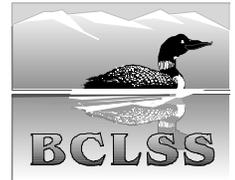




BC Volunteer Lake Monitoring Program

BEDNESTI LAKE 1998



The Importance of Bednesti Lake & its Watershed

British Columbians want lakes to display good water quality, good aesthetics and good recreational opportunity. When we don't see these features in our local lakes, we want to know why not. Is water quality getting worse? Has the lake been polluted by land development? What uses can be made of the lake and its water? And, what conditions will result from more development within the watershed?

BC Environment's Volunteer Lake Monitoring Program (VLMP), in collaboration with the BC Lake Stewardship Society, is designed to begin to answer these questions. Through regular water sample collection, we can come to understand a lake's current water quality, we can identify the preferred uses for a given lake and we can monitor water quality changes resulting from land development within the lake's watershed.

Through regular status reports, the VLMP can provide communities with monitoring results specific to their local lake and with educational material on lake protection issues in general. This information will lead to community and group empowerment as well as to stewardship of the lake resource. Finally, the VLMP allows government to use its limited resources most efficiently thanks to the help of area volunteers, the public, and the non-profit BC Lake Stewardship Society.

Bednesti Lake's VLMP program began in 1998 and has been conducted by the Bednesti Volunteer Lake Water Testing Group. This status report contains information derived from the 1998 sampling program.

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. Bednesti Lake's watershed is shown on the next page.

Watersheds are where much of the never ending water cycle takes place and play a crucial role in the purification of water. No "new" water is ever made - water is only cleansed through its continuous natural recycling in watersheds. The quality of the water resource is largely determined by a watershed's capacity to buffer impacts and absorb pollution.

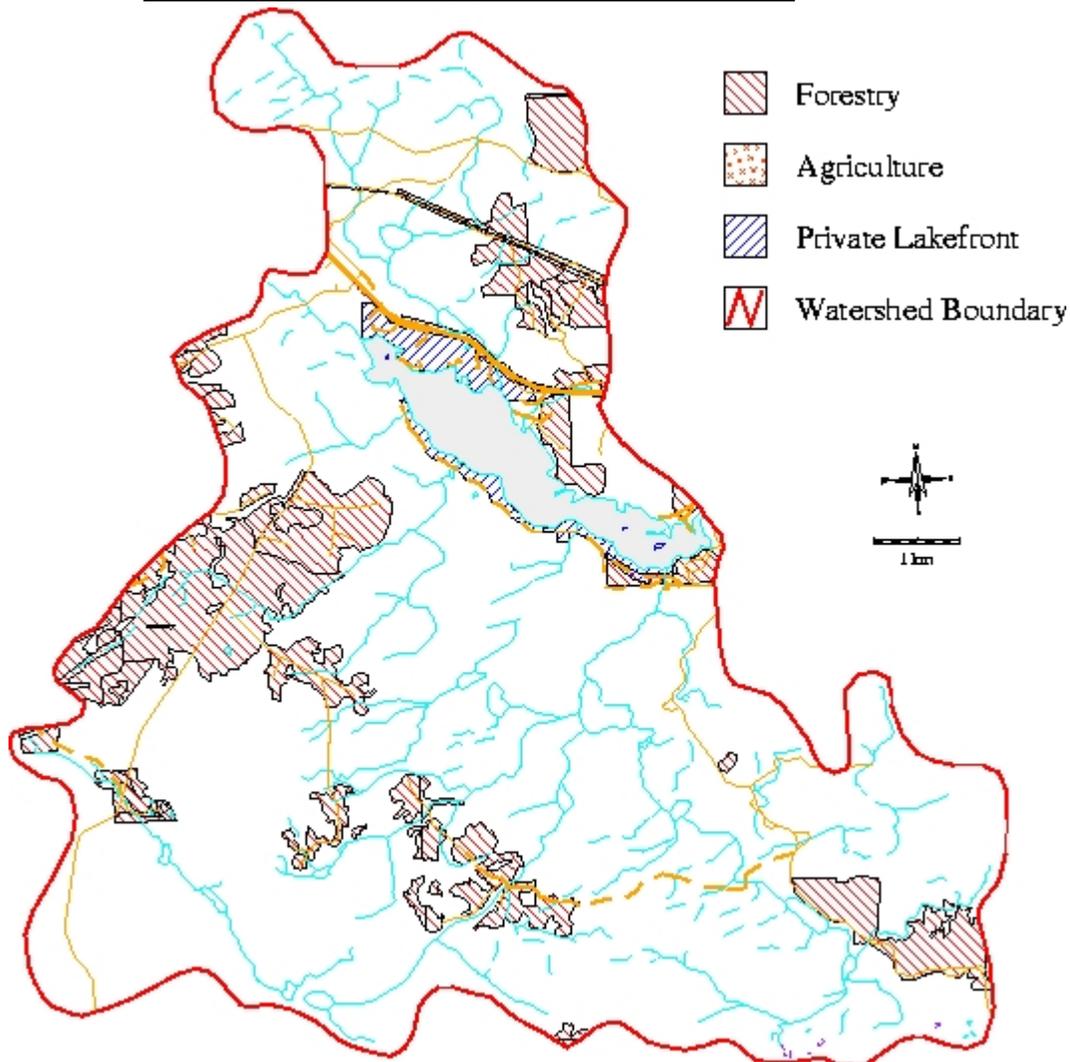
Every component of a watershed (vegetation, soil, wildlife, etc.) has an important function in maintaining good water quality resources and a healthy environment. It is a common misconception that detrimental land use practices will not impact water quality if they are kept away from the area immediately surrounding a water body. This is not true. Poor land-use practices anywhere in a watershed can eventually impact water quality.



Human activities that impact watersheds range from small but widespread "non-point" sources throughout the watershed to large "point" sources of pollution (e.g. spills, outfalls, etc.) concentrated in one place. 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.

Bednesti Lake is located... in the Omineca-Peace region near Hwy 16, 50 km west of Prince George, BC. The lake is roughly 5 km long, has a maximum width of 1 km and a maximum depth of 20.7 m. Its surface area is 261 hectares and it has a shoreline perimeter of 14 760 meters. The lake reportedly contains limited numbers of the following sport fish: rainbow trout (*Oncorhynchus mykiss*), mountain whitefish (*Prosopium williamsoni*) and lake char (*Salvelinus namaycush*). Land use in the watershed includes roughly 70 lakeshore residences, less than 20 of which are used on a full time basis, forest harvesting and one restaurant / motel / camping facility. The lake is used for general recreational purposes, however public access to the shoreline is limited. Some residents use surface water as a potable supply. The greatest challenge to the lake is phosphorus (nutrient) loading. This loading may promote summer algal blooms and the spread of aquatic plants. Canadian pondweed (*Elodea canadensis*) is a recently identified problem in the lake's west end, but was first reported in Bednesti Lake in 1968.

Watershed and Land Use Map



THEORETICAL PHOSPHORUS SUPPLY

Spring Overturn P (mg/L):	0.017
Sedimentation Rate Coefficient:	(0.5)
Flushing Rate (#/yr):	0.41
Yearly P Loading (gm/m ² /yr):	0.127

WATERSHED CHARACTERISTICS

Area:	81.6 km ²
Percent Land Usage:	
	1.5 % Residential (Developed)
	0.6 % Agricultural
	14.0 % Forestry

Non Point Source Pollution and Bednesti Lake

Spills and effluent outfalls are pollution sources that affect water quality. However, other pollution sources exist over broader areas. These are called “non-point” sources of pollution (NPS). **Urban stormwater runoff, onsite septic systems, agriculture, and forestry are common contributors to NPS pollution.** One of the most detrimental effects of NPS is phosphorous loading to water bodies.

Stormwater Runoff

Fertilizers on lawns and gardens, oil and fuel leaks from vehicles, sediment, road salt, and litter can all be washed by rain and snowmelt from our properties and streets into watercourses. 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.

Onsite Septic Systems and Grey Water

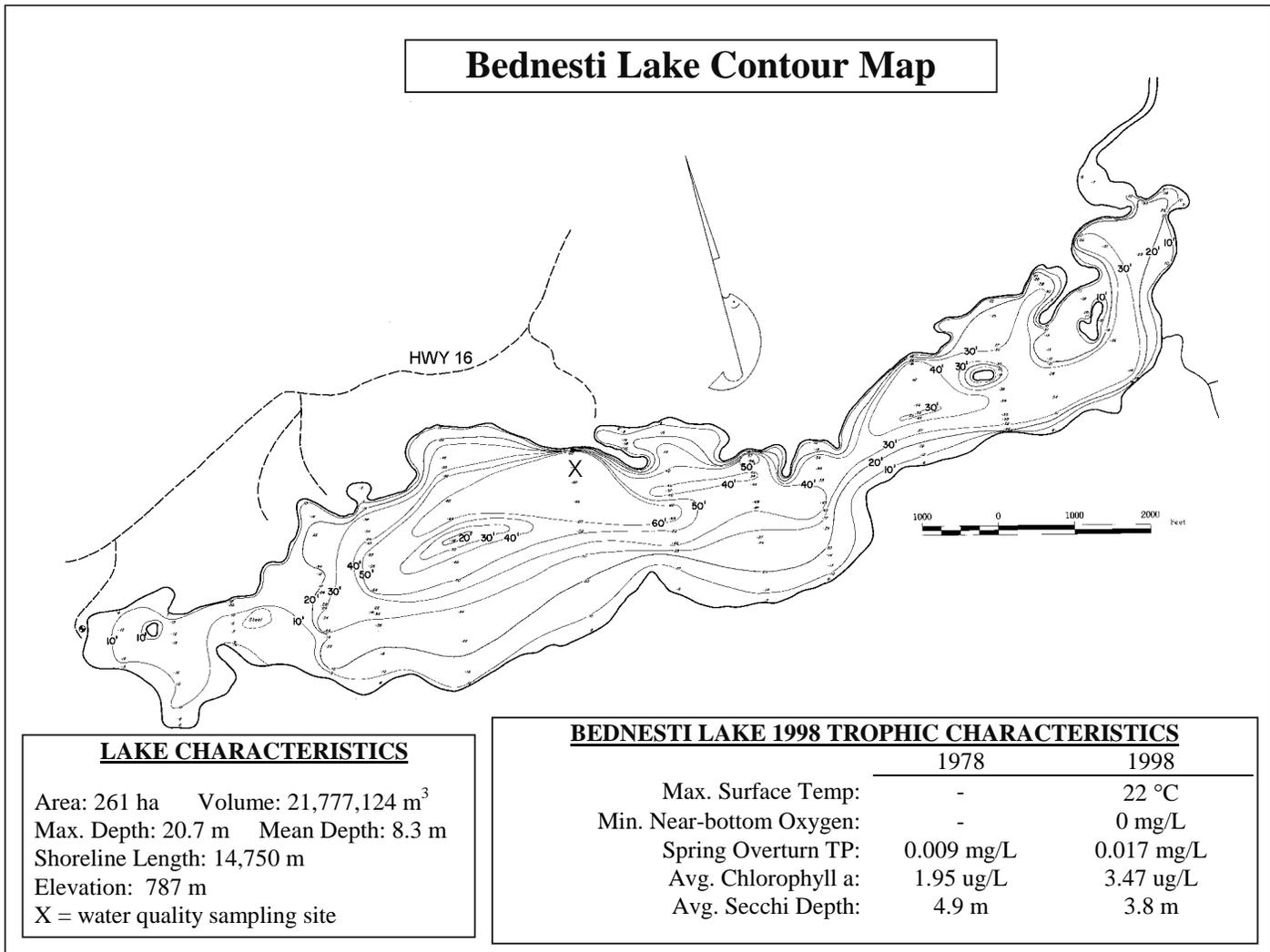
Onsite septic systems effectively treat wastewater as long as the system is properly located, designed, installed, and maintained. When these systems fail they become significant sources of nutrients, pathogens and organic material. Other wash water (grey water) is also a source of these contaminants and must be disposed of properly.

Agriculture

Agriculture is economically and culturally important. However, when improperly managed, significant NPS impacts, such as nutrient and pathogen loading from manure and damage to shorelines from livestock access, can occur.

Forestry

While essential to the economy, forestry can include clear cutting, road building and land disturbances that alter water flow and increase sediment and phosphorous loads to water bodies.



What's Going on Inside Bednesti Lake?

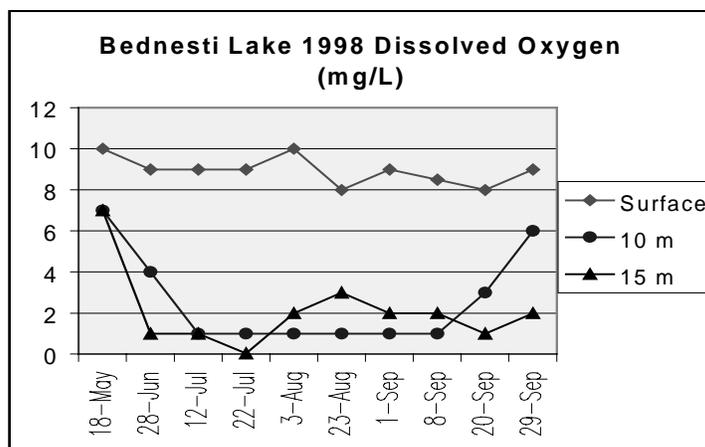
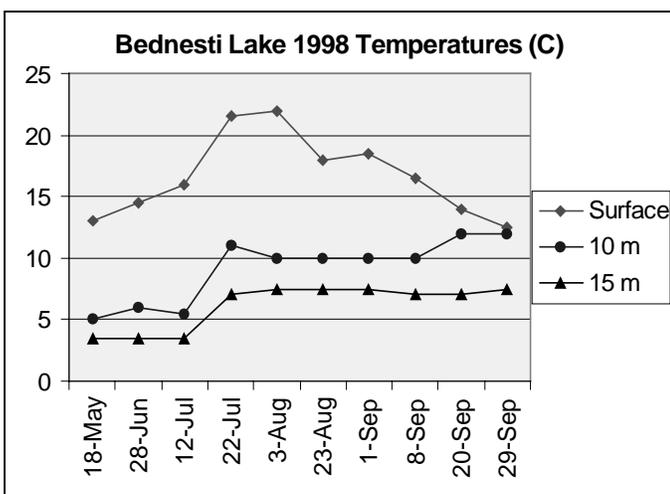
Temperature

BC lakes can show a variety of annual temperature patterns based on each lake's location and depth. Most interior lakes form layers (stratify), with the coldest summer water near the bottom. Because this colder water is denser, it resists mixing into the warmer, lighter upper layer for much of the summer. In spring and fall, these lakes usually mix from top to bottom 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 warmest water (4 °C) near the bottom.

Lakes of only a few metres depth tend to mix throughout the summer or layer only temporarily, depending on wind conditions. In winter, the temperature pattern of these lakes is similar to that of deeper lakes.

Temperature stratification patterns are very important to lake water quality as they determine much of the seasonal oxygen, phosphorus and algal conditions. When abundant, algae can be problematic for most lake users.

The temperature diagram below shows the 1998 temperatures at surface, mid-depth and bottom waters of Bednesti Lake. Because of its moderate depth, Bednesti Lake did stratify beginning sometime in early May. A maximum surface temperature of 22 °C was reached in early August. Mid-depth and bottom temperatures were influenced by warm surface conditions and did rise through the summer. The loss of stratification was not monitored but is expected to have occurred by early October.



Dissolved Oxygen

Oxygen is essential to life in lakes. It enters the lake water from the air through wind action and plant photosynthesis. Oxygen is consumed by respiration of 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 its patterns and quantity of oxygen.

Lakes that are unproductive (oligotrophic) will have sufficient oxygen throughout the year at all depths. But as a lake becomes more 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 the oxygen in the isolated bottom layer may deplete rapidly, forcing fish to move into the upper layer (fish are stressed when oxygen falls below about 20% saturation). Fish kills occur when decomposing or respiring algal populations use up the oxygen. In summer, this usually happens during an algal bloom on calm nights, but most fish kills occur during late winter or at initial spring mixing.

On Bednesti Lake, as expected, oxygen concentrations in surface waters did not drop below 8 mg/L and were adequate to support fish through the summer. Fairly early in the summer, however, bottom and mid-depth oxygen declined to low concentrations of around 1 mg/L. These persisted until late September, would not support fish, and facilitated phosphorus release from bottom sediments to overlying waters. Oxygen saturation would have been regained at all depths with overturn in early October.

What's Going on Inside Bednesti Lake?

Trophic Status and Phosphorus

The term "trophic status" is used to describe a lake's level of productivity. Productivity is dependent on the amount of nutrients (phosphorus and nitrogen) in the lake that are essential for plant growth, including tiny, floating algae called phytoplankton. Algae are important to the overall ecology of the 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 may artificially age a lake.

The trophic status of a lake can be determined by measuring productivity. The more productive a lake is the higher the algal growth and therefore the less clear the water becomes. *Secchi depth* is water clarity measured using a *Secchi disc*. Productivity is also determined by measuring nutrient levels and *chlorophyll* (the green photosynthetic pigment of algae). Spring overturn phosphorus concentrations in a lake drive, and can also be an indicator of, summer algal productivity.

Lakes of low productivity are referred to as *oligotrophic*; 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, including algae, because of higher nutrient levels. Lakes with an intermediate productivity are called *mesotrophic* and generally combine the qualities of oligotrophic and eutrophic lakes.

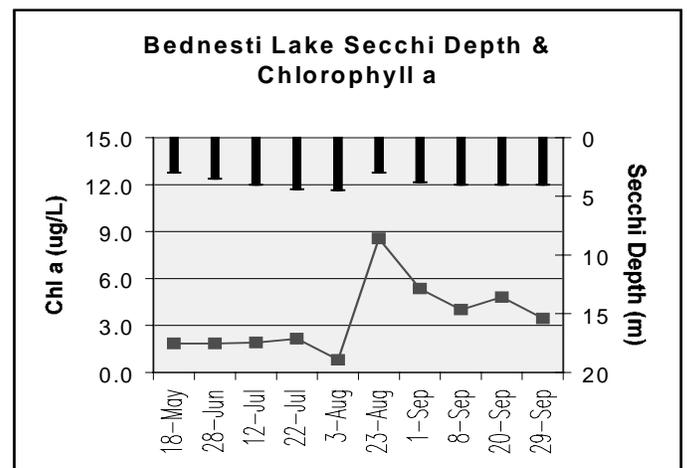
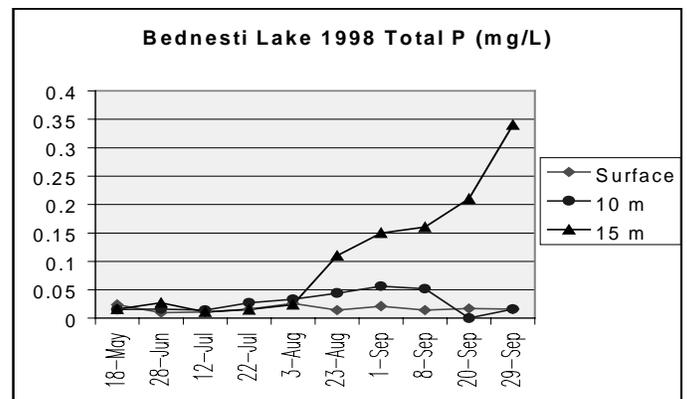
The amount of total phosphorus (TP) in a lake can be greatly influenced by human activities (see NPS section). If local soils and vegetation do not retain this phosphorus, it will enter watercourses where it will become available for algal production.

Lake sediments can themselves be a major source of phosphorus. If deep-water oxygen becomes depleted, a chemical shift may occur in bottom sediments. This shift causes sediment to both release phosphorus to overlying waters and to generate hydrogen sulphide (H₂S). 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.

Bednesti Lake spring TP levels increased from 9 ug/L in 1978 to roughly 17 ug/L in 1998. This implies increased summer algal growth, a shift from oligo- to mesotrophy and declining water quality. Chlorophyll and Secchi data mirror these results. Average summer algal chlorophyll increased from 1.95 ug/L in 1978 to 3.47 ug/L in 1998. In response, average Secchi depths declined from 4.9 m to 3.8 for the same years.

Bednesti Lake also showed clear signs of internal loading in 1998, when deep water TP concentrations averaging 19 ug/L from May to July rose dramatically to peak at 340 ug/L in September. The loss of deep water oxygen and generation of H₂S infer internal phosphorus loading. Internal loading was not assessed in 1978, but limited data suggest that it also occurred in 1983.

This year's VLMP data suggest that Bednesti Lake water quality is deteriorating. Additional years of VLMP data plus sediment coring are required to confirm a deteriorating trend. Regardless, all residents and land developers within the watershed are advised to practice good land management such that nutrient migration to the lake and its tributaries is minimized.



Household Tips to Keep Bednesti 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 low-phosphate or phosphate-free soaps.
- 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 dishwasher only when full and use low-flow showerheads and toilets.

Yard Maintenance, Landscaping & Gardening

- Replant lakeside grassed areas with native vegetation and do not import sand.
- Cultivate plants that discourage pests and minimize high maintenance grassed areas.
- Reduce your use of fertilizers and pesticides.
- Don't 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.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.
- 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.

Boating

- Do not throw trash overboard or use lakes or other waterbodies as toilets.
- Use biodegradable, phosphate-free cleaners instead of harmful chemical cleaners to clean the inside and outside of your boat.
- Conduct major maintenance chores on land.
- Keep motors well maintained and tuned to prevent fuel and lubricant leaks.
- Consider using 4 stroke engines, which are less polluting than 2 stroke engines. Use an electric motor where practical.
- Use absorbent bilge pads to soak up minor oil and fuel leaks or spills.
- Recycle used lubricating oil and left over paints.
- Help educate fellow boaters.

Auto Maintenance

- Do not wash your vehicle in a lake or stream.
- Check your car's fuel, oil, brake, transmission, exhaust and cooling systems regularly. Fix leaks or problems immediately.
- Use a dropcloth if you fix problems yourself.
- Recycle used motor oil, antifreeze, and batteries at collection centres.
- Use phosphate-free biodegradable products to clean your car. Wash your car over gravel or grassy areas, but not over onsite sewage systems.

Agriculture

- Locate confined animal facilities away from waterbodies. Divert incoming and outgoing runoff from these facilities.

Who to Contact for More Information

Ministry of Environment, Lands and Parks

Contact: Bruce Carmichael,
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Regional District of Fraser Fort George

Contact: Gord Simmons
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Bednesti Lake Volunteer Water Quality Testing Group

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Volunteer Monitors: Len Kersey, Betty and Noel
Hubbard, Marg Dureau, Jim Bartlett

The BC Lake Stewardship Society

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