Regional District of Bulkley-Nechako
SHORELAND DEVELOPMENT STRATEGY
October 2009

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PLANNING DEPARTMENT

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"A WORLD OF OPPORTUNITIES WITHIN OUR REGION"

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1.1 INTRODUCTION

The Regional District of Bulkley-Nechako (RDBN) covers a sizable area of over 73,000 square kilometers and is characterized by its numerous lakes and water features. These lakes and rivers are the primary reason for the region's world class reputation as a fishing and outdoor recreation destination. The Region contains over 28,000 water bodies ranging from small ponds to massive features such as Babine Lake and the Nechako Reservoir. The majority of the lakes in the Regional District are remote and remain in a natural state. However, many hundreds of the regions lakes are directly influenced by human development and activities.

In recent years there has been a growing recognition of the need to maintain the water quality in lakes and watercourses throughout the region. As development pressures increase along with the popularity of the region for lake front living and recreation, the Regional District of Bulkley-Nechako recognizes the need to re-examine the way we use and enjoy lakes and watercourses to ensure we are not compromising their natural ecology.

Lakes, rivers and other water features are key components of the natural environment that contribute to our quality of life and economy. The esthetic and recreational values of water features make waterfront properties highly desirable. In our region the tourism industry is based on outdoor recreation, most aspects of which are directly related to water features. Also, many residents remain in the region, or choose the region to live because of the benefits associated with our rivers and lakes. Activities such as fishing, boating, swimming, canoeing, bird watching and wildlife viewing are dependent on high water quality and healthy ecosystems.

1.2 PROJECT OVERVIEW

The RDBN has long recognized the importance of maintaining water quality and preserving riparian habitats. This has traditionally been done through the establishment of Official Community Plan policy that is implemented through land use regulations. This document, specifically devoted to lakeshore development marks the next step in reaffirming the RDBN's commitment to sound lakeshore development practices. This is done to ensure that the regions' water resources remain healthy and vibrant to be enjoyed by residents and visitors alike.

1.2.1 Goals

The goal of this study is to develop a practical strategy, designed for implementation in the RDBN, that ensures that lakeshore development occurs in a manner that:

- Does not negatively impact the natural environment and aquatic habitats.
- Ensures that future residents can enjoy the lifestyle offered by lakes that are healthy and not overdeveloped.
- Results in the regions' lakes and rivers maintain their natural beauty and vital character so that they continue to be a significant attribute to the regional economy by attracting tourists, visitors, and new residents to the region.

The shoreland development strategy resulting from this study is designed to achieve the following objectives:

- Preserve the positive character of existing lakeshore development.
- Identify and promotes sustainable and innovative development practices.
- Encourage property owners to understand how their behavior impacts the ecology of lakes, and understand how they can change their behavior to promote positive impacts.
- Ensure that lakes are not developed to a point where additional regulations and enforcement is necessary in order to protect lake ecology.
- Ensure that lakes are developed in a manner that facilitates public access and minimizes opportunities for conflict between lakeshore residents and the general public.
- Facilitate a cooperative working relationship with the Department of Fisheries and Oceans; the Ministry of Environment, and existing lake/watershed stewardship groups.

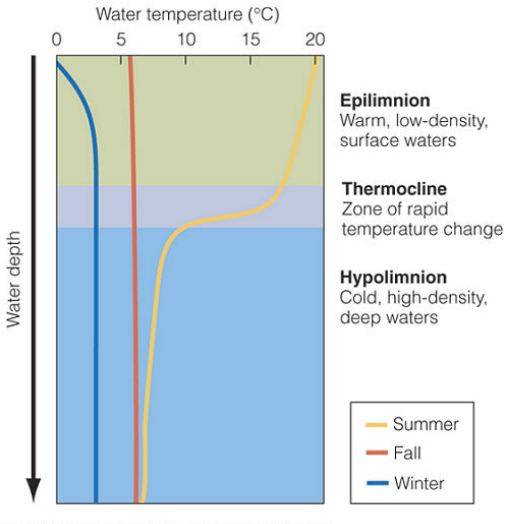
1.3 AQUATIC ECOLOGY

1.3.1 Lakes

Although lakes appear to be simple masses of water, they are in fact complex systems with highly variable physical, chemical and biological characteristics. These characteristics vary both spatially within a lake and temporally over all scales of time. However, despite this variability, lakes are highly structured. Lakes are influenced by both internal factors such as size, shape and depth, and external conditions such as geology, climate and human activities. It is the combination of all these variables that determine the quality of water in a lake and its susceptibility to degradation from human activities.

Dissolved Oxygen and Temperature

Lakes are fundamentally affected by interactions between light, temperature and wind mixing. The amount of solar energy that can enter the water is the major factor that controls water temperature and photosynthesis, which influences the amount of dissolved oxygen in the water. Dissolved oxygen is consumed by the respiration of living aquatic organisms and the decomposition of organic matter. Dissolved oxygen levels are considered the most important and commonly employed measurement of water quality and indicator of a water body's ability to support desirable aquatic life.



The temperature of a lake has the greatest influence on its biology and chemistry. The majority of the deep lakes in the RDBN are dimictic, which means that the temperature of the lake stratifies vertically and mixes twice a year. Generally, in the summer when the surface waters warm, thermal stratification is created with the water temperature decreasing with increasing depth. During the fall when the surface waters cool, the temperature becomes constant throughout the water column and wind energy mixes the layers. In the winter when lakes freeze, because water reaches its highest density at 4° C, the water stratifies again, but in reverse order. The mixing of the layers also redistributes oxygen and nutrients between shallow warm water and deep cold water. Shallow lakes are more easily mixed by wind action and therefore tend not to stratify.

Eutrophication

Trophic status refers to the amount of biological productivity in a system and is directly related to nutrient inputs. At the extremes, deep, cold lakes tend to be unproductive

and are called oligotrophic, while warm, shallow lakes tend to be highly productive and are called eutrophic. Eutrophication is a natural process that occurs in an aging lake, associated with the gradual buildup of organic materials, nutrients and sediments. Eutrophic lakes are generally undesirable for human activities and are characterized by an abundance of aquatic vegetation and cloudy water due to algae growth.

Lakes that are influenced by human development and activities can experience an accelerated rate of eutrophication caused by increased nutrient input, which degrades water quality and makes lakes less appealing to residents and recreational users. In most lakes in North-Central BC, the growth of aquatic plants and algae is limited by the absence of the essential nutrient phosphorous. When additional phosphorous enters the lake it can cause additional aquatic plant and algae growth. Algal blooms are often unsightly, and can discolour and add a bad drinking taste to water. When an algal bloom dies, it can deoxygenate a river or lake causing fish kills and other problems. Human sources of phosphorous include fertilizers, sewage effluents, grey water, and livestock manure.

1.3.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas are those areas requiring special management attention to protect important scenic values, fish and wildlife resources, historical and cultural values, and other natural systems or processes. ESAs in the aquatic environment include wetlands, rivers/streams and creeks, lakes and riparian zones. It is important to identify and protect these areas as they are particularly vulnerable and can be easily damaged.

1.3.3 Water Pollution: Point and Non-Point Sources

Water pollution is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which can be harmful to organisms and plants that live in these water bodies. Generally there are two categories, point and non-point source pollution. Point sources are those that directly enter the aquatic environment from a single identifiable source, such as the outlet of a municipal sewage system. These sources are typically easy to manage because emissions can be closely monitored and any changes are immediate. Non-point source pollution originates from diffuse sources and makes its way into the aquatic environment through runoff or diffusion into streams and groundwater. Sources include fertilized agricultural fields,

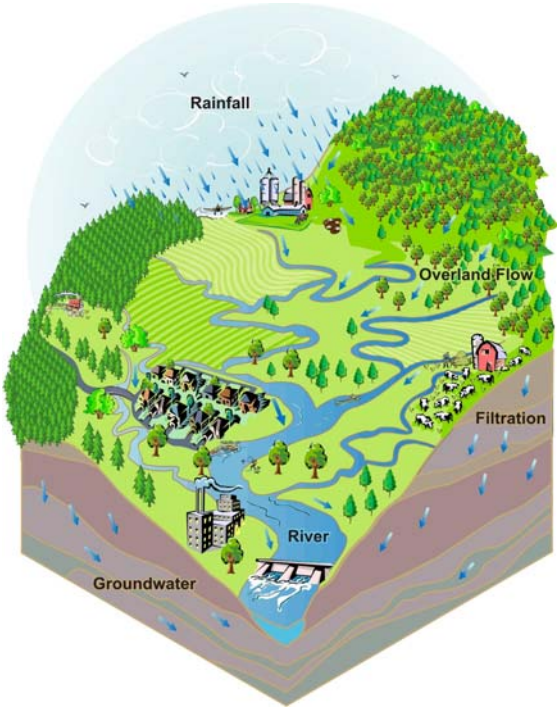
individual residential households (septic systems, fertilized lawns), and roads (stormwater drain runoff). The cumulative effects of these sources are subtle, gradual and difficult to manage. At first glance, small amounts of non-point source pollution from a household do not appear very significant, but the combined effects of pollutants from hundreds or thousands of people pose a real threat to water quality.

1.3.4 Wetlands and Riparian Areas

Wetlands are water laden areas such as marshes, swaps and bogs. Riparian areas are the lands adjacent to a lake or watercourse and are a transition area between terrestrial and aquatic ecosystems. Riparian areas are always associated with a lake or watercourse. Wetlands and riparian areas are exceptionally rich in habitats and biodiversity. They are also vital components of lake ecosystems because of their ability to filter toxins, improve groundwater recharge, dissipate stormwater runoff energy, and provide flood protection and shoreline stabilization. The vegetation in a riparian area provides shade which helps to regulate water temperature and provides important protection to fry and small fish along the shore line. Riparian areas also provide a food source for fish and other species.

1.3.5 Watershed Management

A drainage basin, also known as a watershed is an extent of land where water from rain or snow melt drains downhill into a body of water, such as a river, lake, reservoir, estuary, wetland, or ocean. It includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels, and is separated from adjacent basins by a drainage divide. The drainage basin acts like a funnel, collecting all the water within the area covered by the basin and channeling it into a waterway.



Watershed management is the process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plant, animal, and human communities within a watershed boundary. Features of a watershed that agencies seek to manage include water supply, water quality, drainage, stormwater runoff, water rights, and the overall planning and utilization of watersheds. Landowners, land use agencies, stormwater management experts, environmental specialists, water use purveyors and communities all play an integral part in the management of a watershed.

1.4 IMPACTS FROM LAND USE AND DEVELOPMENT

1.4.1 Lake Access

Access to lakes is a right that is cherished by lake users. Increasing development pressures and existing infrastructure can constrain public access and create conflicts. Conversely, increased accessibility can create increased pressures from private development and overuse from the public. Lakes are public resources and access must be a consideration in all conservation and development proposals.

1.4.2 Public Recreation

One of the primary ways people enjoy lakes is through recreational activities. These activities can have a variety of impacts on water quality and wildlife habitat from disturbing nesting waterfowl to fuel leaks. In order to recreate on a lake, there must be access to it. This can include private properties, public beaches and campsites, boat launches and commercial resorts. How each site is developed determines its degree of impact on water quality.

The use of motorized boats is an integral part of many common recreational activities such as fishing and swimming. In some areas of the RDBN they are also important for transportation. Motorized boats can have a number of negative impacts on a lake. These include oil and fuel leaks, spread of aquatic plants, dumping of litter and septic waste, churning up of bottom sediments and shoreline erosion due to wave action.

1.4.3 Roads and Right of Ways

Road, utility and sewage infrastructure can each have a large impact on water quality. In rural areas public and resource roads are built and maintained by workers contracted by the Ministry of Transportation and Ministry of Forests. Roads in our regional often run along lake shores and watercourses; routine and necessary road maintenance activities such as sanding and salting in the winter and dust control in the summer can affect water quality.

Utility corridors infrequently have a direct affect on lakes and watercourses, but can indirectly impact water quality. They are usually stripped of vegetation either by mechanical or chemical means, and serve as access corridors for motorized and non-motorized recreation. Utility corridor trails can be heavily used with little or no control at stream crossings.

1.4.4 Recreational and Residential Waterfront Development

Many of the water quality issues in the RDBN are associated with existing development on undersized lakeshore properties that were created before modern land use planning standards regarding waterfront lot sizes, sewage regulations, and development controls existed. Many of these lots were created by the Province as recreational lease properties not intended for residential use. Over time as the availability of free-hold lakeshore lots decreased the Province allowed lease holders to purchase their leases. Though most of these leases have already sold there remain a number of them that are regularly sold at the request of the lessee. The Province is able to impose restrictions that are conditions of sale while the property is still Crown land. The RDBN has informed the Provincial Crown land agency of its concerns regarding inadequate or aging on-site sewage disposal systems that exist on most of these properties. At the time of sale the RDBN and the Northern Health Authority have requested that the Province evaluate the ability of the lots to accommodate an on-site sewage disposal system. Currently the Province sells the lots as non-conforming with a covenant on title requiring appropriate sewage disposal. Until this issue is addressed, the sale of recreational lease properties will likely continue to contribute to the degradation of water quality in the region.

Residential land use is a significant cumulative source of non-point pollution. Some of the traditional landscaping features of waterfront property are actually harmful to the environment. Dredging, placement of fill, large lawns and vegetation removal for beaches and views can allow pollution to more easily enter the water and destroy important wildlife habitat. However, conscientious property development and simple everyday actions can minimize residential based pollution. Even properties that are already developed can be rehabilitated by simple practices such as replanting native plants and modifying lawn care practices.

On-Site Sewage Systems

On-site sewage systems are the most common method of sewage disposal in rural areas. Lakeshore properties tend to be small in size in order for developers to

maximize lot yield. Often this results in little room for adequate sewage disposal. Replacing failed systems can be challenging and expensive. Failing on-site sewage disposal systems are probably the highest source of non-point pollution affecting water quality in the region. However, with proper installation and maintenance these systems can be an efficient way to treat effluent effectively.

Community sewage infrastructure can minimize water quality impacts by allowing effluent to be treated more effectively and allowing discharge to be located away from the lake. However, community systems are only feasible in association with higher density developments. The RDBN has not indicated any interest in taking responsibility for the operation, maintenance or funding of any new water or sewer system. New strata developments that rely on a sewer system operated by the strata development will only be considered if it can be demonstrated that the system can be adequately designed and maintained with an appropriate capital reserve for maintenance, repairs or replacements in place.

Landscaping and Day to Day Living

Traditional methods of landscaping waterfront properties can seriously damage fragile riparian ecosystems and habitats. Property owners commonly remove riparian area vegetation to open up views and create beaches. The loss of this vegetation removes valuable wildlife habitat, allows warming of shallow areas that are important to fish and generally upsets the balance of the ecosystem.

Routine activities associated with waterfront dwellings whether occupied full time or seasonally, can have cumulative negative impacts on water quality. This includes the use of fertilizers, pesticides, and harmful or phosphate-containing detergents and soaps. These substances are easily transported directly into the water from runoff or through the ground and have immediate consequences. Fertilizers and phosphorous accelerate the growth of aquatic plants and algae, while pesticides and household chemicals are toxic to fish and wildlife. Many recreational properties have pit-privies and separate gray-water systems. Grey-water is wastewater collected from clothes washers, bathtubs, showers, and laundry or bathroom sinks. Grey-water systems commonly discharge this untreated, high-phosphorous wastewater directly in the environment, instantly reducing water quality.

1.4.5 Agricultural Development

Good farming practices are vital to maintaining clean surface waters and healthy fish and wildlife habitats. Irrigation, livestock watering, manure piles, chemical fertilizers and pesticides, manure spreading, and vegetation removal can all degrade water quality. There are many Provincial and Federal resources to assist farm operators in planning and implementing environmentally sound farm practices.

1.4.6 Commercial and Industrial Development

Many commercial activities that have direct contact with lakes and watercourses are generally tourism based. These include commercial resorts and marinas, which have a variety of impacts on water quality. New resorts and marinas must be thoughtfully located and carefully planned. If properly designed and maintained they can have an overall positive effect on water quality. High water quality is a must for recreational use, and by making lakes more accessible, more people will demand the protection of the resource. However, irresponsible motor boating, littering and other actions by recreational users can reduce water quality. Also poorly designed or maintained resorts and marinas can destroy habitat and pollute water with improperly treated sewage and oil and fuel leaks.

Industrial activities relating to resource extraction such as forestry and mining are regulated by the Provincial and Federal Government. The Provincial Government performs strategic land and resource planning that forms the foundation for balanced solutions that meet economic, environmental, and social requirements throughout the province. These documents are produced by inclusive processes and guide not only government decision makers, but also those seeking natural resource development opportunities.

Forest planning, road building, logging, reforestation, and grazing are regulated by the BC Ministry of Forests and Range under the *Forest and Range Practices Act.* This legislation maintains protection for forest values including watersheds and wildlife habitat, and creates efficiencies for both government and industry through streamlined planning processes. The Forest Planning and Practices Regulation has specific requirements designed to protect water quality, aquatic habitat and riparian areas.

Gravel pits and mining operations are regulated by the BC Ministry of Energy, Mines and Petroleum Resources. Gravel reserves naturally occur near lakes and watercourses. Extraction of these reserves can impact water quality primarily through

sediment, metals and oil transported by stormwater runoff. The most effective way to control this pollution is to divert stormwater, manage runoff and employ erosion and sediment control systems. Several major mining operations have occurred near lakes in the region. Closed mines include the Granisle Copper Mine that was staked on an island in Babine Lake and the Pinchi Lake mercury mine on the north shore of Pinchi Lake, near Fort St. James. The Pinchi Lake mine has been linked to elevated levels of mercury in fish (Weech, Scheuhammer, Elliott, & Cheng, 2004). Currently operational mines include the Endako Mine located near the east end of Francois Lake and the Huckleberry Mine near Tahtsa Lake, which is part of the Nechako reservoir. All new mines must go through rigorous environmental assessments by both the Federal and Provincial governments.

1.5 JURISDICTION AND RESPONSIBILITY

All levels of government have regulations designed to protect the environment and control the impacts of development on waterfront property. It is important that waterfront property owners make themselves aware of these regulations and learn when they are applicable. The main regulatory agencies and their roles are discussed below. RDBN staff often consult these agencies when evaluating waterfront development proposals and developing comprehensive planning documents.

1.5.1 Federal Government

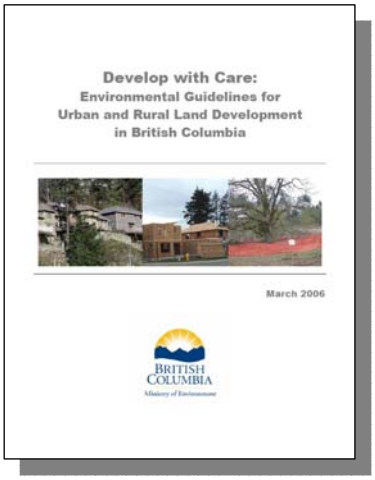
The federal agency that directly affects waterfront property owners the most is the Department of Fisheries and Oceans (DFO). DFO delivers a variety of programs and services that support the sustainable use and development of Canada's waterways and aquatic resources. DFO administers the *Fisheries Act* which, among other things, regulates activities and development affecting fish habitat. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. The local DFO office should be notified prior to any development or removal of vegetation occurring in the water or within 15 metres of a lake or watercourse.

1.5.2 Provincial Government

The Ministry of Environment has different divisions that regulate separate aspects of aquatic environments.

The Environmental Protection Division works to prevent pollution and promote and restore environmental quality. This Division regulates municipal and privately operated high volume sewage disposal systems. Any development proposal that is not exempt under the Environmental Management Act - Waste Discharge Regulation requires an authorization from the Environmental Protection Division. This Division is also tasked with monitoring and protecting water quality. They accomplish this by setting water quality objectives and by studying, monitoring and reporting on specific water sources. The Environmental Protection Division has been involved in the development of several Lake Management Plans within the RDBN.

The Environmental Stewardship Division is responsible for protecting, maintaining, and restoring native species and ecosystems, including fish, wildlife, and their habitats. The Division provides limited direct involvement in evaluation of development or land use, and has developed best management practices and guidelines to promote and assist environmental stewardship. For example the Environmental Stewardship Division created the document "Develop with Care" that provides province-wide guidelines for the maintenance of environmental values during the development of urban and rural lands.



The Water Stewardship Division administers water rights and legislation, such as the *Water Act*, and participates in sustainable water resource planning and management. It is also in charge of watershed planning and drinking water source protection, and provides some direction related to flooding issues. Section 9 of the *Water Act* requires approvals and notifications for "changes in and about a stream", which means:

- any modification to the nature of the stream including the land, vegetation, natural environment or flow of water within the stream, or
- any activity or construction within the stream channel that has or may have an impact on a stream

The Ministry of Agriculture and Lands is responsible for the administration of Crown land, which includes strategic land and resource planning. The *Land Act* is the primary legislation that is used to convey land to the public for community, industrial and business use. Approval from this Ministry through the Integrated Land Management Bureau is required prior to construction on Crown foreshore and drawing water from a lake for consumption.

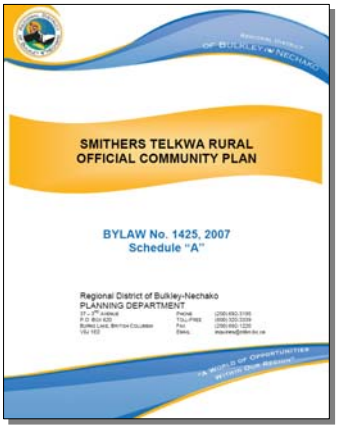
The Ministry of Health administers the *Health Act* and through the local Health Authorities enforces the Sewerage System Regulation, which applies to all sewage disposal systems with a combined daily flow rate of less than 22,700 litres. This Regulation requires that sewage discharge does not cause a health hazard and that sewage systems must be designed, installed and maintained by "Authorized Persons". RDBN staff work in close contact with the Northern Health Authority when reviewing waterfront development proposals to ensure proper sewage disposal is provided for.

The Ministry of Transportation, acting under the *Land Titles Act*, has final approving authority for all subdivision proposals in the RDBN. It is during the subdivision application process that the Ministry of Transportation can request protective measures be taken by property owners with respect to lakes and watercourses. These requests can be made on the behalf of other agencies such as the RDBN, who is referred subdivision proposals to ensure compliance with bylaws and policies. The Ministry of Transportation is also responsible for rural boat launches located on road right of way. The RDBN does not have direct influence with respect to road building and maintenance issues.

1.5.3 Local Government

The Regional District of Bulkley-Nechako Planning Department's core function is to provide for the orderly and strategic use of titled land and associated resources in order to achieve the community's vision and goals for the future, as established by the Regional District Board. The community's visions and goals are identified through the creation of Official Community Plans (OCPs). The goals are implemented through the use of planning tools provided in the *Local Government Act* and the *Community Charter*.

Official Community Plans



The RDBN has seven area specific Official Community Plans. Each OCP indentifies unique objectives and policies with respect to the natural environment. It is these policies that determine the level and form of development controls that may be implemented in each area. Generally, each OCP supports the use of development controls to protect water quality and environmentally sensitive areas.

Zoning Bylaw

The RDBN has one Zoning Bylaw that applies to the entire Regional District. Zoning Bylaw No. 700, Section 4.06 prescribes setbacks from a natural boundary for all buildings and structures except for a fence. Any amendment to this section would require a Development Variance Permit application, which requires Board approval.

Development Proposals

The majority of the lakes in the RDBN that are accessible for development are regulated by existing zoning and Official Community Plan designations. This means that most development proposals will require RDBN approval through the rezoning process, which includes a public consultation component. All development proposals are carefully considered with respect to their impact on the community and the natural environment.

Floodplain Management Bylaw

The RDBN Floodplain Management Bylaw No. 1300 affects the siting of buildings and structures on waterfront properties. This Bylaw specifies both elevation and setback requirements for certain buildings, structures and equipment that may be located in flood prone areas to protect them from flood damage.

Building Inspection

The RDBN provides Building Inspection services to the majority of the settlement areas in the Regional District. The Building Inspectors are instrumental in ensuring that development takes place in the manner permitted through routine inspections.

Regulatory and Incentive Tools

There are a number of regulatory tools available to local governments provided by the *Local Government Act* and the *Community Charter*. The RDBN does not currently use all of these tools, but may consider their use in the future.

- Development Permit Areas

  The RDBN can establish development permit areas with specific guidelines for development. Development permits do not prevent development. They ensure property is developed according to prescribed guidelines. They can be established for the purpose of the protection of the natural environment, its ecosystems and biological diversity. Development permits are commonly used in areas under considerable development pressure where a higher level of regulation is required. The RDBN does not have any development permit areas.

- Screening and Landscaping

  The *Local Government Act* permits local governments to establish bylaws that set standards for and regulate the provision of screening or landscaping for the purpose of preserving, protecting, restoring and enhancing the natural environment.

- Conservation Covenants

  Conservation covenants are legal agreements that allow specific natural features of the land to be permanently protected, while allowing the landowner to retain ownership and use. They can cover all or part of a property and are binding of future landowners. These covenants must be voluntarily entered into by a property owner.

- Riparian Property Tax Exemptions

  The *Local Government Act* provides for a property tax exemption for a landowner who conserves land along a watercourse or lake under a conservation covenant.

- Density Bonuses

  Regulations can be put in place to allow a developer to increase the density of the development on the site in return for public amenities, such as greenspace, in other areas.

- Comprehensive Development Zones

  A local government can create a zone that is specific to site conditions and contains guidelines for environmental protection, such as building setbacks from a specific water feature.

1.5.4 The Public's Role

There are many non-government stakeholders in the RDBN that have a vested interest in responsible shoreland development. These include community groups and private conservation organizations.

Community Groups:

- The Lakes District Watershed Enhancement Society
- The Lakes Protection Society (West Francois Lake)
- Glenannan Community Association (East Francois Lake)
- The Round Lake Watershed Enhancement Society
- The Tchesinkut Watershed Protection Society

- The Tyhee Lake Protection Society
- Lake Kathlyn Protection Society

Conservation Organizations:

- BC Lake Stewardship Society
- Ducks Unlimited Canada
- The Nature Trust of British Columbia

The fragility and uniqueness of lake ecosystems require each person to be aware of how their actions affect these environments. Lakes are public resources and we are all responsible for their stewardship. Government regulation alone can not protect these environments. Public awareness of the issues and a willingness to change negative behaviors are important factors in protecting the future of our lakes.

1.6 CURRENT SITUATION IN THE RDBN

The Regional District contains numerous lakes that face development pressures and maintaining or improving the water quality of these lakes is recognized as a priority. During the development of the latest Official Community Plans, the importance of protecting lakes and water quality has been identified through survey results and during working group discussions. Over the past 15 years Lake Management Plans have been prepared and/or water quality monitoring programs have been carried out for a number of lakes including: Kathlyn Lake, Seymour Lake, Tyhee Lake, Round Lake, Burns Lake, Decker Lake, Tchesinkut Lake, Francois Lake, Fraser Lake and Cluculz Lake. The data available for each lake has been summarized in Section 3 of the Shoreland Development Strategy.

Lakes that do not have plans or monitoring data including Stuart Lake, Babine Lake, Ootsa Lake (Nechako Reservoir), Tachick Lake, Sinkut Lake, Nulki Lake, Uncha Lake, and Takysie Lake. These lakes have not yet experienced high development pressures or are extremely large and more able to absorb the impacts of development. Water quality monitoring programs should be encouraged for these lakes to ensure that increasing development pressures do not have a negative impact on water quality. These can be implemented through dedicated volunteer groups with the support of the BC Lake Stewardship Society and the Ministry of Environment.

1.6.1 Lakes with Limited Development Potential

The current data indicates the lakes that are currently overdeveloped and experiencing cultural eutrophication are Lake Kathlyn, Tyhee Lake, Round Lake, and Cluculz Lake. The potential for further development on Tyhee Lake and Round Lake is inhibited by the Agricultural Land Reserve and potential development on Kathlyn Lake is inhibited by Regional District Zoning regulations. Cluculz Lake has several properties where the current Regional District Zoning allows subdivision down to 8000 square metre (1.94 acre) lots. However, development standards would make it difficult to achieve a lot size of less than 1.2 to 1.6 hectares (3 to 4 acres). Any subdivision proposals for these properties will be referred to the Regional District by the Ministry of Transportation for comment, at which time recommendations can be made with respect to responsible property development. RDBN staff encourage property owners to consider alternative form of development, such as bare land strata.

1.6.2 Lakes with Moderate Development Potential

Seymour Lake and Fraser Lake have both reached or are close to their development potential and are experiencing moderate cultural eutrophication. Burns Lake and Decker Lake have opportunities for more shoreland development but are currently experiencing moderate cultural eutrophication. New development on these lakes must be approached carefully.

1.6.3 Lakes with Good Development Potential

Tchesinkut Lake and Francois Lake have potential for new shoreland development. These lakes have the limited amount of existing development and are currently experiencing mild cultural eutrophication. Areas suitable for new development will be identified in the Official Community Plans that affect these lakes.

1.7 RECOMMENDATIONS TO OTHER LEVELS OF GOVERNMENT

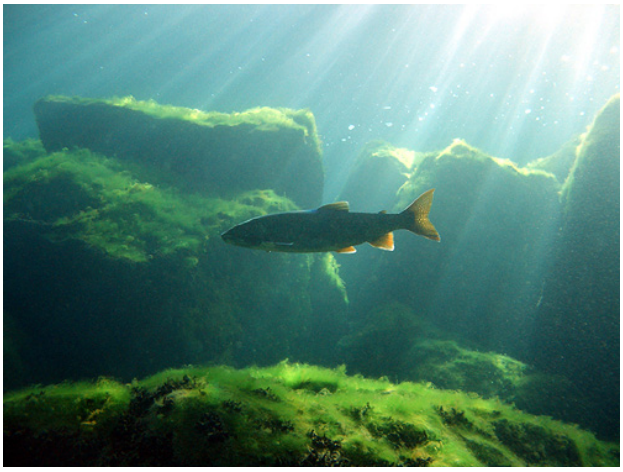
1.7.1 Department of Fisheries and Oceans Canada

The Federal Department of Fisheries and Oceans (DFO) is encouraged to increase their public profile with respect to habitat conservation. Many property owners are unaware that the *Fisheries Act* applies to private property. The habitat protection provisions of the *Fisheries Act* outline powers and authorities to protect the unobstructed passage of fish, provide sufficient flow for fish, prevent fish mortality and prohibit the harmful alteration, disruption or destruction of fish habitat without an authorization from DFO.

In cases where the Regional District is evaluating a development proposal that may impact important fish habitat, DFO is encouraged to provide input to Regional District staff as part of the review process.

1.7.2 BC Ministry of Environment

The Ministry of Environment is encouraged to respond to Regional District land development referrals and provide constructive feedback. Land development referrals will only be sent when Regional District staff identify the potential for environmental impact.



The Ministry of Environment is also encouraged to prepare new Lake Management Plans for lakes that are identified as having water quality issues. Lake Management Plans would be especially useful for Fraser Lake and Cluculz Lake that have existing water quality datasets from volunteer monitoring programs.

1.7.3 Northern Health Authority

The Northern Health Authority is encouraged to participate in the Regional District's planning processes with respect to sewage disposal systems. During the OCP review process the Health Authority could assist in identifying areas that have challenging soil conditions for on-site sewage disposal and make recommendations for setbacks from specific water features. For existing small lots with failing sewage disposal systems, the Northern Health Authority is encouraged to consider appropriate alternative methods of sewage disposal.

1.7.4 Integrated Land Management Bureau

Many of the existing undersized lots were created as recreational leases by the Crown. The lots were not originally intended to support on-site sewage disposal systems. People are now purchasing their leases with the intention of investing in buildings that have higher sewage and grey water disposal demands. The Integrated Land Management Bureau is encouraged to look for opportunities to resolve sewage disposal issues on lease lots before they are offered for sale.

1.8 REGIONAL DISTRICT STRATEGY

The Regional District's Strategy to protect water quality is comprehensive and intended to be built upon in the future as required. The current strategy includes OCP development, an ongoing public awareness campaign, implementation of development controls, support for lake management plans, acquisition of detailed environmentally sensitive areas mapping, and ensuring that zoning of shoreland properties is appropriate as directed by the OCPs.

Water quality and the protection of the natural environment are key components of OCP's, which establish appropriate limits on waterfront development within the Regional District. Examples of policies to protect water quality in new OCPs are as follows.

- Minimum setbacks from a lake for new sewage disposal systems.
- Support for alternative development practices such as lot averaging and bare land strata development.
- Encouragement of the use of conservation covenants.
- Encouragement of dedication of lands to a private land trust, non-government organization or the Province.
- Support and encouragement for the retention of a greenbelt of natural vegetation along watercourses.
- Encouragement of environmentally sound farm practices.
- Encouragement of the replacement of older, on-site sewage disposal systems.
- Discouraging the removal of vegetation along shorelines.

One of the most important ways to encourage the public to consider how their actions affect water quality is to increase the public's awareness of the issue. The Regional District has several means though which this can be done:

- Regional Newsletter
- Mail-outs to waterfront landowners

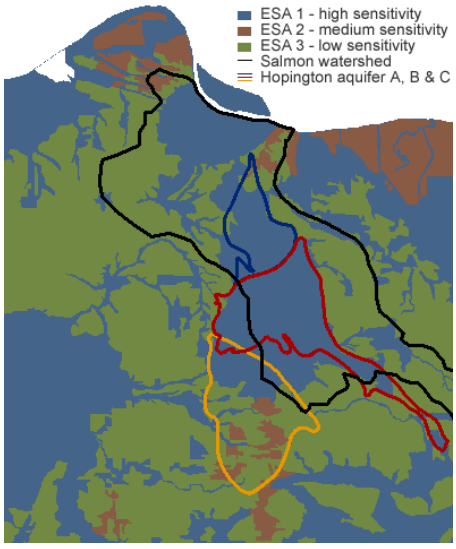
- Tradeshows
- Shoreland development brochure

The Regional District has a number of development controls available that can be exercised with respect to protecting water quality. The controls that the Regional District may use include:

- Zoning Bylaw setbacks from water features and minimum parcel area requirements for unzoned lands
- Conservation Covenants associated with rezoning applications
- Comprehensive Development Zones

Development permit areas are likely the most effective regulatory tool to control the development of waterfront properties. The RDBN could implement development permit areas, however they may not be appropriate at this time. The processing of development permit applications requires a significant amount of staff time, due in part to the requirement for multiple site inspections to ensure compliance with permit conditions. In addition, the majority of waterfront property owners would likely not support such a significant increase in government regulation. Development permit areas may be an item for future consideration.

The Lake Management Plans produced by the Ministry of Environment are extremely valuable tools for protecting water quality. Water quality monitoring programs are also vitally important to establish baseline data and examine the effectiveness of remediation activities. The Regional District is committed to support local volunteer groups and the Ministry of Environment in setting and obtaining water quality goals.



Environmentally Sensitive Area (ESA) Mapping is an important resource for land use planners. Areas that are identified as ESAs can have more strict application of development controls. ESAs would be incorporated into the OCPs as they provide more detail than the current ecological and wildlife values mapping.

The primary regulation that controls land development is zoning. By evaluating the existing zoning surrounding lakes with water quality issues, the Regional District can ensure that new development cannot occur without comprehensive review. Also, development can be directed to appropriate areas as identified in the OCP.

Attitudes towards the natural environment and the role of property owners need to change. Property owners are stewards of the natural environment and can easily lessen their impact on lakes and watercourses though minor lifestyle modifications. Lakes need to be protected to ensure enjoyment of them in the future. Many property owners may be unaware what actions and activities affect water quality and aquatic habitat. The Regional District can play an important role in educating property owners and prospective property purchasers as these people often contact Regional District Staff with development related issues. Voluntary public stewardship and public education is potentially more effective and is preferred over increased government regulation.

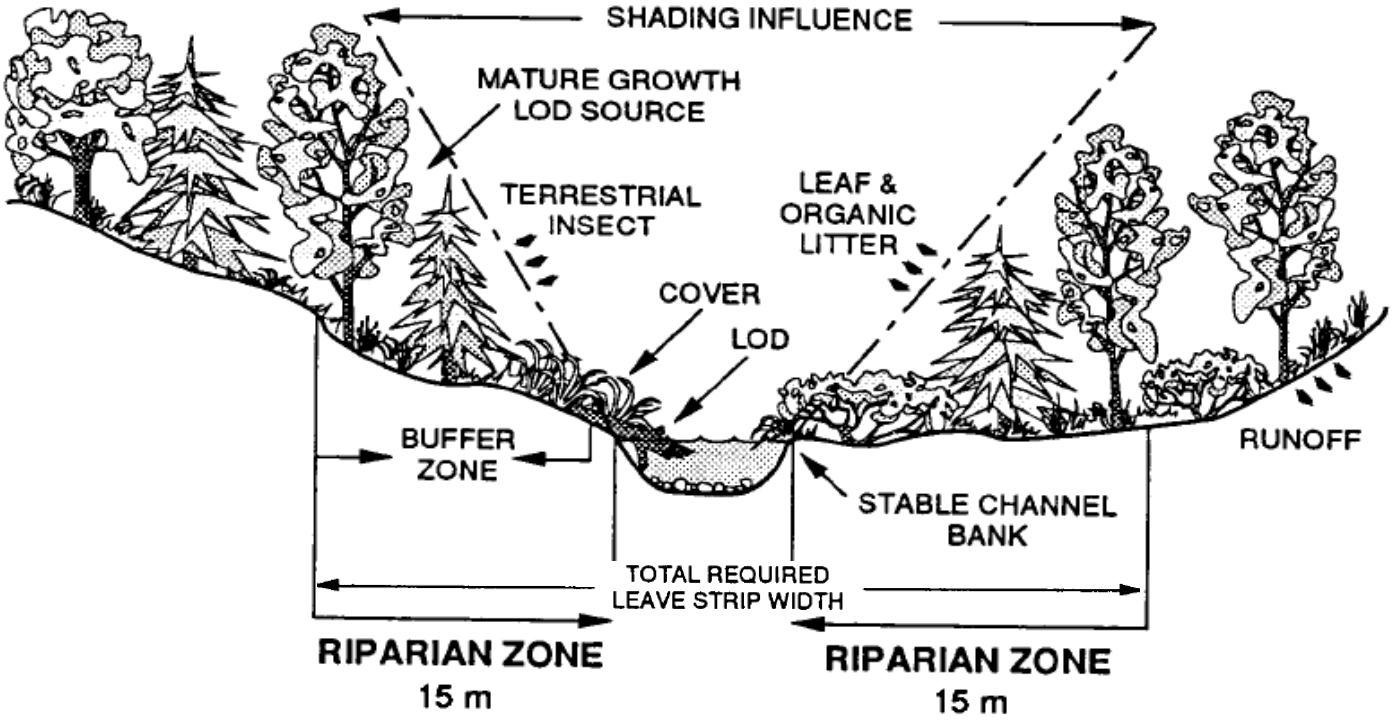
SECTION 2: SHORELAND DEVELOPMENT GUIDELINES

2.1 General Guidelines for Responsible Shoreland Development

Owners of waterfront property have a unique opportunity to serve as environmental stewards. By following simple guidelines these properties can become more enjoyable, see an increase in value, and be preserved for future generations. It is important to note that both the BC Ministry of Environment and the federal Department of Fisheries and Oceans (DFO) have legislation that restricts the modification of the natural environment in and near lakes and watercourses. These agencies should be contacted prior to the commencement of any works near a lake or watercourse.

2.1.1 Leave Strips

Leave strips are areas of undisturbed vegetation next to watercourses that are intended to protect the riparian zone, which is critical to the maintenance of a healthy aquatic environment. The required extent of a leave strip can vary depending on the nature of the lake or watercourse and surrounding land use. The Ministry of Environment and DFO recommend leave strips of a minimum of 15 metres from the high water mark of the watercourse. Leave strips do not only protect the environment, they also protect property from flooding and loss of land due to stream erosion and instability.



2.1.2 Erosion and Sediment Control

Increased sediment loads in lakes and watercourses are a significant contributor to the degradation of water quality and aquatic habitat. Many land development activities such as clearing land, grading slopes, road building, and excavation and stockpiling of materials can contribute to the erosion of sediments into lakes and watercourses. Simple methods can be employed to control erosion and sediment transport when developing land.

- Develop a detailed plan for your project before you start
- Maximize the distance between water features and accesses and construction sites, and retain as much vegetation as possible
- Minimize soil excavation and soil disturbance, and seed or re-vegetate bare soils as soon as possible
- When soils are exposed, use sediment control structures such as sediment traps and silt fences
- Schedule development during dry months of the year when possible
- Consider the topography of the site and its affect on the drainage of the property

2.1.3 Building Setbacks

Section 4.06 of RDBN Zoning Bylaw No. 700 prescribes setbacks for all buildings and structures except fences from the natural boundary of a lake or watercourse. Flood prone rivers and creeks are identified and prescribed a 30 to 45 metre setback, and unspecified watercourses are prescribed a 15 metre setback. Unspecified lakes, marshes, ponds and flood protection structures are prescribed a minimum 7.5 metre setback, however, a 15 metre setback is preferable, and may be required to meet Ministry of Environment and DFO regulations. Locating a building or structure closer than 15 metres from the natural boundary of a lake may require approvals from the Ministry of Environment and DFO.

The RDBN Floodplain Management Bylaw No. 1300 also affects the siting of buildings and structures on waterfront properties. This Bylaw specifies both elevation and setback requirements for certain buildings, structures and equipment to protect them from flood damage.

2.1.4 On-Site Sewage Disposal Systems

In the rural areas of the RDBN sewage disposal is most commonly treated on-site. The majority of existing residential lakeshore development occurs on small properties that were created without consideration for future on-site sewage disposal requirements. As these systems age and approach the end of their life-span, property owners may find replacing these systems to be challenging and expensive.

An appropriate and effective on-site sewage disposal system is very important for waterfront properties. Domestic sewage is an important contributor of phosphorous to lakes and watercourses because primary and secondary treatment removes only about 20 to 30% of the element from sewage.

It is vital that owners of waterfront property install appropriate sewage systems that comply with Provincial legislation. All property owners must ensure that new on-site sewage disposal systems are designed and installed by an "Authorized Person" (a Registered On-site Wastewater Practitioner or engineer) in accordance with the *Sewerage System Regulation* and *Sanitary Regulations* under the *Health Act*. The Northern Health Authority is responsible for the enforcement of these regulations, and is available to advise and provide information to individuals about on-site sewage treatment.

The *Sewerage System Regulation* requires that on-site sewage disposal systems be set back a minimum of 30 metres (100 feet) from lakes and watercourses. The Regional District also has the ability to secure additional setbacks through the rezoning process. For example, in the RDBN Draft Endako, Fraser Lake, Fort Fraser Official Community Plan, septic fields associated with new subdivisions must be set back 100 metres (328 feet) from any lake unless certain conditions are met.

Existing on-site sewage disposal systems should be continually monitored to ensure that they are functioning properly. Poorly maintained septic systems are more likely to fail than systems which are inspected regularly and pumped out as required. The malfunction or failure of an on-site sewage system is usually not obvious until it is expelling untreated sewage, which can be catastrophic to the delicate waterfront ecosystem. This can also cause a significant health hazard, contaminate drinking water and reduce water quality.

2.2 General Guidelines for Everyday Living

Anyone who lives on or near a lake or watercourse can take simple measures in their day-to-day lives that can make notable improvements to water quality and wildlife habitat. This includes things like sweeping driveways and walkways instead of washing them down, washing the car on the grass rather than the driveway (with no-phosphate soap), and properly disposing of pet waste.

2.2.1 Onsite Sewage Disposal Systems

Onsite sewage systems, when properly maintained and constructed in a suitable location can provide effective and affordable treatment of residential waste water.

The following signs can be an indication of a failing system:

- Unusually green or spongy grass over the system.
- Toilets, showers and sinks back up or take a long time to drain.
- Sewage surfacing on your lawn or in a nearby ditch.
- Sewage odours around your yard, especially after rain.

None of these warning signs can be considered a sure indication that a system has failed, but the appearance of one or more should prompt homeowners to have their system inspected. Septic system failures can also occur without any of these warning signs. For this reason, a yearly inspection of systems is recommended.

The following Best Management Practices from the Environmental Protection Division of the Ministry of Environment are designed for homeowners and will help ensure that their systems function properly and maximize the lifetime of the system:

- Make sure that your system meets legal requirements before installing, repairing or upgrading an onsite sewage system. Contact your local public health authority for permits for repairs, improvements, installations and further information.
- Sketch a map of your septic system showing the location of all components and keep it with your maintenance and repair records. This will make maintenance easier and be useful to future owners.
- Keep your septic tank cover accessible for inspections and pumping. Install risers if necessary.

- Have your system inspected annually to ensure that it is working properly and to determine when it should be pumped out. By inspecting and pumping your system regularly you can prevent high repair or replacement costs. A professional can do a thorough inspection of the entire system including the disposal field and individual components of the system.
- Pump out the tank regularly to prevent accumulating solids and clogging the disposal field. The frequency of pump outs will depend on the size of your system, the number of people in the house and the habits of those individuals. A general rule is once every three to five years.
- Upgrade your system when you upgrade your home (i.e. when you add a bedroom or suite).
- Practice water conservation. Continual saturation of the disposal field can affect the quality of the soil and its ability to naturally remove contaminants. The following points will help you to use water wisely:
    - repair any leaking faucets or running toilets;
    - use dishwashers and washing machines only when full;
    - avoid letting the water run when washing or brushing your teeth;
    - avoid taking long showers and install water-saving features in faucets and shower heads;

  - install low-flush toilets or put a toilet dam (e.g., brick) in the tank to reduce the capacity of the tank;
  - space out activities requiring heavy water use, like laundry, over several days;

- Divert roof drains, surface water and sump pumps away from the disposal field. Don't saturate your disposal field with automatic sprinklers.
- Avoid using garburators - this will reduce the amount of solids and grease you put into the system.
- Don't use toilets as trash cans - excess solids can clog your drain field which will cost you money for more frequent pumping. Items that should not be flushed include:

  - coffee grounds
  - disposable diapers
  - sanitary napkins
  - cigarette butts
  - fat, grease or oil
  - dental floss
  - kitty litter
  - tampons
  - condoms
  - paper towels and facial tissue

- 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 system and can contaminate water bodies.
- Use biodegradable household cleaners instead of bleach or other hazardous products (which will kill the good bacteria in your system), and do not use toilet cleaners that are placed in the tank.
- Don't drive, pave or put heavy objects or machinery over the septic system and disposal field. Don't cover the disposal field with a hard surface such as concrete or asphalt since evaporation will be prevented. This area should only have a grass cover which will prevent erosion and help remove excess water.

- Don't plant trees or shrubs near the drain field because their roots can damage or plug the pipes. Plant grass instead.

- Don't use septic tank ‘starters’, additives or similar products. These products usually do not help and can sometimes harm your system. Allow bacteria to act on their own.

- Use low-phosphate or phosphate free detergents.

2.2.2 Docks

Docks are a standard feature on many waterfront properties and are an important part of the recreational use of lakes. Docks and swimming platforms can be alternatives to creating a beach. The location and construction of docks must be done in compliance with all provincial and federal legislation, including legislation dealing with fish habitat, water quality and navigation.

In most instances in BC the area of land between the normal high and low water marks is owned by the Crown. Any permanent construction on Crown foreshore requires approval from the Crown Land Administration Division (CLAD) of the Ministry of Agriculture and Lands. CLAD has adopted a policy that permits lake and river docks of less than 20 m^2 in surface area without the need for an application. However, construction will be expected to adhere to best management guidelines (standards to be developed relating to size, environmental impacts, and conflicts with neighbours, impediments to public access and navigation) in order to be deemed authorized.

The Department of Fisheries and Oceans and the Ministry of Environment Water Stewardship Division require notification prior to the commencement of any foreshore construction activities. There are publications by both DFO and CLAD that describe dock construction requirements in detail.

Dock Construction Tips

- Use existing trails, roads, or cut lines wherever possible to avoid disturbance to the riparian vegetation. If removal of vegetation is necessary, keep it to a minimum.

- Avoid construction or placement of your dock or boathouse in areas of known fish spawning habitat.

- Locate your dock to avoid aquatic vegetation. Minimize disturbance to the lakebed and surrounding aquatic vegetation by positioning the dock in water deep enough to avoid grounding of the dock and/or impacts by prop wash.
- Do not take materials (e.g., rock, logs) to build the dock from the shoreline, from below the high water mark or from any water body.
- Install effective sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs. In addition, avoid doing work during rainy periods.
- Use untreated materials (e.g. cedar, tamarack, hemlock, rocks, plastic, etc.) as supports for dock structures that will be submerged in water. Treated lumber may contain compounds that can be released into the water and become toxic to the aquatic environment.

  - Use only treated lumber that is environmentally-friendly for dock structures that are above water.
  - Cut, seal and stain all lumber away from the water using only environmentally-friendly stains.
  - Ensure plastic barrel floats are free of chemicals inside and outside of the barrel before they are placed in water.
  - Avoid the use of rubber tires or metal barrels as they are known to release compounds that are toxic to fish.
- Prevent deleterious substances such as uncured concrete, grout, paint, sediment and preservatives from entering the water body.
- Vegetate any disturbed areas by planting native trees, shrubs or grasses.

2.2.3 Boating

The use of motorized boats is an integral part of common recreational activities such as fishing and swimming. In some areas of the RDBN they are also important for transportation. Motorized boats can have a number of negative impacts on a lake. These include oil and fuel leaks, spread of aquatic plants, dumping of litter, churning up of bottom sediments and shoreline erosion due to wave action. It is up to each boat operator to be aware of these impacts and act accordingly. Simple measures can prevent these impacts both on shore and on the water.

On Shore:

- Fill fuel containers on shore if possible and clean up all leaks and spills with absorbent bilge pads
- Keep motors well maintained and tuned to prevent fuel and lubrication leaks and conduct major maintenance chores on land
- Consider using four-stoke motors, which generally are quieter, have better fuel economy and have lower emissions
- Use phosphate-free biodegradable products to clean your boat, away from the water and the shore
- Use public boat launches and remove all vegetation from boat, trailer and other equipment when leaving a lake

On the Water:

- Do not throw trash overboard, including waste fishing line, or use lakes or other water bodies as toilets
- Reduce your speed when boating in shallow areas and along shorelines
- Avoid waterfowl breeding or staging areas as boating activities can reduce their success

2.2.4 Landscaping and Lawn Care

The enjoyment of one's property and the protection of the natural environment do not have to be two separate things. However, it is important to recognize that traditional landscaping with large manicured lawns that extend to the shore or an erosion protection structure can cause serious problems for the adjacent lake. Many of the

pleasurable aspects of lakeshore living are dependent on a healthy, well- vegetated shore.

A well vegetated waterfront can:

- Prevent erosion
    - Plant roots stabilize the soil.
    - Plants absorb and dissipate wave energy from wind and boat wakes.
- Prevent flooding damage.
    - Plants slow down the passage of water over land.
- Filter contaminants
    - Shoreline and wetland plants absorb and retain compounds that are toxic to other forms of life.
    - By slowing the flow of runoff they allow sediments to deposit before entering the water.
- Provide habitat
    - Plants provide food, shelter and nesting materials to a variety of birds, mammals, and fish.
    - Plants provide shade which cools the shallow areas of the lake for fry.
- Protect privacy
    - Plants provide a screen from public view.
    - Plants buffer noise from boats and personal watercraft.

Shorelines that remain in a natural state should be protected by a leave strip of natural vegetation at least 15 metres wide. Shoreline buffers have the added benefit of deterring Canada Geese from lawns. If a view to the lake is desired, consider selectively removing a small width of the tops of vegetation only. Minimize the area required to be cleared for beach access and keep disturbances near the water to a minimum. Also, please consult the BC Ministry of Environment and the federal Department of Fisheries and Oceans (DFO) before undertaking any works near or in a lake.

Maintaining a natural landscape can be esthetically pleasing and require less maintenance. Consider smaller lawns with shrub borders or native plantings. Lawn height should be maintained to about 2.5 to 3 inches and mowing should only be done when necessary. Longer grass requires less watering and can be self-fertilizing by leaving grass clippings on the lawn. The application of fertilizers and pesticides should be limited or eliminated altogether. Fertilizers are easily transported into the lake from runoff where they contribute to excessive aquatic plant and algal growth. Pesticides can be toxic to people, wildlife and fish.

2.2.5 Shoreline Rehabilitation

The shorelines of many lakeshore properties have already been significantly altered from their natural state. The important habitats that were lost can be rehabilitated through careful planning and planting. The primary goal of shoreline rehabilitation is to reestablish a natural vegetated buffer between the terrestrial and aquatic ecosystems. The easiest and least expensive method of rehabilitation is to simply stop mowing along the shoreline. If you wish to replant native vegetation, consult with DFO or the Ministry of Environment to determine which plants are suitable.

SECTION 3: LAKE CLASSIFICATION AND INFORMATION SHEETS

3.1 LAKE CLASSIFICATION

Classification of all of the Regional District's lakes has not been included in the current Shoreland Development Strategy. The vast number of lakes within the Regional District and the level of predicted future development pressures make classification of all lakes unnecessary at this time. However, a number of lakes are currently experiencing or are expected to experience significant development pressures and have been selected for closer examination. These lakes have existing water quality data which has been summarized along with currently available general information in the following Lake Information Sheets. Lake Information Sheets may be completed for additional lakes as new data becomes available. Important sources for the Lake Information Sheets include Ministry of Environment Lake Management Plans and Water Quality Assessment Reports.

The following lakes were selected for closer examination: Lake Kathlyn, Tyhee Lake, Seymour Lake, Round Lake, Burns Lake, Decker Lake, Tchesinkut Lake, Francois Lake, Fraser Lake and Cluculz Lake. A Lake Information Sheet was developed for each and all have been classified according to the Regional District of Fraser-Fort George Lake Classification System. The lake classification system identifies which lakes are most suitable for new lot creation through the subdivision of land. Within this system the lakes are classified into one of four categories based on the best available information at the time. The four categories are as follows.

Development Lakes: Lakes capable of accommodating development.

Limited Development Lakes: Lakes with high aesthetic, recreational, or ecological importance that can handle a limited amount of development.

Natural Environment Lakes: Lakes that are very sensitive to subdivision and should remain in their natural state.

Special Case Lakes: Lakes that do not fit the other classifications, but generally subdivision is not allowed.

All of the lakes discussed in the Lake Information Sheets have been classified as Development Lakes. However, some of the lakes currently meet or exceed their maximum development levels.

Development Lakes can accommodate a variety of uses and subdivision to a certain level within the watershed without negatively impacting the lake environment. The use and development along the shore zone may include, but is not limited to, residential development, agricultural activities, outdoor recreation and commercial-tourism use. Generally, these lakes have existing road access with electricity or potential for electricity within the next five years.

Criteria:

- The surface area of the lake is greater than 100 ha and a mean depth greater than 4.5 meters;
- Mean summer chlorophyll-*a* (gives indication of productivity) is less than 5 mg/m3 and Secchi Disk (measures transparency) readings greater than 3 meters. (*Note: this information was not available for all lakes and not all lakes met this criterion*)

a) If the surface area is greater than 800 ha:

$$D_L = \frac{L}{2\sqrt{\pi A_0}}$$

where D_L = Shoreline Complexity Index
L = length of shoreline
π = 3.1428
A_0 - 1 ha = 10,000m^2

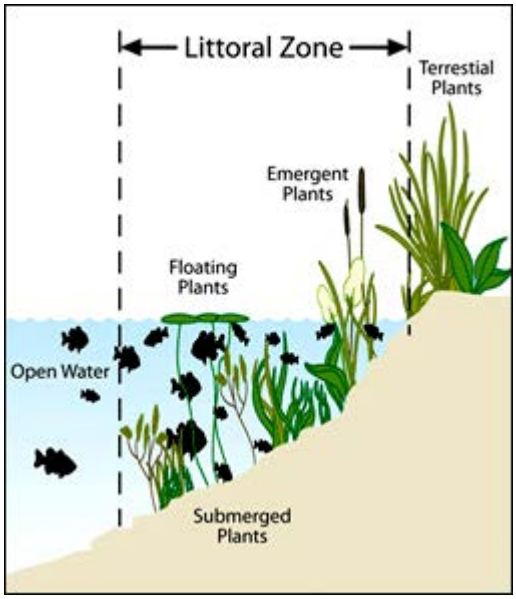
If D_L = 1-2 then 50% maximum allowed subdivision
2-3 then 40% maximum allowed subdivision
> 3 then 30% maximum allowed subdivision

b) If the surface area is between 100 ha to 800 ha:

If D_L = 1–3 then 35% maximum allowed subdivision
> 3 then 25% maximum allowed subdivision

3.1.1 Shoreline Complexity

The Shoreline Complexity Index (D_L) addresses the issue that the amount of subdivision supported by the Guidelines is determined by the percentage of potential shoreline subdivision. As the shoreline length increases (becomes more complex) the allowed percentage of shoreline subdivision is reduced. This is an important issue because Shoreline Complexity reflects the potential increase of *littoral* associated communities in proportion to the volume of the lake. These *littoral* associated communities are very important to a lakes productivity and health. Therefore, an increase in the relative *littoral* area in proportion to the volume of the lake indicates an increase in sensitivity to subdivision.



For example, lakes A and B (see figure below) have the same surface area, but Lake B has a much longer shoreline length. Lake A would have a D_L value of "1" and Lake B would have a D_L value of "3+" when using the Shoreline Complexity formula.

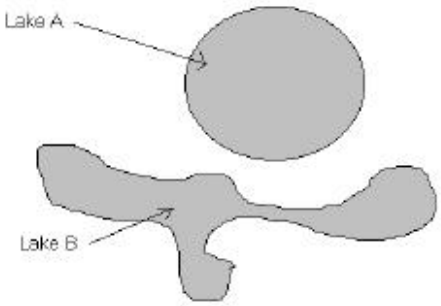


Figure #1: Shoreline Complexity

Note: Shoreline Complexity Index (D_L) is the ratio of the length of shoreline (L) to the circumference of a circle having equal area (A) to that of the lake. A value of "1" is a perfect circle compared to a value of "3" that would have a very complex shoreline.

3.1.2 Method for Measuring Shoreline Subdivision

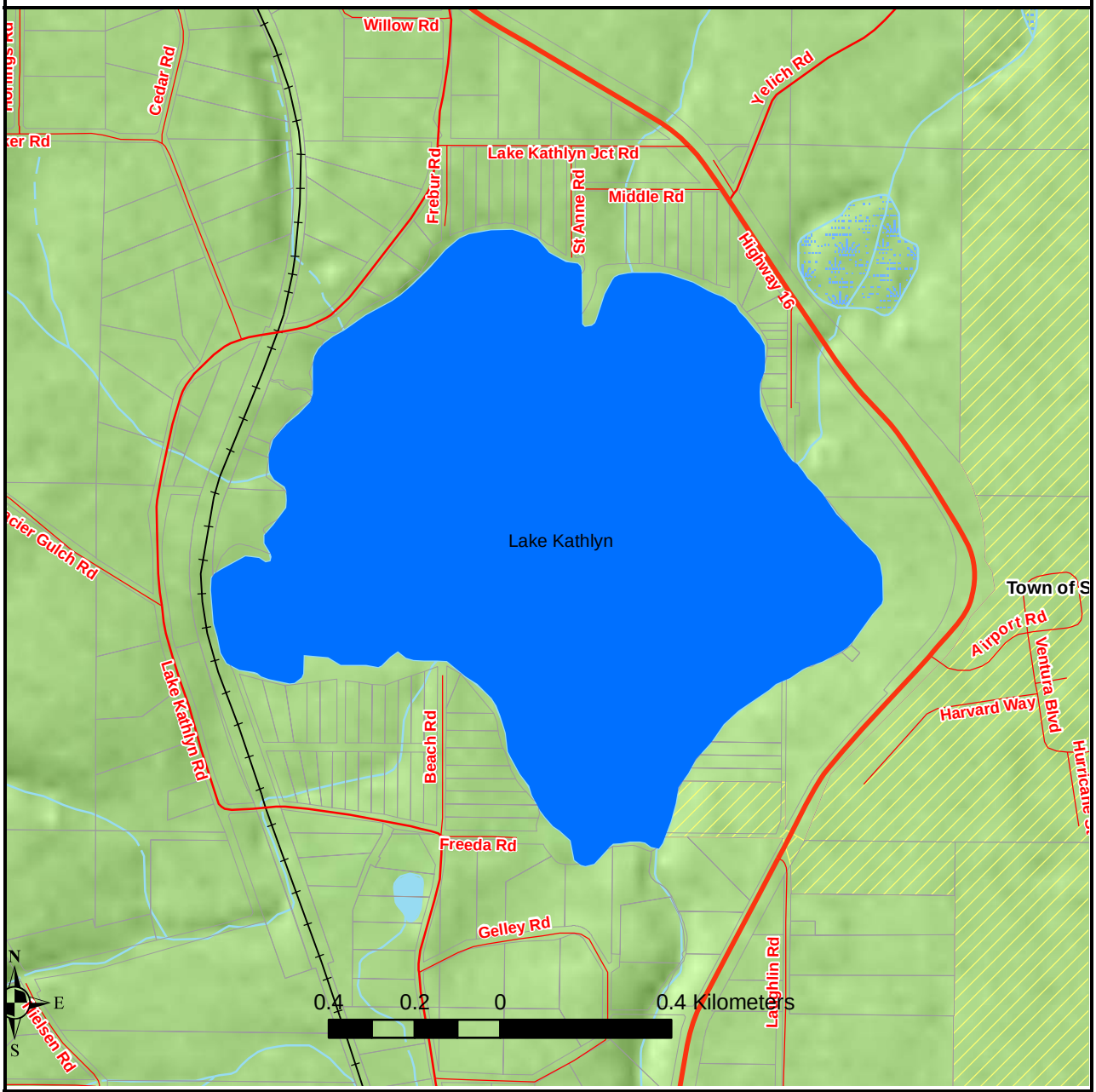
Privately owned land is treated the same whether it is vacant or occupied in calculating the amount of shoreline development. Any subdivision within 50 meters of the shoreline is included in the shoreline subdivision calculation to determine the amount shoreline subdivision.

Table #1: Measuring Shoreline Subdivision

Type of Land		**Method of Measuring Shoreline Subdivision**
1)	Residential or Cottage lots less than 2 ha (5acres) in size.	Measure the actual lake frontage of each lot, whether occupied or vacant.
2)	Private parcels greater than 2 ha (5 acres), but less than 16 ha (40 acres), excluding those uses set out in section (4) below but including agriculture and forestry.	Calculate 90 m (300 ft) for each parcel whether vacant or occupied, or measure the actual shoreline whichever is less.
3)	Parcels 16 ha (40 acres) and over.	Calculate 90 m (300 ft) per parcel whether vacant or occupied.
4)	Commercial, recreation commercial, industrial, or common area for cluster subdivisions.	Measure the actual frontage of any parcel within 50 meters of the shoreline and count as subdivision.
5)	Regional, Provincial, and Federal Parks and camps.	Measure the actual developed shoreline (i.e. beaches).

3.2 LAKE INFORMATION SHEETS

3.2.1 LAKE KATHLYN



Lake Classification: Development		Maximum Allowed Subdivision: 35%		Existing Subdivision: 66.0%	
Perimeter: 6.13 km	Area: 170.0 Ha	Elevation: 472 m	Volume: 7,770,900 m^3	Mean Depth: 4.6 m	Max Depth: 9.5 m

Lake Kathlyn is located northwest of Smithers in Regional District Electoral Area “A” and is part of the Skeena watershed. It is a small shallow lake with a simple shoreline, no islands and one basin. The water retention time of Lake Kathlyn is estimated to be 1.15 years, which calculates to a flushing rate of approximately 90% or 0.9 per year. Major inlets to Lake Kathlyn include the

Kathlyn Glacier at the headwaters of Club Creek as well as Kathlyn Creek. Lake Kathlyn has one outlet, Kathlyn Creek, which flows into the Bulkley River just south of Dohler Flats.

The catchment basin of Lake Kathlyn has an area of approximately 25 km^2. Land use activities in the catchment basin include livestock rearing, forage production, small residential acreages, past mineral exploration and development, and a recreational park. Lake Kathlyn has a boat launch however it is restricted to non-motorized boats only. Lake Kathlyn is a source of drinking water for some shoreline residents. It has been a popular recreation area with high swimming and boating activity levels, however, with the recent algal and macrophyte blooms in the lake, these values are vastly diminished.

Lake Kathlyn is a eutrophic, phosphorous limited lake and water quality has been an issue since the mid seventies. Although the lake is naturally eutrophic, human caused inputs of nutrients in the last 80 years have greatly increased the rate of eutrophication. In late 1981 the Planning Department of the Regional District of Bulkley Nechako requested the Ministry of Environment to undertake a water quality study for Kathlyn, Seymour, Tyhee and Round Lakes. The original goals of the study were to assess the trophic state of the lakes, and identify the major sources of phosphorus. Water quality objectives were established for Lake Kathlyn by the Ministry of Environment in 1985. The primary water uses that the water quality objectives strive to protect are raw drinking water supply and recreation. The water quality of the lake has been periodically monitored to determine if these objectives are being met. Including 2007, monitoring has consistently shown that the objectives for average turbidity, colour, and phosphorus are not being met.

A relatively intense sampling program was completed in 2007 that showed little observable change in overall objective obtainment. For Lake Kathlyn in 2007 the water quality index is rated Poor based on both existing and proposed objectives. The existing and proposed objectives for fecal coliforms and E. coli were met most of the time, however Enterococci, turbidity, phosphorous and colour objectives were frequently not met. The 2007 draft attainment report recommends that domestic water users be warned that microbiological and turbidity objective are occasionally exceeded, indicating that treatment beyond disinfection is required to ensure a safe drinking supply. The source of contaminants to Lake Kathlyn are likely from non-point sources including residential and agricultural development around the lake.

In 1984 investigations of soil properties indicated that two areas of the lake, the south end and the upland area on the east side have poor suitability for septic systems. It was recommended that septic systems in these two areas be set back a minimum of 300 metres from the shoreline. Undoubtedly, long term maintenance of septic systems is an important part of reducing cultural eutrophication of Lake Kathlyn.

A Lake Management Plan, completed to the draft stage, was developed by the Ministry of Environment in 1995. It involved a number of stakeholders including government agencies, lake residents, lake user groups, environmental groups, and others. The plan identified a number of major problems in the watershed and made recommendations on how they should be addressed. It identified that residential users likely have the most at stake in terms of the lake. The value of their land, their quality of life and the water which they drink are all dependent on the state of the water in the lake. For all recreational users, high water quality and lake aesthetic quality are a top priority.

In 2000, sediment cores were taken from Lake Kathlyn and sent for analysis to Queen's University. The analysis indicated that sedimentation rates have not varied much over the past 100 years. It also showed an increase in organic matter that started about 1900, which can be attributed to several factors including increased in-lake production of organic matter, increased

inwash of organic matter, or decreases in the load of inorganic matter of the lake. Since 1945 the cores showed an unprecedented increase in mesoeutrophic plankton from the previously dominant oligotrophic plankton. These factors suggest that the trophic status of the lake has increased slightly over the past 50 years.

Fish which have been identified in Lake Kathlyn include rainbow trout, which were stocked in the late 50s, steelhead, peamouth chubb, northern squawfish, longnose sucker, cutthroat trout, and prickly sculpin. Coho salmon are known to spawn in Lower Kathlyn Creek and have been observed in Upper Kathlyn Creek. Pink salmon have also been observed in Upper Kathlyn Creek.

Wildlife at Lake Kathlyn includes moose, deer, black bear, otter, muskrat and beaver. A variety of eagles, hawks and owls are also a part of the lake ecosystem. Loons, Canada geese, mallards, golden eye, mergansers, grebes and teal nest and live at the lake. Sandhill cranes are among those which use the lake for staging in the spring and fall. Some species of larger wildlife may be able to utilize vast mats of aquatic weeds, for food or habitat, but most lake dwelling species will be presented with an obstacle that will physically prevent them from feeding (on fish, other aquatic vegetation or benthic invertebrates) or finding suitable habitat (open water for escape from predators, floating nest sites).

Extensive aquatic weed and algae growth has consistently been a problem in Lake Kathlyn. In 1977 an aquatic plant survey was conducted on Lake Kathlyn. It was found that there were extensive shallow water areas with beds of plants that are not rooted and therefore must obtain nutrients from the water column. This indicates that there were relatively high concentrations of available nutrients in the water column. In 1992 *Elodea Canadensis* was one of the most abundant aquatic plants in the lake. Cyanobacteria are also predominant, which points to eutrophic conditions, and are also indicative of a potential hazard to human health through drinking water and primary contact recreation.

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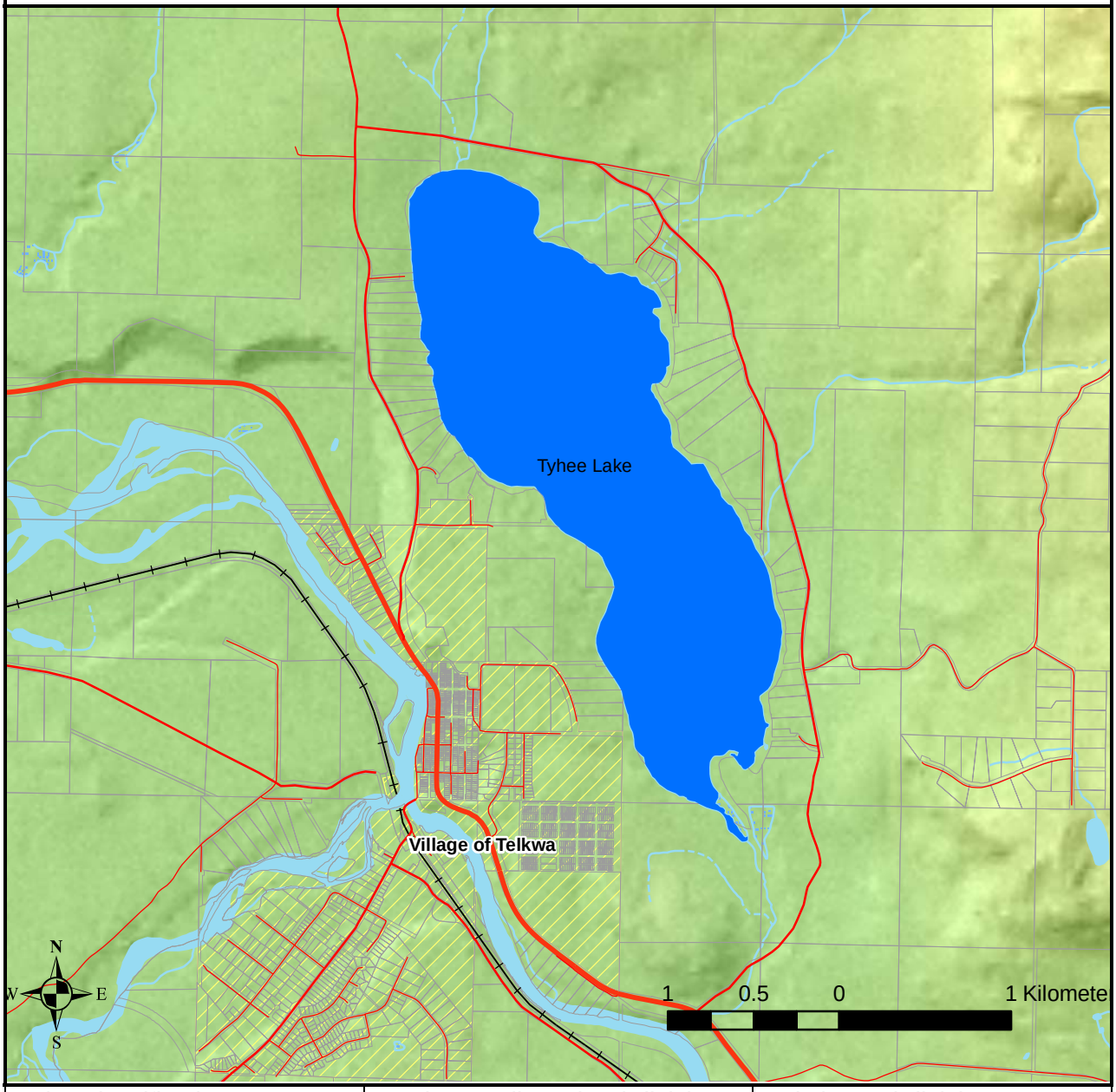
3.2.2 TYHEE LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 25%		Existing Subdivision: 46.0%	
Perimeter: 9.75 km	Area: 318 Ha	Elevation: 549 m	Volume: 35,278,000 m^3	Mean Depth: 11.1 m	Max Depth: 22.2 m

Tyhee Lake is located northeast of Telkwa in Regional District Electoral Area "A" and is part of the Skeena watershed. It is a relatively small lake with a simple shoreline, no islands and one basin. The mean water retention time of Tyhee Lake is estimated to be 5 years, which calculates to a flushing rate of approximately 30% or 0.3 per year. Major inlets to Tyhee Lake include a number of creeks, most of which dry up in the summer. Tyhee Lake has one outlet, Tyhee Creek, which is affected by a beaver dam and flows into the Bulkley River just prior to its confluence with the Telkwa River.

The catchment basin of Tyhee Lake has an area of approximately 35 km^2. Land use activities in the catchment basin include livestock rearing, dairy farming, horse farming, forage production, waterfront residential, an institutional camp, and a provincial park. Tyhee Lake is a source of drinking water for residents and park users. It is also a popular recreation area with high swimming and boating activity levels. These uses are dependent on water quality being maintained within limits as defined by water quality objectives.

Tyhee Lake Park covers 33 ha on the south shore of Tyhee Lake. The park, established in 1956, protects lakeshore aspen forest and waterfowl habitat and provides recreation and camping opportunities for local residents and Highway 16 travelers. The large day-use area is the major swimming, boating and picnic spot for local residents. The conservation role of the park is limited by the extensive development for outdoor recreation activities.

Tyhee Lake is dimictic and limited by phosphorous. Turnover occurs twice a year, once in the spring and once in the fall, however, the turnover is not always complete. The lake also has a fairly low sensitivity to acid precipitation due to a relatively high alkalinity. From rough nutrient budget calculations, it is thought that in Tyhee Lake the majority of phosphorus is from bottom sediments. It is thought that this condition is present as a result of past agricultural practices which did not limit the amount of animal waste entering the lake. However, runoff from agricultural land still accounts for a significant amount of the external nutrient loading to Tyhee Lake.

Another significant external source of nutrients is on-site sewage disposal systems on waterfront properties. Long term maintenance of septic systems is an important part of reducing cultural eutrophication of Tyhee Lake. A diverse range of soil types are found in the Tyhee Lake watershed. There are two areas of the lake, the south end and the upland area on the east side which have poor suitability for septic systems (Boyd, 1984). Boyd recommended that septic systems in these two areas be set back a minimum of 300 metres from the shoreline (1984).

In late 1981 the Planning Department of the Regional District of Bulkley Nechako requested the Ministry of Environment to undertake a water quality study for Kathlyn, Seymour, Tyhee and Round Lakes. The original goals of the study were to assess the trophic state of the lakes, and identify the major sources of phosphorus. Water quality objectives were established for Tyhee Lake by the Ministry of Environment in 1985. The primary water uses that the water quality objectives strive to protect are raw drinking water supply and recreation. The water quality of the lake has been periodically monitored to determine if these objectives are being met. Including 2007, monitoring has consistently shown that the objectives for average turbidity, colour, and phosphorus are not being met.

A relatively intense sampling program was completed in 2007 that showed little observable change in overall objective obtainment. For Tyhee Lake in 2007 the water quality index is rated Fair based on both existing and proposed objectives. In 2007 the water quality objectives were met 97% of the time, but the lake still received a Fair rating because of the high levels of phosphorous found in the lake. The existing and proposed objectives for fecal coliforms, E. coli, turbidity and colour objectives were met 100% of the time; however Enterococci and phosphorous objectives were frequently not met. The 2007 draft attainment report recommends that domestic water users be warned that the microbiological objective is occasionally exceeded indicating that treatment beyond disinfection is required to ensure a safe drinking supply.

A Lake Management Plan was completed for Tyhee Lake by the Ministry of Environment in 1999. It involved a number of stakeholders including government agencies, lake residents, lake user groups, environmental groups, and others. The plan identified a number of major problems in the watershed and made recommendations on how they should be addressed. The Tyhee

Lake Protection Society has determined that control of the aquatic plants is one of the foremost requirements of the lake management plan. An abundance of aquatic plant growth is a common symptom of eutrophication.

In 1977, Dr. Pat Warrington conducted an aquatic plant survey on Tyhee Lake. Then in 1992, samples were collected from Tyhee Lake and analyzed by Dr. Warrington. It was found that there were extensive shallow water areas with dense beds of non-rooted aquatic plants that must obtain nutrients from the water column. The presence of these plants indicates that there are high levels of available nutrients in the water column. It is interesting to note that *Elodea canadensis*, one of the most abundant aquatic plants in the lake in 1992, was not present in the lake in 1977.

In 1996 sediment cores samples were obtained from Tyhee Lake. The analysis indicated that Tyhee Lake is naturally productive (mesotrophic), but has eutrophied significantly in response to human impacts in the late 20th century. A general increase in total phosphorus concentrations within the last 40 years is a convincing indication of increased nutrient loading, occurred in response to human development.

Sport fishing and recreational uses of the lake are extremely important to user groups. The lake is stocked annually with Rainbow trout since 1990, by the BC Environment Fish and Wildlife Branch. Other fish species which exist in the lake include ling cod, peamouth chubb, northern pikeminnow, longnose sucker, and burbot. The lake is also home to a species of fish that was identified in 1965 by McCart, the Giant Pygmy Whitefish. This species is found only in one other lake in British Columbia, McLeese Lake, and is therefore on the rare and endangered species list.

Wildlife at Tyhee Lake includes moose, deer, black bear, otter, muskrat and beaver. A variety of eagles, hawks and owls are also a part of the lake ecosystem. Loons, Canada geese, mallards, golden eye, mergansers, grebes and teal nest and live at Tyhee Lake. Many other species of waterfowl, especially Sandhill Cranes, use Tyhee Lake for staging in the fall as they are flying South. Each of these species is a part of the intricate food web that exists at Tyhee Lake. If eutrophication of Tyhee Lake continues at its present rate, disruption of the natural balancing forces which maintains the aquatic ecosystem in its present form will occur and it is possible that some species will not be able to meet their life cycle requirements in the lake.

According to the Lake Management Plan, the use of motor boats, jet skis and float planes present problems for both the flora and fauna of the area. In the past bird watchers have noticed that the presence of motor boats on the lake has led to reduced reproductive success of the loons. The noise from the motors scares the loons from their nests, leaving the eggs vulnerable to predation. Presence of waves is equally harmful to the nests as they can lead to flooding of the banks and carry the eggs out of the nest or by changing the water level make the nest inaccessible by submerging it.

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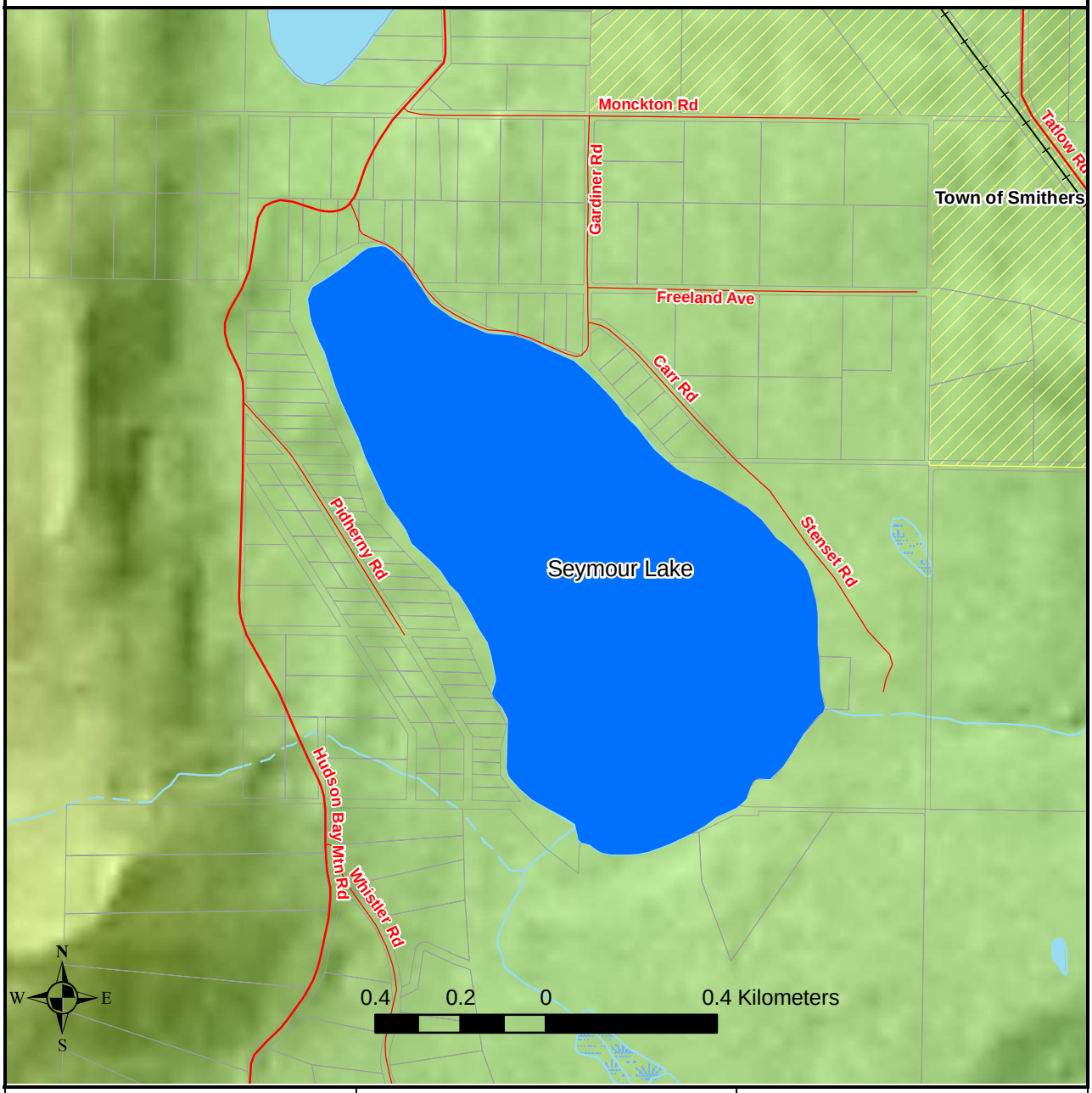
SEYMOUR LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 35%		Existing Subdivision: 35.0%	
Perimeter: 4.1 km	Area: 89.8 Ha	Elevation: 529 m	Volume: 5,120,258 m^3	Mean Depth: 5.7 m	Max Depth: 9.2 m

Seymour Lake is located just southwest of Smithers in Regional District Electoral Area "A" and is part of the Skeena watershed. It is a small, shallow lake with a simple shoreline, no islands and one basin. The water retention time and flushing rate of Seymour Lake have not been recorded. Seymour Lake has one inlet that is unnamed, and has one outlet, Seymour Creek, which flows into the Bulkley River near the Highway 16 bridge. Land use activities in the Seymour Lake catchment basin include residential acreages and cross-country ski trails.

Seymour Lake receives heavy recreational use from local residences, many of which use the lake for drinking water. Seymour Lake is exposed to light fishing pressure and contains rainbow and cutthroat trout and coarse fish. Rainbow trout have been stocked from 1956 and 1959. There are no developed beach areas and boating is restricted to non-motorized only. Access to the lake is from the road along the north end of the lake.

The majority of soils around Seymour Lake are well-suited to adsorb phosphorous and renovate septic tank effluent. However areas on the southwest shore are considered to have poor suitability. It is recommended that new septic drainfield development be 300 m or more from the lake in these soil types. Generally this area has not been developed.

In late 1981 the Planning Department of the Regional District of Bulkley Nechako requested the Ministry of Environment to undertake a water quality study for Kathlyn, Seymour, Tyhee and Round Lakes. The original goals of the study were to assess the trophic state of the lakes, and identify the major sources of phosphorus. Water quality objectives were established for Seymour Lake by the Ministry of Environment in 1985. The primary water uses that the water quality objectives strive to protect are raw drinking water supply and recreation. The water quality of the lake has been periodically monitored to determine if these objectives are being met. Including 2007, monitoring has consistently shown that the objectives for average turbidity, colour, and phosphorus are not being met.

A relatively intense sampling program was completed in 2007 that showed little observable change in overall objective obtainment. For Seymour Lake in 2007 the water quality index is rated Poor based on both existing and proposed objectives. The existing and proposed objectives for fecal coliforms, Enterococci, and E. coli were met most of the time, however the turbidity objective was frequently not met. The 2007 draft attainment report recommends that domestic water users be warned that microbiological and turbidity objectives are occasionally exceeded, indicating that treatment beyond disinfection is required to ensure a safe drinking supply.

The phosphorous cycle in Seymour Lake suggests that the lake sediments release significant quantities of phosphorous during anoxic periods, and the surface water concentrations increased following spring or fall turnover. However, in 1985 the release of phosphorous from the sediments did not occur in sufficient quantities to cause elevated phosphorous concentrations. Internal recycling of nutrients was then eliminated as a source of phosphorous because of the low concentrations at the sediment-water interface. The 1985 report stated that nutrient loading from septic tanks is minimal. One possible source of phosphorous loading is form wind mixing. Turbulence on a lee shore caused by wave action can re-suspend a significant amount of phosphorous in shallow lakes. The long axis of Seymour Lake is oriented to the prevailing winds. As fetch increases so does wave size and therefore turbulence on the lee shore. No data have been collected to test this hypothesis. Consequently the major sources of phosphorous remain unknown.

In 1985 phosphorous and colour objectives were not set for Seymour Lake. In 1996 phosphorous and colour objectives were recommended and in 2004 it was recommended that the colour objective be dropped. These proposed changes were not officially reviewed or designated. Seymour Lake currently does not have a management plan in place and has never undergone a paleolimnological assessment. The historic trophic status of the lake is largely unknown. This is the reason cited in the 1985 report for not applying the phosphorous objective to Seymour Lake. The 2007 Water Quality Objectives Attainment report recommends that a management plan be developed for Seymour Lake so that the lake's trophic status can be assessed and meaningful phosphorous objectives can be set.

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3.2.4 ROUND LAKE

Lake Classification: Development		Maximum Allowed Subdivision: 35%		Existing Subdivision: 33.3%	
Perimeter: 5.33 km	Area: 182.12 Ha	Elevation: 579 m	Volume: 17,515,416 m^3	Mean Depth: 9.6 m	Max Depth: 20.4 m

Round Lake is located approximately 24 km southeast of Smithers in Regional District Electoral Area "A" and is part of the Skeena watershed. It is a small lake with a simple shoreline, no islands and one basin. The water retention time of Round Lake is estimated to be 3.1 years, which calculates to a flushing rate of approximately 32% or 0.32 per year. Major inlets to Round Lake are intermittent and include La Croix Creek and three other unnamed creeks. Round Lake has one outlet, La Croix Creek, which flows into the Bulkley River near Quick Station. The

catchment basin of Round Lake has an area of approximately 27 km^2. Land use activities in the catchment basin are dominated by agriculture that includes livestock rearing and forage production. Other land uses include residential acreages, a boat launch and a commercial resort.

Round Lake is a meso-eutrophic, phosphorous limited lake. Water quality sampling over the past 20 years at Round Lake has revealed that the lake waters are oxygen deficient, and that nutrient, sediment, and fecal contaminant inputs from the watershed are of concern to lake health. These inputs can result in unwanted algal blooms, can affect fish populations and can significantly compromise drinking water quality and the recreational value of Round Lake. In response to these and other concerns, watershed residents formed the Round Lake Watershed Enhancement Society (RLWES), so that local residents could compile ideas and work with other organizations to improve watershed health.

In late 1981 the Planning Department of the Regional District of Bulkley Nechako requested the Ministry of Environment to undertake a water quality study for Kathlyn, Seymour, Tyhee and Round Lakes. The original goals of the study were to assess the trophic state of the lakes, and identify the major sources of phosphorus. Water quality objectives were established for Round Lake by the Ministry of Environment in 1985. The primary water uses that the water quality objectives strive to protect are raw drinking water supply and recreation. The water quality of the lake has been periodically monitored to determine if these objectives are being met. Including 2007, monitoring has consistently shown that the objectives for average turbidity, colour, and phosphorus are not being met.

A relatively intense sampling program was completed in 2007 that showed little observable change in overall objective obtainment. For Round Lake in 2007 the water quality index is rated Poor based on both existing and proposed objectives. The existing and proposed objectives for fecal coliforms, Enterococci, and E. coli were met most of the time, however turbidity, phosphorous and colour objectives were frequently not met. The 2007 draft attainment report recommends that domestic water users be warned that microbiological and turbidity objective are occasionally exceeded, indicating that treatment beyond disinfection is required to ensure a safe drinking supply. The sources of contaminants to Round Lake are likely from non-point sources including residential and agricultural development around the lake.

A Lake Management Plan was completed to the draft stage by the Ministry of Environment in 2004. It involved a number of stakeholders including government agencies, lake residents, lake user groups, environmental groups, and others. The plan identified a number of major problems in the watershed and made recommendations on how they should be addressed. It identified that residential users likely have the most at stake in terms of the lake. The value of their land, their quality of life and the water which they drink are all dependent on the state of the water in the lake. For all recreational users, high water quality and lake aesthetic quality are a top priority.

Round Lake currently has relatively high phosphorus concentrations, high levels of chlorophyll a (algae), and average water transparency. The lake also experiences seasonal low dissolved oxygen levels throughout the water column. Round Lake has relatively warm temperatures throughout the summer and strong thermal stratification occurs during July and August. Temperatures are stratified in the summer and uniform (the lake is well mixed) in spring. In the winter, bottom water temperatures were slightly warmer than temperatures near the surface. Dissolved oxygen profiles throughout 2002 and 2004 indicated that Round Lake has a poorly oxygenated water column, especially throughout the summer months. Low levels of dissolved oxygen facilitate the release of phosphorous from the sediments.

On March 20, 2003 a sediment core sample was obtained from Round Lake deep basin. Total phosphorus estimates indicate stable mid-summer mesotrophic-eutrophic conditions during the last 200 years of the lake's history. The core indicates that sediment delivery rates began to slowly increase in the 1950's with larger increases in the 1980's and that around 1996, a change in the content ratio of the sediment composition occurred. The algal analysis of the sediment core indicated that algal populations in the lake have been historically dominated by species with affinities for meso-eutrophic conditions. In the case of Round Lake, practical mitigation targets to reduce further sedimentation to the lake and maintain the current water quality should be pursued.

In 1992, a brief aquatic plant survey of Round Lake was carried out. Extensive beds of non-rooted plants were observed all around the shoreline. These plants take all of their nutrients from the water column, indicating that there are considerable nutrients in the water column and likely a large reservoir in the sediments as well. Nutrient management would likely be more successful in addressing excessive aquatic plant growth, as phosphorus levels at Round Lake would cause rapid plant re-growth, rendering any other weed control measures futile.

The Round Lake watershed has been identified as important over-wintering habitat for moose. Other animals observed in the area include deer and black bears and a variety of furbearers. Small mammals and amphibians provide the foundation of the food chain for many furbearers and birds of prey. Burbot, prickly sculpin, longnose sucker, northern pikeminnow, and peamouth chub have been observed in Round Lake. The lake was stocked with rainbow trout fingerlings from 1956 until 1991 when cutthroat trout were used instead. Recent stocking included the addition of 3000 cutthroat in both 2002 and 2003. Round Lake is considered to have moderate fishing pressure.

The Round Lake watershed provides important habitat for waterfowl. The lake is utilized by various species of migratory geese and ducks, and the wetlands and lake provide essential breeding grounds for waterfowl such as mallards and loons. A preliminary survey of loon nesting areas in May 2004 indicated that at least 3 nesting pairs presently utilize the lake. Birds of prey found in the area include bald eagles, osprey, and hawks. Numerous smaller non-game birds such as red-winged black birds inhabit the watershed and are an important part of outdoor recreation opportunities in the area.

Lake and stream impacts from development and increasing sedimentation rates are high concerns in the Round Lake watershed. Activities such as tree removal, planting lawns and nonnative vegetation, road construction and riparian and soil movement by livestock usually result in the loss of riparian vegetation, greater shoreline and stream erosion, and increases in sediment and nutrient inputs to the lake. Much of the land in the Round Lake watershed has been cleared, and it has been noted that the main inlet appears more turbid now than in the past. The links between watershed development, waterfowl and wildlife habitat, sedimentation rates, and water quality highlight the importance of investigating and practicing low impact activities around the lake.

Conservation of waterfowl and wildlife habitat is also a high concern for watershed residents. Residents have noted fewer waterfowl offspring and an absence of muskrat populations around the lake. Loss of riparian area habitat can result in less species diversity and can impact water quality and the aesthetic value of the lake. Healthy and diverse wildlife populations reflect a healthy ecosystem and a higher quality of life for watershed residents.

Many lakeshore residents continue to draw water from the lake for drinking and other domestic uses, and recent studies have noted drinking water source quality concerns at Round Lake. At Round Lake, possible threats to drinking water quality include fecal contamination from old on-

site sewage disposal systems and agricultural runoff, high turbidity in runoff from watershed development and blue green algae blooms that can result from high nutrient levels. Fecal contaminants are also known to have adverse effects on livestock health, so reducing contaminant inputs is essential for maintaining the health of people and animals in the Round Lake watershed.

The safety of swimmers and the aesthetic value of the lake is a concern for stakeholders and users of Round Lake. The perceived decreasing recreational value of Round Lake, particularly for swimming, is a concern for many lake users. Fecal contamination and algae blooms can pose a health risk to swimmers, and algae blooms and excessive plant growth affect the aesthetic value of the lake.

Recent water quality results show that Round Lake experiences severe oxygen depletion during the summer and winter months even at near-surface depths. Low dissolved oxygen levels will generally not support healthy sport fish populations and can lead to fish kills. Survey respondents were very concerned about the effect of oxygen depletion on fish populations. Oxygen depletion at bottom depths also promotes the release of nutrients stored in lake sediments making them more readily available for plant and algae growth.

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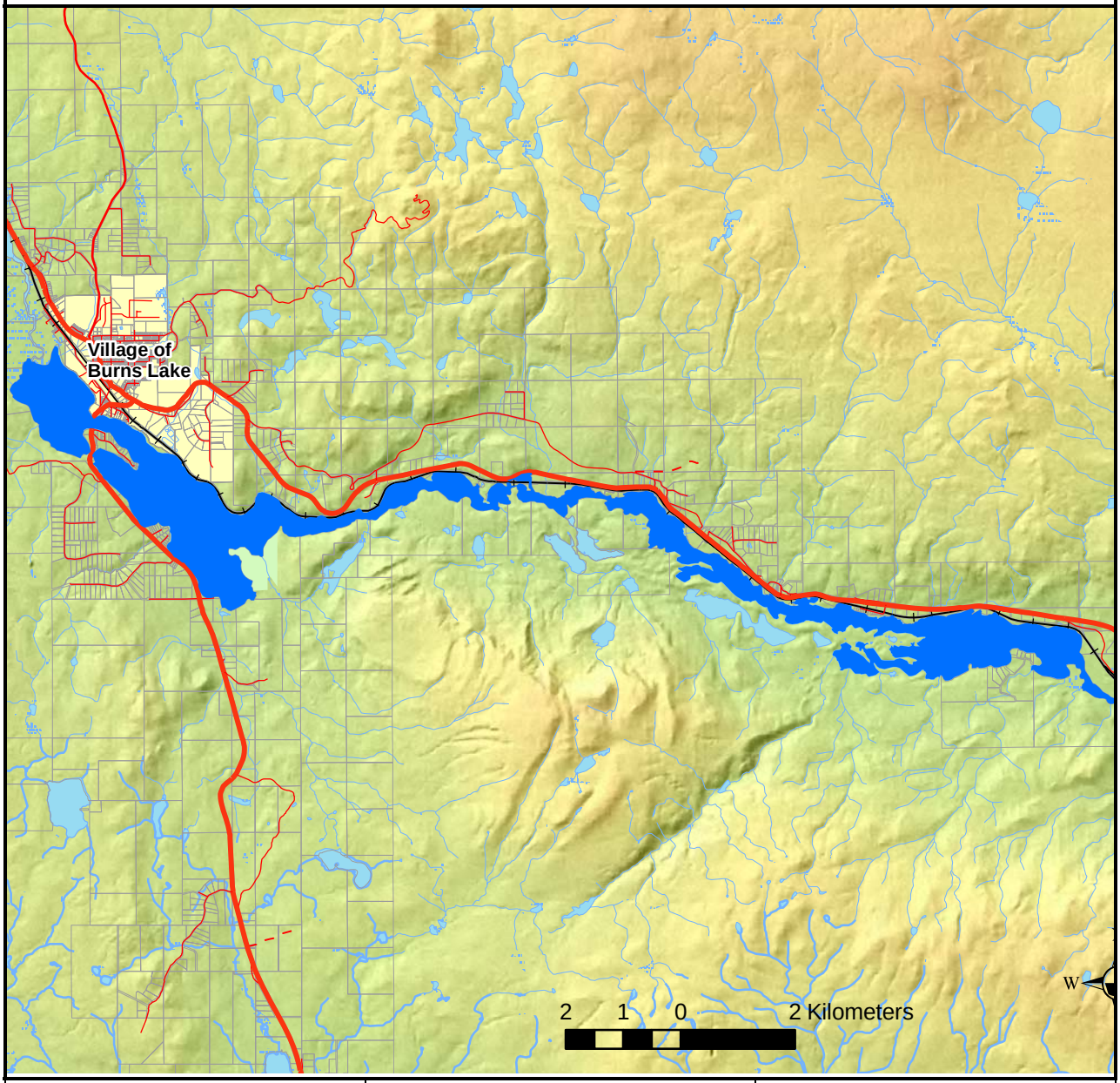
3.2.5 BURNS LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 30%		Existing Subdivision: 25.1%	
Perimeter: 65.07 km	Area: 1180.41 Ha	Elevation: 702 m	Volume: 106,551,400 m^3	Mean Depth: 9 m	Max Depth: 40 m

Burns Lake is adjacent to the municipality of Burns Lake in Regional District Electoral Area "B" and is near the top of the Fraser watershed. It is a long and narrow lake with a complex shoreline, several islands and two basins. The water retention time of Burns Lake is estimated to be 0.76 years, which calculates to a flushing rate of approximately 132% per year. Major inlets to Burns Lake include the Endako River, Guyishton Creek, Stearns Creek, and Tintagel Creek. Burns Lake has one outlet, the Endako River, which flows into the Stellako River near the head of Fraser Lake.

The catchment basin of Burns Lake, which includes Decker Lake, has an area of 1,146 km^2. There are a number of diverse land use activities in the catchment basin including agriculture, forestry, urban and rural residential development, and recreation. Agricultural activities mainly consist of hobby farming, forage production and open range grazing. Forestry includes timber harvesting and silviculture as well as two large sawmills. Decker Lake Forest Products is located at the head of Decker Lake, which drains into Burns Lake, and Babine Forest Products is located at the outlet of Burns Lake into the Endako River. The portions of the Burns Lake municipality that are adjacent to the lake include land uses such as urban residential, a public beach and campsite, and public works yard. In the rural area surrounding Burns Lake there is limited lakeshore development, however development in the Gerow Island, Nourse Subdivision and Stearns Subdivision areas are higher than average density. Highway 16 and the CN railway run along the north shoreline of Burns Lake, and in most cases lie between privately owned property and the lake. The majority of the south shore of Burns Lake is inaccessible and undeveloped, but has high recreation values.

Burns Lake is a highly productive lake that has a naturally high concentration of phosphorous. It is relatively shallow and has a fairly large surface area. This lake was classified as eutrophic in 1985 and in recent years residents have noticed increases in algae and aquatic plant growth and a shift in fish species distribution toward coarse fish. In 2002 a Lake Management Plan was prepared to the draft stage for Burns Lake (and Decker Lake) by the Ministry of Environment in partnership with the local Lakes District Watershed Enhancement Society. This plan created a strategy to enhance and preserve the quality and health of Burns and Decker Lake's watershed. The plan identified a number of major problems in the watershed and made recommendations on how they should be addressed.

Although Burns Lake has naturally high phosphorous levels, it is evident that cultural eutrophication of the lake is also occurring from both point and non-point sources of nutrients. The primary point source of nutrients is the outlet for the municipal sewage system, which has been upgraded to remove phosphorous in recent years. Non-point sources of nutrients include individual on-site sewage disposal systems in the rural area, as well as general agricultural, forestry, and residential activities in the watershed.

The aging and subsequent failure of on-site sewage disposal systems on waterfront properties may be a significant issue in several subdivisions on Burns Lake, most notably Gerow Island and By-Town. Both areas have urban sized lots without community sewage disposal services. The Village of Burns Lake investigated the feasibility of expanding town services to these areas, but it was found not to be economical. The By-Town area is susceptible to flooding which has affected the drinking water quality and inundated existing septic systems, likely releasing effluent into the lake. This area is a candidate for redevelopment in the Burns Lake Rural Official Community Plan for either tourist commercial or limited light industrial uses. Gerow Island is a highly desirable residential area that was originally subdivided in 1956, prior to modern subdivision standards. In this area the most effective action would be an intensive public awareness campaign directed to the local residents and realtors.

Best Management Practices must be encouraged for all land use activities within the watershed including general residential use, agriculture and forestry. This can be accomplished through a public awareness campaign and providing information to property owners and applicants, as well as participation by water quality interest groups in Provincial planning processes.

The amount of aquatic weeds and algae, specifically *Elodea Canadensis*, has been increasingly problematic in Burns Lake and now includes a large portion of the littoral zone. The

development of an Integrated Aquatic Plant Management Plan for the watershed would improve guidance for future activities relating to aquatic weeds. To address site-specific problems such as the aquatic weeds at Radley Beach, benthic barriers or other mechanical weed control measures could be employed in consultation with the Ministry of Environment and Department of Fisheries and Oceans.

Anecdotal evidence suggests that in the past, there were more sport fish (salmonids) and fewer coarse fish in Burns Lake. The lake management plan recommended reducing the number of coarse fish in the lake by holding fish derbies targeting undesirable species. However, a comprehensive fisheries assessment may be beneficial to ensure that a management strategy can be developed.

All of these factors contribute to a decline in the visual and recreational appeal of the lake. A dedicated volunteer monitoring program would be valuable to collect tributary and lake data as well as information on aquatic weeds. This could be facilitated by the Ministry of Environment or the BC Lake Stewardship Society (BCLSS) who would assist a local volunteer group to conduct scientific water quality monitoring, as they have in other areas of the Regional District.

References

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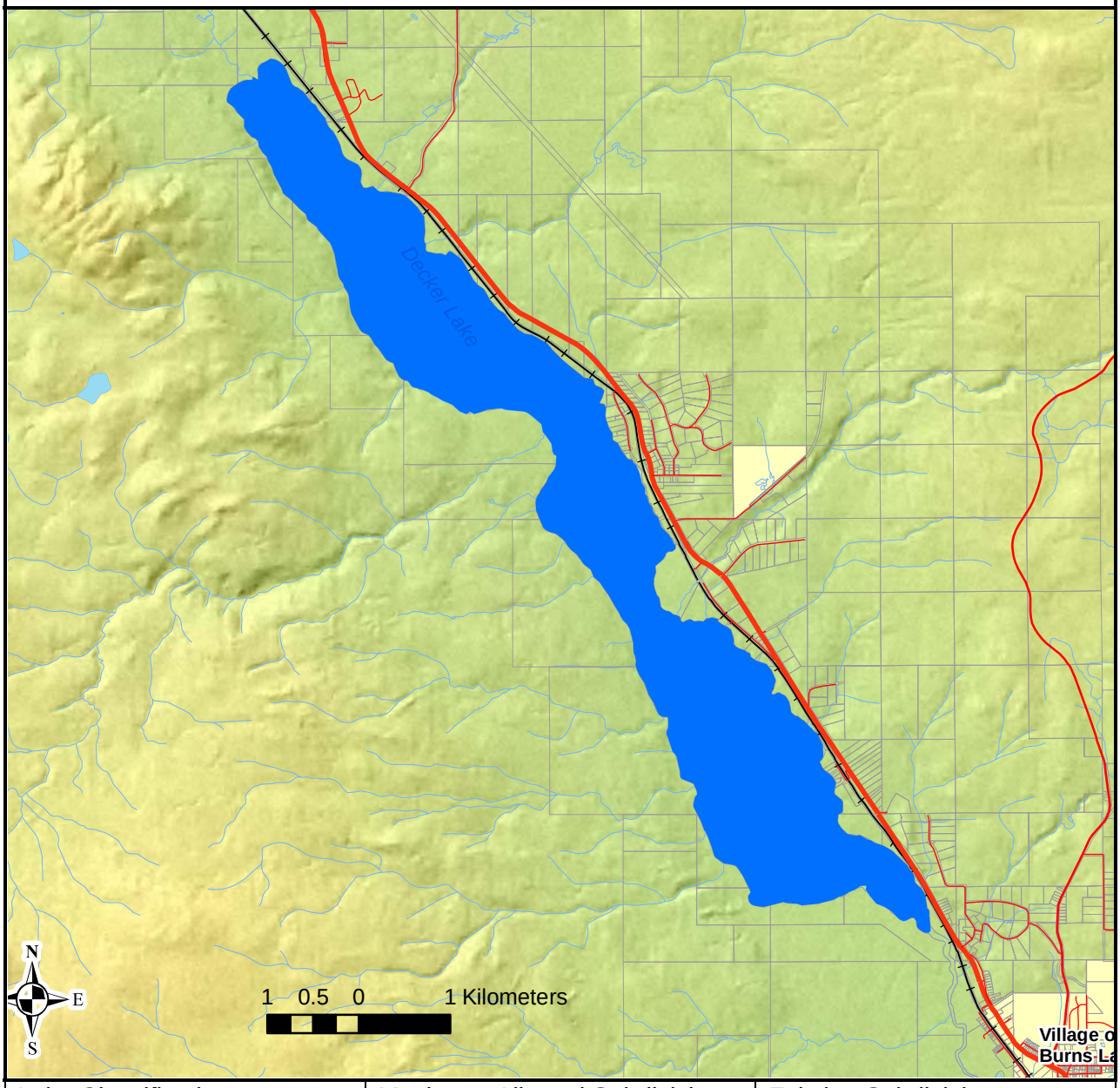
3.2.6 DECKER LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 30%		Existing Subdivision: 20.0%	
Perimeter: 28.78 km	Area: 1122.5 Ha	Elevation: 699 m	Volume: 105,950,000 m^3	Mean Depth: 9.4 m	Max Depth: 16 m

Decker Lake is northwest of the municipality of Burns Lake in Regional District Electoral Area "B" and is near the top of the Fraser watershed. It is an oblong-shaped lake with a simple shoreline, no islands and one basin. Decker Lake does not have a continuous flow monitoring system at its outlet, so it is not possible to calculate either the water retention time or the flushing rate. Major inlets to Decker Lake include the Endako River, Powder House Creek, Decker Creek, and Gerow Creek. Decker Lake has one outlet, the Endako River, which flows into Burns Lake.

The catchment basin of Decker Lake, including Burns Lake, has an area of 1,146 km^2. There are a number of diverse land use activities in the catchment basin including agriculture, forestry, urban and rural residential, and recreation. Agricultural activities mainly consist of hobby farming, forage production and open range grazing. Forestry includes timber harvesting and silviculture, as well as a large sawmill (Decker Lake Forest Products) located at the head of Decker Lake, which drains into Burns Lake.

The southwest side of the lake is undeveloped and consists of mixed mature conifer and deciduous trees. The northeast half of the lake has some residential development, the majority of which is concentrated in three areas: Eckland Rd, Goodwin Rd, and Rowland Rd. Development is limited along this side of the lake by the Highway 16 and the CN railway corridors. The northeast quarter of Decker Lake shoreland lies within the Agricultural Land Reserve. There are few areas that are zoned to allow waterfront subdivision, and those are restricted to 2 hectare parcels. Public access to Decker Lake for recreation is extremely limited and many boaters, canoeists and kayakers travel from Burns Lake through the Endako River channel into Decker Lake.

Decker Lake is a highly productive lake that has a naturally high concentration of phosphorous. It is relatively shallow and has a fairly large surface area. This lake was classified as eutrophic in 1985 and in recent years residents have noticed increases in algae and aquatic plant growth and a shift in fish species distribution toward coarse fish. In 2002 a Lake Management Plan was prepared to the draft stage for Decker Lake (and Burns Lake) by the Ministry of Environment in partnership with the local Lakes District Watershed Enhancement Society. This plan created a strategy to enhance and preserve the quality and health of Decker and Burns Lake's watershed. The plan identified a number of major problems in the watershed and made recommendations on how they should be addressed.

Although Decker Lake has naturally high phosphorous levels, it is evident that cultural eutrophication of the lake is also occurring mostly from non-point sources of nutrients. Non-point sources include individual on-site sewage disposal systems in the rural area, as well as general agricultural, forestry, and residential activities in the watershed.

The amount of aquatic weeds and algae, specifically *Elodea Canadensis*, has been increasing in Decker Lake and now includes a large portion of the littoral zone. The development of an Integrated Aquatic Plant Management Plan for the watershed would improve guidance for future activities relating to aquatic weeds. To address site-specific problems benthic barriers or other mechanical weed control measures could be employed in consultation with the Ministry of Environment and Department of Fisheries and Oceans.

Anecdotal evidence suggests that in the past, there were more sport fish (salmonids) and fewer coarse fish in Decker Lake. The lake management plan recommended reducing the number of coarse fish in the lake by holding fish derbies targeting undesirable species. However, a comprehensive fisheries assessment needs to be conducted so that a management strategy can be developed.

All of these factors contribute to a decline in the visual and recreational appeal of the lake. A dedicated volunteer monitoring program would be valuable to collect tributary and lake data as well as information on aquatic weeds. This could be facilitated by the Ministry of Environment or the BC Lake Stewardship Society (BCLSS) who would assist the Lakes District Watershed Enhancement Society to conduct scientific water quality monitoring, as they have in other areas

of the Regional District.

Best Management Practices must be encouraged for all land use activities within the watershed including general residential use, agriculture and forestry. This can be accomplished through a public awareness campaign and providing information to property owners and applicants, as well as participation by water quality interest groups in Provincial planning processes.

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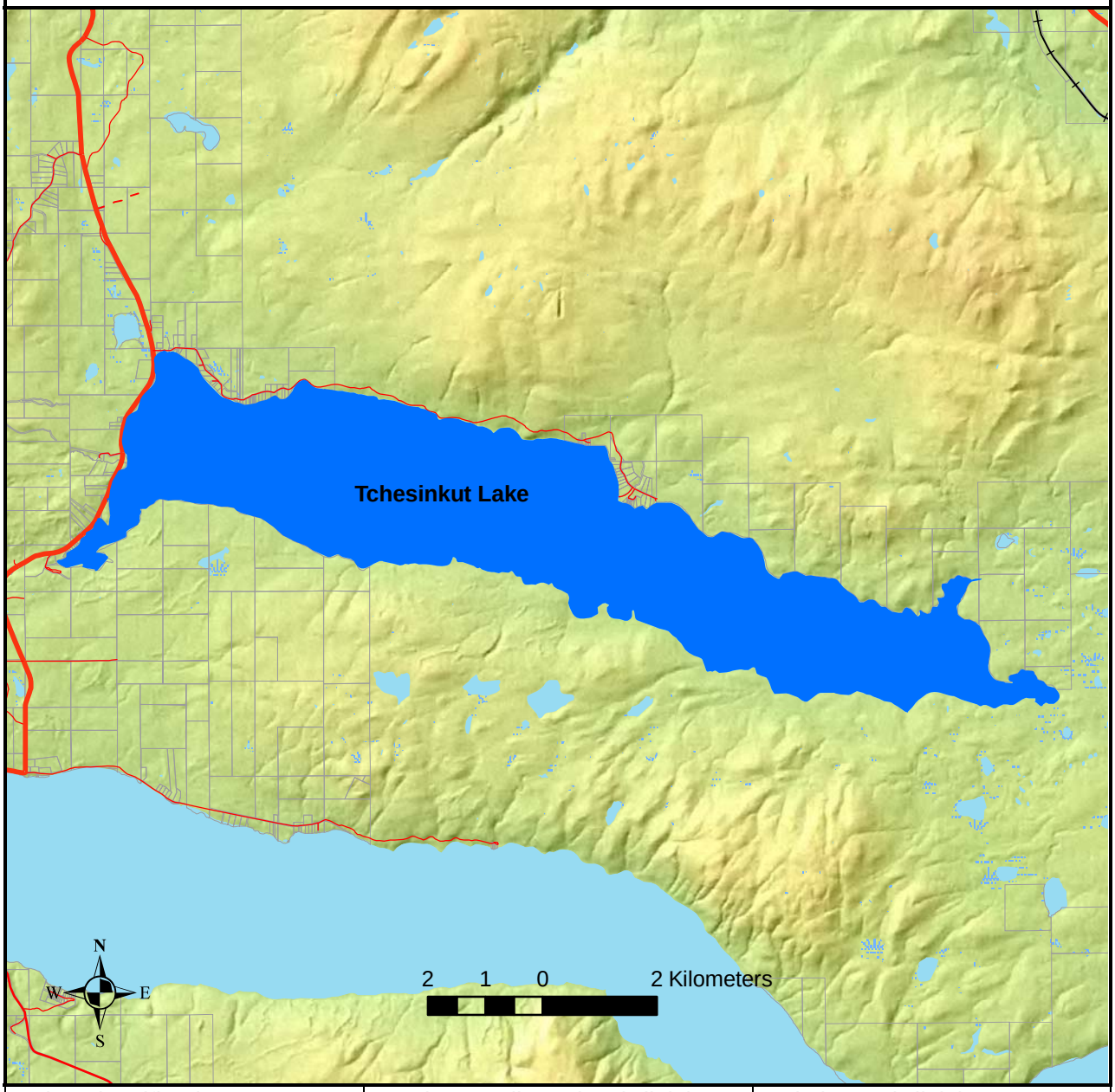
3.2.7 TCHESINKUT LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 30%		Existing Subdivision: 16.8%	
Perimeter: 47.1 km	Area: 3382.7 Ha	Elevation: 743 m	Volume: 2,079,292,300 m^3	Mean Depth: 61.5 m	Max Depth: 149 m

Tchesinkut Lake is located approximately 13 km south of the municipality of Burns Lake in Regional District Electoral Area "E" and is part of the Nechako River watershed. It is a long, wide lake with a simple shoreline, one island and one basin. The water retention time of Tchesinkut Lake is estimated to be 19 years, which calculates to a flushing rate of approximately 5% per year. Major inlets to Tchesinkut Lake are a series of 12 seasonal creeks including Baker Creek. Tchesinkut Lake has one major outlet, Tchesinkut Creek, which flows into the Endako River at a location east of Priestly Hill.

The catchment basin of Tchesinkut Lake has an area of approximately 344.3 km^2. Land use activities in the catchment basin include residential, forestry, livestock rearing, forage production, one commercial resort and a rustic campground. Lakeshore development is concentrated near the west end of the lake and along parts of the north shore. Tchesinkut Road East runs along just over half of the north side of the lake and Highway 35 runs along the western end of the lake. The south side of the lake and the east half of the north shore of the lake are undeveloped. A portion of the southwest part of the lake is in the Agricultural Land Reserve and is used for open range. In the summer cattle often use Tchesinkut Lake as a drinking water source. The northeast quarter of the lake has been identified as having high fish and wildlife management values in the Lakes Land and Resource Management Plan and is designated Park under the 2009 Burns Lake Rural OCP.

Tchesinkut Lake is a phosphorous limited dimictic and oligotrophic lake, thermally stratified in winter and summer and low in nutrients. Aquatic plants are sparse and almost nonexistent throughout the lake, however, local residents have noted excessive algal growth in the northwest corner of the lake. The bottom of almost all shallow areas is mostly gravel and sand with very little detritus. Tchesinkut Lake is a deep lake and has a high proportion of open water habitat. Thus the food web would tend to be based on the organic matter produced by free floating algae. Except for a few shoals, much of the shoreline drops steeply into the water. Tchesinkut Lake is not susceptible to oxygen deficits that are potentially harmful to fish, even in the winter when oxygen levels are typically low in dimictic lakes.

Fish species identified in Tchesinkut Lake include rainbow trout, lake trout, lake whitefish, kokanee and burbot. There are also large numbers of breeding and migratory waterfowl that utilize the lake. At least three areas around the lake have been identified by residents as important nesting sites for loons and other nesting waterfowl. Other wildlife that is dependent on the lake includes eagles, hawks, owls, moose, coyote, fox, beavers and deer. In 2000 a Lake Management Plan was prepared for Tchesinkut Lake by the Ministry of Environment in partnership with the local Tchesinkut Watershed Protection Society. This plan created a strategy to enhance and preserve the quality and health of Tchesinkut Lake's watershed. The plan identified a number of major problems in the watershed and made recommendations on how they should be addressed.

Sport fishing on Tchesinkut Lake provides valuable recreational opportunities for a large number of anglers. The lake contributes substantially to the quality of life in the surrounding communities as well as to the economy of Burns Lake. Tchesinkut Lake has provided a popular year round sport fishery for rainbow trout and lake trout for many years. However, concerned anglers have recently suggested that fishing success on the lake has been deteriorating over the past number of years due to increased fishing pressure. In 2000/2001 a creel survey was performed to assess the impact of sport fishing on fish populations. Since the publication of this study, sport fishing for lake trout in Tchesinkut Lake has been restricted to occur only during July and February each year.

In the past, beaver dams on Tchesinkut Creek have increased the water level in Tchesinkut Lake flooding low-lying properties and threatening homes. In 1997 a Memorandum of Agreement was signed between the Tchesinkut Watershed Protection Society and the Ministry of Environment allowing the Society to remove beaver dams interfering with the Tchesinkut Lake surface water. The Society is required to notify the local Conservation Officer prior to the removal of a dam and is also required to report dam removal the Ministry of Environment on an annual basis.

There are close to 70 homes located on small lakeshore properties on Tchesinkut Lake. Two areas of note are Eldridge Rd (off Tchesinkut Rd East) and Char Rd (off Highway 35) which are characterized by lots that are under 0.4 ha (1 acre) in size. Local residents have identified that the ability of these lots to support on-site sewage disposal systems is a concern. Should the sewage disposal systems on undersized waterfront lots fail, not only is there the potential for significant environmental damage, the property owners may find it challenging and expensive to install a new system. Currently it is unknown if or how many systems are aging and may require replacement. To address this issue the most effective action would be a public awareness campaign directed to the local residents regarding septic system maintenance and responsible lakeshore living.

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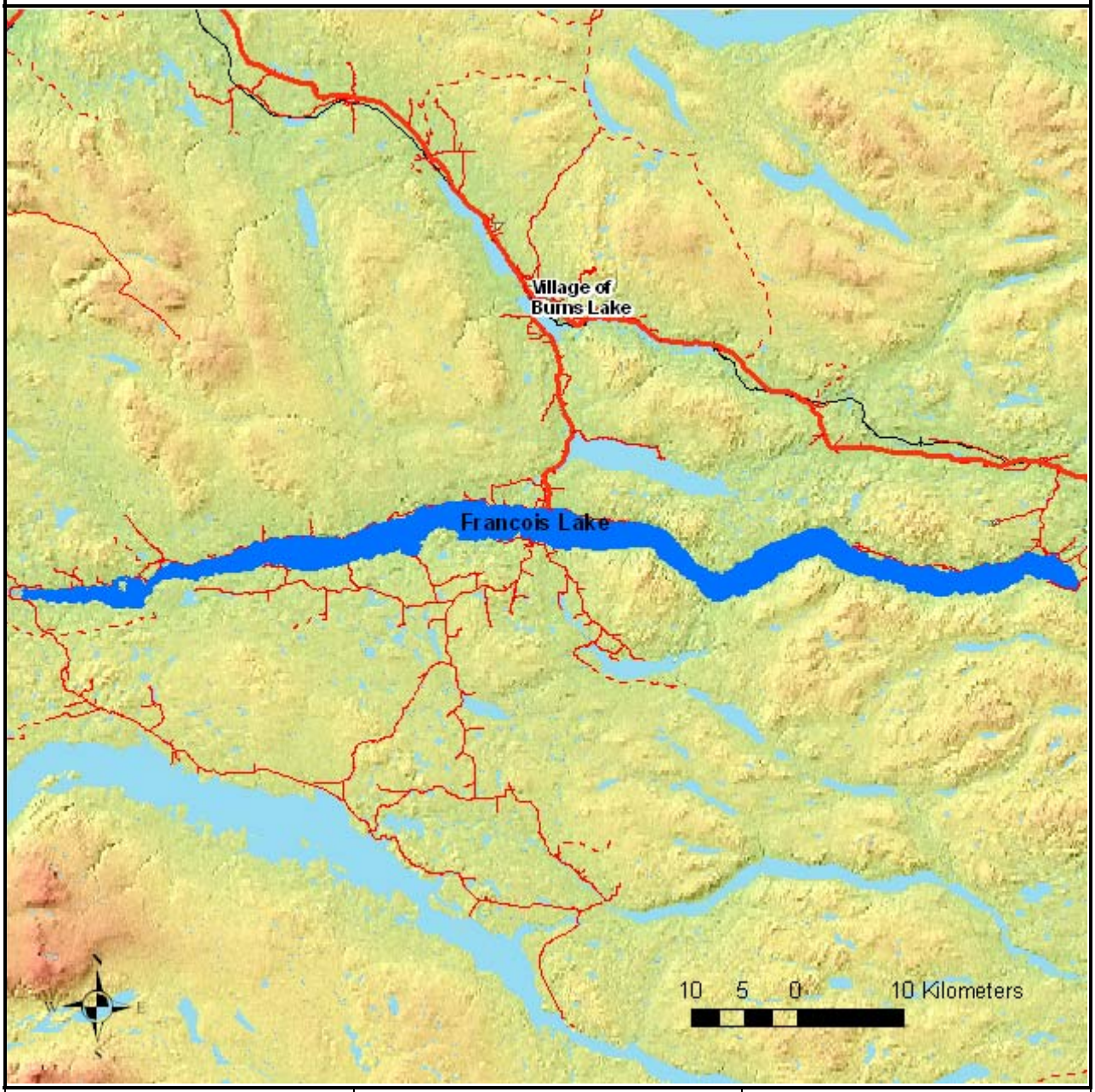
3.2.8 FRANCOIS LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 30%		Existing Subdivision: 17.0%	
Perimeter: 254.5 km	Area: 258 km^2	Elevation: 714.8 m	Volume: 23,087,948,000 m^3	Mean Depth: 86.7 m	Max Depth: 244 m

Francois Lake is one of the largest lakes in the Regional District and is located within both Electoral Area “E” and Electoral Area “D”. Francois Lake can be accessed by three different points through the municipalities of Fraser Lake, Burns Lake and Houston. The east end of Francois Lake, whose roads do not connect to the rest of the lake, is accessed approximately 10 km southwest of the municipality of Fraser Lake. The central part of Francois Lake is accessed approximately 24 km south of the municipality of Burns Lake. The west end of

Francois Lake is accessed both through the municipality of Burns Lake via Colleymount Road and through the municipality of Houston, approximately 60 km south on a resource road.

Francois Lake is part of the Nechako River watershed. It is an extremely long, narrow lake with a simple shoreline and 6 islands. The water retention time of Francois Lake is estimated to be 35 years, which calculates to a flushing rate of approximately 3% per year. Major inlets to Francois Lake are the Nadina River, Nithi River, Van Lear Creek, Arethusa Creek, Parrott Creek, Kivi Creek, Cordella Creek, Isaac Creek, Colley Creek, Ramsay Creek, Wynkes Creek, Graham Creek, Henkel Creek, McDonald Creek, Parkland Creek, Tatalrose Creek, Allin Creek, Snodgrass Creek, Uncha Creek, Peace Creek, Short Creek, Banguarel Creek, and Sweetnam Creek. Francois Lake has one major outlet, the Stellako River, which the Endako River flows into before in drains into Fraser Lake at the west end.

The catchment basin of Francois Lake has an area of approximately 1536.1 km^2. At the east end of the lake, development is concentrated on the north shore and includes over 150 seasonal and full-time residences, 4 commercial resorts, one golf course and the Endako molybdenum mine. This end of the lake is separated from the rest of the lake by Francois Lake Provincial Park and Uncha Mountains Red Hills Provincial Park, which cover almost all of the southeast quarter of the lake as well as a large portion of the north shore. At the center of Francois Lake is the inland ferry terminal that connects the north side of the lake to the south side. Near the north side ferry terminal is a cluster of houses, a convenience store, post office, seasonal restaurant, church, community hall and elementary school. Surrounding the south side ferry terminal is the community of Southbank that has a restaurant, post office, farmers' market, visitor info center, community hall and fire hall in addition to about 70 homes. Outside of Southbank, the south side of Francois Lake is largely undeveloped except for a few clusters of mostly seasonal dwellings. West of the north side ferry terminal is Colleymount Rd which runs along the north shore to the head of Francois Lake. Along Colleymount Road are numerous residences, agricultural operations including livestock rearing and forage production, and two commercial resorts.

Francois Lake is a phosphorous limited lake. In 1997 sediment core samples were taken from Francois Lake and analyzed at Queens University in Kingston. This analysis indicated that Francois Lake is probably a naturally productive lake. It showed that some increased nutrient loading has likely occurred in response to human development; however some reduction has occurred in recent decades. The core samples were also examined for their metal concentrations. It was found that metal concentrations peaked during the first two decades of the operation of the Endako Mine, and that currently metal concentrations have decreased or returned to natural pre-mine levels.

According to residents of the east end of Francois Lake, *Elodea canadensis* has been identified as being one of the aquatic plants growing in the mouth of the Nithi River. Once established *Elodea canadensis* can disperse rapidly through fragmentation from water traffic, animals, currents and waves, which settle into the sediments and take root. The growth of this aquatic plant is characterized by population explosions and declines that are not fully understood.

Francois Lake has an important population of rainbow trout. Eight tributary streams were found to be major contributors of juvenile rainbow trout to the lake fishery in a study conducted by David Bustard in 1988. They are the Nadina River, Nithi River, Ramsay Creek, Uncha Creek, Stellako River, Parrott Creek, Henkel Creek and Allin Creek. At the east end of the lake, the section of the Nithi River extending approximately 4 km upstream from its confluence with Burns

Creek is classified as excellent rainbow trout spawning habitat. The Nithi River has been described as probably the most important spawning system in the Francois Lake System. Other fish species that were inventoried in the lake are lake trout, kokanee, sockeye, burbot and northern pikeminnow.

As well as adding to the quality of life for people living in the surrounding communities, the lake contributes substantially to the economy of Burns Lake and area. Sport fishing on Francois Lake provides valuable recreational opportunities for a large number of anglers. Residents, recreationalists and resort owners are concerned about maintaining healthy fish populations in Francois Lake and have suggested that fishing success on the lake has been deteriorating over the past number of years. Reasons which have been suggested for possible declines in the fish populations include increased fishing pressure, obstructions to fish passage (i.e. culverts and beaver dams) and habitat loss resulting from erosion and sedimentation.

Song birds nest in the riparian vegetation near the lake shore. There are large numbers of breeding and migratory waterfowl that utilize the lake. Swans are known to utilize the open channel provided by the ferry in the winter time. Eagles, hawks, owls, moose, black bears, coyotes, beavers and deer also depend on the lake and nearby wetlands as a part of their life cycle habitat requirements and are therefore a part of the lake biota. In 2000 a Lake Management Plan was prepared for Francois Lake by the Ministry of Environment in partnership with the local Lakes Protection Society. This plan created a strategy to enhance and preserve the quality and health of Francois Lake's watershed.

Many residents of Francois Lake rely on drinking water that comes directly from the lake. Although Francois Lake is notorious for its clean clear water, all surface water supplies must be considered to be of doubtful sanitary quality because of the risk of contamination from animal feces and associated bacteria. Residents using the lake for drinking water are encouraged to test their water on a regular basis. Proper disposal of sewage wastes are also an essential part of health protection and disease prevention. Regardless of the wastewater treatment system being used, all require proper design, operation and maintenance.

Forestry is one of the most prominent land uses in the Francois Lake watershed. Forest development around Francois Lake and its watersheds has been taking place for over thirty years. Forest practices can have negative impacts on wildlife, fish and their habitats by increasing the sediment and nutrient loads of the receiving environments. For aquatic environments this will have a negative effect on the quality and quantity of water over time.

There is an extensive network of unpaved roads throughout the Francois Lake watershed. Most of these unpaved roads are resource roads that were constructed, and are maintained by, the Ministry of Forests. The Ministry of Transportation maintains approximately 100 km of road that is seal coated or paved adjacent to Francois Lake. Because of the extensive number of unpaved roads adjacent to the lake that carry high traffic loads daily, there is a potential for increased sediment loading to the lake as a result of erosion and runoff. Herbicide use along the sides of these roads and removal of vegetation along banks beside these roadways are necessary for road maintenance but can have negative impacts on the lake.

The Endako Mine, located at the east end of Francois Lake, has been extracting and processing molybdenum since the 1960s. Sediment coring of the lake that was completed as part of the Lake Management Plan indicated that from the mid 1960s to the early 1990s molybdenum concentrations in the sediments were persistently increasing as a direct result of mining activities. From the early 1900s to 2000, when the sediment cores were analyzed, the sediment

concentrations were shown to be steadily decreasing, likely due in part to existing rehabilitation measures such as water treatment and effluent controls. Metal concentrations in the water of Francois Lake are regularly tested to assure good water quality.

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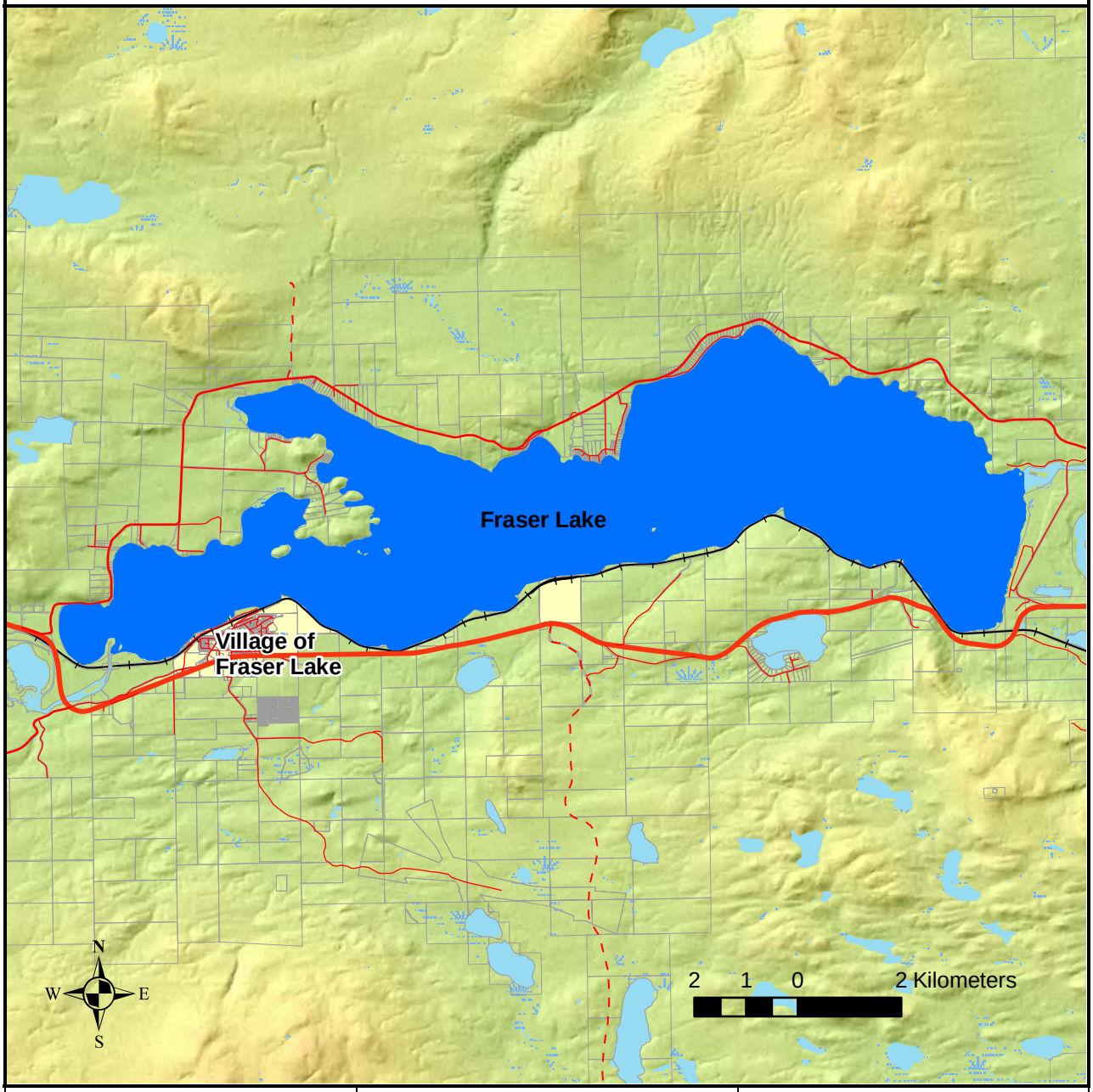
3.2.9 FRASER LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 30%		Existing Subdivision: 32.0%	
Perimeter: 67.1 km	Area: 5,385 Ha	Elevation: 670 m	Volume: 725,287,400 m^3	Mean Depth: 13.3 m	Max Depth: 30.5 m

Fraser Lake is located within Regional District Electoral Area "D" and is adjacent to the Village of Fraser Lake as well as the main settlements of the Stellat'en First Nation and the Nadleh Whut'en First Nation. It is a large, shallow lake that is an important component of the Fraser River watershed. The water retention time of Fraser Lake is estimated to be 0.63 years, which calculates to a flushing rate of approximately 160% or 1.6 per year. The major inlet to Fraser Lake is the Stellako River, which flows into Fraser Lake just after its convergence with the

Endako River. Other inlets to Fraser Lake include Stearn Creek, Perry Creek, Robertson Creek, and Ormond Creek. Fraser Lake has one outlet, the Nautley River, which after only 5 km flows into the Nechako River.

The catchment basin of Fraser Lake has an area of 1,115 km^2, but could be considered much larger since it is directly influenced by both the Burns and Decker Lakes watershed and the Francois Lake watershed. There are a number of diverse land use activities in the catchment basin including agriculture, forestry, urban and rural residential, and recreation. Agricultural activities mainly consist of hobby farming, forage production and open range grazing. Forestry includes timber harvesting and silviculture as well as one large sawmill, Fraser Lake Sawmills, which is located on the south shore of the lake.

The portions of municipality of Fraser Lake that are adjacent to the lake include residential use and a public beach and day use park. Along the south shore of Fraser Lake there is practically no lakeshore development because the CN railway runs adjacent to the lake along the entire south shore. The rest of the lake has significant year-round and seasonal residential development as well as a seaplane base, Provincial campground, rustic campground and one commercial resort. Several areas around Fraser Lake are within the Agricultural Land Reserve and contain farming operations.

Fraser Lake contains the following sport fish: burbot, bull trout, lake trout, mountain whitefish, rainbow trout, sockeye/kokanee salmon, Chinook salmon, and white sturgeon. The lake is also considered an Important Bird Area by Bird Life International. It is a globally significant wintering site for Trumpeter Swans and a continentally important site for fall migrating waterfowl, particularly the American Widgeon. Additionally, Ellis Island (Seagull Island) was designated an ecological reserve in 1991 for the protection of gull colonies, especially Ring-billed Gulls and Herring Gulls.

Fraser Lake is a mesotrophic lake, which means that it is moderately productive. The greatest challenge to lake management is likely the control of phosphorus loading. This loading may promote summer algal blooms and the spread of aquatic plants. Reports do exist in BC Environment files of algae blooms and aquatic plant infestations, with the aquatic plant *Elodea Canadensis* being especially problematic since the early 1980s. From 2000 to 2002 the water quality of Fraser Lake was monitored as part of the Ministry of Environment's Volunteer Lake Monitoring Program in collaboration with the non-profit BC Lake Stewardship Society. The results of the programs were summarized in a brochure that was distributed to lakeshore property owners.

As part of this program, samples were taken at two basins in the lake, one in the centre of the lake and one at the west end. Both basins displayed gradual increases in near bottom total phosphorus. Given the presence of oxygen and the lack of hydrogen sulphide during these buildups, they are more likely the result of organic settling than internal phosphorus loading. Data collected suggested that more of the west basin phosphorus had recently been contributed by external sources (Stellako-Endako River system and the Village of Fraser Lake sewage treatment system).

Fraser Lake's central and west basins were cored and sectioned by BC Environment in 1999. The cores, which represent sedimentation over the last 200 years, were sent to Queen's University for analysis. Both central and west basin cores indicated that Fraser Lake has undergone only minor changes. It has maintained a moderate inferred phosphorus concentration, indicating mesotrophic conditions over the past 200 years. This compares well with the 2000 to 2002 phosphorus measurements that showed little change since 1982. Both

cores also suggested that sedimentation rates have increased since circa 1900 and particularly since 1950 in the west basin. Watershed activities are thought to have caused unusual rates of sedimentation. However, these do not appear to have caused indirect changes in water quality.

The aging and subsequent failure of on-site sewage disposal systems on waterfront properties may be an issue in certain areas of waterfront residential development on Fraser Lake. These areas have undersized recreational lots without community sewage disposal services. They are increasingly being used as year-round residences which are associated with higher sewage flows that require larger disposal systems. Existing sewage disposal systems may prove to be inadequate. The most effective action would be a public awareness campaign directed to the local residents and realtors.

Best Management Practices must be encouraged for all land use activities within the watershed including general residential use, agriculture and forestry. This can be accomplished through a public awareness campaign and providing information to property owners and applicants, as well as participation by water quality interest groups in Provincial planning processes.

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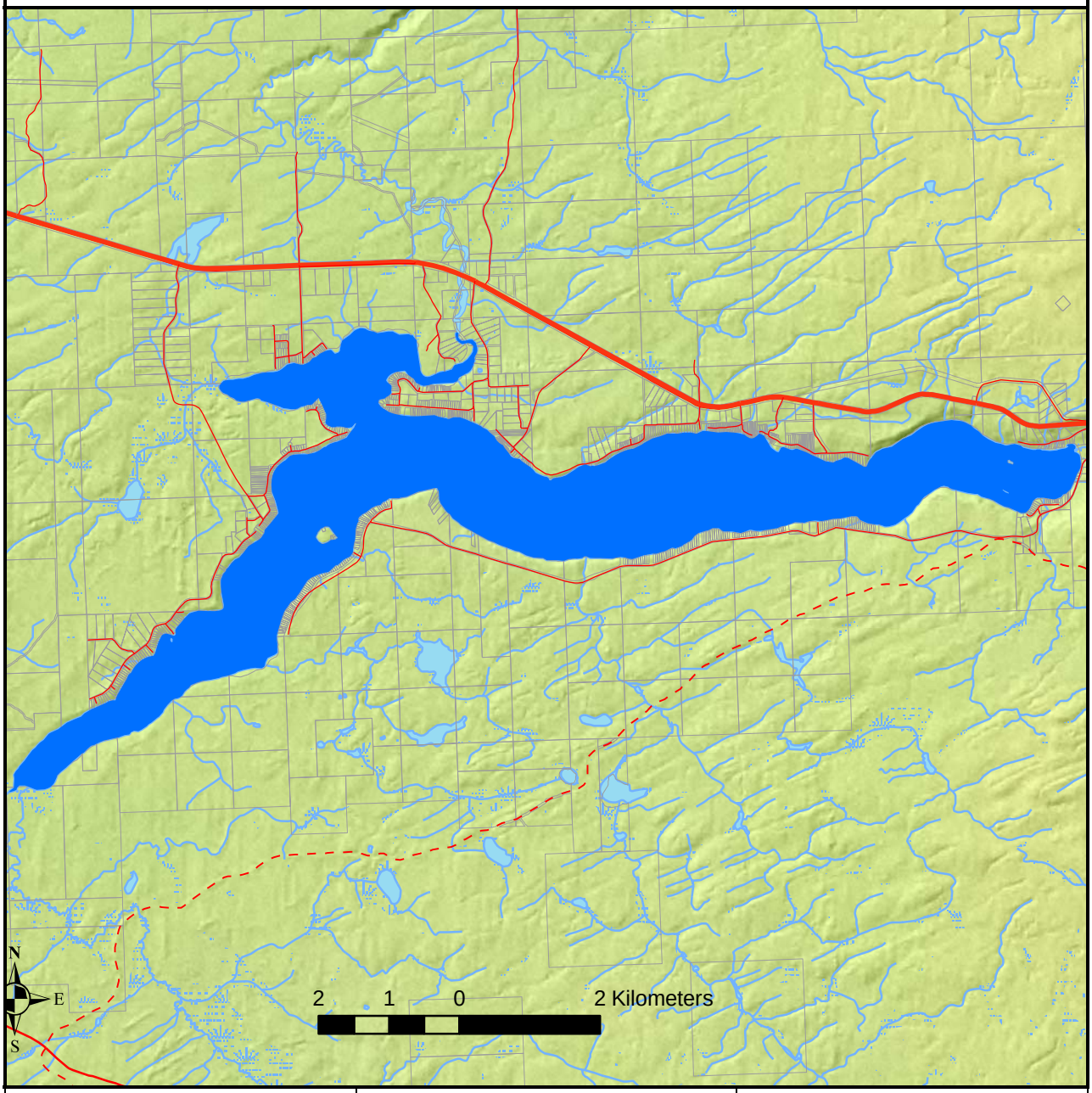
3.2.10 CLUCULZ LAKE



Lake Classification: Development		Maximum Allowed Subdivision: 30%		Existing Subdivision: 52.2%	
Perimeter: 53.1 km	Area: 2520 Ha	Elevation: 762 m	Volume: 713,874,557 m^3	Mean Depth: 30 m	Max Depth: 61 m

Cluculz Lake is located within Regional District Electoral Area “F” and is about 26 km east of Vanderhoof and about 51 km west of Prince George. It is a long deep lake that is part of the Nechako River watershed. The water retention time of Cluculz Lake is estimated to be 10 years, which calculates to a flushing rate of approximately 10% or 0.1 per year. Major inlets to Cluculz Lake include Khai Creek, Norman Creek and Sob Creek. Cluculz Lake has one outlet, Cluculz Creek, which flows into the Nechako River just prior to its confluence with the Stuart River.

The catchment basin of Cluculz Lake has an area of 629.96 km^2. There are a number of diverse land use activities in the catchment basin including lakeshore development, forestry, agriculture, and recreation. There are currently 734 privately owned lakeshore lots, of which 536 are known to have summer or permanent residences. There has been an increase of 11.4% for lots and 16.5% for residences since 1999 when there were approximately 659 lots and 460 residences. The vast majority of the existing privately owned lakeshore lots are smaller than what would be permitted under modern subdivision standards, which ensure adequate space for on-site sewage disposal. In 1999 approximately 140 residences are thought to use surface water as a potable supply.

Both Prince George and Vanderhoof residents use the lake for general recreational purposes. The greatest challenge to the lake is likely the control of phosphorus loading which may be causing increased aquatic plant growth and the occasional outbreak of blue-green algae. Reports of aquatic plant infestations and algal blooms are fairly common within BC Environment files and the aquatic plant *Elodea canadensis* has been identified as a problem species in the lake. In the summer of 1997 there was an algal bloom of Aphanizomenon flos-aquae that may have been promoted by phosphorus loading; unfortunately water quality data were not collected that year.

Cluculz Lake is a dimictic lake that generally has a steep drop-off from shoreline, and has one main basin and three islands. Cluculz Lake contains the following sport fish: rainbow trout, lake char, dolly varden, burbot, kokanee, and mountain whitefish. From 1994 to 1999 the water quality of Cluculz Lake was monitored as part of the Ministry of Environment's Volunteer Lake Monitoring Program in collaboration with the non-profit BC Lake Stewardship Society. The results of the program were summarized in a brochure that was distributed to lakeshore property owners.

As part of this program, samples were taken at two basins in the lake, one at the east side of the lake and one at the west side. Sampling showed that a clear yearly trend for total phosphorous levels is not evident. This along with the oxygen data implies that Cluculz can have variable but generally reasonable water quality. Through numerous years of sampling, the lake has shown no clear signs of internal phosphorus loading.

Cluculz Lake's deep station was cored by BC Environment in 1999. The core represented sedimentation over the last 300 years and was sent to Queen's University for analysis. The analysis of the Cluculz Lake core determined that the lake has only undergone minor changes over the last 300 years. The lake contains historically high concentrations of phosphorus, and recent changes are within the range observed over the core length.

In 1999, BC Environment commissioned a photo survey of lakeshore development practices that may impair Cluculz Lake water quality. The survey found that the most significant practice was riparian clearing (replacing natural vegetation within 15 m of the lake with grass) which was evident for 48% of properties. Other damaging practices included cabin encroachment (within 15 m of the lake) 6%, installation of breakwaters (Concrete, Cobble or Pressure treated wood) and beach creation 4%, and metal barrel floats in docks 3%.

The 1999 monitoring program and sediment coring results suggest that Cluculz Lake has a fair to good recreational water quality that may be in the very early stages of decline. Additional years of data are required to investigate any possible trend.

The aging and subsequent failure of on-site sewage disposal systems on waterfront properties is likely an issue in certain areas of waterfront residential development on Cluculz Lake. These areas have undersized recreational lots and most do not community sewage disposal services. They are increasingly being used as year-round residences which are associated with higher

sewage flows that require larger disposal systems. Existing sewage disposal systems may prove to be inadequate. The most effective action would be a public awareness campaign directed to the local residents and realtors.

Best Management Practices must be encouraged for all land use activities within the watershed including general residential use, agriculture and forestry. This can be accomplished through a public awareness campaign and providing information to property owners and applicants, as well as participation by water quality interest groups in Provincial planning processes.

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SECTION 4: REFERENCES

4.1 REFERENCES

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