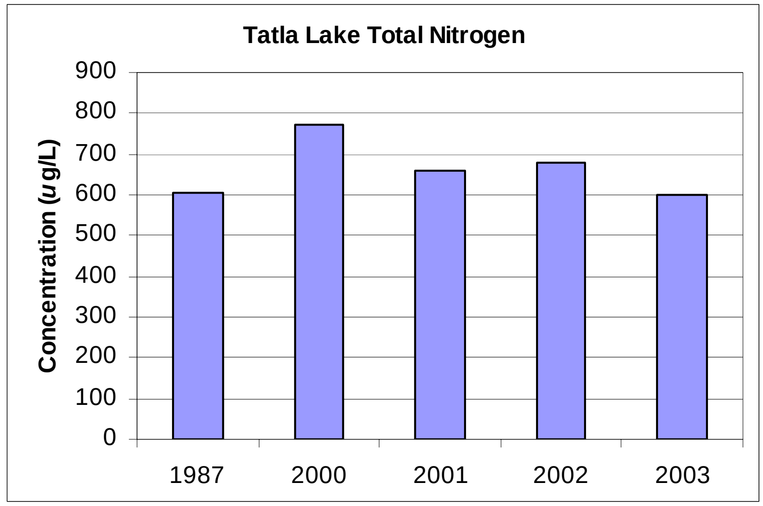
## *Nitrogen*

Nitrogen is the second most important nutrient involved in lake productivity. In BC lakes, nitrogen is rarely the limiting nutrient for algae growth (see phosphorus). In most lakes, the ratio of nitrogen to phosphorus is well over 15:1, meaning excess nitrogen is present. In lakes where the N:P is less than 5:1, nitrogen becomes limiting to algae growth and can have major impacts on the amount and species of algae present.

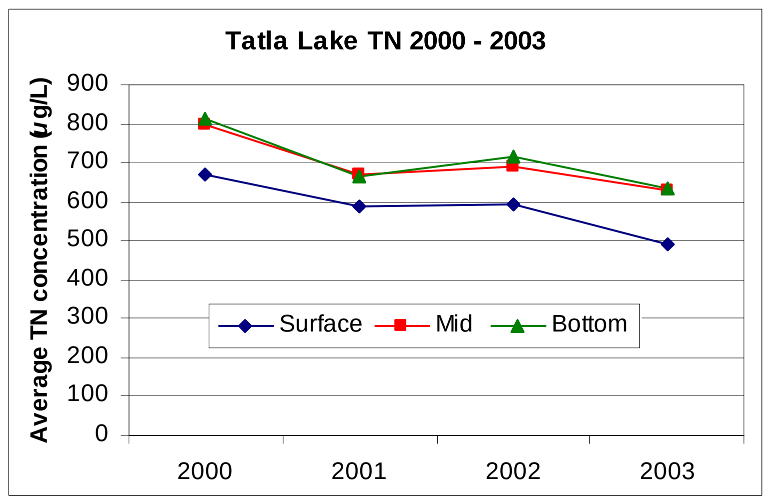
As with the phosphorus data in 2002 & 2003, all nitrogen values were averaged to provide representative overturn values. Total nitrogen (TN) values from 1987 and 2000 - 2003 were relatively constant over the sampling period as displayed in the above following graph.

The adjacent graph displays the TN trend in Tatla Lake from 2000 to 2003. The surface and mid-depth TN concentrations ranged from 493 - 798 *u*g/L. Bottom TN values ranged from 635 - 815 *u*g/L.

The N:P ratio is approximately 28:1, which means the lake is a phosphorus limited system. Although an increase in nitrogen should not increase algae biomass, it could result in a change to the species of algae present, possibly to a less desirable species.




The average spring surface TN in 1987 was 610 *u*g/L. In 2000, 2001, 2002 and 2003 the average spring surface TN was 670 *u*g/L, 587 *u*g/L, 595 *u*g/L, and 493 *u*g/L, respectively. This data reinforces the previous conclusions that the nitrogen concentrations have remained relatively stable since 2000.




# Should Further Monitoring Be Done on Tatla Lake?

The data collected on Tatla Lake indicates that the water quality has remained relatively stable in terms of Secchi depth, phosphorus and nitrogen concentrations. The data collected does not indicate further chemical sampling is necessary at this time. Volunteers are continuing to monitor Secchi depth, which will provide valuable long term records and help identify early warning signs should there be a deterioration in water quality. Continued volunteer monitoring of surface temperature, as well as freeze-up and break up of ice, are valuable for climate change studies. The Ministry of Environment believes it would be worthwhile to repeat the overturn chemistry in the future.

# Tips to Keep Tatla Lake Healthy

## Yard Maintenance, Landscaping & 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

- Locate confined animal facilities, winter livestock feeding and bedding areas as far away from waterbodies (streams and lakes) as possible.
- Divert incoming water and treat outgoing effluent from these facilities.
- Limit the use of fertilizers and pesticides especially on poorly drained soils close to waterbodies.
- Construct adequate manure storage facilities.
- Do not spread manure during wet weather, on frozen ground, in low-lying areas prone to flooding, within 3 m of ditches, 5 m of streams, 30 m of wells, or on land where runoff is likely to occur.
- Install barrier fencing to prevent livestock from grazing on streambanks and lakeshore.
- If livestock cross streams, provide graveled or hardened access points.
- Provide alternate watering systems, such as troughs, dugouts, or nose pumps for livestock.
- Maintain or create a buffer zone of vegetation along a streambank, river or lakeshore and avoid planting crops right up to the edge of a waterbody.

## 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.
- Don't 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.

## 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 or other waterbodies as toilets.
- 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.
- 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 polystyrene (completely contained and sealed in UV treated material) 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.

# Who to Contact for More Information

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