Alberni Valley Drinking Water Reference Guide

Mapping Our Legacy

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For
Save Our Valley Alliance
Public Education Committee

Port Alberni, BC

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Dedication

To the Creator and the Creation.

To the men and women who have fought for our Commons.

To the next seven generations.

To planet Earth.

May we all walk softly.

Acknowledgements

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Cover photo: A spring in the Beaufort Range, by Henty Wolfhagen

Note from Editor: As this guide goes to press, the BC government has, once again, changed. There is a new premier, new ministers, and new ministries—far too much to update this report at this late date. We recommend readers go to the government's website: www.gov.bc.ca for the current names and websites of the various ministries. It is quite likely that the responsibilities as described herein are the same; just the names have been changed.

Executive Summary

Save Our Valley Alliance Public Education Committee (SOVA-SPEC) identified that an overview of current water legislation and practices at local, regional, provincial, and federal levels was needed in order to raise the public's awareness of drinking water and watershed values. The objective of this report has been to provide a synthesis of available information concerning drinking water in the Alberni Valley, to identify any problems and threats and, based on these, to make recommendations for improved governance, management, and usage. To this end, research included an overview of water history, legislation, management, the rationale for water treatment methods, inventories of the various drinking water supplies and requirements in the Alberni Valley, and watershed mapping.

Despite an extensive institutional framework equipped with government regulations and experts who have responsibility for protecting and maintaining water resources and quality in Canada, concerns have arisen nationally and locally over the many challenges to meeting these responsibilities. Water resource managers have adopted a blind push to embrace water treatment technology rather than source protection to solve water quality issues. There is a lack of knowledge about drinking water sources by both the general public and water managers. What information is available is riddled with a proliferation of assumptions rather than facts. During our research, it became apparent that there are major challenges to managing water in British Columbia. Five of these were identified, explained, and their historical context given:

1. Accountability

At each level of governance, multiple acts and regulations exist, many of which contain escape clauses embedded in other pieces of legislation enacted by other government ministries and departments.

Monumental decisions with long-term impacts are not given due consideration and are not democratically reviewed. Short-term economic gains take precedence over long-term losses.

Water needs to be managed at a local level with full integration of the global impacts of pollution, agriculture, climate change, and water as a fundamental human right.

At a local level, water governance is entrenched with little public interest and input. On the other hand, meaningful local public consultation on water governance at all levels is absent and unvalued. Therefore, public education about water governance issues is needed to make a complete transformation if water resources are to be protected.

2. Legislative Continuity

Another problem area is in the lack of legislative continuity and relevance of the legislation to address particular issues. Acts, regulations, and ministries are continually being shifted and adjusted to comply with current political trends and the whims of political parties. Constant changes leave the public unable to clearly identify who is responsible and to whom they are accountable. It also makes it difficult to identify potential violations to legislation and who to contact for enforcement. A disconnect occurs between BC's provincial government ministries, their policies and implementation processes, and the public.

3. Enforcement

The provincial government, as the guardian of our environment, and the local government, with its ability to create and enforce land-use zoning bylaws, alongside the general public, must be willing to adopt and enforce legislation that protects drinking water. Confounding the ability of agencies to protect our drinking water resources is the fact that under the Private Managed Forest Land Act, local governments must not adopt any bylaw under or issue any permit in respect of private managed forest land that would have the effect of restricting a forest management activity.

Health authorities do have some power to protect community health concerns relative to drinking water, but they are not utilising the full range of enforcement options available to them under the Drinking Water Protection Act and Drinking Water Protection Regulation.

4. Funding

Municipalities build, own, and maintain the majority of Canada's infrastructure – infrastructure that supports our economy and quality of life. During the past 20 years, Canadian municipalities have been strangled by increasing responsibilities and reduced transfer payments from higher levels of government. The World Health Organisation's General Comment 15 on the human right to water states that national governments must ensure that local authorities have at their disposal sufficient resources to maintain and extend the necessary water services and facilities.

5. Unsustainable Water Use

Although Canada ranks high among the nations of the world in per capita fresh water availability, a host of factors conspire to make our abundance more apparent than real. The myth of water abundance permeates all areas of water use. British Columbia residents are the largest consumers of water in Canada. Alberni Valley residents have a higher consumption than the BC average.

Rivers that used to run free are now either sluggish or under threat of having their flow regime affected by privately owned and run energy producers; water tables are sinking—a threat that increases as the effects of climate change progress; and natural habitat is disappearing. The promise of a safe, abundant supply of fresh water can no longer be guaranteed.

Methods Used

I undertook interviews and surveys with government personnel at various levels; forest industry representatives; local water purveyors; experts in agriculture, air quality, and karst; and members of the general public. I also conducted watershed field work.

Recommendations

In order to rectify the problems identified in the course of this research, the following recommendations are made.

1. Adopt water as a human right.
2. Create a "Ministry of Water" and regional advisory panels, and restore the role of improvement districts in water protection and management.
3. Form a public, local, ecologically informed water management team.
4. Make long-term infrastructure maintenance mandatory.
5. Establish long-term distinct legislation for Community Watersheds, including mandatory watershed protection.

6. Adopt new water usage values.
7. Adopt a standardised language in relation to water and watersheds.
8. Fully document the ecology, geology, and hydrogeology of the Alberni Valley.
9. Conduct a public review of the Ministry of Environment's draft plan "Interim Guidelines and Procedures on the Designation, Amendment and Cancellation of Community Watersheds under the Forest and Range Practices Act," Appendix 2, Section 2 (a) (ii) and Section 3.
10. Conduct (and publish) research on the effects of water treatment methods on human health and the environment.
11. Legislate (and enforce) complete protection of karst drinking water sources.
12. Establish permanent Real Time Flow and Snow Pack stations in the Alberni Valley watersheds in order to obtain data for drinking water resource management.
13. Include the water-food connection in water resource management.
14. Enact zoning bylaws with a "water-centric" approach.
15. Set enforceable water quality objectives for all Community Watersheds on a local basis.
16. (a) Require the Ministry of Agriculture to create, adopt, and enforce legislation that protects drinking water in rural areas and be pro-active in public education for managing farming activities around water on farms, including hobby farms; and
    (b) Conduct point source testing of streams that contribute to drinking water sources in agricultural areas.
17. Launch a public education campaign on comprehensive watershed protection in the Alberni Valley.
18. Adopt a format for water bills to reflect actual water usage in litres per person per day as compared to BC and Canadian seasonal averages.
19. Conduct research on the value and environmental impacts of rainwater harvesting.
20. Re-establish public service values and practices within the public service.

While the intended audience of this report is the greater community of the Alberni Valley, the *Alberni Valley Drinking Water Reference Guide* was created as a living document and, hopefully, audiences across British Columbia and Canada will find it useful as a reference guide or as a point of comparison to their own communities' water challenges.

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PART 1 MAPPING OUR LEGACY

1.0 Introduction

Mapping Our Legacy is a four-part project undertaken by the Save Our Valley Alliance Public Education Committee (SOVA-SPEC) beginning in January 2007. Its objective is to educate ourselves and the public about all aspects of our local drinking water—from source to tap. To this end, we have sponsored the following community activities:

1. A Speakers Series
   a) Liquid Assets: A presentation by Trevor Wicks, in February 2008
   b) Where Does Your Drinking Water Come From?: A panel discussion with local water purveyors, in February 2009
   c) The World Beneath Your Feet: A presentation by Reid Robinson on karst, in May 2009
2. A series of interactive dramas was developed to encourage public involvement and action on water issues. SOVA sponsored actor and writer Pamela Walker to train with the Forum Theatre group. She then held a local workshop with Canada World Youth participants; together they performed six playlets on water issues in conjunction with a film on water, held at Echo Centre in January 2010.
3. a) A 6-foot by 13-foot laminated aerial photograph of Alberni Valley watersheds was produced in Spring 2009 (thanks to Lori Wilson of the ACRD for this).
   b) A 4-foot by 6-foot landform model of Alberni Valley watersheds was produced in June 2009. This large model, designed and built by Trevor Wicks, is displayed in a variety of local venues, including at City Hall.
4. Research and preparation of the *Alberni Valley Drinking Water Reference Guide*. This report represents the conclusion of the Mapping Our Legacy project.

We realised that an overview of current water issues, including legislation and practices at local, regional, provincial, and national levels was needed to raise the public's awareness of drinking water issues and watershed values. The objective of this report is to provide a synthesis of available information about legislation governing drinking water management and drinking water supply systems in the Alberni Valley. This project also builds upon the Comox Valley Drinking Water Reference Guide, which contains locally relevant information. There is currently no other document that compiles water-related information into a single document for the use and benefit of the public of the Alberni Valley.

1.1 Background

Mapping Our Legacy is a community project initiated at the grassroots level by Alberni Valley residents who met through the Save Our Valley Alliance (SOVA) and were further inspired at the "Our Water, Our Future" conference in Qualicum in November 2006. This conference served as the impetus for the formation of SOVA's Public Education Committee (SPEC) and motivated SOVA to join the Vancouver Island Water Watch Coalition (VIWW). Vancouver Island Water Watch is a coalition of 13 member communities on Vancouver Island that are focused on water stewardship.

The first formal meeting of our committee was held in 2006. Our main focus has been to provide a sharing environment among community members who participate in discussions concerning the protection of our drinking water sources. The Public Education Committee's working goals are:

- to evaluate the status of local watersheds
- to ensure citizen control over water supplies
- to increase the development of water conservation
- to develop and support legislation that protects, maintains, and improves water sources
- to create new initiatives in public education

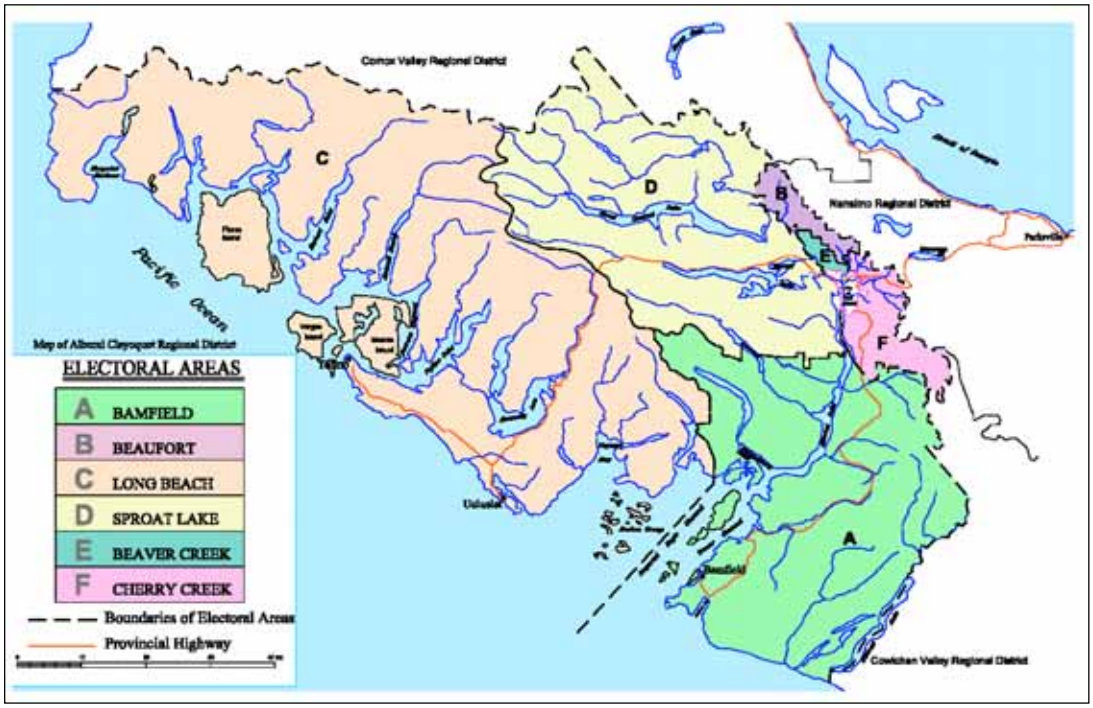
This report is the final product of the Mapping Our Legacy project and meets the following objectives of SPEC:

- synthesise information, especially key terms, legislation, and challenges about our local drinking water resources
- provide applicable records to inform the public concerning water supply and management in the Alberni Valley
- stimulate further discussion about the present and future drinking water resources in the Alberni Valley

1.2 Geographic Focus

The geographic focus of the study is the Alberni Valley, which is defined as the City of Port Alberni and these electoral areas of the Alberni-Clayoquot Regional District: Area B Beaufort, Area D Sproat Lake, Area E Beaver Creek, and Area F Cherry Creek (see Figure 1).

Figure 1. Map of Alberni-Clayoquot Regional District



1.3 Methodology

This report relies on information gathered from a range of sources, including semi-structured interviews, survey questionnaires, field work, academic journals and books, newspaper articles, reports, websites, and the Comox Valley Drinking Water Reference Guide. The focus of the report is on legislation, water supply systems, watersheds, and threats to water quality and quantity in the Alberni Valley. Interviews were held with government employees, water operators, academic researchers, non-governmental organisations and coalitions, and I attended a number of conference workshops. Semi-structured interviews were conducted in person, over the telephone, and by email. The semi-structured format was considered the best way to obtain information that had to be collected from a wide variety of sources rather than a central location.

Field work consisted of watershed tours and watershed mapping using a Garmin eTrex HC series GPS with a <15 meter margin of error and mapping software called Auto Desk Map. Mapping was conducted between March and December 2009. Mapping during the summer months was difficult due to increased undergrowth and dry creek beds. Mapping before March 2009 was slowed due to snow. Data was collected during a variety of weather conditions including rain, fresh snow, and sunshine. Air temperatures varied, but reflected seasonal temperatures for 2009. The Alberni Valley Stream Atlas, local knowledge, and BC Ministry of Environment (IMAP BC) and Natural Resources Canada (NRCan) topographic maps were used to locate stream systems.

Questionnaires were administered to water operators for the City of Port Alberni, Beaver Creek Improvement District, Cherry Creek Waterworks District, Vancouver Island Health Authority (VIHA), Timberwest, Island Timberlands, Regional District of Nanaimo, Ministry of Environment, Ministry of Forests and Range-South Island Forest District, Western Forest Products, and the Private Managed Forest Land Council.

The following organisations provided information for this study:

- Alberni Valley Enhancement Association
- Alberni Environmental Coalition
- Alberni Farmers Institute
- Alberni-Clayoquot Regional District
- BC Tap Water Alliance
- BC Water and Waste Association
- Beaufort Watershed Group
- Beaver Creek Improvement District
- Central Island Caving Club
- Cherry Creek Waterworks District
- City of Port Alberni
- Climate Change Committee
- Comox Water Watch Coalition
- Environment Canada
- Fisheries and Oceans Canada

- H20 Logistics
- Island Timberlands
- Local residents
- McGill Associates Engineering
- Ministry of Community and Rural Development (BC)
- Ministry of Environment (BC)
- Ministry of Forests and Range (BC)
- Ministry of Healthy Living and Sport (BC)
- POLIS Project (Water Stewardship Division, University of Victoria)
- Port Alberni Air Quality Council (Citizens' Stewardship Coalition)
- Port Alberni Historical Society
- Private Managed Forest Land Council
- Regional District of Nanaimo
- Somass Basin Management Group
- South Island Forest District
- Sproat Lake Community Association
- Timberwest
- Vancouver Island Health Authority
- Vancouver Island University
- Vancouver Island Water Watch Coalition
- Water Systems Manager Norway, Sonya Jenssen

Preliminary research consisted of a review of the 1995 Alberni Valley Regional Water Study commissioned by the Alberni-Clayoquot Regional District (ACRD) and the City of Port Alberni. The 1995 study was in its third iteration and review of the document was timely in light of recent requests from the City of Port Alberni and the ACRD to update the study to a fourth version. The new version would address current changes in forestry management, information about climate change, water conservation, agriculture, and understanding of ecological sustainability. Review of the 1995 study revealed some areas of concern, which are outlined in Part 4. Section 4.1.7 presents some information about the new study that was presented to the regional water committee in July 2010.

1.4 Limitations

As awareness of the inherently finite nature of water resources increases, so does conflict over access to adequate and clean water among various user groups. In conducting this study, many eyebrows were raised at requests for information. Obtaining direct access to water purveyors willing to speak candidly was sometimes a challenge. One waterworks district in particular was continuously evasive. While an image of transparency is portrayed to the public by some water purveyors, discussion stopped in response to more probing questions.

Tours of the waterworks were conducted upon request with the City of Port Alberni and the Beaver Creek Improvement District; however, the request was denied by the Cherry Creek Waterworks District due to an expressed lack of funding.

Limited funding also placed constraints on this research, requiring part-time study over 20 months, rather than full-time study. In hindsight, the extended timeline proved to be valuable to bring to light the continued erosion of funding available to safeguard drinking water in the Alberni Valley.

The provincial government's changes to forest management leave concerns for the sincerity of their stated intent to follow through with their own recommendations for source protection outlined in the *Living Water Smart* plan.

Current policy on the application of the Forest Practices Code for areas previously in Tree Farm Licence (TFL) 44, and the switch to the Private Managed Forest Practices Act have lessened drinking water source protection. The provincial government's Private Managed Forest Land Act also gives rise to a number of concerns that its regulatory organisation, which is funded by the landowners, may not have the independence to rigorously enforce forest management regulations in the public interest.

The BC government's refusal to offer grant programs to improvement districts forces people in the Alberni Valley to seek solutions for a robust model having multiple drinking water sources to the less robust single-source option. A less robust model has the potential to negatively impact the safeguarding of drinking water in the Alberni Valley.

The BC government cut the snow pillow survey on Mount Cokely, which had been conducted by the River Forecast Centre branch of the Ministry of Environment. Mount Cokely was the closest snow/water measuring site in the Valley, and was an important data collection resource.

Federal government cuts to stream flow monitoring conducted by the Water Survey of Canada further erode our ability to safeguard drinking water in the Alberni Valley.

1.5 Future Research Topics

Due to the above-mentioned limitations, it was not possible to address some topics within the scope of this project. These topics are important areas of focus for future study and include:

- The effects of climate change on water management for people and ecosystems
- Invasive plant species control methods in the watersheds
- Land use and development
- Impacts of fertilisation on lakes and streams in relation to drinking water
- Groundwater mapping, including its connections to surface water sources
- Bulk water exports in the form of bottled water
- Relationships between water access and governance to labour and trade laws, such as Trade Investment Labour Mobility Agreement (TILMA) and the North American Free Trade Agreement (NAFTA)
- Socio-economic impacts of privatised water supply and treatment systems

- Development impacts and effects on groundwater quality
- Water quality objectives in First Nations reserves
- Expropriation of watershed land by the public
- Community Forest activity in watersheds

As a result of this study, more questions were raised than answers provided. This report serves as an initial guide to understanding the source-to-tap path travelled by drinking water in the Alberni Valley.

PART 2 GLOSSARY OF WATER-RELATED TERMS

I have placed the glossary in the beginning of the document in order to serve one of the primary purposes of this project: public education. Website addresses are given, where appropriate, for readers to find additional information. The main reference for many entries is the *Comox Valley's Drinking Water Reference Guide*, by Sonya Jenssen (2007). All glossary entries that are not referenced are from this report. The other main source is the BC Environment ministry's 2009 reference glossary, which is noted simply as BC Environment 2009 throughout the table to save space and avoid repetition (www.env.gov.bc.ca/wat/wq/reference/glossary).

Acid Rain	Rainfall containing dissolved industrial gases, mainly sulphur and nitrogen oxides, that alter the normal pH of water. With a pH balance of 5 or less, acid rain becomes damaging for terrestrial and aquatic ecosystems. Karst is particularly vulnerable to acid rain and industrial acidic gases, such as sulphuric, nitric/nitrous, and hydrochloric acids (R. Robinson, personal communication, March 27, 2010).
Acidic	A pH below 7: soil normally has a pH of about 6.5.
Agricultural Land Reserve	The Agricultural Land Reserve (ALR) is a provincial zone in which agriculture is recognised as the priority use. Farming is encouraged and non-agricultural uses are controlled. The ALR covers approximately 4.7 million hectares (ha). It includes private and public lands that may be farmed, forested, or left vacant. In total, the ALR comprises those lands within BC that have the potential for agricultural production. The ALR takes precedence over, but does not replace other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land. The Agricultural Land Commission Act sets the legislative framework for the establishment and administration of the agricultural land preservation program (www.als.gov.bc.ca). In the Alberni-Clayoquot Regional District, there are 7,700 hectares designated as ALR.
Algal Bloom	A bloom of algae occurs when their growth is so rapid that they become numerous enough to colour a body of water; a population explosion of phytoplankton in response to changing environmental conditions, including eutrophication from wastewater and non-point sources. Blooms can result in oxygen depletion and biological impacts, such as fish kills; blooms are often the result of urban runoff of lawn fertilisers (BC Environment 2009).
Airshed	Geographical areas in which air quality is a function of the same sources, weather and geography.
Agricultural Land Council	Ensures that activities occurring in the ALR are consistent with the Agricultural Land Commission Act, regulation, and orders of the Commission. ALR lands are situated throughout British Columbia and total approximately 4.7 million ha (Agricultural Land Council 2009, www.als.gov.bc.ca).
Alkaline	A pH above 7 (Wikipedia 2009).
Alluvial deposit	Any sediment, including clay, silt, sand, gravel, or similar unconsolidated material deposited in a sorted or semi-sorted condition by a watercourse.

Alluvial fan	A fan-shaped accumulation of alluvium deposited at the mouth of a ravine or a juncture of a tributary stream with the main stream.
Anthropogenic	Having to do with the activities of humans as opposed to those of nature; modified or influenced by people (BC Environment 2009).
Aquifer	Water within the soil or rocks beneath the surface of the earth. Water in the zone of saturation, where all openings in rocks and soil are filled with water, the upper surface of which forms the water table, the streams or pools of water that flow or collect under the surface of the land and not on the surface. These may be confined aquifers if there are layers of impermeable material both above and below and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer. Unconfined aquifers occur when the upper water surface, the water table, is at atmospheric pressure, and is able to rise and fall (BC Environment 2009).
Aquifer Classification System	Classifies aquifers on the basis of their level of development and vulnerability to contamination. It is map-based and provides a ranking value for aquifers using hydrogeology and water use criteria.
Aquifer Conductivity	The rate of groundwater flow in an aquifer. Rapid groundwater flow in an aquifer allows for the rapid spread of a contaminant.
Aquifer media	The character of the groundwater flow system. The path length and travel time of groundwater within an aquifer will determine how quickly a contaminant will spread through an aquifer.
Aquifer Vulnerability Index	A methodology that can be applied to determine the vulnerability of an aquifer. It is quantitative and based on the thickness of differing overburden types. A numerical index score is generated that can be used to compare groundwater formations.
Aquifer Vulnerability Mapping	To map the vulnerability of an aquifer to contamination from sources. Vulnerability mapping does not consider the type of land use above an aquifer, only the intrinsic vulnerability of the aquifer, typically based on the type, thickness, and extent of overlying geologic materials, depth to water, and type of aquifer materials.
Artesian	An aquifer and the water in it. It can refer to the release of water to the surface from and aquifer without the aid of a pump. Springs along the Beauforts are an example of this.
Assimilative Capacity	The amount of pollution a water body can receive without noticeable degradation, as a result of the natural ability of the water and its associated chemical and biological systems to dilute or transform contaminants (BC Environment 2009).
Backwashing	Reversing the flow of water through a water treatment filter or membrane to clean and remove deposits (BC Environment 2009).
Biomagnification	The increase of a substance or contaminant in a food web such that the organisms contain higher concentrations of the substance than their food sources; the magnification of contaminant concentration in organisms due to increased tissue concentrations at each successive trophic level in a food chain, generally, but not always, occurs due to a contaminant being soluble in fatty tissues and not in water (BC Environment 2009).
Bedrock	Rock underlying soil and other consolidated material.

Best Management Practices	Abbreviated BMPs; sometimes referred to as guidelines; usually not enforceable but left, instead, to voluntary compliance (i.e., not usually complied with).
Biodiversity	The diversity of plants, animals, and other living organisms in all their forms and levels of organisation, including genes, species, ecosystems, and the evolutionary and functional processes that link them.
Biological Pest Control	Biological control agents (usually insects) that are released to attack and weaken targeted invasive plant species and over time reduce their population. A complete listing of biological control agents in general use and those being developed for invasive plants in British Columbia is available online at www.for.gov.bc.ca/ hfp/biocontrol/index.htm (Pest Management Plan 2008, Draft 16).
Buffers	A zone or strip of land that separates two areas, usually to protect a sensitive area from the impacts of the adjacent development activities.
Catchment Area	Also referred to as drainage basin. A drainage basin is a region of land where water from rain or snow melt drains downhill into a body of water, such as a river, lake, dam, estuary, wetland, sea or ocean. The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. The drainage basin acts like a funnel – collecting all the water within the area covered by the basin and channelling it into a waterway. Each drainage basin is separated topographically from adjacent basins by a ridge, hill or mountain, which is known as a water divide or a watershed. Especially in North American usage however, watershed refers to the drainage basin itself. Other terms that can be used to describe the same concept are catchment, catchment area, catchment basin, drainage area, river basin and water basin.
Colony Forming Units	A quantitative measure of the concentration of bacteria in a water sample; bacterial colonies on laboratory media resulting from filtering and culturing bacteria from a water sample. Each colony in the lab culture is presumed to have arisen from the multiplication of a single bacterium in the original sample (BC Environment 2009).
Cistern	Cisterns are commonly used in areas where water is scarce, either because it is rare, the rock substrate prevents well-digging, the water table is too deep, or it has been depleted due to heavy use. Early on, cisterns were used for many purposes, including cooking, irrigation, and washing. Present day cisterns are often only used for irrigation due to concerns over water quality. Cisterns can also be fitted with filters or other water purification methods if the water is meant for consumption. Some leave their cisterns open to catch rain or have more elaborate rain-catching systems. It is recommended to have a system that does not leave the water open to mosquitoes or algae, which can transmit disease to humans. Some cisterns sit on the top of houses or on the ground higher than the house, and supply the running water needs for the house. They are often supplied not by rainwater harvesting, but by wells with electric pumps, or are filled by manual labour or by truck delivery.
Climate Change	Projected global increase in temperature that results in changes on both local and regional scales, including evapotranspiration rate, changes in snow- and rainfall patterns, and changes in intensity, severity, and timing of storms. Effects of these changes result in alterations to soil moisture, water runoff, and regional hydrological cycles. The supply of, and subsequent demand for, water will change, as will water quality. Climate change will impact water resources, hydroelectric generation, human health, navigation, shipping, agriculture, and biodiversity.

Clearcut	A silviculture system that removes an entire stand of trees in a single harvesting operation from an area that is one hectare or greater and at least two tree heights in width. A clearcut is designed to be managed as an even-aged stand where only one age class is present.
Coal Bed Methane Gas	A natural gas found in underground coal deposits contained within the coal seam where it is absorbed or attached to coal particles. During extraction, water is pumped out of the coal seams, which lowers the pressure enough to release the gas for collection and sale.
Coagulation	The use of chemicals (frequently alum) to make suspended solids clump together into aggregates (flocs) for easier filtration or sedimentation (BC Environment 2009).
Coliform	Non-pathogenic natural gut bacteria monitored when testing water to indicate the possible presence of pathogenic bacteria (BC Environment, 2009).
Coliform bacteria	A large group of bacteria, commonly found in topsoil, bodies of water, and animal (fecal) matter (Provincial Health Officer 2006): 1. Total coliform: the level of total coliform indicates whether water has been contaminated from an unsanitary source. It is an indictor of water quality. 2. Fecal coliform: a subgroup of coliforms found almost exclusively in the intestinal waste of humans and animals; capable of growing elsewhere in the environment. If found in water, are an indicator that it has been contaminated with sewage or other intestinal wastes and may be a potential risk, if containing disease causing organisms. Water containing fecal coliforms is generally unsafe to drink. 3. *E. coli*: A type of fecal coliform bacteria; presence in water indicates recent animal contamination and the possible presence of pathogenic micro-organisms.
Community Forest	Where local people strive to practice responsible forest management to foster and support vibrant rural communities. The BC Community Forest Association's guiding principle is to promote culturally, ecologically, and economically sustainable forestry with meaningful public participation in decision making (www.bccfa/ca). There are two Community Forests located in the Alberni Valley.
Community Watershed	The drainage area above the downstream point of diversion on a stream for water use that is for human consumption and that is licensed under the Water Act for waterworks purpose or a domestic purpose if the license is held by or is subject to the control of a water users' community incorporated under the Water Act.
Confined Aquifer	An aquifer bound both below and above by beds of considerably lower permeability than exists in the aquifer itself. The groundwater in a confined aquifer is under pressure that is significantly greater than that existing in the atmosphere.
Contaminant	Solute which through human action intrudes into the hydrologic cycle.
Contamination	Impairment of natural water quality by chemical or bacterial pollution as a result of human activities. The degree of contamination allowed before actual hazard to public health is created will depend upon the intended end use of the water.
Crown Land	BC's Crown land base is the cornerstone of prosperity for British Columbians. Over 20 sectors of the economy depend upon continued use of Crown land, and economic growth for many local economies can only occur if access is secured. The Crown land base and the values associated with it are a public asset and the Province has a responsibility to ensure Crown lands are managed to maximise and

	sustain the flow of economic, social, and environmental benefits to British Columbians now and in the future (www.al.gov.bc.ca).
Cryptosporidium	Protozoan that is resistant to chlorine disinfection (Hrudey et al. 2002). It is a parasite approximately 4-6 micrometers in diameter, most commonly found in mammals. The illness, cryptosporidiosis, consists of watery diarrhea and vomiting.
Cyanobacteria	Also called blue-green algae, cyanobacteria have been part of our environment for billions of years. But with higher nutrient loads to our water bodies and rising temperatures, blue-green algae blooms have become a major problem, threatening aquatic ecosystems, presenting health risks to humans and animals, and challenging the potable water treatment industry for making water safe and palatable (Martine Powlowski [H20 Logics Inc] 2009). Cyanobacteria have been occasionally reported in drinking water sources in the Alberni Valley.
Demand Management	Water management that is based on short-term cost benefits to reduce water needs by conserving the resource, saving money, and reducing the environmental impact. Demand management looks at how to use less water in the supply system and functions in opposition to supply management. It focuses on strategies to limit water use in cost- effective measures; common demand management strategies include low-flow toilets, drip irrigation, water recycling (Brandes and Brooks 2005).
Depth to water table	Represents the thickness of geological material above the water table. Ground water is more vulnerable to contamination where the water table is near the surface; when the barrier zone of soil or rock above the water table is thin. There is little capacity for natural filtration of contaminants before reaching the water table.
Desalinisation	Based on the concept of vaporising salt water, leaving the salts behind as concentrated brine and condensing the produced water vapour for subsequent use. There are three basic methods of desalinisation: distillation, membrane, and reverse osmosis. Water is classified according to its salt content as brackish: dissolved salts of 1,000-3,000 mg/litre; saline: dissolved salts of 3,000-30,000 mg/litre; seawater: dissolved salts of 3,500 mg/litre.
Diffuser	A structure made of perforated pipes placed at the end of an outfall pipe that is designed to spread the effluent widely to facilitate dilution (BC Environment 2009).
Discharge area	An area where groundwater and water in the unsaturated zone is released to the ground surface water or to the atmosphere.
Disinfectant	A chemical, usually an oxidant such as chlorine, chloramine, ozone, hydrogen peroxide, or potassium permanganate; or radiation, such as ultraviolet light or ionising radiation, which destroys pathogens in water. Chlorine is currently the most common disinfectant used with water (BC Environment 2009).
Disinfection	The process of destroying microorganisms in water by the application of a disinfectant; killing most of the harmful and objectionable bacteria in sewage or drinking water usually accomplished by introduction of chlorine or exposure to ultraviolet radiation which sterilises the bacteria (BC Environment 2009).
Disinfection by-products (DBPs)	Chlorinated organic chemicals, including trihalomethanes, are formed when water containing organic materials is disinfected with chlorine. These compounds are toxic; the formation of these compounds can be minimised by filtering or otherwise removing the organic compounds before chlorination (BC Environment 2009).

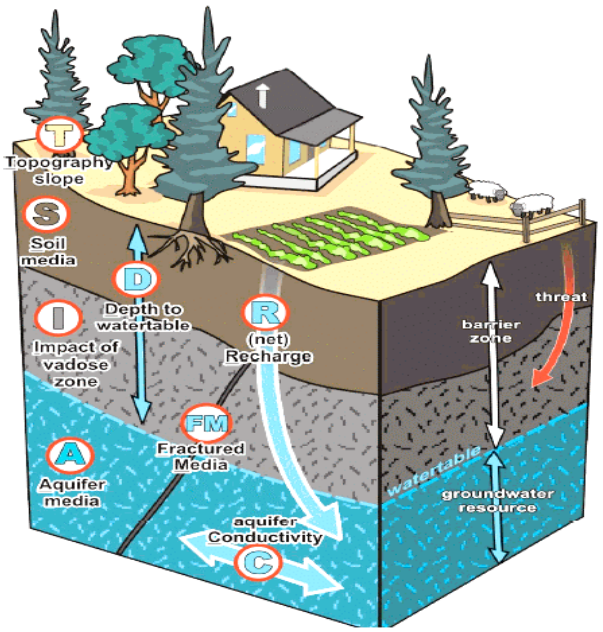
Drainage basin	See Catchment area.
Drawdown	A lowering of the ground water surface caused by pumping from an aquifer or lowering the water surface in a reservoir by releasing water either through the turbine or outlet pipes or over the spillway (BC Environment 2009).
Drilled well	A well constructed with a drilling rig, such as an air rotary or cable tool drilling rig.
Dug Well	A well that is dug by hand or excavated by backhoe. Dug wells are usually shallow.
Drinking Water Protection Act	Prohibition against contaminating drinking water or tampering with system. Some pertinent sections are reprinted below: 23 (1) Subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur, if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system. Request for investigation 29(1) If a person considers that there is a threat to their drinking water, the person may request the drinking water officer to investigate the matter. (2) A request under subsection (1) must be in writing and must include specifics of the facts that the person considers constitute the threat. (3) On receiving a request under subsection (1), the drinking water officer must review the request and consider whether an investigation is warranted. (4) As applicable, (a) if the drinking water officer decides against undertaking an investigation, the officer must advise the requesting person of this, and (b) if the drinking water officer undertakes an investigation, the drinking water officer must advise the requesting person of the results of the investigation. Guidelines and directives respecting drinking water protection 4 (1) The minister may establish (a) guidelines that must be considered, and (b) directives that must be followed by drinking water officers and other officials in exercising powers and performing duties or functions under this Act and the Public Health Act in relation to drinking water. (2) The Provincial health officer must monitor compliance of drinking water officers with guidelines and directives established under this section. Water monitoring requirements 11 (1) In the case of a prescribed water supply system, the water supplier must (a) monitor its drinking water source, the water in its system and the water it provides for the parameters, and at the frequency, established by the regulations and by its operating permit, (b have the sampling required for that monitoring carried out in accordance with the regulations and the directions of the drinking water officer, and (c) have the analyses required for that monitoring carried out in accordance with the regulations, through laboratories that meet the requirements established by the regulations and by individuals who are qualified in accordance with the regulations. (2) The laboratory conducting monitoring analyses under this section must report the results in accordance with the regulations to the drinking water officer and, subject to the regulations, to the water supplier. (3) A water supplier must ensure that a laboratory conducting monitoring analyses

	under this section is aware of the applicable standards and requirements established by the regulations and the operating permit for the water supply system. Water supplier must report threats to drinking water 13 (1) In addition to the requirements under section 12, a water supplier must immediately notify the drinking water officer if the supplier considers there is a threat that is likely to result in the drinking water provide by its water supply system not meeting the requirements of section 6 {water supply systems must provide potable water}. (2) Notice required by subsection (1) must be given in accordance with section 12 (3). (BC Laws 2009, Drinking Water Protection Regulation, includes amendments of December 2008, Contents [March 23, 2010]. www.bclaws.ca).
Ecosystem	A complete system of living organisms interacting with the soil, land, water, and nutrients that makes up their environment. An ecosystem is the home of all living things, including humans. An ecosystem can be any size (a log, pond, field, forest) but it always functions as a whole unit.
Erosion	The movement of soils and material leading to bank failure, mass movements, and scouring of stream banks. Erosion may occur at a slow or an accelerated rate, depending on the cause, whether natural or human-caused. Some causes are the result of water currents, rainfall runoff, or wind. Particular forms of erosion include landslides, debris flows, and slumps. Single particles dislodged by erosion into sediment can clog fish gills and bury fish-spawning gravels.
Estuarine Zone	The lower portion of a river where ocean and river meet; semi-enclosed zone where freshwater mixes with saltwater, such as a bay, salt marsh or lagoon, tidal wetland; usually partially enclosed by land but has free access to the ocean and is at least occasionally diluted by fresh water runoff from the land (BC Environment 2009).
Eutrophication	The process of increasing the nutrient, primarily nitrate and phosphate, content of natural waters, usually resulting in an increase in biomass and productivity of algae, which may result in the depletion of the oxygen concentration in the water leading to a fish kill, from natural erosion and runoff from the land or from anthropogenic sources (BC Environment 2009).
Expropriation	Taking land by an expropriating authority under an enactment without the consent of the owner (BC Laws Expropriation Act [RSBC 1996] Ch 125. www.bclaws.ca).
Evaporation	Water evaporating from the surface of waters, the land, moist soil, and living vegetation into the air as water vapour.
Evapotranspiration	The combination of evaporation from soil and transpiration from plants. A one-hectare stand of Douglas-fir evapotranspires about 235 bathtubs of water vapour.
Fecal Coliform Bacteria	Enteric bacteria typical of warm-blooded animals; fecal coliforms are commonly used as an indicator of contamination; normally measured using filtration and culture on disk media; the coliform bacteria group that is present in the intestinal tracts and feces of warm-blooded animals (BC Environment 2009).
Fertilisation	Lake Fertilisation Component of the federal/provincial Salmonid Enhancement Program. The hypothesis is that the size and condition of the sockeye during the first growing season could be enhanced through fertilisation of the surface waters with inorganic nitrogen and phosphorus and that this would lead to greater returns of sockeye to be harvested in the sea when they returned was tested in Great

	Central Lake by the Pacific Biological Station from 1970 to 1976. The numbers of returning fish increased more than 7 times in those early trials and this success led to the fertilisation of many sockeye rearing lakes along the coast of British Columbia (International Lake Environment Committee 2009, www.ilec.or.jp).
Filtration	A water treatment process that uses a filter medium such as sand, membranes, activated carbon, etc. to remove micro-organisms, organic matter, and silts and clays from water. Filtration reduces turbidity to less than 0.3 NTLU, removes 99.9 percent of Giardia and Cryptosporidium micro-organisms, reduces chlorine demand, and helps to remove unwanted tastes, colour, and odours from the water.
Finished Water	Water that is delivered to consumers after receiving treatment (Davies and Mazumder 2003).
Flocculation	A large-scale treatment process involving gentle stirring whereby small particles in flocs are collected into larger particles so their weight causes them to settle to the bottom of the treatment tank (BC Environment 2009).
Floodplain	A level, low-lying area adjacent to streams that is periodically flooded by stream water. It includes lands at the same elevation as areas with evidence of moving water, such as active or inactive flood channels, recent fluvial soils, and sediment on the ground surface or in tree bark, rafted debris, and tree scarring.
Four-Three-Two-One Policy	The 4-3-2-1 surface water treatment policy is a performance target for water suppliers to ensure provision of microbiologically safe drinking water. Vancouver Island Health Authority (VIHA) supports water suppliers to meet this objective. All water suppliers serving populations greater than 500 people per day should have an implementation plan to meet this policy. Water suppliers will be required to provide long term plans to reach the goals of 4 log inactivation of viruses; 3 log removal or inactivation of *Giardia* cysts and *Cryptosporidium* oocysts; 2 refers to two treatment processes for all surface drinking water systems; 1 for less than 1 NTU of turbidity in finished water (VIHA, Drinking Water Program 2009).
GAR Order	The Government Actions Regulation (GAR) provides the criteria and processes for the creation of localised areas that require special management of certain forest values. These values include soil, wildlife, fish, water quality, visual quality, stream and lake sides and recreation. The regulation also provides for the creation of objectives for managing these areas (BC Forests 2009).
Giardia lamblia	Giardia infection can occur through ingestion of dormant cysts in contaminated water, food, or by the faecal-oral route (through poor hygiene practices). The Giardia cyst can survive for weeks to months in warm water, and can be present in contaminated wells and water systems, in stagnant water sources such as ponds, storm water storage systems, and even clean-looking mountain streams. They may also occur in city reservoirs and persist after water treatment, as the *Giardia* cysts are resistant to conventional water treatment methods such as chlorination and ozonolysis. Giardia infection is a concern for people camping in the wilderness or swimming in contaminated streams or lakes, especially the artificial lakes formed by beaver dams (hence the popular name for Giardiasis, "Beaver Fever"). Symptoms of infection include (in order of frequency) diarrhea, malaise, excessive gas (often flatulence or a foul or sulphuric-tasting belch, which has been known to be so nauseating in taste that it can cause the infected person to vomit), steatorrhoea (pale, foul smelling, greasy stools), epigastric pain, bloating, nausea,

	diminished interest in food, possible (but rare) vomiting which is often violent, and weight loss. Pus, mucus, and blood are not commonly present in the stool. It usually causes "explosive diarrhea" and while unpleasant, is not fatal. In healthy individuals, the condition is usually self-limiting, although the infection can be prolonged in patients who are immuno-compromised or who have decreased gastric acid secretion (Wikipedia 2009).
Grey water	Waste water that is recycled for re-use; usually refers to water that does not enter the sewage or septic tank stream (e.g., laundry or bathwater).
Groundwater and Groundwater Cycle (see Figure 2)	Water within the earth that supplies wells and springs; water in the zone of saturation (phreatic zone) where all openings in rocks and soil are filled, the upper surface of which forms the water table; water that flows in aquifers under the surface of the land and not on the surface; water that flows or seeps downward and saturates soil or rock; the upper surface of the saturated zone is called the water table, water beneath the surface of the ground, consisting largely of surface water that has seeped down; water beneath the earth's surface, occurring in aquifers at one or more depth levels. (BC Environment 2009) There are three types of groundwater: 1. meteoric water that circulates as part of the water cycle; 2. fossil water that is trapped in ancient sediment; and 3. juvenile water that is given off by magma rock. Fossil and juvenile water are not a part of the water cycle but will at some point become released and join the water cycle.
GroundwaterTable	It is the surface of a body of unconfined groundwater at which the pressure is atmospheric and where rock, gravel, and sand are saturated.
Groundwater vulnerability	Generated by concerns about groundwater contamination, vulnerability of ground-water is relative and not directly measurable. It can be assessed through a measure known as DRASTIC, where D means depth to the water table, R means recharge (net), A means aquifer media, S means soil media, T means topography (slope), I means impact of vadose zone media, and C means conductivity of aquifer.
Hard Water	As water moves through soil and rock, it dissolves very small amounts of minerals, with calcium and magnesium being the two most common. Hard water is regarded as healthier to drink than soft water (see www.hardwater.org).
Herbicide	A herbicide is a substance used to kill unwanted plants. Some examples include the following (Wikipedia 2009): Glyphosate (Round Up) is a broad-spectrum systemic used to kill weeds, especially perennials. It may be sprayed and absorbed through the leaves, injected into the trunk, applied to the stump of a tree, or broadcast or used in the cut-stump treatment as a forestry herbicide. Hexazinone is a non-selective broad spectrum herbicide used to control grasses and broadleaf and woody plants. Hexazinone is a known groundwater contaminant. A phenoxy herbicide is a member of a family of chemicals related to the growth hormone indoleacetic acid (IAA). When sprayed on broadleaf plants they induce rapid, uncontrolled growth, eventually killing them. The best known phenoxy herbicide is 2,4-D, one of the most used (and potentially toxic) herbicides.

Figure 2. Groundwater Cycle

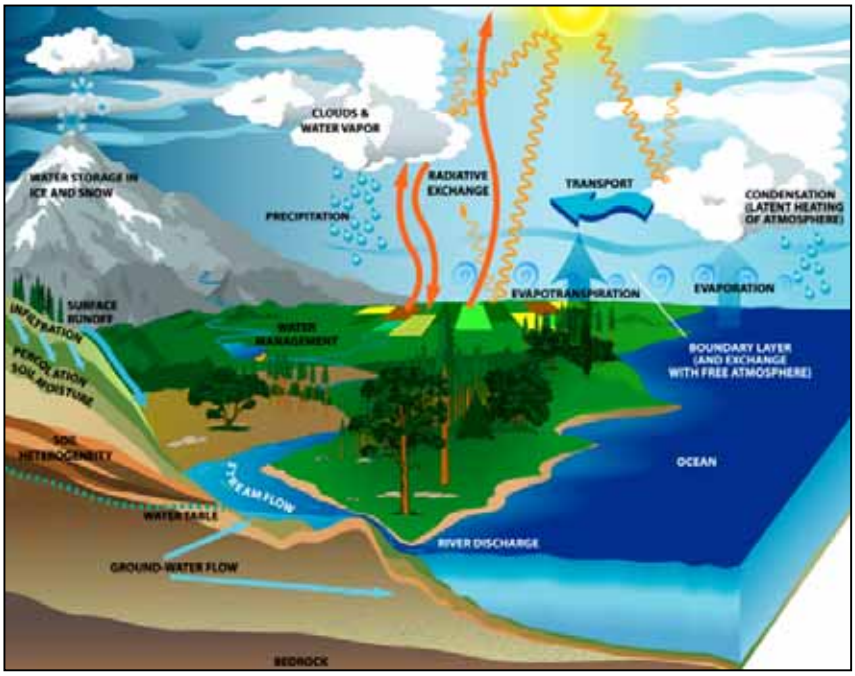


Used with permission from *Comox Valley Drinking Water Reference Guide*.

Humidity	The amount of water vapour present in the air.
Hydrologic Cycle (see Figure 3)	The natural pathway water follows as it changes between liquid, solid, and gaseous states. The biogeochemical cycle that moves and recycles water in various forms through the environment, including: evaporation from the surface to the air, rain and snowfall to the surface, replenishment of ground water, runoff, uptake by plants, and storage in oceans and ice caps. Generally, the movement of water from the atmosphere to the earth and its return to the atmosphere through condensation, precipitation, evaporation and transpiration. The cycle of water from the earth's surface into the atmosphere, from the atmosphere back to earth, and through runoff into streams, rivers, lakes and the oceans (BC Environment 2009).
Hydrology	The science that deals with the hydrologic cycle or water cycle in the environment-land, soil and atmosphere; properties, distribution and circulation of water (BC Environment 2009).
Hydraulic Gradient	The slope of the ground water level or water table.
Infiltration Gallery	A technique that draws water from an adjacent surface water source and filters it. Pipes are placed parallel to the surface water below the water table in a sub-surface collection system that collects the water through perforated pipes into a chamber where water is then pumped to the distribution system.
Hydraulic Head	The level to which water rises in a well with reference to a datum such as sea level.
Hydro-fracturing	Hydro-fracturing originated in the oil drilling business; its popularity in the water well drilling industry has grown over the past few years. When a drilled well is hydro-fractured, high pressure water is injected through a pipe to expand, clear, or fracture the fissures with the expectation that well production will increase. Hydro-fracturing is not legislated. There are no requirements for the distances from the

	ocean or neighbouring wells if one wants to hydro-fracture a well to increase groundwater access. This practice can redirect or increase flows, which may affect neighbouring wells by reduced production or a higher salinity count.
Hydrogeology	Study of groundwater in its geological context.
Hydrologist	Practitioner who studies the movement, distribution, and quality of water throughout the Earth, and thus addresses both the hydrologic cycle and water resources.
Impermeable	Impervious to flow of fluids.
Invasive Species and Invasive Plant Species Control	Invasive species are alien species that have moved into ecosystems and altered their characteristics, can cause structural changes in the system and can change plant community composition, ultimately affecting the wildlife that can occur there (Klinkenberg 2004, www.geog.ubc.ca). Integrated Pest Management (IPM) involves preventing invasive plant encroachment by hand-pulling, seeding, clipping, herbicide spraying, and biological control (BC Forests 2009).

Figure 3. Hydrological Cycle

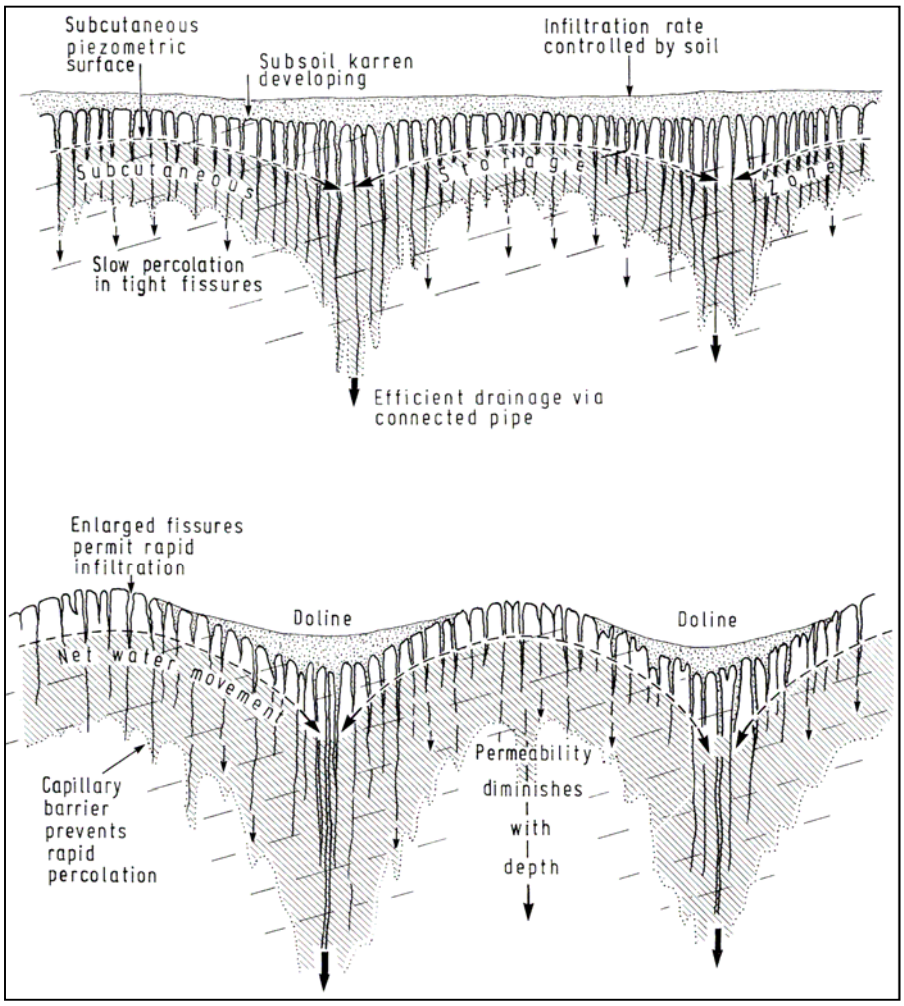


Reprinted from Red Deer River Watershed Alliance Website, accessed July 16, 2009.

Irrigation	Water that is directed in order to supply water for vegetation.
Karst	A type of topography formed over limestone, dolomite, or gypsum by dissolution and that is characterised by sinkholes, caves, and underground drainage (Bates and Jackson 1984).
Karst (epikarst aquifer)	The infiltration capacity at the surface [water movement from the surface] is much greater than the rate of downwards percolation [water moving downwards underground] through the underlying transmission zone [channels]. The water cannot escape as freely as it got in and excess recharge is stored in the void space of the epikarst (Williams 2008).

Karst (Epikarst)	"Skin of the karst" layer. It may be absent because it was scoured off by glaciations, or it may never have developed. Typically 3–10 m deep, but its characteristics can vary considerably. Also known as the subcutaneous zone, it comprises highly weather carbonate bedrock immediately beneath the surface or beneath the soil when present or exposed at the surface. Porosity and permeability are higher near the surface than at depth; consequently, after recharge, percolating rainwater is detained near the base of the epikarst, the detention pooling producing an epikarstic aquifer. Water storage in the epikarst can be permanent enough to sustain aquatic biota. The aquifer is also appreciated as a significant source of water, many epikarst springs being tapped for local water-supply (Williams 2008).
Karst (Ground water) Quality	Available information suggests that in general the quality of karst water is fairly good. An important objective is the maintenance of this quality (Almeida 1995).
Karst Hydrology (see Figure 4a)	The spectrum of discharges from slow, low volume seepages to variable, sometimes large, flows down open shafts that respond rapidly to recharge. The considerable importance of an epikarst aquifer to karst hydrogeology is well recognised. Detaining recharge will moderate floods and attenuates discharge (Williams 2008).
Karst Landscape (see Figure 4b)	Karst landscape is characterised by rocky and weathered limestone outcrops in which subterranean drainage is common. Drainage occurs through sinkholes, fissures, and caves, as well as many smaller fractures and surface depressions that are typical of karst landscapes. Over time, dissolution of soluble host rock expands the size of cave passages and other conduits that help transport and store water in the subsurface. When enough water is stored … we call the formation an aquifer. Karst aquifers are often extremely complex and movement of water in the subsurface can be rapid and unpredictable, making it extremely challenging to understand. Figure 4a is a simplified diagram of karst showing the basic principle of how karst functions with water entering into openings on the surface, subterranean flow, and discharge from springs (http://arbucklekarst.org/ accessed 15 Feb 2011).
Karst Protection	There are many human activities that, intentionally or not, produce severe impacts in karst, often with irreparable damage. For example, in some regions, land degradation has been intense with deforestation and overgrazing leading to soil erosion, destruction of epikarst, and rocky desertification. Legislation and its practical enforcement still appear to be extremely inadequate at facing these problems, even in well-developed countries. Lack of laws specifically devoted to karst is very common, but even when legislation takes into account the complexity and peculiarity of karst, the potential benefits deriving from these laws frequently remain on paper owing to a lack of enforcement and control by the authorities (M. Parise, J. Gunn 2007, http://lyellcollection.org/cgi/content/full/279/1/1, 2009).
Karst Water and its Health Effects	Much environmental pollution is metal-based. Metals are released by erosion and by a number of human activities, such as logging and mining; the use of pesticides; and the breakdown of such items as plastics and pharmaceuticals. Along with over 200,000 man-made compounds, they have a negative impact on an organism's growth, metabolism, or reproduction. Metals undergo an increase in concentration (bioaccumulation) in the tissues of an organism compared to their concentration in water. Metals are more toxic at lower pH because H^+ ions increase bioavailability. Lower pH releases metals from sediments. Higher pH binds metals in sediments. Karst increases pH, providing buffering to metal toxicity (Solomon 2009).

Figure 4a. Karst Hydrology.



Water stored in the subcutaneous zone constitutes an epikarstic aquifer that is perched above a leaky capillary barrier. Dolines [sinkholes] gain topographic expression because of the focusing of flow and dissolution down major leakage paths. Image reprinted from Williams 2008.

Karst Storativity (storage ability/ capacity)	It is determined by three factors: 1. the thickness and continuity of the epikarst. 2. its average porosity (these first two together determine the available storage space). 3. the relative rate of inflow and outflow of water (Williams 2008).
Karst Vulnerability	Die tracing studies indicate that under conditions of slow recharge, seepage inlets had the highest concentrations, but following increased recharge after rain, a sharp high concentration response was obtained again from shaft flow, indicating flushing from storage. At any particular time, concentrations varied significantly between adjacent inlets, indicating that they were not fed from a homogeneous store but from one that was imperfectly mixed. This makes this type of system vulnerable to chemical spraying or waste water discharges because it could be stored and flushed at a much later date, sometimes decades later (Williams 2008). The presence of a detrital cover or overburden formation is the most important natural protection for karst aquifers. The overburden can be effective protection

	against some groups of pollutants (pesticides and other organic contaminants, micro-organisms, heavy metals, ammonia, etc. If the pollutant gains direct access to an underground stream, for example through a swallow-hole or parts of the karst surface permitting an easy connection with groundwater, the pollution can travel very rapidly, and the attenuation and dispersion are minimal. For that reason, the practice common in some regions of disposing of wastes in sinkholes and other karst structures can be very dangerous and must be avoided. Modifications in the conditions of natural recharge, like deforestation and reduction in permeability, and artificial recharge can also produce water quality changes (Almeida et al. 1995, Ch 2).

Figure 4b. Karst Landscape

Simplified diagram of karst showing how karst functions with water entering into openings on the surface, subterranean flow, and discharge from springs (image accessed 15 Feb 2011 at www.arbucklekarst.org).

Karst and Water Flow	The rising volume of water within the epikarst aquifer during storm or snowmelt events increases hydraulic head and so produces a pressure pulse that stimulates a transfer of water (Bakalowicz 1995 in Williams 2008). These effects lead to different pulse-through and flow-through times following a recharge event. The pressure pulse effect can cause percolation drips within an hour or so, whereas the associated flow-through time can be weeks to months (Williams 2008).
Leachate	Water that leaks from a mine, an industrial site, or a disposal site such as a landfill, mine or dump and that likely contains contaminants (BC Environment 2009). The Alberni-Clayoquot Regional District is draining the aquifer around the landfill site to try to contain the leachates from the landfill. The leachate is pumped to the city sewage plant in the Alberni Inlet. According to staff, as of 2009, the aquifer has been pumped continuously for the past 2 years.

Limnologist	Practitioners who study inland fresh waters.
Limnology	The scientific study of physical, chemical and biological conditions and interactions in lentic systems: lakes, ponds and reservoirs (BC Environment 2009).
Lithology	All the physical properties, the visible characteristics of mineral composition, structure, grain size, etc. that give individuality to a rock.
Membrane Filtration	A technique that permits removal of particles from a drinking water source on the basis of their molecular size and shape with the use of pressure and specially designed semi-permeable membranes.
Multi-barrier Approach	An integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to tap.
NAFTA (North America Free Trade Agreement)	It is a commonly held belief that the greatest risks to Canada's water resources under NAFTA are related to exports. In fact, the more immediate area of public policy concern is not water exports but water use in Canada by firms that are American or have US investors. Private sector firms issued water licenses by government, be it for hydroelectric generation or for snowmaking, hold NAFTA rights far superior to any rights held by Canadians if those firms are American or have American investors. Investor rights – which trump conflicting provincial legislation - include the right to national treatment and compensation for losses to investment, profits, markets and goodwill if those rights are expropriated by the Government of Canada or any province. There is no difference between water used for bitumen extraction, water used for hydroelectric production, or water used to make snow for a ski hill. When the entity holding rights to Canada's water is American or has American investors, all such takings are covered by NAFTA. NAFTA investment defences would trump (and, experts fear, eventually influence the direction of) provincial and federal environmental laws. Even when water licenses are reduced or cancelled on a non-discriminatory basis, for a public purpose, and pursuant to provincial legislation, they give rise to NAFTA claims for compensation under Chapter 11. The result is an erosion of Canadian policy sovereignty and a denigration of the rights of Canadian communities vis a vis foreign investors. This risk is unacceptably high when the commodity in question is water (Holme 2008, article Sept 26, 2008).
Nephelometric Turbidity Unit (NTU)	The unit of measure for the turbidity of water, a measure of the cloudiness of water as measured by a nephelometer, based on the amount of light that is reflected off particles in the water (BC Environment 2009).
Nitrate	An essential plant nutrient found in fertilisers produced during the breakdown of organic waste. Excessive fertiliser application, improper agricultural waste management or underground septic tanks may increase nitrate levels in ground-water. Nitrates reduce the ability of blood to carry oxygen. Infants under six months are particularly at risk from drinking well-water containing excessive nitrates.
Non-filterable Residue	Solids that are not in solution and can be removed by filtration, they usually contribute to turbidity; small particles of solid pollutants that resist separation by conventional methods; greater than 0.45 microns in size; also known as suspended solids, suspended matter or suspended sediment (BC Environment 2009).

Non-point Source Pollution	Water pollution caused by activities over a broad area. Agriculture, forestry and urban development are examples of activities that contribute to NPS pollution. Non-point source pollution in aquatic ecosystems can be grouped into five main categories: 1. Pathogens: These microorganisms - bacteria, viruses, and protozoa - can cause waterborne illnesses. While most pathogens come from human sewage (primarily leaking or aging sewage collection systems, onsite sewage systems, stormwater runoff, and combined sewer overflows), manure from livestock and wild animal droppings are also common sources. 2. Oxygen-depleting substances: When organic wastes (manure, sewage, pulp and paper mill effluent) decay in water, bacteria oxidise the waste, using up oxygen in the water. If the oxygen is consumed beyond a safe threshold, fish are stressed and will die when lethal levels are reached. Anaerobic decomposition (without oxygen) produces gases, such as hydrogen sulphide, that are lethal to many organisms. 3. Nutrients: Organic wastes and fertilisers introduce plant-feeding nutrients, such as nitrogen and phosphorus, into runoff. When onsite sewage effluent or runoff enters a water body, nutrients can cause algal blooms and dense weed growth that disrupt the balance of aquatic ecosystems and interfere with recreation such as swimming and boating. When an algal bloom occurs, oxygen in the water is depleted, which can cause odour problems as well as kill fish and other organisms. 4. Sediments: Suspended soil particles make water turbid and unpleasant to drink, and increase water treatment requirements. Sediments also reduce light available to algae and aquatic plants, kill or injure fish by damaging their gills, cover spawning gravel and smother fish eggs, and reduce the quality of recreational activities such as swimming and boating. 5. Toxins: Substances such as ammonia, nitrate, metals, pesticides, and a variety of organic toxins can poison humans, livestock, wildlife, and aquatic organisms. Some toxins cause cancer. In addition, chloramines—a comparatively persistent drinking water treatment chemical—can be very harmful to aquatic life when discharged in fisheries-sensitive areas.
Nutrient	A substance, element, or compound necessary for the growth, development, and reproduction of plants and animals. As a pollutant, any element or compound, such as phosphorous or nitrogen, that encourages abnormally high organic growth in ecosystems (BC Environment 2009).
Observation Well	A well constructed for the objective of undertaking observations such as water levels, pressure readings, and groundwater quality.
Oligotrophic	Having a low supply of nutrients and thus a low productivity or biomass (BC Environment 2009).
Outfall	The end of the pipe leading from a sewage treatment plant that delivers wastewater to the environment, often via a diffuser; the discharge point for a wastewater flow, for example from a sewage treatment plant or refinery; the place where a wastewater treatment plant discharges treated water into the environment; the place where a sewer, drain, or stream discharges, the outlet or structure through which reclaimed water or treated effluent is finally discharged to a receiving water-body (BC Environment 2009).
Particulate	Consisting of many small individual particles, not dissolved (BC Environment 2009).

Polychlorinated Biphenyls (PCBs)	Man-made liquid chemicals that are stable, non-corroding, fire resistant, toxic and relatively non-biodegradable. Once used in electrical transformers because of these properties. Composed of two joined phenol molecules that have chlorine atoms replacing many of the hydrogen atoms. Frequently found in industrial wastes, and subsequently in surface water and ground waters. PCBs accumulate in the environment, particularly in the sediment where they can remain indefinitely. Virtually banned in 1979 but continuing to appear in the flesh of fish and other animals (BC Environment 2009).
Perched Water Table	A separate continuous body of groundwater lying (perched) above the main water table. Clay beds located within a sedimentary sequence, if of limited aerial extent, may have a shallow perched groundwater body overlying them.
Percolation	The movement of water through the subsurface soil layers, usually continuing downward to the ground water or water table (BC Environment 2009).
Permeability	The property of a porous rock, sediment or soil for transmitting a fluid, it is a test of relative ease of fluid flow in a porous medium.
Photic Zone	The upper portion of the water column that admits sufficient light for photosynthesis. The photic zone is reduced with increased turbidity (BC Environment 2009).
Point Source Pollution	Water pollution from a single identifiable source, such as a pipe through which an industrial or municipal treatment plant releases wastewater and pollutants into a waterbody. Point sources are often controlled through effluent standards, water quality guidelines, permitting programs, and liquid waste management plans.
Potable Water	Water provided by a domestic water system that meets the standards prescribed by regulation and is safe to drink and fit for domestic purposes without further treatment.
P3s (Private Public Partnerships)	There is one important distinction: the P3 fee is always higher for the simple reason that governments can borrow money at a lower rate than private companies. On a big project, that can mean tens of millions of dollars in extra costs. As for keeping debt off the books, even the free-market International Monetary Fund has severely criticised governments for this accounting trick, demanding that they begin treating yearly P3 payments as debt and not operating costs (Dobbin 2005, article Dec 29, 2005, accessed March 24, 2010 at www.ibew258.bc.ca).
Precautionary Principle	Where there is the possibility that a practice may cause serious or irreversible damage to the environment, that practice should be modified or curtailed (BC Environment 1999). This principle recognises the dynamic nature of ecosystems and humanity's current limited understanding about the interrelationships between parts of the system and how they function.
Prescribed Water Supply System	A water supply system that is prescribed by regulation.
Primary Treatment	To physically remove settled solids and most discrete suspended and floating solids from a wastewater stream by neutralisation, filtration, and sedimentation. The wastewater influent is divided into three output pathways: primary effluent, primary sludge, and aerosols.

Private Managed Forest Land Act 2003	This Act applies to private managed forest land other than land that is in a tree farm licence, a woodlot licence, or a community forest. Pertinent sections are listed below: Soil conservation 12 The forest management objective for private managed forest land with respect to conservation of soil for areas where harvesting has been carried out is to protect soil productivity on those areas by minimising the amount of area occupied by permanent roads, landings, and excavated or bladed trails. Water quality 13 (1) The forest management objective for private managed forest land with respect to water quality is to protect human drinking water, both during and after harvesting. (2) Nothing in subsection (1) requires an owner to retain additional streamside trees or additional understorey vegetation to address problems with water quality that originate outside of the owner's private managed forest land. Restriction on local government authority re uses of private managed forest land: 21 (1) A local government must not (a) adopt a bylaw under any enactment, or (b) issue a permit under Part 21 or 26 of the Local Government Act in respect of land that is private managed forest land that would have the effect of restricting, directly or indirectly, a forest management activity. (2) For certainty, this section applies if the bylaw or permit would have the effect described in subsection (1) even though the bylaw or permit does not directly apply to land referred to in that subsection (BC Laws, Private Managed Forest Land Act [SBC 2003] Ch 80 [March 24, 2010]).
Private Managed Forest Land Council	The object of the council is to encourage forest management practices on private managed forest land, taking into account the social, environmental, and economic benefits of those practices (PMFLC 2009 www.pmflc.ca).
Plume	A portion of a waterbody distinguishable because it is not completely mixed and its characteristics are measurably different; generally downstream from the junction of another stream of water from a tributary or waste discharge; the area taken up by contaminants in an aquifer (BC Environment 2009).
Porosity	A measure of the water-bearing capacity of subsurface rock. It is not just the magnitude of porosity that is important, but the size of the voids and the extent to which they are interconnected, as the pores in a formation may be open and interconnected, or closed and isolated. Clay may have a very high porosity for potential water content, but it constitutes a poor flow medium as an aquifer because the pores are usually so small (BC Environment 2009).
Primary Sewage Treatment	The first stage of the wastewater treatment process consisting of mechanical removal of large settle-able solids through filtering, screening, and/or settling, primary sewage treatment is a mechanical treatment in which relatively large solids are removed from the sewage by settling out as sludge; mechanical methods, such as filters and scrapers, are used to remove pollutants; solid material in sewage also settles out in this process (BC Environment 2009).
Profundal Zone	The deep-water region of a lake not penetrated by sunlight (BC Environment 2009).
Raw Water	Water that is untreated or unfiltered (Davies and Mazumder 2003).
Real Time	The near real-time information presented on this website is received via satellite or

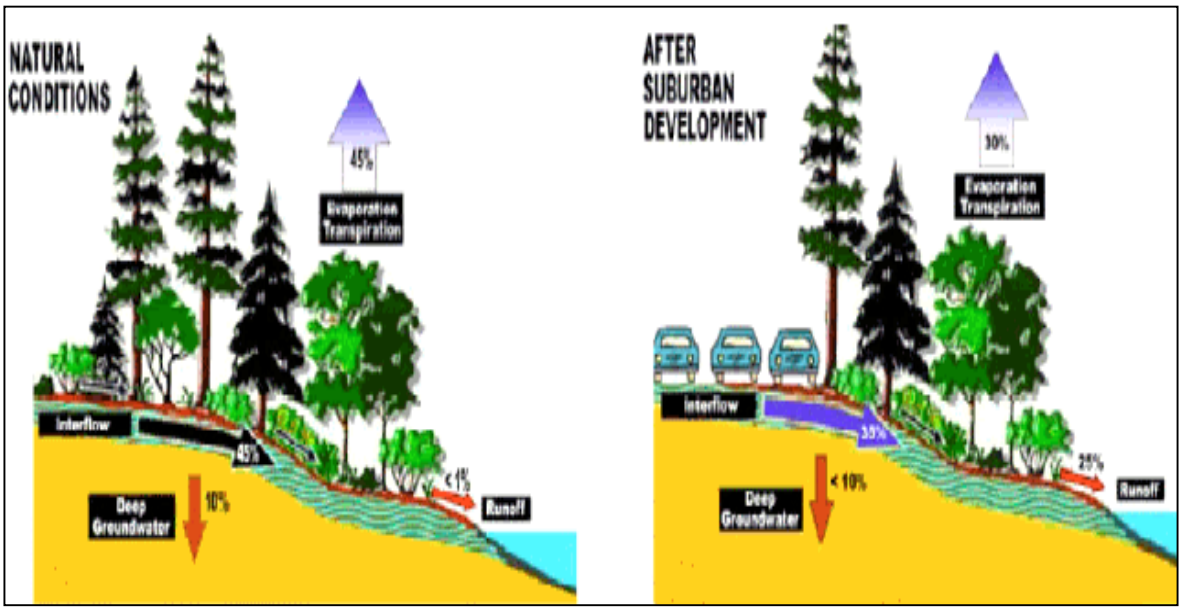
Hydrometric Data	land-line transmissions from hydrometric gauging stations owned by Environment Canada and its partners. These data are normally posted (in graphical form) within four hours of observation (Environment Canada 2009, scitech.pyr.ec.gc.ca/waterweb/formnav.asp).
Recharge Area	This reflects the amount of water that percolates from the surface to the water table. The greater the flow of water, the more likely that contaminants will pollute the groundwater below the water table from the water flow.
Recharge	Water entering an underground aquifer through faults, fractures or direct absorption; replenishing an aquifer (BC Environment 2009).
Recycled Water	See grey water.
Regulation	A law that is passed by the provincial or federal cabinet, the executive branch of government. Cabinet may only pass regulations where the legislature or parliament has delegated the power to do so through an enactment.
Residence Time	The period of time water is retained in a reservoir, bay or other system, based upon flow rates into and out of the system (BC Environment 2009).
Residual Chlorine	The unreacted chlorine which remains in solution after the reactions with all the organic compounds present have occurred (BC Environment 2009).
Reservoir	A natural or artificial basin for collecting and holding a supply of water; tanks, dammed areas, lakes or underground aquifers, where water is collected and used for water storage, regulation and control. Large bodies of ground water are called ground water reservoirs, water behind a dam is called a surface reservoir. The creation of a reservoir entails the flooding of land and the submergence of vegetation, which increases the introduction of mercury into the food chain, and carbon dioxide and methane into the atmosphere.
Reverse Osmosis	A water treatment method whereby water is forced through a semi-permeable membrane which filters out impurities, similar in function to a kidney dialysis machine and used in most space programs and navy vessels to turn waste water into potable water, removing salts from water using a membrane. The product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed. An external force is used to reverse the normal osmotic process, resulting in the solvent moving from a solution of higher concentration to one of lower concentration (BC Environment 2009).
Riparian	Area adjacent to a stream that may be subject to temporary, frequent, or seasonal inundation. It supports plant species that are typical of an area inundated or saturated. Soil conditions are distinct for plant species on freely drained adjacent upland sites due to the presence of water.
River Forecast Centre	River Forecast Centre (RFC) collects and interprets snow, meteorological, and streamflow data to provide warnings and forecasts of stream and lake runoff conditions in BC. Most of the meteorological and streamflow data are collected by other agencies, but the RFC is the lead agency for the collection, quality control, analysis, and archiving of snow data (BC Environment, River Forecast Centre 2010).
Runoff	The amount of water that leaves a watershed. The formula used to measure this is Runoff = [Precipitation - Evapotranspiration].

Run-of-River Power Project	Run-of-river power projects in BC will result in the privatisation of many of our rivers and streams without considering environmental consequences and cause our electricity rates to dramatically rise (www.oceansidecoalition.org 2009). "If anyone thinks that privatising BC's rivers is just about 'green power', they are deluding themselves. The ultimate goal: Control the water" (Rex Weyler, Save Our Rivers Board of Advisors; www.saveourrivers.ca 2009).
Salt Water Intrusion	Movement of salty or brackish groundwater into wells and aquifers previously occupied by fresh groundwater, either through upwelling or sea water encroachment.
Sandstone	A sedimentary rock composed of mostly sand-sized particles.
Saturated Zone	The subsurface zone in which all voids are filled with water under pressure greater than atmospheric.
Sea Water Encroachment	The lateral land-water movement of sea water into wells and freshwater aquifers.
Secondary Waste-water Treatment	Includes primary sewage treatment and provides in addition conditions conducive to the biological oxidation of the remaining organic wastes. The second step in most waste treatment systems, in which bacteria break down the organic parts of sewage wastes, usually accomplished by bringing the sewage and bacteria together in trickling filters or in the activated sludge process. Removes floating and settle-able solids and about 90 percent of the suspended solids. Disinfection is the final stage of secondary treatment (BC Environment 2009).
Sedimentation	The process of subsidence and deposition by gravity of suspended matter carried in water, usually the result of the reduction of water velocity below the point at which it can transport the material in suspended form.
Sewage Treatment [Tertiary]	A third step in sewage treatment usually directed towards greatly increasing the removal efficiency of nutrients; removal from wastewater of traces of organic chemicals and dissolved solids that remain after primary sewage treatment and secondary sewage treatment; selected biological, physical, and chemical separation processes to remove organic and inorganic substances that resist conventional treatment practices. Consists of flocculation basins, clarifiers, filters, and chlorine basins, or ozone and ultraviolet radiation processes. The additional treatment of effluent beyond that of primary and secondary sewage treatment methods to obtain a very high quality of effluent (BC Environment 2009).
Sewer	An artificial conduit or system of conduits used to remove human sewage and to provide drainage. Sewers are generally gravity powered.
Shale	A fine-grained sedimentary rock formed by the consolidation of clay, silt, or mud and characterised by finely laminating structure sufficiently hardened so that it will not fall apart on wetting.
Snow Pillow Monitoring	Remotely sensed snow and meteorologic data from Automatic Snow Pillows (ASPs), transmitted via satellite, are collected at over 50 sites around the province. Data are transmitted several times daily with this near real- time data updated on a daily basis. Stations are actively monitored from the beginning of October until all the snow has melted, usually in July. Manually sampled snow survey data are collected from almost 200 sites around the province. Measurements are made at the beginning of the month from January through April and twice monthly in May and June, although not

	all stations are measured at every sampling period (BC Environment 2009). The Mt Cokely station was cancelled in January 2010.
Soft Path	A planning approach for fresh water that views water as a means to accomplish certain tasks, rather than viewing water as the end product. 'Why use water in this application at all' is the driving philosophy. The soft path works within ecological limits and promotes public participation. It is called the soft path partly because it requires less steel and concrete, i.e., less infrastructure, better on the environment, and also because it relies on solving society's water problems by working with nature rather than trying to overcome it (Brandes and Brooks 2005).
Soil Erosion	The wearing away of the earth's surface by water, gravity, wind, or ice.
Soil Media	The effectiveness of the soil to act as a barrier to surface contaminants depends on its physical properties. For example, thin, permeable soils are ineffective barriers.
Solar Aquatics	Sun-based method of purifying waste without hazardous chemicals. This water treatment process mimics the natural cycle at an increased rate.
Source-to-tap	The entire water supply system, from the source water in a watershed through the treatment and distribution systems to where water reaches the consumer.
Source Water	The body of water from which a drinking water supply originates. Source water can be surface water or groundwater.
Specific Capacity	The rate of discharge from a well per unit drawn.
Specific Conductance	A quantitative measure of the ability of a water to conduct an electrical current, related to the type and concentration of ions in solution, it can be used for approximating the total dissolved solids concentration in water. One can monitor electrical conductivity quickly in the field and estimate total dissolved solids (TDS) without doing any lab tests by using hand-held testers, expressed in units of electrical conductance (Siemens per centimetre at 25 degrees C). Used in groundwater monitoring as an indicator of the presence of ions of chemical substances that may have been released by a leaking landfill or other waste storage or disposal facility (BC Environment 2009).
Spring	Natural appearance of groundwater that comes to the surface. We have many examples of this throughout the Alberni Valley Watershed.
Static Water Level	The level of water in a well that is not being influenced by groundwater withdrawals. The distance to water in a well is measured with respect to some datum, usually the top of the well casing or ground level.
Stratigraphy	The study of rock strata (layers), especially the distribution, deposition, and age of sedimentary rocks.
Stewardship	Stewardship refers to the concept of responsibly managing natural resources for the benefit of present and future generations and encouraging the active participation of persons or groups, including citizens, communities, governments, and industry.
Storm Drain	A drainage system designed for stormwater, which is surface runoff from streets and other impervious surfaces associated with urbanisation or other anthropogenic activities and distinct from the sewage system; a sewer that carries only surface runoff, street wash, and snow melt from the land. Storm drains are separate from those that carry domestic and commercial wastewater (BC Environment 2009).

Storm Sewers	Large pipes that transport storm water runoff from streets avoid street flooding.
Stormwater and Stormwater Run-off (see Figure 5)	Water that originates during precipitation events. It may also be used to apply to water that originates with snowmelt or runoff water from over-watering that enters the storm water system. Storm water that does not soak into the ground becomes surface runoff, which either flows into surface waterways or is channelled into storm sewers. Storm water is of concern for two main issues, one related to the volume and timing of runoff (flood control and water supplies), and the other related to potential contaminants that the water is carrying (pollution). Because impervious surfaces (parking lots, roads, buildings) do not allow rain to infiltrate into the ground, more runoff is generated than in the undeveloped condition. This additional runoff can erode watercourses (streams and rivers) as well as cause flooding. When the water is flushed out of the watershed during the storm event, little infiltrates the soil, replenishes groundwater, or supplies stream base flow in dry weather.
Stream Classification as per Private Managed Forest Land Council Policy	The Council's (PMFLC) policy for stream classification upstream of the point where water is diverted by a licensed waterworks intake (LWI); applies to streams and portions of streams located upstream of a LWI for a distance of 1,000 m (a map radius). If a stream is located beyond 1,000 m but a section upstream of that point is within 1,000 m, the guideline does not apply (PMFLC Policy FP-02; www.pmflc.ca).
Subsidence	In unconsolidated aquifers, groundwater is produced from pores between particles of gravel, sand, and silt. If the aquifer is confined by low-permeability layers, the reduced water pressure in the sand and gravel causes slow drainage of water from adjoining confining layers. If these confining layers are composed of compressible silt or clay, the loss of water to the aquifer reduces the water pressure in the layer, causing it to compress from the weight of overlying geologic materials. In severe cases, compression can be observed on the ground surface as subsidence. Unfortunately, much of the subsidence from groundwater extraction is permanent (elastic rebound is small). Thus the subsidence is not only permanent, but the compressed aquifer has a permanently reduced capacity to hold water (Wikipedia 2009).
Supply Management	A water management philosophy that strives to meet the water demands of the consumers - in contrast to demand management. Policies are based on the presumed need for new infrastructure and how to best meet projected water needs given current trends in water use and population growth (Brandes and Brooks 2005).
Suspended Matter	Solids that are not in true solution and that can be removed by filtration, they usually contribute directly to turbidity. Small particles of solid pollutants that resist separation by conventional methods; operationally greater than 0.45 microns in size; also known as non-filterable residue, suspended solids or suspended sediment (BC Environment 2009).
Sustainable Development	"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" is the most widely used definition (from the Brundtland Commission). This is a complex term that could refer to the goal of establishing a balance between environmental, social, and economic interactions. The concept of sustainable water development is now widely considered essential in most countries in the world, albeit sustainable water management is inherently impossible to achieve.

Figure 5. Stormwater Run-off. Effects of Urbanisation on Stormwater (Ministry of Environment 2006).



Used with permission from Comox Valley Drinking Water Reference Guide.

Sustained Yield	Rate at which groundwater can be withdrawn from an aquifer without long-term depletion of the supply.
Swale	A low tract of land that is moist or marshy. The term can refer to a natural landscape feature or a human-created one. When created by humans, this open drain system is designed to manage water runoff (Bates and Jackson 1984).
Swallet	Usually related to karst, may be a sinkhole; could refer to a streamsink (often associated with a cave entrance); is one of the major entry points for recharge waters that drain underground in carbonate rock areas, such as limestone. Swallets may empty directly into open or choked cave features such as shafts, or simply be a zone of gradual downward percolation from the base of a streambed (Bates and Jackson 1984).
Total Dissolved Solids (TDS)	A quantitative measure of the total dissolved organic and inorganic solids concentration in water; an indicator test used for water analysis; a measure of the mineral content of bottled water and ground water. One can monitor electrical conductivity quickly in the field and estimate TDS without doing any lab tests using hand-held testers, since there is a relationship between TDS and conductivity. The sum of all dissolved materials, such as salts, that are non-filterable and remain following evaporation of the water (BC Environment 2009).
Thermal pollution	An increase in air or water temperature that harms the ecology of an area; reduction in water quality caused by increasing temperature, often due to disposal of waste heat from industrial or power generation processes (BC Environment 2009).
Transmissivity	Groundwater flow (Piscopo 2001). Values are expressed in square metres per day (m2/day) or as square meters per second (m2/s).
Transpiration	When plants absorb water from soil and exhale it into the air as water vapour.

Trihalomethanes	Chlorinated organic chemicals formed when water containing organic materials is disinfected with chlorine. These compounds are toxic (Wikipedia 2009).
Topography Slope	The slope of land; changes in slope can influence the proportion of rainfall that stays on the surface as runoff vs how much filters into the soil. Flatter ground at the base of steep slopes can be important areas of water infiltration.
Turbidity	Commonly known as cloudy water; a measure of the interference of the passage of light through water. Turbidity in water can interfere with disinfection by creating a potential shield for disease-causing organisms, maintenance of an effective chlorine residual, and bacterial testing of water. Turbidity is measured in units called nephelometric turbidity units (NTUs).
Ultraviolet (UV) Disinfection	A physical process rather than a chemical one that decreases the use of chemicals in water treatment. A superior way to protect against pathogens.
Unconfined Aquifer	An aquifer in which the water table is free to fluctuate under atmospheric pressure.
Vadose Zone	The zone of partly saturated soil and rock above the water table. It determines how quickly water and contaminants can infiltrate the water table.
Wastewater Collection System	The portion of a wastewater system, including pumping stations, in which wastewater is conveyed from the property line, in the instance of a residential or commercial connection, or the perimeter of a unit process, in the case of an industrial connection to the wastewater treatment plant or the receiving water.
Wastewater Treatment Plant	The portion of a wastewater system that improves or alters the physical, chemical, and microbiological quality of the wastewater, other than through the process of screening and/or disinfection, prior to discharge to the receiving environment.
Water Balance	A record of the outflow from, inflow to, and storage in a hydrologic unit like an aquifer or drainage basin.
Water Cycle	The natural pathway water follows as it changes between liquid, solid and gaseous states; the biogeochemical cycle that moves and recycles water in various forms through the ecosphere; the circuit of water movement from the oceans to the atmosphere and to the Earth and back to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration (BC Environment 2009).
Water Distribution System	The portion of a potable and/or process water system in which water is conveyed from the water treatment plant or point of supply to the point of consumption.
Water Management	Water supply, water treatment, water distribution, wastewater collection, and processing, flood control, navigation, hydropower production, and aquatic recreation, all of which interact with one another and through government policies.
Water Quality	Comprised of selected physical, chemical, biological, and microbiological indicators that classify water according to their quality.
Water Rights	Rights to a claim on water that include formal rights embodied in permits and legislation, less formal rights based on customary patterns, and rights that are implicit in social norms and local practices. For example, it is our customary pattern to receive water 24 hours a day, whereas this is not uniform practice globally. In Canada, the right to access water is based on riparian law and prior allocation. There are federal, provincial, and regional laws regulating water rights, making

	water allocation not a single legal process but a negotiated process that involves many stakeholders, laws, history, and practices.
Water Scarcity	When the demand for water exceeds the available supply. Demographic variables strongly influence demand for water, thus water scarcity is economically and socially driven. Scarcity can be classified into three causes: absolute scarcity is limited by technology and is a function of the hydrological climate; economic scarcity is limited by economic choices and, while there may be plenty of water in an area, it is located far from where it is needed; and induced scarcity is from the political choices acerbated by human behaviour.
Watershed	The land area where precipitation runs off into streams, rivers, lakes, and reservoirs; a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge; large drainage basins that contain many smaller drainage sub-basins; land area drained by a river or stream; the natural hydrologic unit associated with numerous ecological and physical processes involving water; the most appropriate geographic unit for management of water quality (BC Environment 2009).
Water Supplier	A person who is the owner of a water supply system.
Water Supply System	Two plus hook-ups are considered a water system. A water operator is someone certified to maintain this system. A water purveyor is a combination of the engineering, technical, and staff that provide water to people on the water system.
Water Table	Also known as water-table aquifer, a water table is the upper surface of ground-water. Below the water table is an unsaturated zone where pores and cracks are only partially filled with water, and containing air as well. Only swamps and marshes do not have an unsaturated zone.
Water Treatment Plant	The portion of the water system, exclusive of the act of disinfection or fluoridation, which improves or alters the physical, chemical, or microbiological quality of the water being treated.
Water Users	Classified by the type of water one needs and the economic capabilities linked to those decisions. Different water users include households, industry, public utilities, agriculture, and tourism (Spulber and Sabbaghi 1998). Regions vary in their water demands and vary dependent on the geography, the amount of time, and quantity used relative to which economic sector exists in the region, seasonal fluctuations, population size, migration, urbanisation. Generally on a global scale, agriculture uses 70%, industry uses 20%, and domestic uses 10%.
Water Vapour	An invisible gas that is water evaporated from its liquid state. Water molecules that are a part of water vapour in the atmosphere tend to return quite quickly as they are in constant motion.
Well	An artificial excavation, by any method, for the purposes of withdrawing water from the underground aquifer; a bored, drilled, or driven shaft, or a dug hole whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies or oil, or to store or bury fluids below ground (BC Environment 2009).
Well Interference	When an area of influence, or the cone of depression, around a water well comes into contact with or overlaps that of a neighbouring well pumping from the same

	aquifer and thereby causing additional drawdown or drawdown interference in the wells.
Well Recharge Zone	Area of land from which water percolates into an aquifer and is transmitted into one or more wells that are used or are intended to be used to provide drinking water.
Wetland	Area that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year; an area where water saturation is the dominant influence on soil parameters and on composition of the plant community; a bog, pond, fen, estuary, swamp, peatland, or marsh (BC Environment 2009).

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PART 3 WATER HISTORY AND LEGISLATION

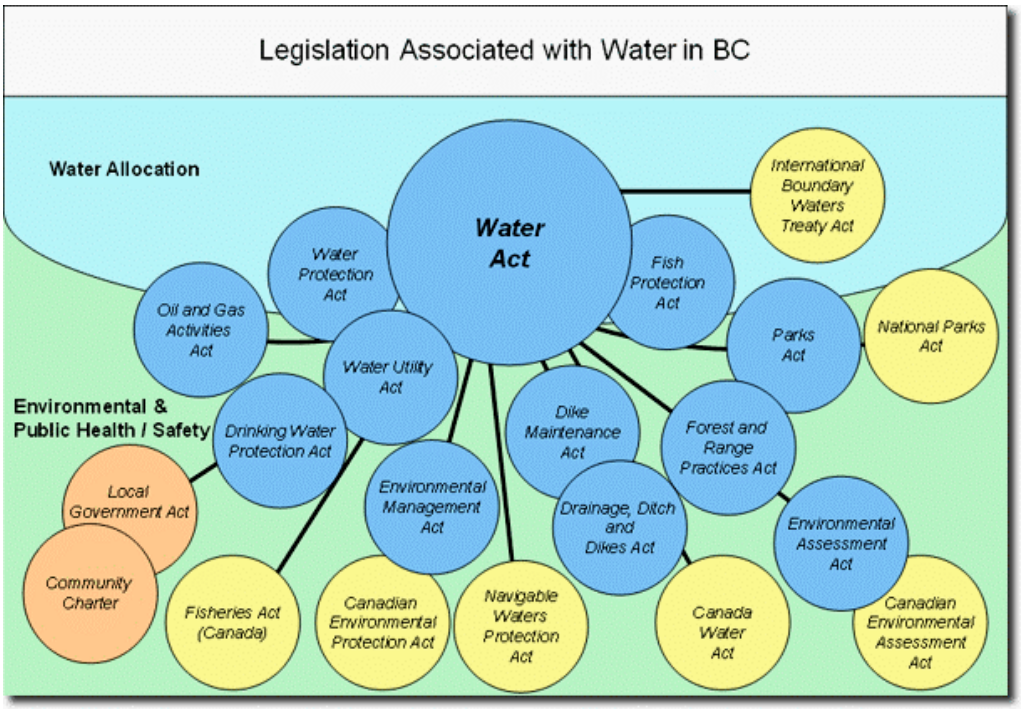
I would like to acknowledge Sonya Jenssen, author of the *Comox Valley Drinking Water Reference Guide*. Some of Part 3 is taken directly from that document; changes herein were only done to make text relevant to the Alberni Valley.

I would also like to alert readers to the fact that in the time since this report was originally drafted, many of the provincial ministries have undergone a variety of transformations, both in name and in some of their responsibilities. These have been changed throughout this report where appropriate. At the time of final editing, some of the changes were so recent that not all of the ministries had made final decisions on their mandates or duties. Readers are advised to consult the BC government website for the most up to date information (www.gov.bc.ca).

3.0 Introduction

Drinking water in BC is currently managed by local governments, seven provincial ministries, and a number of federal departments. Generally, drinking water management employs a source-to-tap model that monitors water quality at various points in the system; i.e., original source, storage and treatment, distribution. There is no single government body, such as a Ministry of Water, that has complete responsibility for all aspects of drinking water management. A diagram of the various jurisdictions and regulatory framework to do with water, as shown on the BC Environment website (http://livingwatersmart.ca/water-act/framework.html highlights this fact.

Figure 6. Legislation associated with water in BC



BC Environment (image accessed 20 Feb 2011 from http://livingwatersmart.ca/water-act/framework.html)

As well as the comparatively numerous government agencies within different ministries and at different levels, there are also a variety of regulations, programs, plans, and other activities—many of which are in a state of flux from one year to the next—over water governance that easily cause confusion in trying to determine who is responsible for what. As well as periodic changes in provincial ministries, BC is currently engaged in developing a new Water Sustainability Act. A report on the recommendations of the Walkerton Inquiry by Sierra Legal Defence Fund (2003) states:

> BC's recent regulatory revisions do not implement adequate source water protection. In fact, when the revisions are looked at in conjunction with other legislative changes, they actually weaken protection measures.

In addition, there is a growing number of non-governmental organizations, streamkeeper groups, labour representatives, and coalitions forming with a watershed and/or drinking water focus. All government bodies located at the regional, provincial, and federal levels have some mandate in their respective jurisdictions to manage drinking water. The municipal sector deals with water supply and treatment, as well as land use zoning, which affects activities and development in watersheds and floodplains. The province deals with proprietary rights to water resources, authorisation and use of water, and the implementation and enforcement of health regulations for drinking water. The federal government has responsibility for First Nations community water supply systems, water legislation in the territories, navigation, and fisheries in both freshwater and oceans, transboundary water agreements inter-provincially and internationally, and habitat protection in national parks. The Federal-Provincial-Territorial Committee establishes the Guidelines for Canadian Drinking Water Quality, which is published by Health Canada and is used nationally as a guide for provinces to legislate water quality standards. Part 3 of this report deals with some identified challenges in water governance and management, the history of water rights, and the roles of regional authorities, provincial authorities, and federal responsibilities for drinking water management (Jenssen 2007).

3.1 Challenges to Water Management

The biggest hurdle to implementing responsible water-management strategies is the commonly held belief that Canada is a water-wealthy country (de Loë and Kreutzwiser 2007). The reality of the water situation in Canada is that the resources are not distributed evenly throughout the country; approximately 60% of Canada's freshwater resources drain to the north, while 85% of the population lives along a 300-kilometre-wide swath across the southern portion of the country. Rainfall varies greatly across Canada, ranging from less than 100 millimetres to more than 5,000 millimetres per annum. There are water "problems" in Canada. Close to home, the Okanagan Basin, which is the driest watershed in Canada and the fastest growing area in the province, will soon be unable to issue water licenses as there will be no more water to allocate. In 2006, the village of Tofino feared water scarcity and was preparing to close its doors to tourists on the biggest holiday weekend of the year. During the same year, Comox Valley residents receiving water from the Comox Lake reservoir came within 10 days of having no water coming out of their taps (Jenssen 2007). During summer 2009, the City of Port Alberni had water restrictions.

Concerns over sufficient water supply will increasingly become a reality for the average Canadian. Concerns about water quality made national headlines in 2000 with the outbreak of *E. coli* and Cryptosporidium in Walkerton, Ontario. Severe water quantity and quality problems already exist for many First Nations communities across Canada (Jenssen 2007).

The traditional response to synchronising availability with human demands is to apply supply management by building water storage and diversion projects for power generation, irrigation, flood control, and other waterworks. Newer approaches focus on demand management and the "soft path" which uses a more holistic, ecological framework that includes humans as part of the watershed (Jenssen 2007).

The myth that Canada is a water-rich country will have to be debunked before there are any major shifts in attitudes and behaviours towards water management. A new water study calls average water use by Canadians alarming. The study indicated that most Canadians consider water to be the country's most valuable natural resource, yet they use it at "disturbing rates" and they're not cutting back. Canadians currently use an average of 329 litres of water per person per day, second only to the United States in the developed world, and more than twice as much as Europeans (Jolicoeur 2009). The average usage in BC is 426 litres per person per day. This study revealed that water consumption in the Alberni Valley is considerably higher than the BC average.

Throughout the course of this research, it became apparent that there are five major challenges to water-management in British Columbia:

- accountability
- legislative continuity
- enforcement
- funding
- sustainable use

Water governance—nationally, provincially, and locally—is characterised by management frameworks that distribute responsibility to a variety of agencies through legislation, regulations, and bylaws that are neither integrated nor strictly enforced (Jenssen 2007).

3.1.1 Accountability

One of the challenges to water management in British Columbia is locating which government agencies have which responsibilities and to whom they are accountable. As noted, no single jurisdiction has the sole responsibility for water protection and access; all levels of government (municipal, provincial, and federal) bear some level of responsibility for protection of and access to water (Davies and Mazumder 2003). At each level of governance, multiple acts and regulations exist, many of which contain escape clauses embedded in other pieces of legislation enacted by other government ministries and departments.

An example of this is *Community Watersheds*. In community watersheds, maintaining water quality, quantity, and timing of flow are the primary management objectives of the land use zone (Ministry of Forests and Range, Community Watershed Guidebook 2, accessed April 2,.2010). The guidelines protect watersheds by guiding and regulating forest resource activities. The Forest Practices Code of British Columbia Act brings into effect new restrictions on forestry and range

practices in Community Watersheds (Ministry of Forests and Range, Community Watershed Guidebook 1, accessed April 2, 2010).

In 2004, with the removal of private lands from Tree Farm Licence 44 (TFL 44), the Private Managed Forest Land Act came into effect. Under the Private Managed Forest Land Act, local governments must not adopt a bylaw or issue a permit in respect of private managed forest land that would have the effect of restricting a forest management activity (Ministry of Forests and Range, Regulation for Private Forest Land, accessed April 2, 2010).

Community Watershed boundaries can include both Crown and private lands (Ministry of Environment 2008). The Forest Practices Code guidelines pertain only to Crown (provincial) forest land (Ministry of Forests and Range, Community Watershed Guidebook 1).

The BC Ministry of Environment commented that many of the privately owned parcels of land in TFLs have since been removed and some are being harvested in accordance with the Private Managed Forest Land Act. There are still some parcels that are true Crown land and other lands where the Crown only has the surface and/or subsurface rights. It is very confusing, and to do a complete status check on all the lands in question [in the Alberni Valley Community Watersheds] would be very time consuming (Ministry of Environment, T. Pobran, personal communication, June 30, 2010).

The number of non-government organisations and coalitions with a focus on watershed protection, streamkeeping, and drinking water rights is growing. It has been suggested that, in concert with globalisation, the central or national State has been "retreating" from its traditional functions and that a variety of non-State and local or sub-national actors are filling the void (de Loë and Kreutzwiser 2007).

The presence of multiple organisations and government ministries involved in water management could be presented as a positive model that takes into account the complex nature of water management; it also highlights that inter-governmental and inter-jurisdictional communication and cooperation is vital for a successful water management model (Jenssen 2007). While conducting this study, it became apparent that with the transfer of different aspects of water governance from one ministry to another, there was the potential to lose aspects of water resource protection.

For example, Designated Community Watersheds are managed by the Ministry of Environment. According to Ted Pobran (Ministry of Environment Policy Analyst, personal communication April 8, 2010), this portfolio may be better served by the Ministry of Healthy Living and Sport (now the Ministry of Health Services), so the Community Watershed portfolio has been left in limbo for years until it is ready to take responsibility for Designated Community Watersheds.

Another example: watershed protection has been the responsibility of the BC Ministry of Environment. It is now the responsibility of the Ministry of Healthy Living and Sport (now the Ministry of Health Services) and its agent, the Vancouver Island Health Authority (VIHA). The Vancouver Island Health Authority is poorly equipped for source protection and it is more reactive, rather than proactive, when it comes to being protectors of the source (MOE, Epps, personal communication, April 8, 2010).

3.1.2 Legislative continuity

Another potential problem area is the lack of legislative continuity and relevance of the legislation to address particular issues. Acts, regulations, and ministries are continually being adjusted to comply with current political trends and the whims of political parties.

In 2001, the dissolution of the Ministry of Water, Air and Land Protection into many different ministries, followed by reconsolidation into the Ministry of Environment in 2005, exemplifies the fragmented nature of environmental priorities of the provincial cabinet. Another example of poor continuity is the short-lived Forest Practices Code, which was in existence for less than a decade. The Code was split into the Forest and Range Practices Act and the Drinking Water Protection Act. This constant change leaves the public unable to clearly identify who is responsible and to whom they are accountable. It also makes it difficult to identify potential violations to legislation and who to contact for enforcement (Jenssen 2007).

In a further example of poor legislative continuity, Special Report #22 of the Provincial Ombudsman (2008) indicated that, across British Columbia, regional health authorities have not adopted a common approach to assessing, explaining, and imposing boil water advisories for high turbidity situations. As a result, the Ministry of Health received a report in 2008 from a Ministerial Technical Advisory Committee on turbidity, concluding that there is no one indicator in all situations that is sufficient to determine when a water quality advisory should be issued in high turbidity events (Ombudsman 2008).

The report recognised that a consistent province-wide process could reduce a perception that different processes and criteria are used by different health authorities. The Ombudsman concluded that from an "administrative fairness perspective," it should be possible for a standard method to be developed that can apply across the province. The Ombudsman further concluded that if Nephelometric Turbidity Units (NTUs) do not trigger an advisory, then it is reasonable to expect an explanation as to what does. Therefore, it was recommended that the Health authorities have a written policy on turbidity, develop it, and make it publicly available (Ombudsman 2008).

3.1.3 Enforcement

Another challenge to water management is that there is little to no enforcement of the legislation intended to protect our drinking watersheds (Mazumder 2007). While public inspections of water supply systems are conducted on an annual basis, the monitoring of activities in a watershed that should or could be limited by legislation is not readily enforced. Legislation is meant to direct and limit behaviour. Who is responsible for ensuring that those working "on-the-ground" are familiar with legislation and know what constitutes a violation? Legislation is only one part of proper management; poor enforcement capacity can render laws and regulations useless (Jenssen 2007).

The provincial government, as the guardian of our environment, and local governments, with the ability to create and enforce land-use zoning bylaws, and the general public, must be willing to adopt, enforce, and obey legislation that protects drinking water .(Jenssen 2007).

An example of an enforcement issue is that of water quality objectives. Water quality objectives are prepared by the Ministry of Environment's Environmental Protection Division for water

bodies and for water quality characteristics that may be affected by the activities of people, now and in the foreseeable future (MOE-EPD 2001).

The objectives are policy guidelines for resource managers to use in protecting water users in specific waterbodies (MOE 2001). These guidelines and procedures apply only to lands held by holders of agreements within a community watershed established under the Forest and Range Practices Act [Crown land]. MOE staff will endeavour to utilize other available legislation and regulations to ensure that other [private] lands within a community watershed are managed in a manner consistent with the community watershed water quality objective (MOE-WSD 2008).

The Ministry says the objectives have no legal standing, and their direct enforcement would not be practical. They say this is due to the difficulty of accurately measuring contaminants in receiving waters and attributing contaminants to particular sources, for legal purposes, for contamination exceeding an objective, and thus of proving violations and their causes (MOE-EPD 2001).

According to the Provincial Ombudsman (Ombudsman 2008):

> Health authorities are not utilising the full range of enforcement options available to them under the Drinking Water Protection Act and Regulations. While the regional health authorities acknowledge the importance of progressive enforcement policies, in practice, action taken under those policies rarely extends to issuing orders or violation tickets or laying charges for non-compliance with the Drinking Water Protection Act (DWPA). Our review of the files related to these orders showed limited escalation of enforcement to the formal level. Generally, a very long period was spent working to obtain voluntary compliance and, in some cases, no timelines for compliance or consequences were imposed for failing to comply with an order.

3.1.4 Lack of funding

In the Alberni Valley, as well as in much of Canada, the lack of funding to repair aged infrastructure is constricting the ability of local water providers to meet required standards within allotted time frames.

Municipalities build, own, and maintain the majority of Canada's infrastructure—infrastructure that supports our economy and quality of life. During the past 20 years, Canadian municipalities have been strangled by increasing responsibilities and reduced transfer payments from other levels of government. Unlike other levels of government, municipalities are not allowed to run deficits on their operating budgets. Lack of funding, in turn, has put tremendous pressure on municipal capital budgets, delaying capital investments. This has fuelled the growth of a substantial deficit in national municipal infrastructure. According to Saeed (2007), "if the federal government launches a new $4.5 billion to repair aging water infrastructure, there will be a shortfall, as municipalities have estimated they need about $31 billion in public investments to bring water and wastewater infrastructure back up to acceptable levels."

Local governments are often at the front line in providing water and sanitation services. They are frequently given responsibility by national governments to ensure access to these services, as well as the power to determine who receives the services, and under what conditions. General

Comment 15 on the right to water states that national governments must ensure that local authorities have at their disposal sufficient resources to maintain and extend the necessary water services and facilities (WHO, accessed April 23, 2010).

3.1.5 Unsustainable water use

The myth of water abundance permeates all areas of water use. British Columbia residents are the largest consumers of water in Canada. Canadians currently use an average of 329 litres of water per person, per day- second only to the United States in the developed world and more than twice as much as Europeans (Jolicoeur 2009). BC average use is 426 litres per person per day. This study revealed that in the Alberni Valley in 2008/2009 the residents of the City of Port Alberni used 986 litres of water per person per day during the summer and 733 litres per person per day during spring. It is unknown how much of that is residential use. The figures for the winter are unknown. Residents of Beaver Creek Improvement District in 2008 used 856 litres of drinking water per person per day. At the peak of water consumption, Cherry Creek residents in 2003 used 511 litres of water per person per day; in 2009 water usage was 444 litres per person per day.

The present vision of Canadian water being an unlimited resource must be transformed to allow a sustainable water use model to be implemented. Although Canada ranks high among the nations of the world in per capita fresh water availability, a host of factors conspire to make our abundance more apparent than real:

- Geography: Most of our big rivers flow northward, while we live mainly in the south.
- Hydrogeology: Less than 2% of the water in the Great Lakes is renewable; the rest is a stock that, if withdrawn, will not be replaced.
- A tradition of over use: We are second only to the US in per capita water use.
- Poor management: We waste more water than we use productively.
- Wild cards: Climate change, ecosystem deterioration, new forms of pollution all pose unknown future challenges (Brandes and Brooks 2007).

Figure 7 shows the average municipal water use in BC. Figure 8 shows the average residential water use in BC. Both are from “The Soft Path for Water in a Nutshell,” a public document (Brandes and Brooks 2007).

The data in these two figures indicate that 35% of residential water use is used for shower and baths. 30% is for used to flush toilets. 20% is used in laundry. 10% is used in the kitchen and for drinking. 5% is used for cleaning. I think it would be helpful to point out that, for all these purposes, the highest quality of drinking water is used to perform each function. I would suggest, that in a world with dwindling drinking water resources, it would be time to rethink some of our water uses to reflect the quality of water needed to match the purpose of its use.

The traditional response to water scarcity is simply to develop more supply. This type of water management is called Supply Management. Unfortunately, this response has many adverse consequences for our environment. Rivers that used to run free are now sluggish, water tables are sinking, and natural habitat is disappearing. The promise of a safe, abundant supply of fresh water can no longer be guaranteed. In most cases, the best and cheapest sources of water have already

been tapped, and costs (per cubic metre) to develop new water supplies are doubling every decade (Brandes and Brooks 2007).

It is time to rethink the typical urban water use model, one where water flows into the city, is used once, and then leaves the city – usually becoming polluted in the process. This flush-and-forget model that so dominates urban water systems will not be viable over the longer term (Brown 2004).

Reducing water use to a level that can be sustained by aquifers and rivers worldwide involves a wide range of measures not only in agriculture but also throughout the economy. Among some of the more obvious steps are shifting to more water-efficient irrigation practices and technologies, planting more water-efficient crops, adopting more water-efficient industrial processes, and using more water-efficient household appliances. Recycling urban water supplies is another obvious step to consider (Brown 2004).

In most communities, demand management programs [as outlined above] are developed incrementally without long-term planning. The tendency is to start with low-cost and politically acceptable measures such as public information and watering restrictions. This short-term, ad hoc approach is the result of narrow planning time frames of usually 2 to 3 years, aligned with electoral cycles to demonstrate concrete results to voters in a short period. Effective Demand Side Management (DSM) programs require staff with the right skills. What often happens, however, is that program design and administration gets tacked onto the responsibilities of municipal water engineers, not necessarily the right people for the job (Brandes, Maas, Reynolds, 2006).

A new type of water management called The Soft Path strives for efficiency in water use, but goes beyond efficiency by fundamentally challenging today's patterns of freshwater consumption. By focusing on "why," the soft path greatly increases the number of possible solutions (Brandes and Brooks 2007).

Four principles of the Soft Path:

1. Treat water as a service rather than an end in itself. This change of perspective liberates water planners and managers from the constraints of merely supplying more water, and permits innovative thinking. The objective is not to flush toilets or to irrigate crops, but to remove wastes and to grow food.
2. Make ecological sustainability a fundamental criterion. Soft paths recognize ecosystems as legitimate users of fresh water. Environmental constraints are built in from the start to limit the amount of water withdrawn from natural sources and to establish conditions on the quality of water returned to nature.
3. Match the quality of water delivered to that needed by the end-use. High quality water is critical to human health. Yet, in most of Canada, we irrigate with drinking water. The key is to cascade water systems, ensuring that wastewater from one use becomes input for another, for example, washing machine to garden.
4. Plan from the future back to the present. "Back Casting" (Brandes and Brooks 2007).

Water soft paths depend on changing patterns of water use, the adoption of conservation attitudes, and building different water institutions and infrastructure. These changes require careful analysis, planning, public consultation, and strategic implementation (Brandes and Brooks 2007).

In order to have access to infrastructure grants, there has to be a meaningful water conservation strategy demonstrated in the grant proposal. However, a report by The Forum for Leadership on Water (FLOW) in 2008 says, “There is a risk that through efforts to resuscitate the economy, resources will simply be poured into the creation of traditional, expensive and energy-intensive pipelines, pumps and plants. Fuelling this outdated approach to water infrastructure will create new debt for future generations, increase pressure on freshwater ecosystems, and increase Canada’s public healthcare costs and carbon emissions” (Desouza 2008).

Figure 7. BC Municipal Water Use by Sector in 1999. The data indicates that BC water usage includes 13% leakage, 16% Industrial, 19% Commercial, and 52% Residential.

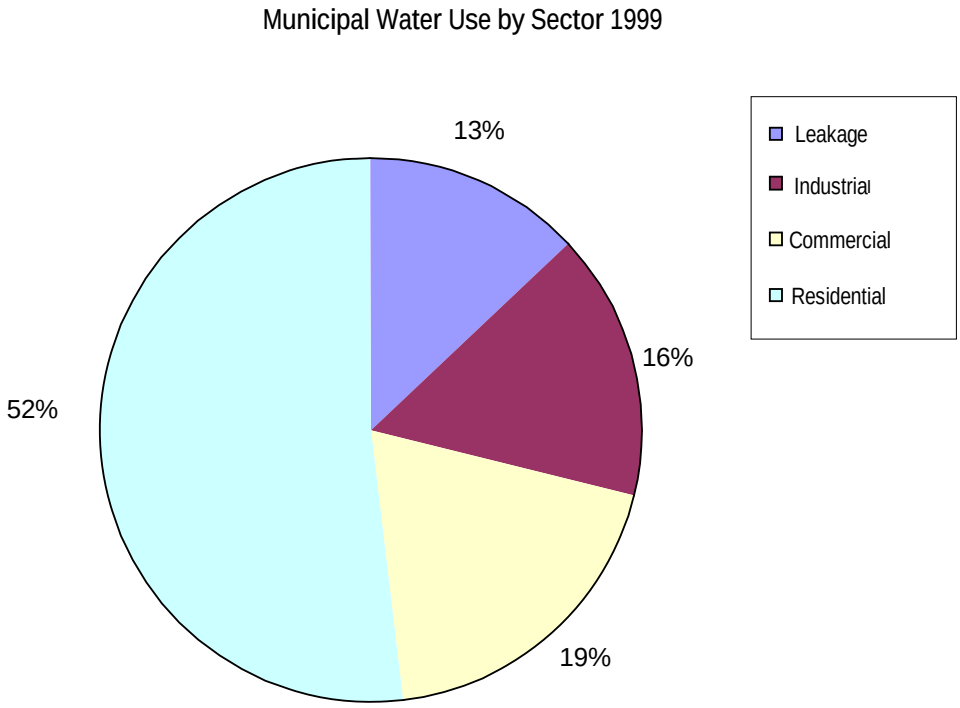
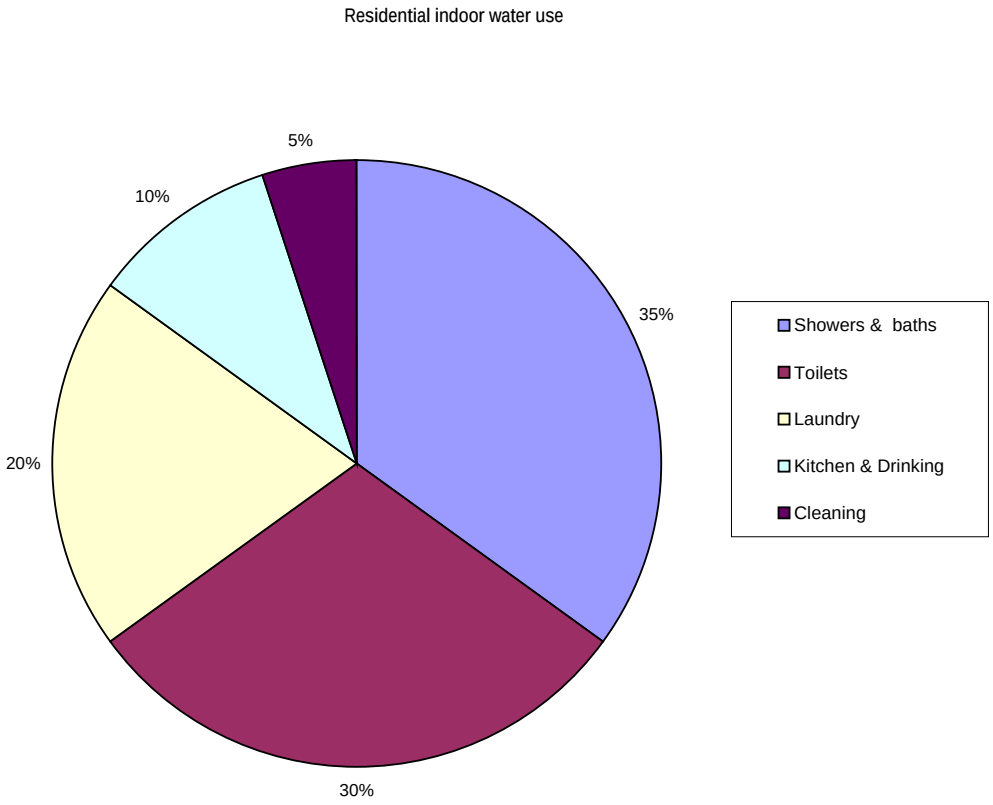


Figure 8. Residential Indoor Water Use



3.2 History of Watershed Law in British Columbia

The creation of BC's Watershed Reserves by concerned water users and politicians began about 100 years ago. The watershed reserves were administered through provincial and federal Crown land legislation that protected public drinking water sources, mainly from commercial logging and public trespass. Evidence presented in 1944-1945 at BC's second Royal Commission on Forest Resources described many reserves in the province and noted that BC's water users wanted the provincial government to continue applying this form of protection (Koop 2006).

The reserves, created under the Provincial Land Act, were public lands specifically set aside and protected as community drinking and domestic water sources. Early forest atlas maps, the central information reference for all Forest Service activities, displayed in large letters a standard disclaimer over the drinking watershed sources: NO TIMBER SALES. The protection of the public's drinking water was obligatory, a fiduciary responsibility—what the Chief Forester's office reluctantly understood as a "moral obligation" (Koop 2006).

A "Watershed Reserves scandal" occurred in the early-1980s, in which Ministry of Forests secretly transferred public drinking water source areas scheduled for legislative protection as Order-in-Council Land Act Reserves to the timber-harvesting land base (Koop 2006).

In 1980, the Community Watersheds designation was introduced and defined as the drainage area above the downstream point of diversion (on a stream) for water that is for human consumption and that is licensed under the Water Act for waterworks or domestic purposes.

In November 1993, the Forest Practices Code of British Columbia Act was proposed and it was decided to incorporate many of the Community Watershed Guidelines relating to forestry activities into the Forest Practices Code. The selection criteria to qualify for Community Watershed designation was then revamped (Ministry of Environment, Water Stewardship, Community Watershed Definition home page, accessed April 2, 2010).

3.3 History of Water Law in British Columbia

The distribution of power to manage water is accomplished under Canada's Constitution Act. Management of water has been divided among federal and provincial governments, where the provincial governments have been assigned the more direct responsibilities (de Loë and Kreutzwiser 2007). Local governments (defined as municipalities, regional districts, and improvement districts) are subject to provincial jurisdiction and hold only those powers and responsibilities that their provincial governments have assigned to them. Each Canadian province and territory has developed its own laws governing water protection and rights of access. Water laws in the four western provinces are closely linked historically and have associative ties to the American model of prior appropriation (Jenssen 2007).

There are four basic tenets to water management in Western Canada:

1. The Crown retained ownership of the water;
2. The Crown distributed rights to water on a first come, first serve basis;
3. Initially water rights were granted for indefinite periods;
4. Competition between licensees for the available supply of water was governed in law by the principle of prior allocation.

Water rights and regulations in British Columbia were derived from the English common law that prevailed at the time of colonial development and settlement. Access to water was governed by the law of riparian rights. Because English Common Law was based on a more humid climate than in the prairies, it was applied in western Canada in conjunction with the American system of prior allocation. A central feature of the riparian doctrine is that water rights are restricted to those who own property adjoining a body of water. Riparian owners were entitled to "receive the flow of water to their property undiminished in quantity and unimpaired in quality, to gain access to navigable rivers, to fish, and to protect their land from flood water." Their use was not to diminish the flow of the water or interfere with the rights of others. Riparian owners were entitled to take water for their domestic and non-domestic purposes. The law at the time did not establish to what extent a non-domestic use by an upstream riparian owner could interfere with the flow of water downstream (Jenssen 2007).

Riparian rights are based on two theories. The "natural flow theory" suggested the downstream owner was entitled to receive water in its natural state, in quality and quantity; the "reasonable use theory" suggested that riparian owners were entitled to non-domestic use of the water provided it did not interfere with the legitimate use by other riparian owners (Jenssen 2007).

The inability of the riparian doctrine to accommodate major uses of water by non-riparian owners of land was a limit to growth and development from the influx of European settlers and was first

recognised as a barrier during the gold rush era. The Gold Fields Act in 1859 allowed miners to obtain water rights, even if they did not own the riparian land, by filing a claim with the Gold Commission. Also in 1859, the Land Proclamation, extended the possibility of water rights to any holder of Crown lands. It was not until the Land Ordinance in 1870 that a clear right to obtain water for agricultural purposes was extended to all those lawfully occupying and cultivating Crown land. This ordinance pertained only to watercourses adjacent to or passing through Crown land owned by the applicant (Jenssen 2007).

The 1892 Water Privileges Act established the right to use water as vested in the provinces, except for what was under federal jurisdiction. In 1925, amendments were made to declare that ownership of all water would be vested in the Crown. Once the Crown secured control of water, it granted water rights on a basis of first come, first serve, following the principle of prior allocation. While prior allocation still exists in law in practice, communities are opting to share resources rather than uphold the law of prior allocation, which is considered outdated due to its basis in early Canadian development and expansionism (Jenssen 2007).

The need to share the limited resource, rather than battle over it, is increasing. Prior allocation is only challenged when licences with the same priority date are on the same stream; on these rare occasions, priority of use is in order from domestic, waterworks, mineral trading, irrigation, mining, industry, power, hydraulics, storage, conservation, conveying, and lastly land improvement. As settlement continued, water rights were granted free of charge to those who were able to put the water to use, known as the "beneficial use of water" (Jenssen 2007).

Knowledge of groundwater resources is incomplete and regulation of groundwater usage in Canada is relatively unknown; licensing of groundwater does not exist in British Columbia. Based on English common law, riparian rights of access applied to surface water and groundwater that flowed in defined channels, i.e., in streams underground (Nowlan 2007). The Rule of Absolute Capture was applied to all other classifications of groundwater, which allowed homeowners to withdraw groundwater from under their property regardless of damage caused to neighbouring properties. This Rule was based on the principle that everything beneath the land belongs to the landowner and was unlike the riparian right of access that limited withdrawal if an impact was noted by other water users on the same source. The characterisation of groundwater as mysterious and unknowable, and the separate development of the law of groundwater and the law of surface water, continued well into the second half of the twentieth century. British Columbia remains the only jurisdiction in Canada that has no general licensing for groundwater extraction. The BC Water Act established in 1909 contains licensing provision that could apply to all water extractions if Cabinet chose to designate it as such (Jenssen 2007).

3.4 History of Water System Governance

The following institutions have been reviewed in this section (Jenssen 2007):

- Environmental Operators Certification Program (EOCP)
- Local Government: Municipalities, Regional Districts, and Improvement Districts
- Coastal Water Suppliers Association

3.4.1 Background to changing water safety standards

In May 2000, over 2,000 people become ill and seven died due to water tainted by the spreading of manure contaminated with *E. coli* and *Campylobacter* pathogens near a source well that was used as the main water supply for the community of Walkerton, Ontario. A public inquiry established that, in addition to the unregulated farming practice of manure spreading, local water operators had not conducted daily chlorine residual testing nor had they reported contaminated water to the health authority (O'Connor 2002 in Jenssen 2007). The presence of chlorine residual indicates that a sufficient amount of chlorine was originally added to inactive bacteria and that the water is still being protected from recontamination during storage. The presence of residual chlorine is correlated with the absence of disease-causing organisms and is a measure of potable water. In order to avoid similar tragedies, there needs to be a shift away from the "pervasive culture of complacency" held by key players managing water systems (Hrudey et. al 2002 in Jenssen 2007). Recommendations were made that each individual element in the water system be effectively maintained, while a sense of personal accountability be conveyed to all those responsible for the provision and management of drinking water. Walkerton impacted the institutionalisation of more stringent water quality guidelines in Canada (see p. 98 for comment on "results-based" and commentary on recommendations from the Walkerton Inquiry). Some of the changes post-Walkerton include lower allowable limits of turbidity from 5 NTUs (nephelo-metric turbidity units) to 1 NTU, increased insurance costs for water operators, and renewal of the water operator's certification. A cross-country reaction to Walkerton entailed increased public distrust of tap water safety, which may account for an increase in the consumption of bottled water and a higher degree of trust in the private sector provision of water services (Jenssen 2007).

3.4.2 Environmental Operators Certification Program

A program for certification of water and wastewater treatment and facility operators has existed in British Columbia since 1966. Operators are qualified to operate, maintain, or repair a water supply system if they are certified by the Environmental Operators Certification program as regulated under the Drinking Water Protection Act 2001. One way of continuing the provision of safe drinking water is to raise the knowledge of operators and to test their level of competency. Commencing January 2008, operators are required by the Ministry of Health to take continuing education credits as a means to renew their certificates every two years. This continuing education credit applies per operator not per certificate, although operators who hold more than one certificate have a further requirement that a minimum of 25% of the training must be directly applicable to each certificate, with the balance of the training generally applicable to each of the certificates. A graduated hierarchy is in place to license operators relevant to the classification of the facility they are operating (Jenssen 2007).

Since 1975, water and wastewater facilities have been classified on a voluntary basis with standards adopted by the Association of Boards of Certification. Water distribution systems and wastewater collection systems are classified based on flow and complexity. Activities such as booster pumping, coarse screening, chlorination, or fluoridation are considered an integral part of the water distribution system and not that of a water treatment facility. Facility classifications include small water systems, small wastewater systems, water distribution and treatment systems

(Levels I to IV), wastewater collection and treatment systems (Levels I to IV), and industrial wastewater treatment systems (Levels I to IV). Water and wastewater operators will generally be certified as Small Water or Wastewater System, Operator-in-Training, Level I, Level II, Level III, or Level IV in accordance to the facility classification (Jenssen 2007).

Criteria for Small Water System, Bulk Water Delivery, and Small Waste Water Systems:

a. The facility/system serves a maximum population of 500 people;

b. The facility/system is classified as a Class I or Class II facility;

c. The operator has at least six (6) calendar months of hands-on experience operating the facility/system or one equivalent to it or higher;

d. The operator has a minimum of 50 hours of hands-on experience operating the facility/system or one equivalent to it or higher; and

e. The operator must have completed appropriate training for which a minimum of 1.2 continuing education units have been awarded by the EOCP.

The most basic level of certification is the Small System Operator. Typically, small water distribution, water treatment, wastewater collection, or wastewater treatment facilities have operators who are not required for full-time daily attention. The systems are relatively simple, serve only a small population, and/or are operating for only a portion of any given year. Small System Classification and Operator Certification are intended to ensure the competency of operators who work on systems that do not normally fit within the regular certification process (Jenssen 2007).

Section 12 (3) (a) of the BC Drinking Water Protection Regulation 2003 established that small water systems would be required to have the operator certified according to EOCP standards by January 1, 2005. However, the regulation was amended in December 2004 to extend the compliance date to January 1, 2006. The BC Health ministry has indicated there may be further changes to the regulatory framework for small water systems but that operator certification requirements will likely remain for all but the smallest of systems (Jenssen 2007).

3.4.3 Coastal Water Suppliers Association

Formerly known as the Vancouver Island Water Distributors, the Coastal Water Supplier Association was founded in 1971 as a lobby and education group. This group is comprised of individuals with professional ties to water purveying. Full-voting membership is open to Improvement Districts, Municipalities, Regional Districts, and private water purveyors, and non-voting membership is open to consultants, individuals and companies that provide goods or services to the water supply industry. In 2010, the association represents 62 water suppliers and 30 associate members in the Vancouver Island and Coastal BC region. The goals of the Coastal Water Suppliers Association are to encourage cooperation and information sharing, to represent concerns and interests to government, and to provide training opportunities.

These goals are pursued under the following objectives:

- Education: Keep members up to date about changes in the industry and provide training sessions for management and staff of all member organisation. Topics range from operational safety to staff development, and legal and legislative issues.
- Government lobbying: Preserve and protect the long-term interests of members, lobbying government regarding legislation for watershed protection and management, growth management, and water licensing.
- Water suppliers representation: Act in an advisory role to smaller districts by linking with organizations and other districts that administer policies affecting those districts (e.g., BC's ministries of Environment, and Health and Community Services).
- Affiliations with water-related industrial associations: Promote cooperation and industry-wide understanding, by maintaining alliances with organizations such as the American Water Works Association, the B.C. Water and Waste Association, the Water Supply Association of BC and the Small Water Users of BC.
- Communications with members: Produce newsletters, website information and other frequent publications to keep members informed about association activities, issues, accomplishments.
- Adherence to regulations: Adhere to the regulations and guidelines as legislated by all levels of government and operate in a responsible nature (Jenssen 2007).

In 2010, the Coastal Water Suppliers Association (CWSA) Board of Directors was comprised of six representatives from three districts. The current Board is comprised of members from North Salt Spring Island Waterworks District, Bowser Water Works District, and Van Anda Improvement District (Texada Island). One position is currently not filled. The Board also consists of three associates and one administrator who is appointed. Board members are volunteers that are elected annually at the Annual General Meeting to serve a three-year term (P. Berkmann, personal communication, June 29, 2010).

CWSA Board of Directors forms committees. In 2010, the primary focus of the CWSA is education of its members. CWSA provides courses that meet mandatory EOCP continuing education credits at affordable rates to its members. Government lobbying is not a focus at this time (P. Berkmann, personal communication, June 29, 2010).

Also in 2010, CWSA membership includes the City of Port Alberni, Beaver Creek Improvement District, and Cherry Creek Waterworks District.

3.5 Regional Authorities

Regional levels of government provide direct water services to the public and mitigate impacts to watersheds through zoning bylaws. The local government system in British Columbia is comprised of municipalities, regional districts, and improvement districts. Local-level governments are largely responsible for controlling the amount of development and population growth in their communities, which directly impacts water supply and protection (Jenssen 2007).

3.5.1 Regional districts

Regional districts, conceptualised in 1965, are local governments that provide specific services to rural communities that are not incorporated municipalities and region-wide services to various

municipalities and rural areas. There are 27 regional districts in the province, divided into electoral areas. Subject to specific limitations under provincial legislation, a regional district may operate any service that the regional district board considers necessary or desirable for all or part of the regional district. A regional district may operate a service directly or through another public authority or organisation. Most regional district services must be established through a service area bylaw. While most services are delivered within the boundaries of the regional district, the board may deliver services outside its boundaries with the consent of the neighbouring local government (Jenssen 2007).

The Local Government Act provides a framework for implementing a regional growth strategy (RGS), which is a local government strategic plan to promote socially, economically, and environmentally healthy human settlement that makes efficient use of public facilities, land, and other resources. An RGS is initiated, prepared, and enacted by a regional district with the full involvement of its member municipalities, provincial agencies, and others. The legislation enables any regional district to voluntarily initiate an RGS by resolution of its board. No provincial government approval is required for the initiation or enactment of an RGS. The Local Government Act outlines the following minimum content requirements for any strategy, although the rest of an RGS is largely left up to the local governments:

- a 20-year minimum time frame;
- regional vision statements;
- population and employment projections; and,
- regional actions for key areas such as regional interests, housing, transportation, regional district services, parks and natural areas, and economic development (Jenssen 2007).

The legislation requires that the regional district consult with individuals, organisations, and authorities considered to be affected by the strategy, and adopt a consultation plan in this regard. The RGS is enacted in a bylaw (Jenssen 2007). The Alberni-Clayoquot Regional District (ACRD) areas and the City of Port Alberni do not currently have a regional growth strategy management plan.

An RGS gives long-range planning direction for the regional district and the municipal Official Community Plan (OCP) to provide a basis for decisions regarding implementation of provincial programs in the area. An OCP can be developed by both municipalities and regional districts. The OCP provides a longer term vision for the community. Under the Local Government Act Section 875, an OCP is a statement of objectives and policies to guide decisions in planning and land use management (Jenssen 2007). The Alberni Clayoquot Regional District electoral areas are currently developing OCPs for their communities in the Alberni Valley.

3.5.2 Municipalities

Municipalities are the cornerstone of the local government system in British Columbia. All forms of local government – municipal, regional districts, and improvement districts – have jurisdiction to purvey water and enact bylaws to conserve and protect water sources (Jenssen 2007).

Municipalities are created under the provisions of the Local Government Act overseen by the Ministry of Community and Rural Development. There are 157 municipalities in British Columbia, ranging in population from small villages of fewer than 250 persons to large cities approaching 600,000. The median population size is 4,800. There are four classes of municipalities: village, town, district, city. The definition is population-based, however the authorities for each class are the same (Jenssen 2007).

Municipal councils are democratically elected bodies accountable to their electorate. Councils are comprised of a mayor and councillors. Council size varies from five to nine members depending on the population of the municipality. Municipalities, along with non-municipal areas, form part of the regional district system. Councils appoint one or more members to sit as municipal representatives on their respective regional board. They operate primarily under the Community Charter which recognises them as an order of government within their jurisdiction. This recognition is unique in Canada and enables municipalities to provide a wide variety of services that are reflective of their community's needs and desires. Municipalities have broad service authority to provide core responsibilities that include but are not limited to the following (Jenssen 2007):

- general government
- transportation – streets and roads, in some cases urban transit
- protection – police, fire
- environment – water treatment and supply, waste water treatment, refuse
- collection/disposal
- recreation and culture – recreation centres, playing fields, parks, libraries
- land use planning and regulation, building regulation, zoning
- regulation – animal control, public health, signs, business licensing, municipal services

Municipalities have flexibility in how they provide services, including the ability to enter into private partnership and to generate revenue to finance operations. Financing of services is done primarily through the property tax system, but municipalities have the ability to charge fees for services. Municipalities are not responsible for schools, social assistance and hospitals. These are provincial responsibilities (Jenssen 2007).

3.5.3 Improvement districts

Historically, the Ministry of Community Services [in 2011, the Ministry of Community, Sport & Cultural Development (MCSCD)] has been responsible for the improvement district system in the province since 1979.

Improvement districts were first established in the 1920s as a method to provide public management for several large irrigation systems in the Okanagan Valley. These systems were under private management, but they were in danger of going bankrupt. Incorporating improvement districts to manage irrigation or domestic water systems provided access to provincial borrowing programs. Transfer of ownership of the private water systems to public

ownership became necessary as some utility owners were unwilling or unable to operate, or residents wanted the advantages of public control (Ministry of Community Services 2006).

In 1945, improvement districts began to administer fire protection. This administrative change occurred because, at the time, municipalities were the only public body that could provide local services and it was not always viable to incorporate small rural communities where the residents only wanted one or two services, not general governance (Ministry of Community Services 2006).

In 1965, legislation enabling the creation of regional districts was introduced. Regional districts were created for three purposes: to provide services to the entire region; to provide a framework for inter-municipal service deliveries; and to provide general local governance for areas outside municipal boundaries. The establishment of regional districts was slow. Regional districts were in direct competition with already existing improvement districts. However, it would take some time for the regional district system to become fully established. Therefore, a strategy of "gentle imposition" was imposed upon improvement districts for them to adopt the Regional District Model (Ministry of Community Services 2006).

In 1979, the first comprehensive review of the regional district system was undertaken by the Farmer Commission. In the period of 1983-86, a second review was undertaken. As a result, in 1989, a comprehensive rewrite of the regional district section of the Municipal Act was conducted by then Minister of Municipal Affairs, Dan Campbell, which strengthened Regional Districts (Ministry of Community Services 2006).

In 1979, the legislative provision relating to improvement districts was removed from the Water Act, and responsibility for all improvement districts was transferred from the Ministry of Environment to the (then) Ministry of Municipal Affairs. Between 1979-1989, the focus of the Ministry of Municipal Affairs was on creating a strong foundation for regional district government in the province. Very little policy attention was paid to improvement districts. During this period of time, improvement district incorporation was still promoted, particularly as a means of converting private water utilities into public ownership. Also throughout this period, there was no comprehensive strategy in place to guide the integration of improvement districts into the local government system or ministry program areas (Ministry of Community Services 2006).

In 1989, the ministry established the Task Force on Rural Services and Governance. The task force wrote a report entitled "Rural Service Delivery and Governance in BC," which identified the ministry's recommendations about the role improvement districts should play. Specifically, the report proposed that improvement districts would continue, but ministry efforts would be focused on reinforcing the role of regional districts as the primary local government for rural areas. The report was never published, nor did it receive widespread media attention. However, the report had a significant impact on ministry decision-making. In fact, the ministry has followed the Task Force recommendations since 1989, discouraging the creation or expansion of improvement districts and encouraging the use of regional districts as the primary rural area servicing vehicle. Also as a consequence of the report, the management responsibility of the Ministry of Municipal Affairs [in 2011, the MCSCD)] was reshaped to reflect a similar management strategy as used by all other local governments. Emphasis was placed on providing

advice, direction, and assistance to maintain the viability of improvement districts in the province (Ministry of Community Services 2006).

In 1994 and 1997, the Ministry of Municipal Affairs conducted further reviews regarding improvement district governance. In 1998, an external report called "Improvement Districts in BC - A Review of Suggested Strategies for Management and Change" confirmed that the ministry objective of facilitating conversion to regional district and municipal jurisdiction was the right one. The Ministry's strategy has been successful in its fundamental objective of dissolving improvement districts. There were 87 fewer improvement districts in 2006 than in 1989 (Ministry of Community Services 2006).

Ministry of Municipal Affairs Program Management Policies (2006):

Local Government structure:

1. The ministry will not create new improvement districts.
2. The ministry will dissolve all improvement districts which are wholly or partially within an area which is newly incorporated.
3. The ministry will encourage and facilitate regional districts assuming greater responsibility for local services in rural area.
4. The ministry will encourage rural improvement districts to convert to municipal jurisdiction through extension of municipal boundaries.
5. The ministry will take a proactive approach to restructure improvement districts which are experiencing problems with their infrastructure, have serious management problems, are facing irreconcilable conflicts with municipalities or regional districts, or are not complying with legislative requirements (Ministry of Community Services 2006).

The Ministry of Municipal Affairs vision [was] to encourage conversion of improvement districts to regional district service areas. Consistent with that, it is important to maintain the existing financial incentives for conversion. Specifically, the ministry will restrict water infrastructure grants to regional districts and municipalities (Ministry of Community Services 2006)

Objectives of the Ministry of Municipal Affairs (2006):

- Provide financial and administrative advisory services to improvement districts.
- Provide advice on all aspects of improvement district finance and administration.
- Improve reporting practices of improvement districts.
- Assist in conversion of improvement districts to municipalities or to other forms of governance.

Improvement districts (IPDs) are the most localised form of government to purvey water; the districts are funded by local property taxes and water billing. IPDs are autonomous local government bodies responsible for providing one or more local services for the benefit of the residents in a community. IPDs vary considerably in size from small subdivisions to urban communities, but are usually located in rural areas of the province where there was no alternative form of local governance available, suitable, or desirable for the community. IPDs are brought into existence by the province through a Cabinet Order which authorises the passage of a document known as a Letters Patent. Some of the provisions contained in a Letters Patent include

the name of the IPD, its boundary, and the services which it intends to provide to the residents within that boundary. The incorporation of an IPD will only be considered where the local regional district is unable or unwilling to establish a service area, the service alternative is considered a viable option, and a majority of the landowners in the area endorse its formation (Jenssen 2007).

The affairs of every improvement district are directed by elected trustees, one of whom acts as chair. Each trustee is elected for a two or three-year term by the eligible landowners of the improvement district. In general, to be eligible to vote or to be a candidate for trustee, a person must be eighteen years of age, a Canadian citizen, a owner of land in the improvement district and a resident of BC for the previous six months (Jenssen 2007).

In the Alberni Valley, there is one improvement district in Beaver Creek and one waterworks district in Cherry Creek. There is no difference between the two titles as they both provide the same service of water delivery in the Alberni Valley. The service structure is the same. Both are made up of volunteers from the local community who are elected as members of the Boards of Directors. The board members are elected annually at an Annual General Meeting (AGM) and serve a three-year term.

In the Alberni Valley, finding volunteers willing to serve as members is a challenge. The Alberni Valley is not unique in this. According to D. Lockhart (2007), we are witnessing a decline in the number of volunteers in Canada. Volunteer fatigue occurs as volunteers who are committed continue to be asked to give more time (Lockhart 2007). In the Alberni Valley, board members have been re-elected term after term. Some trustees have served for 10–15 years. Organizations can get entrenched with the same leaders year-in and year-out (American Society of Clinical Oncology 2006). Maintaining the status quo often ends up the easiest way to govern with an entrenched system of governance. One example used to prevent an entrenched system is the Michigan Society. The Michigan Society's bylaws limit the president's term to two years. Term limits encourage current leadership to identify and promote their successors (American Society of Clinical Oncology 2006).

In the Alberni Valley, election of the Board of Trustees/Directors usually occurs at the AGM. The nomination and election process is the last item on the agenda of a long meeting. The filling of the positions of board trustees/directors is not a high priority of the AGM as the process is given the least amount of time of the agenda. There are no qualifications required to serve as a board member.

The powers exercised by the board members flow from the improvement district's Letters Patent, applicable sections of the Local Government Act, and other relevant statutes. These powers include the ability to enact and enforce regulations and charges; to assess and collect taxes; to acquire, hold, and dispose of lands; to borrow money; and to expropriate lands required to carry out its objectives. These powers are enacted by the trustees through the passage of bylaws (Jenssen 2007).

Although improvement districts are independent public corporations and can sue and be sued, they are also subject in some respects to supervision by the Ministry of Community Services [in 2011, the Ministry of Community, Sport & Cultural Development] (Jenssen 2007).

3.6 Provincial Government Authorities

The provinces are responsible for managing most Canadian natural resources, including issuance of proprietary rights to waters located within provincial borders through the granting of water licences. The province establishes the primary legislation that governs access to and protection of drinking water. Listed below are the key provincial ministries that have influence on the integrity of source water, the quality of drinking water, and the issuing of licences and permits to do with water (new ministry names as of February 2011). To find the latest ministry changes and contact information for each ministry, see the government website (http://www.gov.bc.ca/ministries/) or contact Inquiry BC at 1-800-663-7867.

- Ministry of Environment (formerly Ministry of Water, Air and Land Protection)
- Ministry of Health Services (formerly Ministry of Healthy Living and Sport)
- Ministry of Forests, Mines, and Lands (formerly the Ministry of Forests and Range)
- Ministry of Agriculture (formerly Ministry of Agriculture and Food)
- Ministry of Transportation and Infrastructure (formerly Ministry of Transport)
- Ministry of Energy (formerly Ministry of Energy, Mines and Petroleum Resources)
- Ministry of Community, Sport and Cultural Development (formerly Ministry of Community Services)
- Ministry of Natural Resource Operations (a new "ministry of everything" that issues most licences and permits)

Table 1 below outlines water legislation in British Columbia and the lead provincial ministry that has jurisdiction over the water governance duties of that piece of legislation.

Table 1. British Columbia Provincial Water Legislation

Legislation	Purpose	Lead Agency
Water Protection Act 1996	1. Confirms Crown ownership of surface and ground water and prohibits large scale diversion or removal of water, i.e., a person must not remove water from BC. 2. Maintains existing bulk water removal rights. 3. Prohibits bulk removal of water outside the province. 4. Prohibits large scale diversion between major watersheds. Specific activities do not need formal approval as long as they are carried out in compliance with the regulations.	Ministry of Environment
Water Act 1991	Provides for the approval of surface water use by the granting of licences. A licence holder may: divert and use beneficially water, store water, construct and operate water works, alter or improve a stream.	Ministry of Environment
Water Regulation 1988	Acquisition of water licences, fees, and protection of streams.	Ministry of Environment
Groundwater Protection Legislation 2005	Requires all wells to be properly constructed, maintained, and deactivated when no longer in use. New wells as of 2005 must register with the Ministry of Environment and are required to have a	Ministry of Environment

	surface seal, secure well cap, well casing stick-up, wellhead graded, well identification plate and controlled or stopped artesian flow. All wells must be constructed by or under the supervision of a qualified well driller except for wells less than 15 meters (50 feet). It is illegal to put any "junk", i.e., pesticides, animal waste, construction materials etc in an active or abandoned well..	
Strata Property Act 1978 Bare Land Strata Regulations	Regulates the relationship between development plans and water bodies and access to water and sewage works. Restrictive covenants must be placed on areas that are subject to flooding hazards in order to minimise claims on public funds and damage to property. A waiver of liability is included for the province and local authority.	Ministry of Finance
Waste Management Act 1996	Requires permits, approvals or operation certificates under a liquid and solid waste management plan for discharges to land, air and water and handling of solid and toxic wastes; prohibits dumping/discarding litter and sewage.	Ministry of Environment
Dam Safety Act 2000	Identifies the requirements for proper application, operation and maintenance, and inspection of dams.	Ministry of Environment
Dike Maintenance Act 1996	The role and responsibility of the dike inspector and diking authority. Appeals and offences are listed.	Ministry of Environment
Water Utility Act 1996	Applies only to water utilities subject to the legislative authority of BC. Water utilities are defined, in part, as an operation to divert, develop pump, impound, distribute, or furnish water for compensation.	Ministry of Environment
Environmental Management Act 2003	Outlines authority of minister and provides for environmental assessments, protection orders, environmental emergency measures, water quality guidelines and enforcement.	Ministry of Environment
Environmental Assessment Act 2002	Requires environmental impact assessment for specified development projects and activities. Projects proposing to extract ground water at a rate equal to or greater than 75 litres per second are subject to an environmental assessment. High extraction rates can lead to salt intrusion.	Ministry of Environment
Fish Protection Act Sensitive Streams Designation and Licensing Regulation 2000	Protects fish by ensuring healthy fish-bearing streams and plentiful stocks. A schedule of designated streams is listed.	Ministry of Environment
Riparian Areas Regulation 2005, Replaces the Streamside Protection Regulation 2001	Enacted under the Fish Act, ensures a 30 meter riparian assessment of sites being considered for development reviewed by a qualified environmental professional. Does not apply to farming, mining and forestry activities.	Ministry of Environment
Pesticide Control Act 1996	Regulates the use and application of pesticides.	Ministry of Environment

Health Act 1996	Regulates approval of construction camps, public water supplies, sewage disposal (under 22.7m3/d to land and for single or double unit dwellings to water), sanitation and food supply operations.	Ministry of Health Services
Drinking Water Protection Act 2003 replaces the Safe Drinking Water Regulation under the Health Act	Specifies that drinking water sources, including aquifers, are to be protected. Water supply systems defined as a domestic system serving more than one single family residence. Potable water that meets the standards set out in the Regulations associated with the Act. According to these standards, there are three contaminants to be monitored for: fecal coliform bacteria, *Escherichia coli,* and total coliform bacteria. Under the Act, the Vancouver Island Health Authority (VIHA) issues construction permits for water treatment plants, reservoirs, disinfection systems, water transmission and distribution systems. The VIHA construction permit requirements stipulate that water transmission and disinfection systems must provide 225 L/person/day and that water quality must meet the VIHA standards that fall between the BC drinking water standards under the BC drinking water protection regulation and the Canadian Guidelines for Drinking Water Quality.	Ministry of Health Services
Forest Practices Codes of BC Act 1994 – 2004	Establishes forest and range practices, standards and requirements, had included a Community Watershed Guidebook.	Ministry of Forests Mines & Lands Ministry of Environment
Forest Practices and Range Act 2004	Defines forest stewardship plans, woodlot licenses, forest practices, forest health, range use plans, grazing schedules, and protection of resources, compliance and enforcement.	Ministry of Forests Mines & Lands
Private Managed Forest Land Act 2004	Outlines logging practices in and around streams and community watersheds on privately held land.	Ministry of Agriculture
Soil Conservation Act	Establishes permitting requirements for soil removal from an agricultural land reserve, and regulates use of land in agricultural land reserves.	Ministry of Agriculture
Farm Practices Protection (Right to Farm) Act	Ensures that farmers can farm in agriculture land reserves; adds specific powers to local governments; may regulate farm conduct and prohibit specific farm operations.	Ministry of Agriculture
Local Government Act 1996	Gives local governments, including Island Trust, jurisdiction over land use planning to adopt zoning, subdivision and other bylaws; permit construction; develop solid and liquid waste management plans, provide water and sewer services and address environmental concerns (e.g., protecting water quality). Development in floodplains is now a municipal responsibility.	Ministry of Community, Sport & Cultural Development
Growth Strategies Act	Establishes basis for local government to develop Regional Growth Strategies and Official Community Plans to achieve environmental, social and economic objectives.	Min Community, Sport & Cultural Development

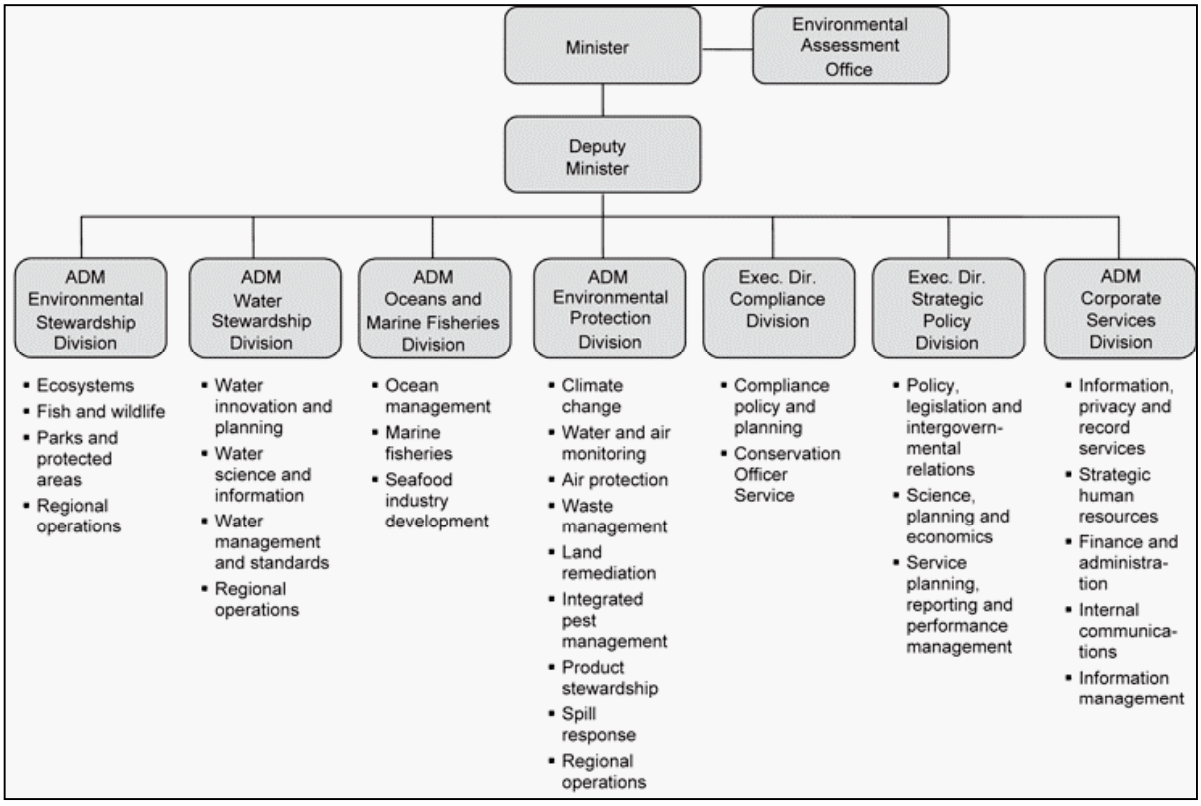
Community Charter 2003	Allows council to make bylaws that regulate, prohibit, and impose requirements in relation to the protection of the natural environment. The purpose of a municipality includes providing for stewardship of public assets of its community and fostering the economic, social and environmental well-being of its community.	Min Community, Sport & Cultural Development
Rural Subdivision Approval Regulations	Applies to subdivision in an area that is not a municipality. Subdivision approvals are issued only to proposals indicating that there is an adequate supply of potable water at the proposed building site. If there is no subdivision bylaw, the approving Officer may require proof of 2500 litres per day per dwelling unit, as well as a statement from a laboratory regarding the water quality. Water may be supplied from individual surface sources, individual wells on site, or from an extension of an existing water system.	Ministry of Transportation and Infrastructure

Table used with permission; *Comox Valley Drinking Water Reference Guide* (p.49-53), Jenssen 2007.

3.6.1 Ministry of Environment

The Ministry of Environment plays a stewardship role by overseeing water protection, liquid and solid waste management, land use planning, and management of water, land and resource data (Jenssen 2007). The organisational structure of the ministry is shown in Figure 9.

Figure 9. Ministry of Environment Departmental Flow Chart



Comox Valley Drinking Water Reference Guide; reprinted with permission (Jenssen 2007).

To divert water, an application must be submitted to the Ministry of Environment and the Integrated Land Management Bureau, where a technical assessment is conducted by the Water Stewardship Division and the license is granted by the Controller of Water Rights. Once a water license is granted, the water is essentially under a private rental agreement between the Ministry of Environment and the licensee. To obtain a water license, the applicant must be any of the following:

- An owner of land or a mine;
- A holder of a certificate of convenience and necessity issued under the Public Utilities Act, RSBC 1960, c. 323, or under the Water Utility Act;
- A municipality, improvement district, water users' community, or development district;
- The Crown as represented by a minister appointed by the Governor General or the Lieutenant Governor;
- A commission, board or person having charge of the administration of any land, mine or other property owned or controlled by a ministry, department, branch or other subdivision of the government of Canada or of British Columbia;
- The Greater Vancouver Water District or any other water district incorporated by an Act of the Legislature;
- The British Columbia Hydro and Power Authority (Jenssen 2007).

The Ministry of Environment leads the Assistant Deputy Minister's Committee on Water, with representation from all seven of the key provincial ministries that have an impact on drinking water in their jurisdiction. These are the Ministry of Agriculture (formerly the Ministry of Agriculture and Lands); Ministry of Community, Sport and Cultural Development (formerly the Ministry of Community and Rural Development); Ministry of Energy (formerly the Ministry of Energy, Mines and Petroleum Resources); Ministry of Forests, Mines and Lands (formerly the Ministry of Forests and Range); Ministry of Health Services (formerly Ministry of Healthy Living and Sport); Ministry of Transportation and Infrastructure (formerly the ministry of Transport); the Ministry of Environment; and a new ministry called the Ministry of Natural Resources Operations, under which are two agencies primarily concerned with issuing licences and permits called FrontCounter BC and the Integrated Land Management Bureau. There is an Inter-Ministry Committee on Drinking Water that includes all of the same seven ministries at the level of directors with administrative responsibility for water source, treatment, or distribution (Jenssen 2007).

The Ministry of Environment is currently the lead agency for drafting a new Water Sustainability Act (WSA), which is an evolution of the Freshwater Strategy of 1999, and "Living Water Smart–BC's Water Plan" and amounts to a modernisation of the province's Water Act. The government's website (http://www.livingwatersmart.ca/) encourages the public to contribute to the dialogue on developing the new legislation, and says:

> Beginning in January 2011, Ministry of Environment staff will explain key features of the WSA in greater detail on the Living Water Smart Blog (http://blog.gov.bc.ca/livingwatersmart/).

Modernising the Water Act is about making our water laws simpler to understand, communicate, administer, and enforce to respond to current and future challenges. New information about the four goals that are shaping the Water Act review is now online:

- Protecting stream health and aquatic environments
- Improving water governance arrangements
- Introducing more flexibility and efficiency in the water allocation system
- Regulating ground water use in priority areas and for large withdrawals

3.6.1.1 Water licensing background

Under provisions in the Water Act, all surface water is owned by the Crown on behalf of the residents of British Columbia. Aquifers are treated differently from surface water as access to groundwater is not licensed, and the right to access an aquifer on your property does not require a licence (Jenssen 2007).

A water licence entitles the holder: to divert and use water for the purpose and time stipulated for the quantity of surface water specified in the license; to store surface water; to alter or improve a stream or channel; and to construct, maintain, and operate the works authorized under the license and necessary for the proper use of the water or of the power produced from it. The rights of the licensee supersede those of anyone else's right to use, divert, or affect that particular water source (Jenssen 2007).

Water licenses are granted on a "first come, first served" principle, which, in theory, means that the oldest license gets access to their water allotment prior to all other licenses on the same water source. Short-term water licenses under Section 8 are given a limited timeline and are used for purposes such as road spraying. This water licence could allow for withdrawal from an adjacent stream. Short-term licenses are for a small quantity over a short period of time (Jenssen 2007).

All water licences are allotted a quantity. For example, a domestic water licence is allocated 2,273 litres per day for each dwelling. It is an offence, and the water licence can be revoked, if a user applies for one purpose and uses the water for another, i.e., at a cheaper rate. It is also an offence if the water licensee does not make "beneficial use of water." If a user is granted a domestic water licence and does not install waterworks, the water licence can be revoked. Water licences have no end date, except for Section 8 short-term licences, but as a condition of the water licence, there is a deadline for when the waterworks must be in place, and annual license fees must be paid. A water licence holder is charged an annual fee and a volume fee. The charge is based on the amount allotted and the intended end use as stipulated in the license. In 2001, a fee review of water rates was requested by the provincial Cabinet. New rates are based on a cost-recovery model to be fully implemented by 2009. Rates range from $0.001/m3 for water storage for conservation purposes to $1.10/m3 for mining operations. Cabinet instructed the Ministry of Environment not to increase rates for the domestic or irrigation sectors, and to increase the rates for mining and industry (Jenssen 2007).

There are approximately 45,000 licenses issued to 30,000 clients, which means that some clients hold multiple licenses. The biggest water customer in the province is BC Hydro. Local authorities for waterworks and irrigation users report on their water consumption annually and are billed by

the Ministry of Environment according to the volume consumed. All other water licence holders are billed for the water allocated in the licence regardless of the actual water use (Jenssen 2007). According to the water licensees interviewed during this project, water usage is not monitored for small private domestic water users in the Alberni Valley.

There is the challenge of maintaining affordable water rates so that user groups do not turn en-masse to the use of groundwater, which currently does not require a water licence to access. Water licences can be relinquished or modified if the user conserves or uses less so that the user pays only for the consumed or allocated amount. For example, if a pulp mill recycles its grey water for other industrial purposes and uses less water, it can reduce its water licence and pay lower fees. However, if a user amends a water licence, the water rights attached to the licence are permanently lost. Bulk water transfers are prohibited under the Water Protection Act; it is prohibited to remove water from the province or transfer water from one major watershed to another (Jenssen 2007).

There are nine classified major watersheds in the province:

1. Fraser watershed
2. Mackenzie (Peace) watershed
3. Columbia watershed
4. Skeena watershed
5. Nass watershed
6. Stikine watershed
7. Taku watershed
8. Yukon watershed
9. Coastal watershed (includes watersheds on Vancouver Island and the rest of the province not outlined above)

An exception to the ban on removal of water from British Columbia is made for carrying in vehicles, vessels, or aircraft for the use of persons or animals being transported, or in the removal of water in containers 20 litres or less in volume. This exception permits bulk water removal in the form of exported bottled water (Jenssen 2007).

3.6.1.2 Legislation for community watersheds under the Forest & Range Practices Act and Regulation

British Columbia is a unique province in that most of the population derives its water from surface water. Approximately 86% of the population uses surface water as its drinking water supply (Ministry of Forests 1996).

Most community watersheds in British Columbia are quite small in area. A small watershed area usually means the intake is close to potential contaminants, stream response times are short, and opportunities for dilution or settling are small. These watersheds are therefore sensitive, and applications of Community Watershed Guidelines are essential to maintain water quality and quantity (Ministry of Forests 1996).

Community Watersheds were defined in 1980 as the drainage area above the downstream point of diversion on a stream for water that is for human consumption and that is licenced under the Water Act for waterworks or domestic purposes. In 1980, the criteria for the selection of community watersheds included:

1. A water licence held by a community for drinking water.
2. Greater than 50% of the watershed held by the Crown.
3. A drainage area less than 500 km2 (Ministry of Environment, Water Stewardship Division [WSD], Community Watersheds, home page accessed April 2, 2010).

In September 1992, a multi-agency Technical Advisory Committee comprised of BC government representatives was formed to:

1. Develop new guidelines for protecting drinking water in community watersheds from the impacts of multiple resource use, such as logging, road building, recreation, agriculture, etc.
2. Update the original list of community watersheds compiled in 1977.

In November 1993, the Forest Practices Code of British Columbia Act was proposed and it was decided to incorporate many of the Community Watershed Guidelines relating to forestry activities into the Forest Practices Code (Ministry of Environment, WSD, Community Watershed Definition home page, accessed April 2, 2010). The selection criteria to qualify for Community Watershed designation was then revamped to read as follows:

> The drainage area above the most downstream point of diversion on a stream for a water use that is for human consumption and that is licensed under the Water Act for:
>
> 1) a waterworks purpose, or
>
> 2) a domestic purpose if the licence is held by or is subject to the control of a water users' community incorporated under the Water Act; or
>
> 3) if the drainage area is not more than 500 km2 and the water licence was issued before June 15, 1995 (Ministry of Environment, WSD, Community Watershed Definition home page, accessed April 2, 2010).

Community Watersheds can include both private and Crown land. A notable change for Community Watersheds is that the Forest Practices Code is only enforceable on Crown land.

This definition excluded communities whose source of drinking water is provided by lakes and springs. Some of the lake sources are being reviewed and will be designated as community watersheds where appropriate. A procedure is being developed for defining the source area for springs so that these can also be considered under Section 41(10) (Ministry of Environment, WSD, Community Watershed Definition home page, accessed April 2, 2010).

In addition, there are watersheds where the community water use of a stream may be somewhat less well defined than the waterworks systems defined above, but where the concept of a community using the water is still recognised. These include individual water users and/or joint works water system that are licensed under the Water Act for domestic purpose (Ministry of Environment, WSD, Community Watershed Definition home page, accessed April 2, 2010).

3.6.1.3 Designated community watersheds in Tree Farm License (TFL) 44

The Province of British Columbia reached a Settlement Agreement with MacMillian Bloedel Ltd (MB) in 1999 for the timber harvesting rights the company lost due to the creation of provincial parks on Vancouver Island since 1991 (Alberni Environmental Coalition 1999).

Tree Farm Licence 44 Schedule A lands:

> Lands included in the agreement include almost all of the Schedule A land within the TFL (73,820 ha), which is concentrated in two large blocks extending northwest (area of Somass and Ash rivers) and southeast (Cameron River area) from Port Alberni, and the remainder scattered in parcels further west across the TFL.

Tree Farm Licence 44 Schedule B Lands:

> Lands include scattered pieces in the vicinity of Esary and Lizard Lake (approximately 828 ha) located near Port Alberni (Alberni Environmental Coalition 1999).

In 1999, Weyerhaeuser Corporation acquired MB`s forest assets (Macauley 2007). In 2004, the private lands held by Weyerhaeuser were removed from TFL 44 and Weyerhaeuser then sold its assets on Vancouver Island to Brascan, which moved the private lands to Island Timberlands (Macauley 2007).

3.6.1.4 Designated community watersheds within Private Managed Forest Lands

In 2004, when the private lands under the jurisdiction of Tree Farm Licence (TFL) 44 were taken out of the Forest Practices Code of British Columbia Act, a new act was created for these private lands called the Private Managed Forest Land Act (PMFLA).

What that meant for watersheds in the Alberni Valley is that they no longer were under the Ministry of Forest and Range jurisdiction, but now under a new entity, the Private Managed Forest Land Council (PMFLC). The PMFLC is a public-private agency established under the PMFLA. The Council is accountable to the government, managed forest land owners, and to the public (Ministry of Finance, Private Managed Forest Land Council, accessed April 3, 2010). The watersheds on these private lands are bound by the Drinking Water Protection Act enforceable by the Ministry of Healthy Living and Sport, and the Council is responsible for enforcement of forest practices under the PMFLA (Ministry of Finance, Private Managed Forest Land Council, accessed April 3, 2010).

The province offers financial incentives to landowners who agree to some government control over the way they manage their lands for timber production. The Act sets out very general objectives for soil conservation, water quality, fish habitat, critical wildlife habitat, and reforestation (West Coast Environmental Law, BC Guide to Watershed Law and Planning, accessed April 3, 2010).

The forest practices rules are minimal, and private land logging has been quite controversial on Vancouver Island due to impacts on streams, community viewsheds, the rate of logging, etc. (West Coast Environmental Law, BC Guide to Watershed Law and Planning, accessed April 3, 2010).

Critics of the Private Managed Forest Land Act argue that (West Coast Environmental Law 2009):

- The Council is too closely connected to the logging industry owners of managed forest land, resulting in a form of self-regulation.
- Higher practices standards should be required on private managed forests to protect the publicly owned resources affected by logging.
- Local governments should be able to place some controls on private managed forest lands.
- Many if not most of the logs from private lands are exported, resulting in little economic benefit to the province.

A local example of an issue with the inadequacy of the Private Managed Forest Act and its general objectives reads as follows:

The complex geology of the Beaufort Range plays a major role in catchment, recharge, storage, and release of large quantities of groundwater that resurface as numerous springs from the Alberni Highway to the Ash River valley, a distance of about 22 kms (Robinson 2008).

Field observation of karst terrain/features (including an unusual deposit of precipitated calcite in a surface stream), personal communication, topographic and karst mapping, and chemical analysis of various water supplies strongly suggest that major karst drainage systems have developed in the limestone bedrock deposits. These karst systems play a major role in the catchment of surface water, storage, and lateral distribution of groundwater, intersecting geologic faults, fractures, and non-karst sedimentary bedding planes (Robinson 2008).

The absence of karst-specific regulatory standards to protect and conserve key public environmental resource values such as drinking water source areas, wildlife and fisheries on private managed forest lands is a major concern for most water purveyors, area residents and environmental groups (Robinson 2008).

3.6.1.5 Designated community watersheds in the Esquimalt & Nanaimo (E&N) Land Grant

Lands along the Beaufort Range (the ridge that forms the east boundary of the Alberni Valley, north of the city) were originally part of the E&N land grant in the 19th century and were never part of any TFL (Macauley 2007). Cold Creek Designated Community Watershed (Cherry Creek Water Works District's source) is located in the Beaufort Range.

3.6.1.6 Administrative requirements under the Forest and Range Practices Act

In January 2004, the Forest & Range Practices Act replaced the Forest Practices Code. Under the Act:

> Community Watersheds Section 150 (1) The Lieutenant Governor in Council may make regulations:
>
> (a) authorising;
>
> The Minister of Sustainable Resource Management (now the Minister of Agriculture and Lands) to designate an area of land in a watershed as a community watershed, or
>
> (ii) the Minister of Water, Land and Air Protection (now the Minster of Environment) to establish water quality objectives in relation to a community watershed, and

(b) prescribing the circumstances in which the discretion conferred in the authorization may be exercised.

Section 150 (2) The Lieutenant-Governor-in-Council [Cabinet] may make regulations respecting community watersheds, including but not limited to prescribing requirements in relation to community watersheds (BC Laws 2010).

The Ministry of Environment's authority under the Forest and Range Practices Act includes Community Watershed and water quality objectives.

Government Actions Regulation:

Section 8(1) The minister responsible for the Land Act by order may designate as a community watershed all or part of the drainage area that is upslope of the lowest point from which water is diverted for human consumption by a licensed waterworks, if satisfied that, to protect the water that is diverted for human consumption, the area requires special management, that is not otherwise provided for under this regulations or enactment,
(a) to conserve the quality, quantity and timing of water flow, or
(b) to prevent cumulative hydrological effects that would have a material adverse effect on the water.

Section 8 (2) The minister responsible for the Wildlife Act by order may establish for a community watershed water quality objectives respecting a matter referred to in subsection (1) (BC Laws 2004).

Under the Forest Planning and Practices Regulation, objectives set by the government in Community Watersheds include:

Section 8.2 (1) In this section "Community watershed" means a community watershed (a) that is continued under section 180 (e) of the Act, and (b) for which a water quality objective has not been (i) continued under section 181 of the Act, or (ii) established under the Gover4nment Action Regulation.

Section 8.2 (2) The objective set by government for water being diverted for human consumption though a licensed waterworks in a community watershed is to prevent to the extent described in subsection (3) the cumulative hydrological effects of primary forest activities within the community watershed from resulting in

(a) A material adverse impact on the quantity of water or the timing of the flow of the water to the waterworks, or

(b) The water from the waterworks having a material adverse impact on human health that cannot be addressed by water treatment required under
(i) an enactment, or
(ii) the licence pertaining to the waterworks.

Section 8.2 (3) The objective set by government under subsection (2) applies only to the extent that it does not unduly reduce the supply of timber from British Columbia's forests (BC Laws 2004).

A notable change to the protection of drinking water under the Forest & Range Practices Act and the Private Managed Forest Land Act is that local communities are required to use water

treatment to address water quality issues, and that the Ministry of Environment water quality objectives are secondary to timber supply.

> Section 8.2 (5) Community watershed boundaries can include both Crown and private lands that are defined by that area upslope of the lowest point form which water is diverted for human consumption by a licensed waterworks. The guidelines and procedures document only applies to Crown lands held by agreement holders pursuant to the Forest and Range Practices Act and its Regulations within a community watershed.

For lands not administered under the Forest & Range Practices Act, Ministry of Environment staff should endeavour to utilize other available legislation, e.g., the Water Act, to ensure that other lands within a community watershed are managed in a manner consistent with the community watershed water quality objective. A more comprehensive approach will help protect water quality (BC Environment 2008).

3.6.1.7 Community watersheds designation, amendment, and cancellation under the Forest and Range Practices Act

The authority for the designation, amendment, and cancellation of community watersheds under the Forest & Range Practices Act and Regulation was transferred to the Deputy Minister of the Ministry of Environment from the Minister of Agriculture and Lands in 2007. Pursuant to section 8(2) Government Actions Regulation (GAR), the Minister of Environment may also establish water quality objectives for a community watershed.

The Ministry of Forests is responsible for ensuring that the results and strategies in licensee Forest Stewardship Plans are consistent with community watershed designation and any associated water quality objectives (Ministry of Environment 2008).

Community watershed status may be amended or rescinded if:

- the lowest point of diversion (POD) within a watershed is lower or higher than originally mapped, thereby changing the boundaries of the community watershed;
- the water licence(s) authorising the works is cancelled or abandoned;
- the water licence(s) are amended to exclude use for human consumption;
- the category of water licence described in 5 is dissolved or becomes non-functional;
- the medical health officer, as defined in the Health Act, has deemed that the quality of the water poses a long-term health hazard and should not be used for human consumption (BC Environment 2008).

According to staff at the Ministry of Environment, the Designated Community Watersheds portfolio has been in limbo for the last couple of years, however Ministry of Environment staff are expecting the Ministry of Healthy Living and Sport will take over the responsibility (Ministry of Environment, T. Pobran, personal communication, April 8, 2010).

3.6.1.8 Geological and hydrogeological responsibilities

Little information was found on the geology or hydrogeology of the Alberni Valley. Local knowledge advises that the complex geology of the Beaufort Range plays a major role in catchment, recharge, storage, and release of large quantities of groundwater that resurface as

numerous springs from the Alberni Highway to the Ash River valley, a distance of approximately 22kms (Robinson 2008).

Field observation of karst terrain/features; including an unusual deposit of precipitated calcite in a surface stream, personal communication, topographic and karst mapping and chemical analysis of various water supplies STRONGLY suggest that major karst drainage systems have developed in the limestone bedrock deposits. These karst systems play a major role in the catchment of surface water, storage and lateral distribution of groundwater intersecting geologic faults, fractures and non-karst sedimentary bedding planes (Robinson 2008).

Calcareous deposit VANISL 76, for example, has two major karst groundwater systems that basically flow in opposite directions. One of these groundwater systems appears to flow towards Lacy Lake, while the other recharges the Cascade Cave/Hobbit Hole system. Its downstream resurgence is the primary water supply for residents of the Elkford Road, Mountain View Mobile Home Trailer Park, Export Road, Alberni Highway, and Alberni Veterinary Clinic. In 2002, 34 area residents petitioned the Ministry of Forests "to act to protect our water supply" from "proposed logging and road building on Carbonate Unit 76 Karst Lands" (Robinson 2008).

The other VANISL 76 karst system appears to support the Cherry Creek Waterworks intake, which is installed in a small river reservoir a short distance downstream from Lacy Lake. A submerged resurgence within Lacy Lake provides the primary recharge for the lake, downstream reservoir and Cold Creek. Dye tracing would eliminate the element of uncertainty. The Cherry Creek Waterworks provides drinking water for approx. 2500 residents (Robinson 2008).

Chemical analysis of the China Creek water supply for the City of Port Alberni, plus personal communication, topographic and karst mapping, indicate a hydrologic connection to calcareous deposit VANISL 129. Preliminary evidence suggests there are at least two major karst systems associated with VANISL 129 as well; one recharges Duck Lake, while the other recharges Lizard Lake (plus non-karst catchment). During summer, the main valve at the Lizard Lake reservoir is opened to satisfy demand. Both lakes contribute water to the city's China Creek water supply. (Robinson 2008).

Approximately 80-90% of the total catchment area for all of the above mentioned water supplies is located on privately owned land subject to Private Managed Forest Land Council (PMFLC) regulations (Robinson 2008).

The absence of karst-specific regulatory standards to protect and conserve key public environmental resource values such as drinking water source areas, wildlife and fisheries on private managed forest lands is a major concern for most water purveyors, area residents and environmental groups (Robinson 2008).

The calcareous limestone and dolomite bedrock exposures were originally mapped between 1931 and 1952 via aerial photographs taken by the Royal Canadian Air Force, and from surveys by the (then so named) British Columbia Department of Lands and Forests.

Calcareous deposits of the Mount Mark formation are usually conformably underlain by argillite, siltstone, chert, and greywacke of the Cameron River Formation (Muller's "sediment-sill" unit), but sometimes rest unconformably on volcanics of the McLanghin Ridge and Nitinat formations.

Basaltic flows of the Upper Triassic Karmutsen Formation unconformably overlie the limestone (Fischl 1992).

In 1995, a number of goals for the management of karst were identified by the Chief Forester (Robinson, personal communication, Sept 30, 2010). One of the initiatives resulted in classification of carbonate units to determine the potential for karst in the calcareous bedrock exposures identified in the earlier Geological Survey Branch's survey. In 1999, Terra Firma Geoscience Services and Cave Management Services classified calcareous deposits for their Karst potential (see Figure 10). Red colour indicates a high potential for karst. Three criteria were used. Criteria #3 identified the presence of caves or major karst features; it is used to highlight polygons of documented or observed karst development. Polygons are highlighted with light cross-hatching and the polygon numbers are labelled c, k, or ck to indicate the presence of known caves, major karst features, or both, respectively (Terra Firma Geoscience/Geosoft Systems 1999).

Several significant limestone outcrops of the Mount Mark Formation Group with a high potential for karst and known major karst features and caves were identified in the Alberni water supply catchment areas (R. Robinson, personal communication, Oct 2010).

Karst potential needs to be updated with ground research because the karst that has been documented was limited to exposed calcareous bedrock outcropping features. Field research for this report identified karst features other than those in Figure 10, which highlights the need for further investigation.

3.6.1.9 Watershed protection

It is not required to have a watershed protection plan in place for drinking watersheds. Some barriers to achieving a sound water plan include the fact that our current provincial government does not allocate funds for this purpose, the high cost of planning processes, and the continued importance placed on the economy over the environment (Jenssen 2007).

It would be beneficial to implement watershed planning for key provincial watersheds that considers the water in the stream, the stream network, and the land management impacts that affect the quality of the streams, such as road construction and pesticide application. BC lags behind other provinces in legislated watershed planning. Entrenched watershed management plans exist in Ontario and Manitoba, but in BC, there is no policy to support mandatory watershed management plans and there are no funds allocated to support planning processes. Plans and planning processes can be expensive. There used to be policies for integrated watershed management plans that looked at source water impacts on water for water quality purposes, and at water within the stream used for water supply purposes. These have been superseded by other policies. In general, the people who want to make decisions on water quality (as opposed to, say, industrial activities within watersheds) do not have the power to make those important decisions. Water is an essential service and should be treated as such without political agendas (modified from Jenssen 2007).

Figure 10. Map of the karst geology in the Alberni Valley

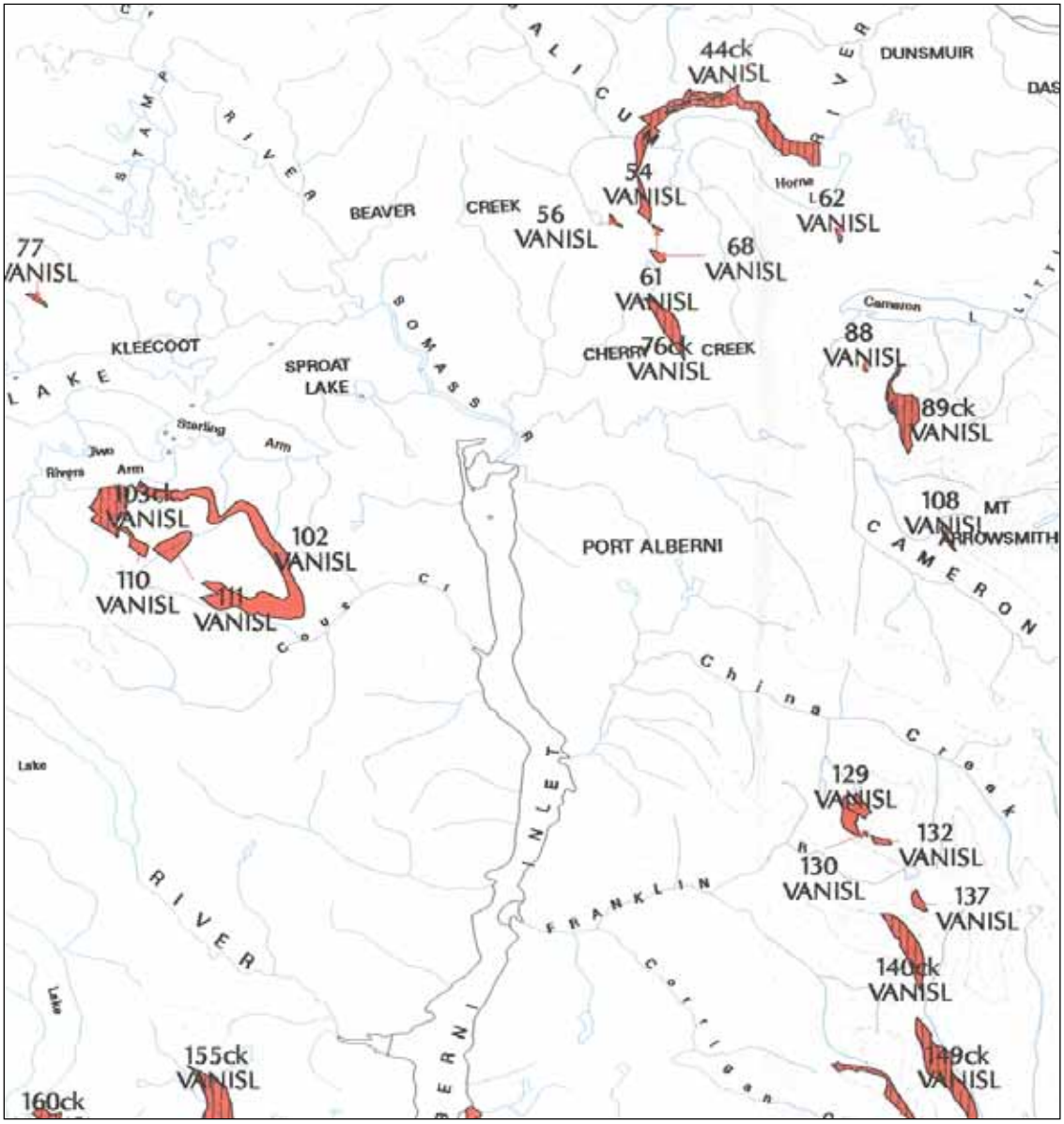


Image from Terra Firma Geoscience/Geosoft Systems, 1999; File # 16400-20/Karst Map 092F Criterion #1, #2, #3: Reconnaissance Karst Potential Mapping and Inventory For British Columbia: Testing of KISP1 Methodology).

Most of the watersheds in the Alberni Valley are on Private Managed Forest Lands (see Figure 11). This poses an immediate challenge to the management of the water resource in direct competition with other resources such as timber and mining. This was not always so. Up until the 1960s watersheds were protected reserves. In 1957, a comprehensive investigation was painstakingly summarised in the *Continuous Forest Inventory of British Columbia* by the Lands and Forests Service. Drinking watershed sources were identified in the inventory, alongside the few public parks, as off-limits for inclusion in the sustained yield land base for commercial logging. Successive inventories continued to state the same restrictions about drinking watersheds as late as 1975 (Koop 2006).

In 1957, the *Continuous Forest Inventory of British Columbia* stated that in watersheds "the forest land for which the best current use is to continue as watersheds, and to preserve the far-back headwaters of river systems from erosion." Therefore, since the 1960s, the best current use for watersheds changed (Koop 2006).

In 2002, 34 area residents petitioned the Ministry of Forests "to act to protect our water supply" from "proposed logging and road building on Carbonate Unit 76 Karst Lands." The absence of karst-specific regulatory standards to protect and conserve key public environmental resource values, such as drinking water source areas, wildlife, and fisheries on private managed forest lands is a major concern for most water purveyors, area residents, and environmental groups (Robinson 2008). In 2002, their petition was successful. In 2010, petitioning the MOF would no longer be an avenue open to such requests as this is now private property subject to self-regulation via the PMFLC. Harvest plans are again imminent for Carbonate Unit 76 (Leine, Island Timberlands, personal communication, July 5, 2010).

Ultimately, the most economical way to protect a drinking watershed is to maintain the water source, rather than process it through treatment facilities that cost millions of dollars to build and maintain. Davies and Mazumder (2003) clearly state that "the relationship between surface – source and finished water quality, in its simplest form, is that cleaner source water requires less intense water treatment and has lower associated acute and chronic health risks" (Jenssen 2007).

Buffer zones around a community watershed would vary in maximum distance dependent on a number of variables such as the slope, stability of the soil, forested, grassland, soil type, potential for erosion, geology of the area, and what activities are occurring in the watershed (Jenssen 2007).

Figure 11. Map of Private Managed Forest Lands in the Alberni Valley

Map image from the Ministry of Agriculture and Lands.

Streams in figures 12 and 13 (taken 2010) are tributaries of the Somass River upstream of the Beaver Creek Improvement District Water intake. Figure 13 (taken 2008) is at the City of Port Alberni's China Creek water intake. These photos highlight the need for buffer zones in watershed areas.

Figure 12. Washouts along Log Train Trail taken Jan 2010.

Reprinted with permission of ACRD.

In Figure 14 (the China Creek intake site), the clearcut slash area can be seen clearly through the scant row of trees acting as the buffer zone for the City of Port Alberni's water intake.

In 2001, the Alberni Valley Enhancement Association commissioned a study by LGL Limited Environmental research associates. The study was called *Stream Corridor Management Plan for Beaver and Big Hal Creeks* (Gaboury 2001).

The purpose of this study was the development of a stream channel and corridor management plan incorporating specific Best Management Practices (BMPs) to guide land and stream management, seen as fundamental to maintaining and rehabilitating habitats and water quality within these watersheds (Gaboury 2001). Recommendations from the report included:

1. Protect, maintain, and restore the creek by establishing and adhering to a Stream Corridor Management Plan.
2. Maintain and restore a diverse stand of riparian vegetation a minimum of 20 m wide along each bank of the stream corridor.

Benefits of following the recommendations:

- Improved conveyance of low and moderate discharges and reduced flooding of adjacent public and private lands
- More agricultural production from adjacent crop, pasture, and hay lands
- More functional stream channels with meanders, pools, and riffles

- Improved rearing habitat for coho and cutthroat trout
- Stable banks that reduce erosion and release of sediment that can cover spawning habitat and suffocate fish eggs
- Improved water quality as a result of sediment and nutrients being filtered by riparian zones
- Increased shading that cools the water, increases the amount of dissolved oxygen, and reduces in-stream vegetative growth
- Preservation and improvement of habitat for a variety of bird species
- Improved riparian zones with functional and diverse vegetative communities

Figure 13. Tree debris in stream. Photo taken Jan 2010

Reprinted with permission of ACRD.

3.6.1.10 Water quality objectives

Water quality guidelines are environmental benchmarks that are set by the MOE, Environmental Protection Division (EPD). They are safe levels of substances for the protection of a given water use. They are developed in order that water quality data can be assessed and site-specific water quality objectives can be prepared (MOE EPD 2006). Fifty-one water quality guidelines have been developed, and seven are being developed or reviewed (MOE 2006).

Figure 14. China Creek water intake for City of Port Alberni. Photo taken May 2008

Reprinted with permission of Gail Morton.

Water quality objectives are prepared for specific bodies of water. Objectives are prepared for waterbodies and for water quality characteristics that may be affected by man's activity, now or in the foreseeable future (MOE 2001).

Objectives are set on a site-specific basis (MOE 2001, 2006) with due regard for the water quality, water uses including aquatic life, water movement, waste discharges, and socio-economic factors at a given location. The objectives are based on scientific guidelines called water quality criteria, which relate to physical, chemical, or biological characteristics of water, biota, or sediment that protect the most sensitive designated water uses (MOE 2001).

Water quality criteria are a maximum and/or minimum values applicable province-wide, which must not be exceeded to prevent specified detrimental effects from occurring to a water use, including aquatic life, under specified environment conditions (MOE 2001). The objectives are policy guidelines for resource managers to use in protecting water users in specific waterbodies (MOE 2001).

Water Quality Objectives and Criteria are set after a five-step review process, each new draft incorporating appropriate corrections reflecting the review comments made (MOE 2001). Public consultation is not included in the review process.

To develop water quality objectives for a waterbody, a knowledge of the following is required in relation to the physical, chemical, or biological characteristics of water, biota, or sediment (MOE EPD 2001). The criteria provide, insofar as possible:

- information on short-term (acute) and long-term (chronic) effects, persistence, accumulation in biota or sediment, antagonism or synergism with other substances, and environmental fate of substances;
- the existing and potential quality of the waterbody;
- the temporal and spatial variability of water, biota, sediment characteristics;
- the existing and potential aquatic life in the waterbody, including species, geographic distribution of species, life history or stage use, the presence of rare or endangered species, and the importance of the aquatic life to humans;
- the flow or circulation pattern of the waterbody, and its relation to the quality of water, sediments and aquatic life;
- the existing and potential loadings of contaminants from point and diffuse sources, and their relation to water movement and quality, including the behaviour of the contaminants in the local water; and
- the existing and potential uses of the water by humans.

Assimilative capacity is the ability of a waterbody to receive contaminants without impairing the use of the water by humans, plants, and animals. The concept is controversial. It is difficult to define the assimilative capacity as it is different for each contaminant. Interrelated measurements of water quantity and quality, sediments, and aquatic life must be made. The pressure to use assimilative capacity can be high, especially in cases requiring costly pollution control measures to maintain water quality (MOE EPD 2001).

Assessing whether objectives are being met can be difficult because of the temporal and spatial variability of water quality. The BC Water Quality Index is based on the [level of] attainment of water quality objectives. The objectives are safe [within the available information being reviewed] limits set by the ministry to protect all the uses of a body of water. If monitoring shows that all objectives are usually met everywhere in a water body, all the time, then the index will be close to zero, indicating excellent water quality. The more monitoring shows that objectives not being met, the more the index [value] increases, indicating a worsening of water quality. The index is applicable to any body of water for which objectives have been set and tested.

A limitation with the index is that it provides a general statement about water quality that cannot always show the effect of local variations or random short-term events, such as a spill, unless it occurs more frequently or for a longer time. Also, water quality on which the index is based does not always account for habitat changes, such as low water levels, high stream velocities, or disruption of gravels. These factors would be incorporated into an ecosystem index, the development of which remains a challenge for the future (MOE, EPD 2001).

3.6.1.11 Air quality

The main concern at the air/water interface is that anything falling out of the air into lakes and streams could potentially affect that water quality for both aquatic life and for those who drink the water. Particulate matter 2.5 (PM2.5) (particles that are 2.5 microns and smaller) are a cause for concern. The very size of the particles poses problems to health, as they are small enough to pass from our lungs into our blood stream and can lodge in many tissues other than the lung. If the particles are not expelled, and if they happen to be toxic, they can become the seeds of diseases such as cancer. Even if the PM2.5 particles do not carry toxins, their size and volume can lead to various reactions, including changes to lung and heart tissues, even death (Port Alberni Air Quality Council, Jan 12, 2010).

3.6.1.12 Alberni Valley survey

The Ministry of Environment Water Stewardship Division was given the opportunity to participate in a survey about Alberni Valley drinking water. The survey questions included requests for information about watershed protection plans, TFL 44, karst, designated community watersheds, forestry activities, watershed reserves, water quality objectives, water quality changes in the Alberni Valley, etc. Their answers would have been part of this project; however, after five months of reminders, no survey reply was received.

3.6.2 Ministry of Health Services

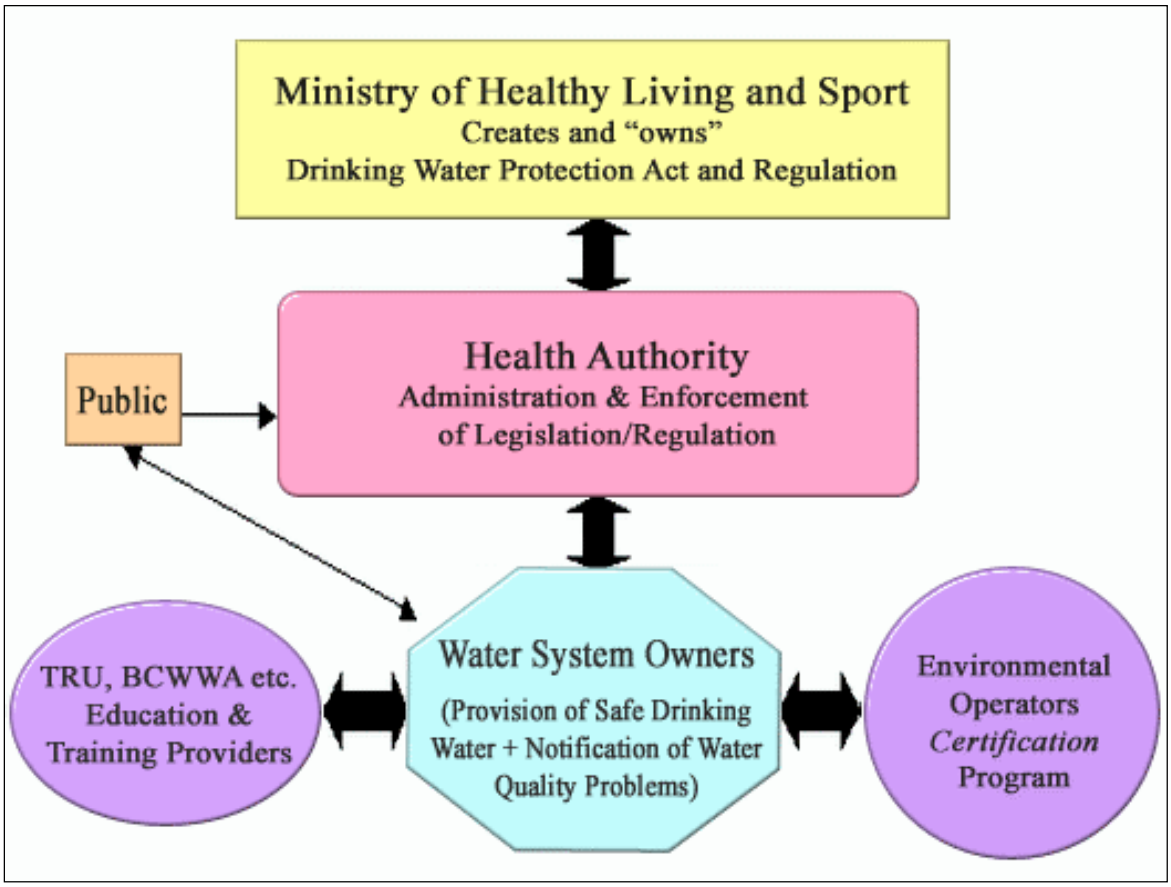
British Columbia is the only province where the enforcement of water quality standards falls under the Ministry of Health Services, not under the BC Ministry of Environment or federal Department of Natural Resources (Jenssen 2007).

Prior to 1992, drinking water quality standards were regulated under the Health Act through the Sanitary Regulation. This regulation prohibited the contamination of source waters and specified setback distances required between sources of contamination and water supplies. In October 1992, the Safe Drinking Water Regulation was brought into force, which, pursuant to the Health

Act, regulated the construction and operation of waterworks systems. In 2002, the Action Plan for Safe Drinking Water was formed and the Ministry of Health was designated as the lead agency responsible for implementing the plan. This Action Plan led to the Drinking Water Protection Act (DWPA). The Ministry of Health (now called Ministry of Health Services) is responsible for ensuring that the DWPA is applied throughout the province, and that staff and other resources are available to administer the legislation (Jenssen 2007).

Outlined in Figure 15 is the organisational structure of water quality authorities in BC.

Figure 15. BC Water Quality Authorities



This figure was taken from the Ministry of Healthy Living and Sport website, accessed July 8, 2010.

The Drinking Water Protection Act establishes certain requirements for water operators to ensure the provision of safe drinking water. In summary, the Act requires:

- the approval of water construction proposals by Public Health Engineers
- minimum water treatment standards, monitoring/testing and specifies water quality standards
- water operators to have microbiological samples analysed by an approved laboratory and to release the water quality report to their customers annually
- public notification of water problems
- that water operators serving more than 500 individuals become certified through the Environmental Operators Certification Program

Table 2 shows the number of public water connections and water systems on Vancouver Island in 2007.

Table 2. Public Water Systems on Vancouver Island

Number of Public Water Connections	Number of Public Water Systems
More than 300	53
15-300	189
2-14	266
1 public connection, such as a park, restaurant, logging camp	316
Total	824

From Comox Valley Drinking Water Reference Guide (p.60), Jenssen 2007. Reprinted with permission.

The Drinking Water Protection Act came into force in 2003 [amended 2005] and applies to all public water supply systems in the province that are larger than a single-family dwelling. A public water supply system is defined as any drinking water system that serves water to the public; a privately-owned system is subject to the same regulations. There are approximately 4,000 public water systems in BC, not including the 302 water systems in First Nations communities across the province. Of the 4,000 public water systems provincially, 824 are on Vancouver Island, again, not including those on Indian Reserves. First Nations communities are under federal jurisdiction with separate health inspectors and regulations (Jenssen 2007).

The Act requires public water supply system operators to be certified. Water suppliers are now required to notify the public of water quality concerns or problems, classified as "water quality advisories," "boil water notices," or "do not use water" notices. The Act brought a multi-barrier approach to water safety that recognises that drinking water needs to be protected in its entire path as it travels from the source to the tap. The multi-barrier approach monitors water quality at the various stopping points and includes public water supply systems assessments, source water protection, water treatment, distribution system maintenance and upgrades, water quality monitoring and operator training and certification (Jenssen 2007). Outlined in Table 3 are the water quality parameters and standards for potable water according to the guidelines for Canadian drinking water quality.

Table 3. Water quality parameters and standards for potable water

Parameter	Standard
Fecal coliform bacteria	No detectable fecal coliform bacteria per 100 ml
Escherichia coli	No detectable *Escherichia coli* per 100 ml
Total coliform bacteria a. One sample in a 30-day period b. More than one sample in a 30-day period.	 No detectable total coliform bacteria per 100 ml At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml

From Comox Valley's Drinking Water Reference Guide (p.61), Jenssen 2007. Reprinted with permission.

Water quality standards take direction from the *Guidelines for Canadian Drinking Water Quality*, which serve as guidelines and allow for flexibility for the local authorities to take into account local risks, needs, and resources. Under the Drinking Water Protection Act, drinking water must be disinfected if the water originates from surface water or groundwater that is at risk of containing pathogens. A minimum level of chlorine is required in drinking water that is between 0.25 and 0.3 parts per million (ppm). There are three drinking water quality standards (a standard is a specific target of water quality) in the Act for *E. coli*, fecal coliforms, and total coliforms. These are the only three that exist for water quality standards, and all communities have to make sure that they actually meet these standards (Jenssen 2007).

Outlined in Table 4 are the Health Authorities' requirements for the frequency of drinking water samples required to ensure water quality objectives are met by the water providers.

Table 4. Frequency of Monitoring Samples for Prescribed Water Supply systems (1)

Population served by the prescribed water supply system	Number of Samples required per month
Less than 5,000	4
5000—90,000	1 per 1,000
More than 90,000	90 per 10,000

From Comox Valley Drinking Water Reference Guide, Jenssen 2007. Reprinted with permission.

"(1) Prescribed water supply system" is a water supply system that is of a class prescribed by regulation. These types of systems must have a written emergency response and contingency plan in accordance with regulations (Jenssen 2007).

All cases of waterborne illnesses are to be reported, as required by the Health Act Communicable Disease regulation. The most prevalent global health risks associated with drinking water are pathogenic bacteria, protozoa, and viruses, such as:

- Bacteria: *E. coli*, *Vibrio cholerae*, Shigella, *Campylobacter jejunni*, Salmonella, *Yersinia enterocolitica*
- Protozoans: *Giardia lamblia*, *Cryptosporidium parvum*, *Entamoeba histolytica*, *Toxoplasma gondii*, *Balantidium coli*
- Viruses: Norwalk and Norwalk-like, Rotavirus, Hepatitis A and E (Davies and Mazumder 2003 in Jenssen 2007)

Some programs in place to help monitor and maintain drinking water quality are: the off-stream watering program that promotes locating cattle watering stations away from watercourses, the environmental farm plan program that promotes environmental stewardship of farm practices, and the observation well network that monitors groundwater supplies in the province's major aquifers. All of these programs are voluntary. In 2007, a Drinking Water Leadership Council served as the single point of contact on drinking water issues (Jenssen 2007).

In order to check the effectiveness of the Act, the government is in the process of developing performance measures. These measures include investigating:

- the rate of reported intestinal illness

- the number of public water supply systems under boil water advisories
- the number of public water supply systems with trained operators
- the number of drinking water supplies that have been assessed for potential health hazards versus those that have not
- the percentage of the population that receives drinking water that does or does not meet the quality requirements as established in the Act (Jenssen 2007)

As previously mentioned, the provincial government is also in the process of developing a new Water Sustainability Act and is currently (as of January 2011) seeking public input to the process they call "Water Act Modernisation" (see http://livingwatersmart.ca/water-act/framework.html; see also http://livingwatersmart.ca/water-act/docs/wam_tbr.pdf to download the technical background report on the Water Act Modernisation process).

Drinking water data has not been reliably collected across the province; an appointed information management team will aim to create a comprehensive database that will be accessible by all relevant government ministries and professionals. According to the Office of the Provincial Health Officer, there are a number of challenges faced by the government, health authorities, and water suppliers in fully implementing the Drinking Water Protection Act. These challenges include:

- gaps in accountability related to the multiple provincial ministries whose programs, activities, and legislation relate in some way to drinking water yet are not coordinated or reliably interactive
- the lack of routinely collected information about drinking water systems and supplies
- the multiple and potentially competing ways in which watersheds are used
- the lack of true accounting costs incurred in producing high-quality drinking water; i.e., infrastructure, training, monitoring
- the resources need to access training
- the sheer number of small water systems (Jenssen 2007)

3.6.2.1 Drinking Water Program

The Ministry of Healthy Living and Sport (MHLS) manages the water resource through the Drinking Water Program; its mandate is ensuring safe, reliable, and accessible drinking water for all British Columbians (Ministry of Healthy Living and Sport, website accessed July 8, 2010). The purpose of the Drinking Water Program is to:

- develop provincial legislation, guidelines and policies on drinking water;
- ensure that drinking water interests are considered in broader government policy and administration;
- act as a resource for Health Authorities to help provide a consistent approach; administer the Drinking Water Protection Act and the Drinking Water Protection Regulation;
- facilitate the coordination of provincial drinking water training initiatives and liaise and coordinate provincial initiatives which may impact drinking water;
- to consult with drinking water suppliers, educational providers, water associations, and other stakeholders on current drinking water issues

How Drinking Water is Managed in BC

The Drinking Water Program is administered locally by Drinking Water Officers, Public Health Engineers, and Medical Health Officers, who are responsible for direct service delivery in BC's Health Authorities.

Drinking Water Officers (DWOs) provide surveillance and monitoring of drinking water systems that may affect the public's health. They also administer and enforce the Drinking Water Protection Act, the Drinking Water Protection Regulation, and the Health Act, and provide interventions to minimise health and safety hazards.

DWOs and Public Health Engineers are to be contacted prior to the creation or alteration of drinking water systems. Drinking water systems require construction permits and operating permits to ensure that water systems are created and maintained to ensure the safety of the drinking water supplied to customers.

New water systems must also ensure that that they obtain the proper certificates and approvals with other government Ministries. Water suppliers are also required to have the water from their systems analysed for the presence of microbiological pathogens and other indicator organisms by a laboratory approved by the Provincial Health Officer (Ministry of Healthy Living and Sport, website accessed July 8, 2010).

The Drinking Water Protection Regulation sets out requirements for drinking water quality including aspects around treatment, construction and operation of water systems, monitoring, reporting and public notification in the event that water becomes undrinkable for any particular reason (Ministry of Healthy Living and Sport, July 8, 2010).

The Drinking Water Protection Regulation was amended to reflect the needs of small water systems in the Province (those serving under 500 people in a 24-hr period), while continuing to protect public health. The regulation was also changed to address other outstanding and general regulatory changes (Ministry of Healthy Living and Sport, July 8, 2010).

The regulation and its amendments are part of the Province's ongoing work to improve the Province's drinking water protection as outlined in the Action Plan for Safe Drinking Water in British (Ministry of Healthy Living and Sport, July 8, 2010).

3.6.2.2 Drinking water source-to-tap screening tool

In 2004, the Province developed the self-screening tool for use as a secondary method for assessing risk in drinking water systems. This survey is to be completed by the water purveyor on a voluntary basis or as required by the local drinking water officer and submitted to the drinking water officer who evaluates the results. If significant risks are identified, the drinking water officer can determine if a water supplier needs to undertake a comprehensive source-to-tap assessment to further analyse the risks (MHLS website accessed July 8, 2010).

The tool is formatted as a question-and-answer document consisting of 97 questions in the following categories:

- Administration, management, operation, and water system description
- Water source

- Water treatment
- Water storage
- Distribution
- Tap water quality

3.6.2.3 Comprehensive Drinking Water Source-to-Tap Assessment Guideline

The intended audiences for this guideline are professionals who will be conducting assessments, drinking water officers, and water suppliers.

In addition to fulfilling a regulatory requirement, the Comprehensive Drinking Water Source-to-Tap Assessment Guideline (CS2TA) serves as a tool to help water system managers develop a more comprehensive understanding of the risks to drinking water safety and availability. It also helps water system managers learn how to operate more effectively and ensure the best possible water quality and assured quantity. This guideline can be applied both under orders by a Drinking Water Officer or as a voluntary measure by water suppliers wanting to understand risks to drinking water safety in their systems.

Should significant risks to a water system be identified through the drinking water source-to-tap screening tool or by some other means, a DWO can order an assessment of the water system. DWOs can, at their discretion, specify that the CS2TA is used to complete this assessment, either using all of the modules, or taking a more targeted approach and using only the modules that will address the risks identified through the screening tool. Prior to beginning an assessment using this guideline, it is important that the introduction be reviewed in detail for information on the assessment process.

This guideline for conducting assessments in British Columbia provides a structured and consistent approach to evaluating risks to drinking water and satisfying the assessment requirement under Part 3 of the *Drinking Water Protection Act* (DWPA).

The CS2TA is broken into an introduction and eight modules, each of which addresses a different aspect of the drinking water system from source to tap (Ministry of Healthy Living and Sport, July 8, 2010).

3.6.2.4 Drinking water protection plans

The Ministry of Healthy Living and Sport may designate an area for developing a drinking water protection plan.

> Order designating area for planning process:
>
> **31** (1) The minister may, by order made on the recommendation of the provincial health officer, designate an area for the purpose of developing a drinking water protection plan for the area.
>
> (2) The provincial health officer may only recommend that an order be made under this section if
>
> > (a) based on monitoring or assessment results, the provincial health officer is satisfied that a drinking water protection plan will assist in addressing or preventing a threat to

drinking water that the provincial health officer considers may result in a drinking water health hazard, and

(b) no other practicable measures available under this Act are sufficient to address or prevent the drinking water health hazard.

(3) The provincial health officer must consider whether to make a recommendation under this section if requested by a drinking water officer.

(4) A local authority or water supplier may request a drinking water officer to make a request under subsection (3) (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Plan development process:

32 (1) The minister may, by order, establish the process by which a proposed drinking water protection plan for a designated area is to be developed.

(2) Without limiting subsection (1), an order under that subsection may

(a) establish who is to be responsible for preparing the proposed plan,

(b) establish the terms of reference for the plan, or authorise the preparation of some or all of the terms of reference subject to approval by the minister, and

(c) require the establishment of a technical advisory committee in relation to development of the plan.

(3) The terms of reference for a proposed drinking water protection plan must include

(a) the purpose of the plan,

(b) the issues to be addressed in the plan,

(c) a process for public and stakeholder consultation, and

(d) a time limit for completing the plan.

(4) As examples of terms of reference that may be established for a plan, but without limiting the issues that may be addressed, the terms of reference for a drinking water protection plan may include one or more of the following:

(a) whether changes are required to a water supply system, including measures respecting its water source, intake, treatment, storage, transmission and distribution;

(b) whether the operating permit for a water supply system should include additional provisions respecting monitoring, standards or other requirements;

(c) consideration of the economic and social costs and benefits of addressing risks through treatment, source protection or other means;

(d) whether an implementation regulation under any of sections 35 to 38 should be made.

(5) In preparing a proposed drinking water protection plan, consideration must be given to the results or progress of provincial government or local government strategic, operational and land use or water use planning processes within the designated area.

(6) A proposed drinking water protection plan may be prepared in conjunction with a proposed water management plan under Part 4 *[Water Management Plans]* of the *Water Act*.

(7) The minister may, by order, extend the time for completing a proposed drinking water protection plan whether or not the time previously set has expired (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Drinking water officer authority:

33 (1) For the purposes of developing a proposed drinking water protection plan, the drinking water officer may do one or more of the following:

(a) order a water supplier to participate in the process;

(b) undertake investigations, tests and surveys that the drinking water officer considers advisable;

(c) authorise persons to undertake investigations, tests and surveys referred to in paragraph (b).

(2) The drinking water officer or any person authorized under subsection (1) (c) may exercise any of the powers under section 40 *[inspection authority]* for the purposes of investigations, tests and surveys under subsection (1) (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Approval of drinking water protection plan:

34 (1) After a proposed plan has been prepared, it must be submitted to the minister, who must refer it to the Provincial health officer for review.

(2) After the review required by subsection (1), the minister must place the proposed plan and the comments of the Provincial Health Officer before the Lieutenant Governor in Council, who may approve all or part of the proposed plan as a drinking water protection plan.

(3) If a drinking water protection plan is approved under subsection (2), the minister must arrange for the plan to be made public (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Implementing a plan; effect on statutory decisions:

35 (1) For the purposes of implementing a drinking water protection plan, the Lieutenant Governor in Council may, by regulation applicable in relation to all or part of the designated area for the plan, do one or more of the following:

(a) require that persons making decisions or classes of decisions under a specified enactment must consider the plan in making those decisions;

(b) restrict the issuance or amendment of licences, approvals, permits or other authorisations under a specified enactment;

(c) restrict the exercise of a power under a specified enactment;

(d) provide that specified provisions of the plan are a higher level plan for the purposes of the *Forest Practices Code of British Columbia Act*.

(2) Despite an enactment specified under subsection (1), a regulation under subsection (1) (b) may establish requirements that must be imposed in issuing or amending a licence, approval, permit or other authorization under an enactment.

(3) Requirements imposed under subsection (2) are deemed to be imposed under the enactment under which the authorization is issued or amended.

(4) The issuance or amendment of a licence, approval, permit or other authorization contrary to a regulation under subsection (1) (b), or the exercise of a power contrary to a regulation under subsection (1) (c), has no effect (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Implementing a plan; relationship with other planning processes:

35.1 (1) For the purposes of implementing a drinking water protection plan, the Lieutenant Governor in Council may, by regulation, do one or more of the following:

(a) require that other specified provincial government or local authority strategic or operational planning processes, or classes of such processes, consider the drinking water protection plan;

(b) require that the results of specified provincial government or local authority strategic or operational planning processes, or classes of such processes, be consistent with the drinking water protection plan;

(c) provide that specified provincial government or local authority strategic or operational plans, bylaws or other planning documents, or classes of such plans, bylaws or other documents, do not have legal effect to the extent of any inconsistency with the drinking water protection plan.

(2) A provision under subsection (1) (c) applies despite any other enactment (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Implementing a plan; restrictions on well drilling:

36 (1) For the purposes of implementing a drinking water protection plan, the Lieutenant Governor in Council may, by regulation applicable to all or part of the designated area for the plan, restrict or prohibit one or more of the following:

(a) the drilling of wells;

(b) the alteration of wells;

(c) the installation of well pumps;

(d) the conduct of flow tests.

(2) In relation to a regulation under subsection (1), the Lieutenant Governor in Council may, by regulation, do one or more of the following:

(a) prescribe exemptions from a requirement for a drilling authorization under section 81 *[drilling authorisations]* of the *Water Act*;

(b) prescribe requirements for the giving of notice respecting an application for a drilling authorization;

(c) prescribe classes of persons who may appeal a decision respecting such an application under section 92 *[appeals to Environmental Appeal Board]* of the *Water Act* (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Implementing a plan; enforcement of water source standards:

37 (1) For the purposes of implementing a drinking water protection plan, the Lieutenant Governor in Council may, by regulation,

(a) prescribe all or part of a drinking water source,

(b) establish water quality standards in relation to the prescribed drinking water source or part of a drinking water source,

(c) prohibit persons from doing anything that results in the prescribed standards not being met, and

(d) establish exceptions to a prohibition under paragraph (c).

(2) A prohibition under subsection (1) applies despite any other enactment or authorization under an enactment (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Implementing a plan; local government authority:

38 (1) If requested by a local government for the purposes of implementing a drinking water protection plan, the Lieutenant Governor in Council may, by regulation applicable to all or part of the designated area for the plan,

(a) provide that

(i) the issuance or amendment of licences, approvals, permits or other authorisations under a specified enactment, or

(ii) the exercise of a power under a specified enactment,

is subject to this section, and

(b) despite an enactment specified under paragraph (a) but subject to subsection (2), authorise the local government to

(i) establish terms and conditions that must be included in an authorization under a specified enactment, or

(ii) restrict the exercise of a specified power under an enactment,

subject to any limits or conditions established by the regulation

(2) A local government may only exercise an authority under subsection (1)

(a) after consultation with the relevant decision maker and the drinking water officer, if this consultation is required by regulation, and

(b) in each case, if the local government has reason to believe this is necessary for the purpose of protecting the potability of drinking water.

(3) Terms and conditions established under this section are deemed to be imposed under the specified enactment to which they relate.

(4) For the purposes of undertaking work specifically contemplated by a drinking water protection plan, the minister responsible for the *Local Government Act* may, by order, exempt a local government from the requirement for approval of the electors, assent of the electors or other elector approval under the *Community Charter*, the *Local Government Act*, the *Vancouver Charter* or another enactment, subject to any conditions established by the minister (BC Laws 2010, Ch 9, Part 5, Section 31-39).

Review and amendment of plans:

39 The minister may, by order made on the recommendation of the provincial health officer, direct that a current drinking water protection plan be reviewed to determine whether amendments should be made, and this Part applies to the review and to any amendment to the plan proposed by the review (BC Laws 2010, Ch 9, Part 5, Section 31-39).

3.6.2.5 Alberni Valley Drinking Water Protection Plan

A Drinking Water Protection Plan (DWPP) is intended to address a drinking water health hazard. The need for a Drinking Water Protection Plan has not been identified for the Alberni Valley (VIHA, Magee, personal communication, Feb 18, 2010).

3.6.2.6 Comox Valley Drinking Water Protection Plan failure

On October 6, 2008, the Provincial Health Officer recommended the designation of the Comox Regional District, excluding Denman and Hornby Islands, as an area for the development of a Drinking Water Protection Plan. The Ministry of Healthy Living and Sport says it is committed to ensuring that all British Columbians have access to clean, safe drinking water:

> Local input, planning, and decision making are important parts of that process. Accordingly, I am taking time to consider the potential benefits of ordering a drinking water protection plan and accessing its potential role in relation to the Regional District planning currently underway in the Comox Valley, including the RGS and the work of the water supply commission. This is the first drinking water protection plan to have been recommended under the province's Drinking Water Protection Act, and I want to ensure that consistency with local drinking water planning priorities is given proper consideration (Minister Mary Polak, correspondence to Comox Valley Water Watch Coalition, April 9, 2009).

The Comox Valley has not yet received such an order from the minister. There are asset-holders around some of the drinking water supplies that have taken a very active approach at targeting the Medical Health Officer and downplaying the need for the DWPP. It is interesting that many of the stakeholders cannot sit at the same table (CVWWC April 9, 2009).

As of May 2010, the Comox Valley is still waiting for the DWPP (CVWWC May 2010). On Sept 10, 2010, VIHA issued a boil water advisory affecting 40,000 residents in the Comox Valley (CVWWC, personal communication Sept 11, 2010).

3.6.2.7 Source protection

The provincial government needs to take a holistic [ecological] perspective on water management that looks beyond whether or not microbes are present in the water source. The first line of defence in a multi-barrier approach is "watershed-based, locally organised source protection planning" (Justice O'Connor in de Loe and Kreutzwiser 2007).

Good source water protection is necessary but not sufficient; even the most pristine watershed devoid of all human activity can still harbour contaminants harmful to human health from wildlife or elements naturally present in bedrock, like arsenic and uranium (Jenssen 2007). In particular, surface water is highly vulnerable to contamination as compared to groundwater; 75% of the drinking water in the province comes from surface water, while the remaining 25% is withdrawn from aquifers (Jenssen 2007). In the Alberni Valley, most of the drinking water likely has its origins in karst, which has its own unique vulnerabilities, as outlined throughout this study.

Climate changes will also impact water quality. The pathogens and nutrients on the land are driven by rain into tributaries and surface source water. Extreme events like higher temperature or higher rainfall in combination with heavily-used land conditions will increase what natural and man-made substances are driven into the water, which increases the risk of pathogens and algal

blooms. In a drought year, water is drawn from a lower level, making the lake [and reservoirs] shallower, and shallow systems are more prone to forming water quality problems because the water column circulates in a smaller area. Mixed, shallow water columns are much more prone to producing poorer water quality than deeper water columns (Jenssen 2007).

Toxic Blooms on Salt Spring Island, BC

Toxic cyanobacteria blooms have occurred on Salt Spring Island. The toxins produced by these blooms are a health threat. Blooms are caused by excess nutrient inputs to lakes, and these nutrients come from many different sources within a watershed. Since VIHA deals only with the final health threat, it does not address the causes. Further, since the causes are a collective result of many different human activities, the solution needs to be a collective one (Cusheon Watershed Management Plan 2007).

Some mechanism is needed to identify the sum total of activities necessary to protect water sources and to foster co-operation of agencies and people. Protecting one part of the watershed will be ineffective if activities in another part negatively affect the source waters; therefore, a coordinated, whole watershed approach is necessary (Cusheon Watershed Management Plan 2007).

In the Alberni Valley, watersheds are no longer under the Ministry of Forest & Range jurisdiction, but now under a new entity, the Private Managed Forest Land Council (PMFLC). The PMFLC is a public-private agency established under the PMFLA. The Council is accountable to the government, managed forest land owners and to the public (Ministry of Finance, PMFLC, accessed April 3. 2010). The watersheds on these private lands are bound by the Drinking Water Protection Act enforceable by the Ministry of Healthy Living and Sport and the Council is responsible for enforcement of forest practices under the PMFLA (Ministry of Finance, PMFLC, accessed April 3, 2010).

3.6.2.8 Ministry of Health Services: water treatment methods

The goal of water disinfection is to inactivate waterborne pathogens. Treatment primarily used is chlorine, ozonation, or ultra-violet radiation, with filtration used to remove particles prior to disinfection (Davies and Mazumder 2003).

All water purveyors contacted in this study use chlorine in its liquid or gas state in water treatment; a minimum level of treatment for surface water supplied to the public is required by the Drinking Water Protection Act.

Chlorine Treatment

Chlorine was first demonstrated to kill bacteria in 1881. Regardless of water purveyor size, chlorine remains the least expensive and most effective treatment for microbiological pathogens. Despite the benefits of disinfection, several pathogens are resistant to traditional chlorination processes; two of these pathogens are *Cryptosporidium* and *Giardia* (Davies and Mazumder 2003).

There are some drawbacks to the use of chlorine. While acute infection risks are lowered by disinfection processes, the disinfectant (usually chlorine, chloramines, chlorine dioxide, or ozone) reacts with organic compounds in water and produces secondary compounds known as

disinfection by-products (DBPs) that have been divided into three main categories (Jenssen 2007):

1. substances that may cause deleterious toxic, carcinogenic, or genotoxic effects;
2. assimilable organic carbon that stimulates bacterial growth in distribution systems; and
3. compounds of objectionable taste and colour.

The Ministry of Health (2006) maintains that it is important to remember that potential effects from DBPs are generally recognised as being of secondary concern to the known and immediate health threats associated with not disinfecting drinking water, such as ingesting microbiological pathogens. Ideally, drinking water protection should focus on raising and maintaining the quality of the source water rather than increasing the sophistication of the treatment (Jenssen 2007). With the current focus on the end product, achieving good quality drinking water is a consequence of water source, treatment, and distribution (Davies and Mazumder 2003).

Numerous studies concerning the association between gastrointestinal (GI) illness and drinking water turbidity have concluded that turbidity by itself is not a causal explanation for infectious illnesses (Allen et al. 2008).

No single source indicator, for source water or unfiltered treated water, is by itself a reliable criterion for issuing a water quality notice, unless there is an empirically demonstrated relationship between turbidity and microbial load for the specific system in question (Allen et al.. 2008).

One of the proposed hypotheses was that aggregates and particulates could afford protection to microorganisms. While numerous papers have described the effects of aggregation, this still remains a question to be answered and remains an unproven hypothesis in terms of public health risk. In relatively unpolluted source waters, turbidity is not an indicator of the presence of pathogens (Allen et al. 2008).

When chemical disinfection is used, turbidity containing a significant organic content can result in increased production of disinfection by-products that may have long-term health effects, especially when elevated disinfectant dosages are required to better ensure microbial safe water (Allen et al. 2008).

Filtration Treatment

Both conventional sand filtration and membrane filtration have a drawback: pathogens are essentially concentrated on or in the filters and the backwash or reject water needs to be further treated at a second stage to inactivate the concentrated pathogens. It is now recommended practice to return the waste water from filtration to waste water treatment plants or to treat back wash waters prior to discharge or reuse. Direct discharge of untreated filtered backwash waters back to source waters will increase their level of contamination (Allen et al. 2008).

Evidence has come to light that extremely filtered water could be a health hazard in itself as the body may not have the natural defenses against such minute particles, whereas the larger microbes can be intercepted by the body’s natural immune responses. (M. Barlow, Council of Canadians 2009).

Ultraviolet Treatment

In the early 2000s, ultraviolet (UV) treatment was demonstrated to be an efficient and cost-effective method of inactivating water borne pathogens, including protozoan parasites, such as *Giardia* and *Cryptosporidium* (oo)cysts. This opened a new avenue for the treatment of water (Allen et al. 2008).

3.6.3 Vancouver Island Health Authority (VIHA)

The Drinking Water Protection Act requires that all water supply systems provide potable water. The Drinking Water Protection Regulation further states that drinking water originating from surface water must be disinfected (VIHA 2007).

VIHA's 4-3-2-1 policy

1. All water supply systems within VIHA that use surface water sources will be required to maintain the following treatment specifications:
   - **4** log removal/inactivation of viruses, which equates to 99.99% reduction.
   - **3** log removal/inactivation of *Giardia* cysts and *Cryptosporidium* oocysts, which equates to 99.9% reduction.
   - **2** treatment processes, usually filtration and disinfection
   - **1** NTU turbidity (maximum) in finished water (VIHA, 2007).

2. Under the following conditions, a water supply system may be permitted to operate without filtration:
   - Daily average source water turbidity – 1 NTU or less (95% of days) and not above 5 NTU on more than 2 days in a 12 month period.
   - *Escherichia coli* 20/100 ml or less in 90% of source water samples.
   - Two primary disinfectants are provided, which together achieve a 4-log removal/inactivation of viruses and 3-log reduction in *Giardia* and *Cryptosporidium*

According to VIHA, there has been no record of water-borne diseases in the Alberni Valley (VIHA May 21, 2010).

The watersheds are privately owned. Primary activities in the watersheds are forestry, recreation, private hydroelectricity, and industry (gravel and concrete factory). There was a watershed assessment plan conducted by the owner (Island Timberlands) in Feb 2007, prepared by Streamline Environmental Consulting Ltd. This is not a public document. Issues include increased turbidity, landslides, and increased velocity of runoff over aquifer.

VIHA participated in a survey about Alberni Valley drinking water. For the City of Port Alberni, the primary sources include China Creek, Bainbridge Lake, and Lizard Lake. A secondary source is the Somass River. All sources except the Somass River are Designated Community Watersheds. The following was excerpted from the survey:

a) Please define VIHA's position on Source-to-Tap protection for this area?
VIHA response:
Use of the source-to-tap multi-barrier approach to safe drinking water is a best practice for all water supply systems, and VIHA is supportive of this approach.

b) Is there a Watershed Protection Plan in place for this area? If so, where is it located? Is it available for public viewing?
VIHA response:
If a water quality issue is identified, the first step would typically include the use of education and outreach, and existing legislation and compliance tools to attempt to reduce the risk of land use activity that may be impacting water quality. There are potentially a number of different watershed protection planning processes. Plans could be initiated to address a specific water quality/quantity issue or, in cases where there are multiple threats, a more comprehensive planning process may be needed to address the threats. MOE Water Quality Objectives are near completion for China Creek – this information may be transferable to other streams in the region. Watershed Protection Plans are generally produced by local government, so the question would best be asked of the City of Port Alberni or the Alberni Clayoquot Regional District.

c) Was Vancouver Island Health Authority aware that the land taken out of TFL 44 and placed in Private Managed Forest was in fact a threat to drinking water supply for the residents of the City of Port Alberni? If they were aware of this threat, what action did they take to remedy the situation and what were the results?
VIHA response:
Transfer of land use is not in itself a threat to drinking water. Both natural occurring and anthropogenic activities and events could contribute to threats. There are existing regulations applicable to forest operations on both Crown and private forest lands. For information on Private Managed Forest Lands, please refer to http://www.pmflc.ca/ and http://www.pmflc.ca/docs/Policy-for-Stream-Class-Upstream-of-a-LWI_Final.pdf. VIHA has a process for investigation of complaints and threats to drinking water under Section 29 of the Drinking Water Protection Act. More information can be found at http://www.viha.ca/mho/environment/water_quality/

d) Who is responsible to ensure the ecological sustainability of the water resource?
VIHA Response:
Federal, provincial and local governments, water suppliers and water consumers, business/industry, and the people of the area are all responsible for maintaining the ecological sustainability of the water resource.

e) Have there been any steps taken to gather data about flow rates of the source above the intake site?
VIHA Response:

Ministry of Environment may have data on this area. Environment Canada and/or DFO may also be collecting flow data on this source. I suggest you check with them.

f) Has any information been gathered to measure ground water quality or aquifer recharge?
VIHA Response:

Ministry of Environment may have this information, either through the Water Stewardship Division or their Climate Change division.

g) Who is responsible for the stewardship of this source, and what resources are available to this end?
VIHA Response:
Everyone is responsible including federal, provincial and local governments, business/industry, and the people of the area. Requests for information regarding available resources for stewardship would best be asked of each individual group.

h) The Chief Medical Health Officer for the Comox Valley (in 2007) has requested that the Ministry of Healthy Living and Sport order a Drinking Water Protection Plan for the area of Comox. In reply to the request, the Minister Mary Polak wrote that "this is the first Drinking Water Protection Plan to have been recommended under the province's Drinking Water Protection Act." My question is: Has there been a Drinking Water Protection Plan requested for the residents of the Alberni Valley? If not, why not?
VIHA Response:
A Drinking Water Protection Plan is intended to address a drinking water health hazard. In the Comox Valley, a comprehensive source-to-tap assessment identified concerns with both the source and the system, and it was felt that the Drinking Water Protection Plan was required to address the hazard. The need for a Drinking Water Protection Plan has not been identified for the Alberni Valley.

*Note: As of May 2010, no protection plan has been put in place for the Comox Valley.

i) What are the implications for Alberni Valley residents with regard to VIHA's 4-3-2-1 policy using the parameters of 5 or 1 NTU, given the following information?
VIHA Response:
VIHA Policy 4-3-2-1, Drinking Water Treatment for Surface Water Supplies, requires water supply systems using surface water to meet the following standards: 4-log removal/ inactivation of viruses; 3-log removal/inactivation of Giardia cysts and Cryptosporidium oocysts; 2 treatment processes, usually filtration and disinfection; 1NTU turbidity (maximum) in finished water.

Meeting these standards will provide adequate removal and/or inactivation of pathogenic organisms that may be present in the raw water. Removal of turbidity containing organic material by filtration will reduce the potential for formation of disinfection by-products that may have long term health effects.

j) The recommendations from the Ombudsman (June 2008 Special Report no. 32) to the Vancouver Island Health Authority are that a 5NTU water safety limit be set. However, as pointed out, this is merely for administrative fairness and is not scientifically based.

According to the report "Turbidity and Microbial Risk in Drinking Water," prepared for the BC Minister of Health (Allen et al. Feb 28.2008) in response to the Ombudsman's recommendation:

> Numerous studies concerning the association between GI illness and drinking water turbidity have concluded that turbidity by itself is not a causal explanation for infectious illnesses (Allen et al. 2008).
>
> No single source indicator, for source water or unfiltered treated water, is by itself a reliable criterion for issuing a water quality notice, unless there is an empirically demonstrated relationship between turbidity and microbial load for the specific system in question" (Allen et. al. 2008).
>
> One of the proposed hypotheses was that aggregates and particulates could afford protection to microorganism. While numerous papers have described the effects of aggregation, this still remains a question to be answered and remains an unproven hypothesis in terms of public health risk" (Allen et. al. 2008).
>
> In relatively unpolluted source waters, turbidity is not an indicator of the presence of pathogens" (Allen et al. 2008).
>
> When chemical disinfection is used, turbidity containing a significant organic content can result in increased production of disinfection by-products that may have long-term health effects, especially when elevated disinfectant dosages are required to better ensure microbial safe water" (Allen et. al. 2008).

VIHA Response:
This report was commissioned and completed prior to the Ombudsman's recommendations. For more information please see http://www.hls.gov.bc.ca/protect/dwcommittee.html.

k) Evidence has come to light that extremely filtered water could be a health hazard in itself, as the body may not have the natural defenses against such minute particles, whereas the larger microbes can be intercepted by the body's natural immune responses. What is VIHA's position with regards to this?

VIHA Response:
If you could provide this evidence, I will forward it to our Medical Health Officers for review and input.

Questions asked for ACRD Electoral Areas F, D, B, E were identical except that the background for each area was representative of its own unique watershed qualities. Responses given by VIHA for the other areas in the Alberni Valley were mostly identical, reflecting the lack of local knowledge and consistent application by VIHA. The few responses that were different are shown below:

Sproat Lake: Alberni -Clayoquot Regional District Area D

> Residents of this area are reporting changes to their water quality and quantity [Author's note, no baseline data exists for much of Canada], including:
>
> - Increasing salt content in their water supply.
> - Wells that dry up or well water that causes near-fatal health hazards.

- The taste and smell of sulphur in their water supply.

VIHA Response:

Please provide historical baseline and current data to support these claims.

There are a number of small systems in this area, subject to the Drinking Water Protection Act and Drinking Water Protection Regulation, including the requirement for water treatment.

d) Have there been any steps taken to gather data about flow rates of the source above the intake site?

VIHA Response:

The Ministry of Environment may have data on this area. Environment Canada, DFO and/or BC Hydro may also be collecting flow data on this source. Catalyst owns the Stamp River Dam at the outlet of Great Central Lake and is likely to have data on flow rates and lake levels. I suggest you check with them.

Beaver Creek: Alberni-Clayoquot Regional District Area E

Long time residents are reporting changes to their water supply quantity and quality, including:

- increased turbidity
- discoloration of water
- silt and sand found in supply
- decreased water levels in wells
- increased salt in water
- changes in recharge rate in wells

VIHA Response:

Please provide historical and current data to support these claims. Beaver Creek Improvement District has been issuing more Boil Water Notices (BWN) than in the past; however that is due to changes in processes for issuing BWN, including the installation of a turbidity meter that warns of increasing turbidity.

3.6.4 Vancouver Island Watershed Protection Steering Committee

Enquiries concerning watershed protection for Cherry Creek Waterworks District (i.e., Lacy Lake and Cold Creek, which are located within Regional District of Nanaimo) were answered by RDN as follows:

An opportunity to bring issues related to water quality in your area exists via the Vancouver Island Watershed Protection Steering Committee. This committee works with VIHA and various provincial ministries, and many of Vancouver Island's Regional Districts to mutually work on issues related to water quality and watershed protection. The committee chair is Lynne Magee of VIHA (250 755 3339) (Regional District of Nanaimo, Jan 2010).

3.6.5 Ministry of Forests, Mines and Lands

[Author's note: At the time of writing, the ministry's name was "Ministry of Forests and Range." The new name has not been substituted in all locations in this section in order to retain the nomenclature and context. As well, and for the same reasons, the former names of ministries and branches have been either substituted or retained. Also, some of the duties and responsibilities discussed below may now be within the new Ministry of Natural Resources Operations.]

Logging in British Columbia's forest sector accounts for 7.5% of the province's gross domestic product, and 60% of all exports. Much of the land is harvested by clear cutting, a method that can cause substantial soil erosion, particularly in rainy areas, and higher accumulation of snow on the ground than if trees were left standing. With warmer temperatures, higher-than-normal snowmelt can cause elevated sediment levels in the water (Jenssen 2007).

There are over 37,000 kilometres of logging roads throughout the province. Logging road construction, use, and maintenance causes up to 90% of the sedimentation in water. Prescribed burning, preparation of logged sites for replanting, fertiliser and pesticide applications, and the burning of logging slash are all potential sources of water contamination. Effects can include sedimentation, nutrient loading, introduction of toxic chemicals and organic debris, temperature changes, and stream flow increases or decreases. Any or all of these can negatively affect fish, fish habitat and water quality, including drinking water (Jenssen 2007).

3.6.5.1 Watershed Reserves

The creation of BC's Watershed Reserves by concerned water users and politicians began about 100 years ago. The Reserves were administered through provincial and federal Crown land legislation that protected public drinking water sources, mainly form commercial logging and public trespass (Koop 2006).

Evidence presented in 1944 and 1945 at BC's second royal Commission on Forest Resources described many Reserves throughout the province and noted that BC's water users wanted the provincial government to continue applying this form of protection. In 1991, the Forest Resources Commission mysteriously failed to mention anything about Watershed Reserves, despite the fact that a provincial Task Force (1972-1980) had created and re-created about 300 of them under the protective powers of the Land Act. The BC Lands Ministry continued to create Watershed Reserves until the late 1980s, at which time the Social Credit government, heavily influenced by resource industry titans, began to uniformly ignore these preserves (Koop 2006).

The protection of the public's drinking water was obligatory, a fiduciary responsibility—what the Chief Forester's office reluctantly understood as a "moral obligation" (Koop 2006).

In a memorandum by District Forester, J.R. Johnston, Nelson Forest Region July 17, 1964: "Much of the remaining mature timber in the district is in the watershed of creeks which are the source of somebody's water supply. This can be an important source of conflicts of interest: between the interests of the industry and the water user. Two alternative solutions to the problem are possible: 1) Keep operators out of the watersheds altogether, or 2) permit harvesting of timber in watersheds, subject to stringent controls designed to protect the water supply. As you know, we have, within reason, settled on the second choice. In many areas, we will not be able to supply

local industry's needs unless we can invade the watersheds. If, in doing this, we fail to protect the users' interests, this timber reserve will not be available to us much longer" (Koop 2006).

3.6.5.2 Watershed Reserves in the Alberni Valley

In 1980, the List of Watershed Reserves in the Alberni Valley included:

1. Andrews Creek, Category #1, Watershed number 8, used by Hupacasath Indian Reserve No.6. 100% owned by the federal Crown.
2. Cold Creek, Category #1, Watershed number 5, used by Cherry Creek Waterworks District. Private ownership; 0% owned by the Crown.
3. McFarland Creek, Category #1, Watershed number 3B, used by the City of Port Alberni. Private ownership; 0% owned by the Crown.
4. China Creek, Category #2, Watershed number 3C, used by the City of Port Alberni.16 % owned by the Crown.
5. Rogers Creek, Category #2, Watershed number 9, used by Sahara Heights. 0% owned by the Crown. (Koop, 2006)

3.6.5.3 History of Tree Farm Licence (TFL) 44

The Province of British Columbia reached a Settlement Agreement with MacMillian Bloedel Ltd (MB) in 1999 for the timber harvesting rights the company lost due to the creation of provincial parks on Vancouver Island since 1991. As a result of the creation of these parks, MB lost access to approximately six million cubic metres of timber in timber licenses, and also lost allowable annual cut from Crown land. The parks created in 1991 and 1995 eliminated MB`s timber harvesting rights on approximately 7,633 hectares of timber licences, and on an additional 43,877 hectares of Crown land within two TFLs. The Province agreed to pay MB $83.75 million. The Settlement Agreement specified the settlement amount may be paid to MB in resource rights, land, and/or cash. Candidate settlement lands included TFL 44. The Province would not use any of the potential non-cash forms of currency without extensive, prior public consultation. A TFL is a form of tenure established under the Forest Act; it occupies a specific area of land and is managed by the licensee. TFL land is comprised of the licensee`s private forest land (Schedule A) and Crown forest land (Schedule B). Any land parcels that form part of the final settlement package will become private land held in fee simple and will not be subject to the Forest Practices Code (Alberni Environmental Coalition 1999).

Tree Farm Licence 44 Schedule A lands:

Lands included in the agreement include almost all of the Schedule A land within the TFL (73,820 ha), which is concentrated in two large blocks extending northwest (area of Somass and Ash Rivers) and southeast (Cameron River area) from Port Alberni, and the remainder scattered in parcels further west across the TFL. Excluded from the settlement agreement are Schedule A lands at the mouth of the Nahmint River, at Mack Creek, extending 200 metres on each side of Draw Creek, and extending 200 metres from the northern and western shores of Maggie Lake (Alberni Environmental Coalition 1999).

Tree Farm Licence 44 Schedule B Lands:
Lands include scattered pieces in the vicinity of Esary and Lizard Lake (approximately 828 ha) located near Port Alberni (Alberni Environmental Coalition 1999).

In 1999, Weyerhaeuser Corporation acquired MB`s forest assets (Macauley 2007).

In 2004, the private lands held by Weyerhaeuser were removed from TFL 44 and Weyerhaeuser then sold its assets on Vancouver Island to Brascan which moved the private lands to Island Timberlands (Macauley 2007).

3.6.5.4 Private managed forest lands

In 2004, when the private lands under the jurisdiction of Tree Farm Licence (TFL) 44 were taken out of the Forest Practices Code of British Columbia Act, a new act was created for these private lands, the Private Managed Forest Land Act (PMFLA).

What that meant for watersheds in the Alberni Valley is that they no longer were under the Ministry of Forest and Range jurisdiction, but now under a new entity, the Private Managed Forest Land Council (PMFLC). The PMFLC is a public-private agency established under the PMFLA. The Council is accountable to the Government, Managed Forest Land owners and to the public (Ministry of Finance, Private Managed Forest Land Council, accessed April 3. 2010). The watersheds on these private lands are bound by the Drinking Water Protection Act (enforceable by the Ministry of Healthy Living and Sport), and the Council is responsible for enforcement of forest practices under the PMFLA (Ministry of Finance, Private Managed Forest Land Council, accessed April 3, 2010).

3.6.5.5 Designated community watersheds

The Forest Practices Code of British Columbia Act was in existence from 1994-2004. The Code recommended that watershed assessments of community watersheds, those used for human consumption , be conducted every three years, unless agreed upon as unnecessary (Ministry of Forestry 1999). The Code included standards and requirements for forest planning and development, and measures for conserving biological diversity, soil, water, fish, wildlife, scenic diversity, and other forest resources. The Code recognised water quality, quantity, and timing of flow as principal values in watersheds. The Ministry of Health provided input into policies affecting drinking watersheds (Jenssen 2007).

Most Community Watersheds in British Columbia are quite small in area. A small watershed area usually means the intake is close to potential contaminants, stream response times are short, and opportunities for dilution or settling are small. These watersheds are therefore sensitive, and applications of Community Watershed Guidelines are essential to maintain water quality and quantity (Ministry of Forests 1996).

In November 1993, the Forest Practices Code of British Columbia Act was proposed and it was decided to incorporate many of the Community Watershed Guidelines relating to forestry activities into the Forest Practices Code (Ministry of Environment, Water Stewardship, Community Watershed Definition home page, accessed April 2, 2010).

Under the Forest Practices Code, before a community watershed designation could be created, varied or cancelled, a referral and advertising process must occur. An application for change to

the community watershed status is usually made by a water licensee and submitted to the BC Environment regional water manager. The regional water manager then sends the application for comment to:

1. The Ministry of Health Services (regional health officer)
2. The Ministry of Forests, Mines and Lands (formerly Forests and Range) (district manager)
3. The Ministry of Forests, Mines and Lands (formerly Employment) (district inspector of mines)
4. Other agencies where appropriate (Ministry of Natural Resources Operations) (Ministry of Forests 2010)

If the Ministry of Forests (now Forests, Mines and Lands) regional manager supports the application, the manager must advertise in a local newspaper their intention to change the status of a community watershed in 60 days. The advertisement must read:

1. That a community watershed is to be proposed, varied, or cancelled
2. The location of the community watershed
3. That a copy of the proposed order to establish, cancel or vary the community watershed and a map showing the boundaries of the watershed are available at the Ministry of Forests regional and district offices
4. That comments on the proposal may be delivered to the regional or district office for 60 days after the date of the newspaper advertisement (Ministry of Forests 2010).

The Ministry of Forests (now Forests, Mines and Lands) regional manager and designated environment official (i.e., regional water manager) review all comments received in the 60-day period. If they subsequently approve the designation, variation or cancellation, they must advertise in the newspaper that:

1. The watershed has been designated, varied or cancelled as a community watershed.
2. A copy of the order and a map showing the boundaries of the community watershed are available at district and regional offices.

Under the Forest Practices Code of British Columbia Act, the Ministry of Forests regional manager, with the agreement of the designated environment official, can remove community watershed status from a land area when a water license is cancelled or if the purpose use code changes; e.g., where a community has switched to an alternate water supply and the watershed is now supplying water solely for irrigation (Ministry of Forests and Range 2010).

Under the Forest Practices Code, a forest licensee operating within a community watershed was required after June 15, 1997 to submit a long-term forest development plan for the portion of the area under the plan that is in a community watershed (Ministry of Forests and Range 2010).

Also under the Forest Practice Code, public involvement in developing community watershed plans varies from referral and review to full participation at all stages, depending on the complexities of issues and the nature of the watershed. The public is involved in full consensus negotiations for strategic land use plans such as landscape unit plans. Therefore, in most cases,

public involvement in community watersheds focuses on opportunities to review and comment on the operational plans (Ministry of Forests and Range 2010).

In January 2004, the Forest and Range Practices Act replaced the Forest Practices Code. The Community Watershed Guidebook 1996 that had been a part of the Code was not continued, having been superseded by the Forest and Range Practices Act 2004 and the Drinking Water Protection Act 2001 (Horel and Higman 2006).

The Forest and Range Practices Act 2004 is results-based, which means that a licensee is:

- not required to submit road designs for approval;
- not required to undertake Terrain Stability Field Assessments for harvest areas;
- not required to hire professionals to carry out assessments

The down side of "results-based" is that (1) Damage has to be proven. (2) If proven, who is responsible? (3) Can the problem be restored or remedied? (4) Who has responsibility for the remedy? (5) Who does the work? (6) Who pays for it?

In a 2003 report by Sierra Legal Defence Fund (now Ecojustice), titled *Watered Down: A report on waterborne disease outbreaks in British Columbia 1980-2002*, the authors comment that "both the DWPA and DWPR adopt a results-based approach to control the introduction of health-threatening materials to drinking water sources." In this approach, they say,

> …not only [is] it necessary to prove a deposit of a harmful substance occurred, but it is also requires proof of 'harm'. This would be akin to changing drunk driving laws so that there is only an offence when someone is driving while intoxicated and someone or something is harmed as a result.

This report also states:

> BC's Drinking Water Protection Regulation fails to cover a wide range of potential contaminants. In fact, the water quality standards set out in the DWPR are no better than those in the Safe Drinking Water Regulation, in place prior to the Walkerton outbreak.

Under the Forest And Range Practices Act, the licensee decides who to consult and what assessments to complete (Horel and Higman 2006).

The Act does not recognize the importance of stream temperature for habitat protection and microbiological controls. The Act merely calls for the retention of sufficient shade to prevent material adverse impacts on fish streams that have been designated as temperature sensitive. According to Teti (2006), there is a limited ability of forest professionals to manage stream temperature in BC …by the relative novelty of appropriate shade measurement methods, a lack of baseline shade data, and an absence of quantitative shade guidelines (Teti 2006).

Under the new Forest and Range Practices Act, the Private Managed Forest Act, and the Fisheries Act, due diligence can be used as a defence (Horel and Higman 2006).

BC is unique among the world's leading forest producers because 95 percent of its land base is public land. Vancouver Island is different from the rest of BC as it is dominated by private land ownership. There are five million hectares (12.4 million acres) of private land, including an area of southeast Vancouver Island that was granted to a local railroad in 1886 as part of the E&N land

grant and later sold to forest companies. Logging activities on private lands are subject to the Private Managed Forest Land Act enforced by the Private Managed Forest Land Council (Jenssen 2007). The majority of Alberni Valley watersheds are privately owned. More specific details of the private land ownership in the Alberni Valley can be found in Part 2 and 4.

Community watersheds can include both private and Crown land. A notable change for Community Watersheds is that the Forest Practices Code is only enforceable on Crown land.

The province offers financial incentives to landowners who agree to some government control over the way they manage their lands for timber production. The Act sets out very general objectives for soil conservation, water quality, fish habitat, critical wildlife habitat and reforestation (West Coast Environmental Law, BC Guide to Watershed Law and Planning, accessed April 3, 2010).

Under the Private Managed Forest Land Act, the Community Watersheds Guidebook does not apply. Instead, the management objectives on private land in relation to water, as stated in Chapter 80 Section 13 (1), say the forest management objective for private managed forest land with respect to water quality is to protect human drinking water both during and after harvesting. Section 13 (2) says, "Nothing in subsection (1) requires an owner to retain additional streamside trees or additional understorey vegetation to address problems with water quality that originate outside of the owners' private managed forest land" (BC Laws 2003).

The forest practices rules are minimal, and private land logging has been quite controversial on Vancouver Island due to impacts on streams, community view sheds, the rate of logging, etc. (West Coast Environmental Law, BC Guide to Watershed Law and Planning, accessed April 3, 2010).

Critics of the Private Managed Forest Land Act argue that:

- The Council is too closely connected to the logging industry owners of managed forest land, resulting in a form of self-regulation;
- Local governments should be able to place some controls on private managed forest lands (West Coast Environmental Law 2009).

3.6.5.6 Designated community watersheds in the Alberni Valley

In the Alberni Valley, the South Island Forest District's historical record 95.06.15 to 03.01.27, updated in 2007, indicates that China Creek and McFarland Creek (Bainbridge Lake), Cold Creek and Sproat Lake/Sproat River are designated Community Watersheds.

3.6.5.7 Government Actions Regulation (GAR) karst resource protection on Crown land

The South Island Forest District Manager established a Government Actions Regulation (GAR) Resource Feature Order effective Jan 15, 2010. The order identifies " important" and "significant" surface karst features, including karst caves as resource features, however, the use of such terms without well-defined definitions may prove to be problematic with respect to enforcement. The order doesn't remove karst lands from the district's forest inventory, but instead provides a measure of protection for specific karst resource features (R. Robinson, personal communication, Jan 2010).

In 2005, communication from South Island Forest District staff said the Coast Forest Region's Karst Technical Team's GAR Resource Feature Order template was developed. The template was awkward, absent of definition, to specifically define identified resource features. G.G. Runka's 1992 report to the Ministry of Forest entitled "Stewardship of Cave and Karst Resources in British Columbia," advised against using problematic terms such as "significant" and "important." Nevertheless, district managers are the sole designated decision-makers responsible for the wording and enforcement of GAR orders within their respective districts (R. Robinson, personal communication, Jan 2010).

3.6.5.8 Karst resource protection on private land

The absence of karst-specific regulatory standards to protect and conserve key public environmental resource values such as drinking water source areas, wildlife, and fisheries on private managed forest lands is a major concern for most water purveyors, area residents, and environmental groups (Robinson 2008).

The Ministry of Forests and Range is responsible for logging activities on Crown land. The Ministry is responsible to enforce the Forest Act and the Forest and Ranges Practices Act on Crown land. Logging activity on private land is subject to the Private Managed Forest Land Act enforced by the Private Managed Forest Land Council. Logging activity on both Crown land and private lands is subject to the Drinking Water Protection Act.

An exception to this is under the Forest and Range Practices Act 8.2(3). The objective set by government under subsection (2) applies only to the extent that it does not unduly reduce the supply of timber from British Columbia's forests (BC Laws 2010). However, under the GAR, timber companies can apply for an exemption of the karst orders (R. Robinson, personal communication, Oct 11, 2010).

3.6.6 Ministry of Transportation and Infrastructure

This ministry plays a lead role in subdivision approval, which is critical in the creation of new public water supply systems. The Ministry of Transportation and Infrastructure is charged with source water protection by preventing pollution while building and maintaining roads (Jenssen 2007).

3.6.7 Ministry of Energy

This ministry is currently creating an environmental database, the Environmental Resource Information Project, which will contain information related to groundwater and coal bed methane development. The goals and objectives of this project are to (Jenssen 2007):

- address community and First Nations concerns for easily accessible environmental resource information prior to coal bed gas development;
- encourage responsible coal bed gas development through a better understanding of environmental values, with a special focus on water resources; and
- contribute to science-based resource development decisions when coal bed gas activities commence.

3.6.8 Ministry of Agriculture

The Ministry of Agriculture does not have acts and regulations specific to drinking water source protection; rather, farming activities fall under the acts and regulations of other ministries (both federal and provincial). The federal Fisheries Act, provincial Water Act, and provincial Drinking Water Protection Act apply to farms. Much of the legislation directed at farming relates to activities that may cause environmental risks. The legislation relating to these activities also exists in other ministries' acts, including the Agriculture Waste Control Regulation and the Environmental Management Act, which are administered and enforced by the Ministry of Environment (Ministry of Agriculture, personal communication, July 9, 2010).

Point source testing needs to be done to verify that a farm is causing pollution that causes human health concerns. According to the Ministry of Agriculture, staff the Ministry of Environment has the legislation to deal with waste control (Ministry of Agriculture and Lands, personal communication, July 9, 2010).

The Ministry of Agriculture is not responsible for forestry activities on lands in the Agricultural Land Reserve; the Ministry of Forests, Mines and Lands and the Private Managed Forest Land Council are responsible for that (Ministry of Agriculture, personal communication, July 9, 2010).

Riparian setback is not specific as there are many different types of farming practices. The Ministry of Agriculture and Lands makes riparian guidelines available to farmers; however it is up to the farmers if they choose to voluntarily participate with the guidelines. The Department of Fisheries and Oceans has the enforcement authority should the farm be found to be causing stream pollution (Ministry of Agriculture and Lands, personal communication, July 9, 2010).

Environmental Farm Plans are administered by the Ministry of Agriculture and Lands. These plans do have riparian guidelines. In the Alberni Valley, there are very few farms that qualify under the tax rules. There are many hobby farms in the Alberni Valley but there is no leverage to force change in their practices because, as they are not really farmers, they do not have a business incentive to change. Public education information is available to hobby farmers; however it is on a voluntary basis if they choose to heed the guidelines (Ministry of Agriculture and Lands, personal communication, July 9, 2010).

The BC Agricultural and Environment Initiative has funding available for source protection research, to do testing on streams if it can be proven that the study would be for agricultural benefit. The research project must be approved by a local Farmers Institute. In the Alberni Valley, the Alberni Valley Farmers Institute could initiate such a study. Funding is available on a cost share basis (Ministry of Agriculture and Lands, personal communication, July 9, 2010).

3.6.9 Ministry of Community, Sport and Cultural Development

Formerly named the Ministry of Community and Rural Development, this ministry is the lead funding organisation for water system planning and infrastructure improvements. The Local Government Department works with all levels of government as well as non-government organizations to help move British Columbia towards a more sustainable approach to managing water resources (Ministry of Community and Rural Development 2010).

3.6.9.1 Grant Program

The Local Government Department supports the development of sustainable drinking water infrastructure with two types of grants: Infrastructure Planning Grants and Capital Grants. The Infrastructure Planning Grant Program provides local governments with grants up to $10,000 to study the feasibility and planning for sustainable drinking water projects. Eligible drinking water projects include, but are not limited to (Ministry of Community and Rural Development 2010):

- Business water use audits
- Infrastructure reinvestment plans
- Comprehensive water conservation plans
- Integrated watershed management plans
- Groundwater protection plans

Capital Grant Programs provide partial funding to local governments for the renewal, upgrade and/or development of new drinking water infrastructure. Eligible projects may include, but are not limited to:

- water treatment plant upgrades,
- installation of water meters and
- distribution system upgrades.

Under this program, the federal, provincial, and local governments each cover one-third of project costs. New legislation requires any infrastructure project over $20 million to be open for bid in the form of Private-Public Partnerships (P3s) (Jenssen 2007).

3.6.9.2 Water Conservation Objective

British Columbians consume 30% more water than the average Canadian. Though British Columbia is considered "water rich," much of this water is not directly accessible and/or costs associated with treatment and distribution are prohibitive. The perception of an endless supply of fresh water, together with pricing structures that undervalue the true cost of water, have encouraged a pattern of over-consumption and water waste (Ministry of Community and Rural Development 2010).

Water conservation reduces water system operations and maintenance costs, which saves money for end users. Reduced water demand conserves limited supplies and may enable water purveyors to defer large scale capital infrastructure projects such as reservoir expansions (Ministry of Community and Rural Development 2010).

3.6.9.3 Community Water Improvement Program

Program funds have been fully allocated; applications are no longer being accepted (Ministry of Community and Rural Development 2010).

3.6.10 Ministry of Natural Resource Operations

This is a new ministry created in October 2010. Its “Service Plan,” presented to the Legislature in February 2011, states that the mandate of the ministry is to be “the province’s ‘one land manager’.” Page 3 of the Service Plan states that this ministry will “bring all of the decision-

making activities on the land—from permitting to First Nations consultation to wildlife management—together in one ministry" (MNRO February 2011).

The ministry has a Water Management Branch. Page 9 of the Service Plan states:

> BC's growing communities, economic growth, healthy food, clean energy and our beautiful environment need a plentiful amount of clean water. As a finite resource, water's limits must be recognized, meaning that the days of taking our "unlimited" supply of water for granted have passed. With changes in climate, population, and water use, government is reviewing the *Water Act* to address new pressures on water. Modernizing the *Water Act* is not about fixing something that is broken. Instead it is about recognizing that the context and foundation upon which the *Water Act* was built was very different 100 years ago. Our ways of doing business have, and will continue to change to reflect today's context and play a key role in the future sustainability of BC's water resources.
>
> The Ministry is contributing to the modernization of the *Water Act* which is part of *Living Water Smart: BC's Water Plan* – government's vision and commitment to ensuring that our water stays healthy and secure for future generations.

The Service Plan also states (pp. 3-4) "We're working towards 'one project, one process' to create a single framework for project reviews… We are ensuring coordination across government through two provincial bodies: The Natural Resource Sector Management Board and the Environmental Land Use Committee."

Two primary agencies of the Ministry of Natural Resource Operations are the Integrated Land Management Bureau and FrontCounter BC.

The ministry lists its responsibilities as including water, Independent Power Projects (IPPs), watershed restoration, drought management, dyke and dam safety and regulation, and floodplain management.

It remains to be seen how this new ministry will interact with other agencies, organisations, and members of the public who are concerned about source-to-tap drinking water issues.

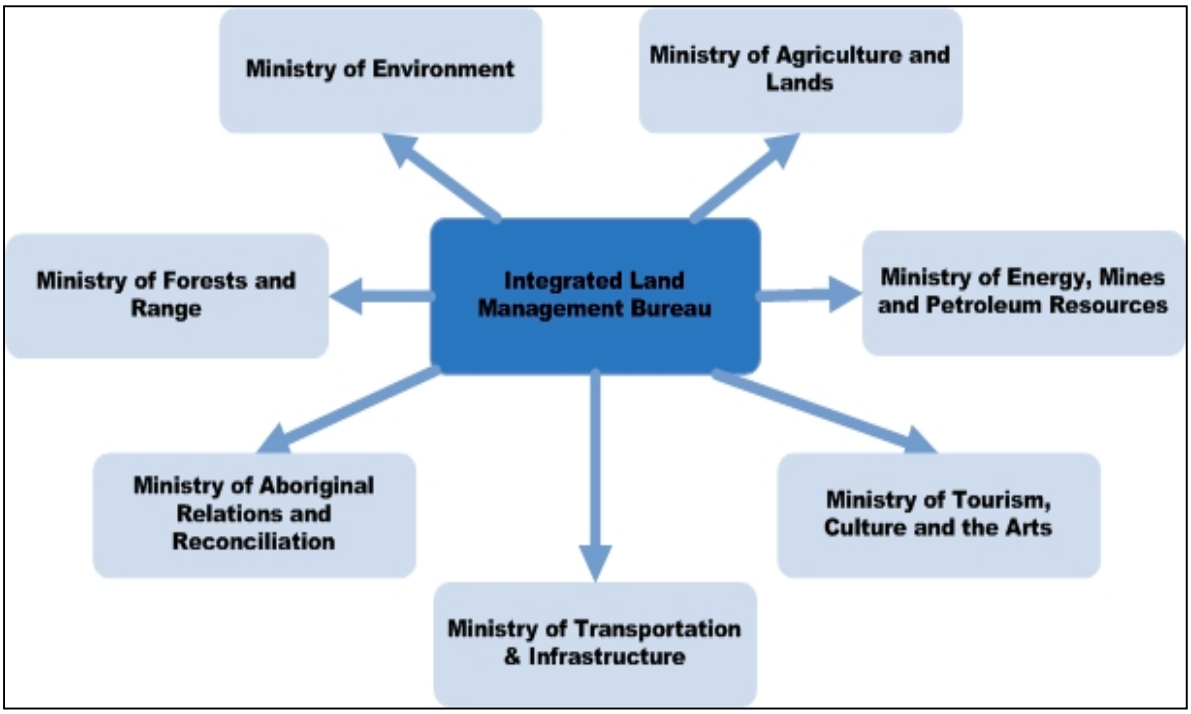
3.6.10.1 Integrated Land Management Bureau

The Integrated Land Management Bureau (ILMB) has a mandate to provide British Columbians with access to integrated Crown land and resource authorisations, planning dispositions and resource information services. Many of these services are provided to, or on behalf of, provincial natural resource and economy ministries (Integrated Land Management Bureau 2010).

ILMB is responsible for integrating, managing and delivering a range of critical services to the province's private, corporate and public citizens. Below is a brief description of these services (ILMB 2010).

Outlined in Figure 16 are the Integrated Management Bureau's main clients. [Author's note: This diagram could not be edited to insert the new ministry names, nor to show how the new Ministry of Natural Resource Operations fits into the picture. Please refer to list of new ministries at the beginning of Part 3.]

Figure 16. Integrated Land Management Bureau's main clients



* From the Integrated Land Management Bureau website, accessed July 9. 2010.

First Nations Initiatives

Supports an enhanced relationship with First Nations, which will lead to improved business practices, and increased understanding and consideration of their interests by provincial resource agencies. Also supports both a coordinated approach to engaging First Nations on natural resource issues and the pursuit of related strategic agreements (ILMB 2010).

Regional Client Services

FrontCounter BC, with eight locations throughout the province, delivers a wide range of natural resource access and use permits on behalf of client agencies. This one window approach to application, referrals, adjudication, and other Crown land and resource services adjudicates Crown land tenures, Crown land partnership and sales, and planning at the strategic level to promote sustainable use of Crown land and resources (ILMB 2010).

GeoBC

Integrates, manages and delivers provincial land and resource information on behalf of client agencies to public, corporate and private citizens (ILMB 2010).

For ILMB to operate effectively, it must collaborate and share information with client agencies in a variety of formal and informal ways. The committee structure that supports this work is vital to success:

- Integrated Land Management Bureau Board of Directors oversees ILMB's key accountabilities and deliverables and makes recommendations with respect to corporate priorities.

- Assistant Deputy Ministers' Committee for Integrated Land Management oversees the effective provision of services from ILMB to its client agencies.

Three Inter-Agency Management Committees (Coast in Nanaimo, Southern Interior in Kamloops, Northern Interior in Prince George) coordinate the delivery of cross-government initiatives at the regional level (ILMB 2010).

The Minister of Forests and Range and Minister Responsible for the Integrated Land Management Bureau have ministerial accountability for delivering ILMB's mandate and for ensuring that British Columbians receive maximum value for Crown resources within the government's social and environmental frameworks.

3.6.10.2 FrontCounter BC

FrontCounter BC is the “single window service for clients of provincial natural resource ministries and agencies.” Its website (http://www.frontcounterbc.gov.bc.ca/about.html) explains that this agency will have offices across the province where natural resource clients can obtain all the information and authorisations they need to start or expand a business. It further states:

> This site provides access to citizens and businesses seeking government permission for activities occurring on Crown land and the extraction of provincial resources. Once you have found the type of authorization that you may require, you will be directed to the appropriate natural resource sector ministry’s site or application form, which will advise on required approvals, guidelines, eligibility criteria and cost of completing an application. The information contained on this site is subject to change and additional information may be required to ensure you are submitting a complete up-to-date application package. We would like to hear from you. Our goal is to make this site helpful to users. If you can provide any suggestions for improving this site, please contact us at ILMBWebServices@gov.bc.ca

No doubt some of the projects seeking permits will include IPPs and extraction water for bottled water businesses. In fact, some of these are already in the beginnings of the permitting process.

3.6.11 Provincial integrated water management, or forest industry control?

BC is unique among the world’s leading forest producers because 95% of its land base is public (Crown) land. Vancouver Island is different from the rest of BC as it is dominated by private land ownership. There are 5 million hectares (12.4 million acres) of private land, including an area of southeast Vancouver Island that was granted to a local railroad in 1886 as part of the E&N land grant and later sold to forest companies. Logging activities on private lands are subject to the Private Managed Forest Land Act enforced by the Private Managed Forest Land Council (Jenssen 2007). The majority of Alberni Valley watersheds are privately owned.

Ministry of Environment

Under the Forest and Range Practices Act 8.2(3)the objective is to prevent the cumulative hydrological effects of primary forest activities within the community watershed from resulting in (a) a material adverse impact on the quantity of water or the timing of the flow of the water from the waterworks, or (b) the water from the waterworks having a material adverse impact on human

health that cannot be addressed by water treatment required under (i) an enactment, or (ii) the licence pertaining to the waterworks. (3) The objective set by government under subsection (2) applies only to the extent that it does not unduly reduce the supply of timber from British Columbia's forests (BC Laws 2010).

Water Quality Objectives set by the Ministry of Environment Environmental Protection Division:

> The objectives are policy guidelines for resource managers to use in protecting water users in specific waterbodies (MOE 2001). These guidelines and procedures only apply to lands held by holders of agreements within a community watershed established under the Forest and Range Practices Act [Crown land]. MOE staff will endeavour to utilize other available legislation and regulations to ensure that other [private] lands within a community watershed are managed in a manner consistent with the community watershed water quality objectives (MOE WSD 2008).
>
> The objectives have no legal standing, and their direct enforcement would not be practical. This is due to the difficulty of accurately measuring contaminants in receiving waters and attributing to particular sources, for legal purposes, contamination exceeding an objective, and thus of proving violations and their causes (MOE EPD 2001).

VIHA

Watershed protection has been the responsibility of the Ministry of Environment. It is now the responsibility of the Ministry of Health Services and its agent the Vancouver Island Health Authority. The Vancouver Island Health Authority is poorly equipped for source protection and they are more reactive rather than pro-active when it comes to protectors of the source (MOE, Epps, personal communication April 8, 2010).

3.7 Federal Government Authorities

In general, federal responsibility focuses on national drinking water quality guidelines, conducting research, and international agreements. It is the provinces and municipal governments that have the ability to legislate regulations and are responsible for direct water supply.

The Government of Canada has proprietary rights to federal lands and water in its territories and is responsible for a wide range of water supply systems under federal jurisdiction in British Columbia. These systems include Indian Reserves, federal penitentiaries, port authorities, military bases, some airports, vessels, and common carriers such as ferries and airplanes. The Constitution Act of 1867 is the responsibility of the federal government whose objective is:

1. Management of the resources and activities over which it has direct jurisdiction, including resources in the northern territories, fisheries, navigation, and international waters.
2. Protection of the natural environment of Canada in general. While still respecting the province's individual constitutional authority, the federal government must set minimum standards and monitor and regulate these with the scope of their legislation.
3. Research, collection data, and dissemination information.
4. Preservation and enhancement of water sources by providing information and guidance, advocating and supporting needed changes, and ensuring equitable resolution of disputes among other jurisdictions in Canada and with the United States (Jenssen 2007).

There are over 20 federal government bodies with a significant interest in water. Environment Canada has approximately 45% of the responsibility; other stakeholders include Fisheries and Oceans, Indian Affairs and Northern Development, Agriculture, Transport, Health and Welfare, and the International Joint Commission. The focus of responsibilities has not changed much since 1986 and includes the following concerns (Jenssen 2007):

- Inter-jurisdictional water resources shared between provinces and the United States (an 8,900 km long border)
- Pollution of water resources
- Political pressures to export water internationally
- Conservation and other strategies and approaches to water problems
- Climate changes altering water resources and water availability on a global scale

A deeply-rooted historical challenge for the federal government is the jurisdictional divide that exists for Canada's First Nations people (Mate 2006, in Jenssen 2007). There are over 80 First Nations communities continuously under a boil water advisory, sometimes continuously for several years. In an examination of First Nation's communities across Canada, 25% were found to have water systems that posed health and safety risks (Davies and Mazumder 2003). Water quality is of major concern for many First Nations communities; water access is also limited and sometimes non-existent. Water supply falls under federal responsibility for First Nations communities so these communities have distinct water quality and enforcement standards different from the rest of Canada (Jenssen 2007).

There are 302 First Nations public water supply systems in BC. Similar to non-aboriginal communities, water-management falls under many government jurisdictions. Indian and Northern

Affairs Canada (INAC) provides funding assistance for the design, construction, operation, and maintenance of water systems; Health Canada ensures that drinking water quality monitoring programs are in place; and Environment Canada develops technical guidance and training material about source water protection and sustainable water use. First Nations communities are responsible for the daily operations and management of their own water systems. In addition, INAC established a Protocol for Safe Drinking Water in First Nations Communities that sets standards for all aspects of water management from source to tap, as well as a Circuit Rider Program that brings in outside trainers to educate water operators (Jenssen 2007).

Table 5 outlines some of the federal Acts and Guidelines for Canadian Drinking Water Quality, and the international agreements between Canada and the United States.

Table 5. Federal Water Legislation

Legislation	Purpose	Lead Agency
Canada Water Act 1970	Authorises federal-provincial joint committees on water management, enables federal water quality programs for inter-jurisdictional water, and includes provisions for regulating discharge of waste into some protected areas.	Environment Canada
International River Improvements Act 1970	Provides for the licensing of activities that may alter the flow of rivers into the United States.	Environment Canada
Department of Environment Act 1978, 1985	Assigns national leadership for water management to the Minister of the Environment	Environment Canada
Water Policy 1987	To encourage the use of freshwater in an efficient and equitable manner, to protect and enhance the quality of the water resource, to promote the wise and efficient management and use of Environment Canada water. Five strategies are proposed: water pricing, cost-recovery, scientific research, integrated planning, holistic approach, relevant legislation, public awareness.	Environment Canada
International Boundary Waters Treaty Act 1909	No person shall use or divert boundary waters by removing water from the boundary waters and taking it outside the water basin in which the boundary waters are located. Applies only to the water basins described in the regulation and the bulk removal of boundary waters.	Foreign Affairs and International Trade
Fisheries Act 1868, 1970, 1985	The general pollution control provisions (Section 36) prohibit harmful alteration of fish habitat and the deposit of deleterious substances. The protection of fish means the protection of the waters in which they live.	Fisheries and Oceans/ Environment Canada
Canadian Environmental Protection Act 1988,1999	Pertains to water and water source protection. Focuses on the regulation of toxic substances.	Environment Canada/ Health Canada
Canadian Environmental Assessment Act 1992	Requires environmental impact assessment of all projects funded or authorized by the federal government, or which take place on federal lands.	Canada Environmental Assessment Agency
Canada Wildlife Act and the Migratory Bird Conventions Act 1985, 1994	Protects wildlife, migratory birds and associated habitats.	Environment Canada
Northwest Territories Water Act 1992	Outlines the management of water resources in the Northwest Territories.	Indian and Northern Affairs
Mackenzie Valley Resource Management Act 1998	To provide for an integrated system of land and water management in the Mackenzie Valley, to establish certain boards for that purpose and to make consequential amendments to other Acts.	Indian and Northern Affairs

Nunavut Waters and Nunavut Surface Rights Tribunal Act	To respect the water resources of Nunavut, to establish a water board and surface rights tribunal, outlines water rights and access in Nunavut.	Indian and Northern Affairs
Yukon Waters Act 2003	Establishes a compensation system to protect existing water users who may suffer adverse effects, losses or damages when a new license is issued to the same water source.	Indian and Northern Affairs
Arctic Waters Pollution Prevention Act 1985	To prevent pollution in the arctic waters adjacent to the mainland and islands of the Canadian arctic. Navigation recognises Canada's responsibility for the welfare of the Inuit and others and the preservation of the ecological balance that exists in the water, ice, and land.	Transport Canada
Dominion Water Power Act 1985	Covers development of water-power or transmission, distribution or utilisation of the force or energy produced from water-power on federal lands south of the 60th parallel. Primary focus on reserve lands and national parks. Does not include water powers under the control of the Commissioner of Yukon. Waterpower includes any force or energy capable of being produced or generated from flowing or falling water in such a quantity to give it commercial value.	Indian and Northern Affairs Canadian Heritage Parks Canada
Canada Shipping Act 1985	Regulates shipping, including ship sourced pollution, and the designation of water bodies under the Pleasure Craft Sewage Pollution Regulations and Non-Pleasure Craft Sewage Pollution Regulations.	Transport Canada Fisheries and Oceans Canada
Navigable Waters Protection Act 1985	Regulates activities on navigable waters.	Fisheries and Oceans Canada Transport Canada

From Comox Valley's Drinking Water Reference Guide (Jenssen 2007). Reprinted with permission.

* The Guidelines for Canadian Water Quality are developed by the Federal-Provincial-Territorial Committee on Drinking Water published by Health Canada. These guidelines propose standards for drinking water quality and the protection of aquatic life across Canada. This is not legislation and a province can either chose to adopt all of the recommendations or amend them as relevant to their ecosystems and socio-political culture (accessible at www.hc-sc.gc.ca/waterquality) (Jenssen 2007).

** Natural Resources Canada provides information and policy advice about scientific and technical innovations to minimise impacts of the natural resource sector on aquatic ecosystems (Jenssen 2007).

3.7.1 Health Canada

Health Canada is involved in many activities related to water quality including:

- Developing national drinking water guidelines with provincial and territorial drinking water authorities
- Providing emergency advice in cases of drinking water contamination, when requested by another government department or agency
- Developing guidelines for water used for recreational activities, such as lakes where people swim
- Ensuring the safety of drinking water on cruise ships, airlines, passenger ferries, trains, and other common carriers

- Working with other departments to make sure all federal government employees have access to safe drinking water in their workplaces
- Monitoring drinking water quality on First Nations reserves, as part of its wider mandate to deliver public health services in these communities
- Regulating the safety and quality of bottled water, prepackaged ice, and water used in food processing
- Working in collaboration with partners and stakeholders on broader water quality issues, including the development of water policies and research priorities (Jenssen 2007).

The Federal-Provincial-Territorial Committee (FPTC) establishes the Guidelines for Canadian Drinking Water Quality (GCDWQ). The FPTC meets twice annually, once in Ottawa and once in one province. The guidelines are published by Health Canada but it is up to each province to adopt the guidelines, resulting in diverse drinking water quality standards across the country (Stauffer 2004, in Jenssen 2007).

If a province chooses to adopt these guidelines, only then do they become legally enforceable as legislation. In contrast, in the United States, federal public drinking water standards are administered by the Environmental Protection Agency under the Safe Drinking Water Act and are legally binding across the country (Stauffer 2004, in Jenssen 2007).

The Guidelines for Canadian Drinking Water Quality address the physical, chemical, radiological, and microbiological quality of water. Outlined in Table 6 are the guidelines for Canadian Drinking Water quality parameters.

Table 6. Guidelines for Canadian Drinking Water Quality Parameters

Parameters	Maximum Acceptable Concentrations (MAC)	Aesthetic Objectives (AO)
Physical True colour, tcu		< 15 AO
Turbidity, ntu	<1 MAC	<5 AO
Chemical (mg/L) Alkalinity (Calcium carbonate)		
Arsenic	<0.025 MAC	
Calcium		
Hardness (Calcium carbonate)		
Iron	<0.3 MAC	
Manganese	<0.05 MAC	
pH	6.5 – 8.5	
Sodium	<200 MAC	

From Comox Valley's Drinking Water Reference Guide (Jenssen 2007). Reprinted with permission.

Characteristics such as colour, turbidity, pH, taste, and odour affect the aesthetics of the water. Chemical and radiological characteristics affect possible short- or long-term health effects. Microbiological characteristics are associated with waterborne disease. A committee establishes a list of priority contaminants for review by Health Canada scientists, who begin by determining what level of contaminant produces no negative health effects, labelled "No Observed Adverse

Effect Level" (NOAEL) (Stauffer 2004 in Jenssen 2007). With this information, the Tolerable Daily Intake (TDI) is calculated, and then Maximum Acceptable Concentrations (MAC) for substances which have known or suspected health effects and aesthetic objectives (AO) for substances which can impact consumers' acceptance of the supply or interfere with good water supply (Stauffer 2004 in Jenssen 2007).

3.7.2 International agreements

A dispute over the sharing of waters from the St. Mary River and Milk River watersheds spanning Montana, Saskatchewan, and Alberta lead to the 1909 Boundary Water Treaty between Canada and the USA and the establishment of the International Joint Commission (IJC) (Halliday and Faveri 2007, Jenssen 2007). The IJC was to establish local international boards that would oversee adherence to rules and regulations related to the utilisation and safeguarding of American and Canadian boundary waters. Broadly speaking, two types of boards were established: boards of control and advisory boards (Petersen 1984, Jenssen 2007). The IJC sets basic principles for guiding boundary water relations between Canada and the United States. Canada is signatory to several treaties and agreements with the United States (Jenssen 2007), including:

- Boundary Waters Treaty 1909
- Lake of the Woods Convention and Protocol 1925
- Rainy Lake Convention 1940
- Niagara River Water Diversion Treaty 1950
- Columbia River Treaty 1961 and Protocol 1964
- Skagit River Treaty 1984
- St. Lawrence Seaway Project 1952
- Great Lakes Water Quality Agreement 1972, 1978, 1989
- Water Supply and Flood Control in the Souris River Basin 1989

3.7.2.1 Water as a Human Right

Human rights are protected by internationally guaranteed standards that ensure the fundamental freedoms and dignity of individuals and communities. They include civil, cultural, economic, political, and social rights. Human rights principally concern the relationship between the individual and the State. Governmental obligations with regard to human rights can be broadly categorised in obligations to respect, protect, and fulfil (WHO 2002, accessed April 23, 2010).

Respect: The obligation to respect requires that States Parties (that is, governments ratifying the treaty) refrain from interfering directly or indirectly with the enjoyment of the right to water.

Protect: The obligation to protect requires that States Parties prevent third parties such as corporations from interfering in any way with the enjoyment of the right to water.

Fulfil: The obligation to fulfil requires that States Parties adopt the necessary measures to achieve the full realisation of the right to water.

Regardless of their available resources, all States Parties have an immediate obligation to ensure that the minimum essential level of a right is realised. In the case of water, this minimal level includes ensuring people's access to enough water to prevent dehydration and disease. Other immediate and inexpensive obligations include non-discrimination and the respect and protection of the existing enjoyment of rights.

The recognition that the realisation of human rights is dependent upon resources is embodied in the principle of progressive realisation. This principle mandates the realisation of human rights within the constraints of available resources. It also creates a constant and continuing duty for States to move quickly and effectively towards the full realisation of a right. This neither requires nor precludes any particular form of government or economic system being used to bring about such change. Steps towards the full realisation of rights must be deliberate, concrete and targeted as clearly as possible towards meeting the human rights obligations of a government and may include legislative, administrative, financial, educational and social measures or the provision of remedies through the judicial system.

A rights-based approach has implications for a range of actors concerned directly or indirectly with water issues. Governments, as primary duty-bearers, must take concrete steps to respect, protect and fulfil the right to water and other water-related rights and to ensure that anyone operating within their jurisdiction - individuals, communities, civil society, and the private sector - do the same. This means paying attention to these rights also in processes, ensuring the right of beneficiaries to participate in decision-making that affects them and guaranteeing transparency so that individuals have access to information and are able to understand, interpret, and act on the information available to them.

A rights-based approach is also premised upon the principle of freedom from discrimination and equality between men and women. This is closely linked to the issue of accessibility. For example, the right to water specifically rules out exclusion from needed services according to ability to pay. This is crucial in ensuring the delivery of services to the poor.

A central feature of a rights-based approach is the notion of accountability, which in practice requires the development of adequate laws, policies, institutions, administrative procedures and practices, and mechanisms of redress. This calls for the translation of the internationally recognised right to water into locally determined benchmarks for measuring progress, thereby enhancing accountability (WHO 2002, accessed April 23, 2010).

A rights-based approach may deliver more sustainable solutions because decisions are focused on what communities and individuals require, understand and can manage, rather than what external agencies deem is needed (WHO.2002, accessed April 23, 2010).

Duty to protect: regulating third parties

A government is not the only actor that can endanger or restrict the right to water. Individuals and corporations have the potential to interfere with a person's or community's water supply. For example, pollution from factories, farming or sewage can greatly damage the quality of water used for drinking. A private individual can deny access to a river needed for washing, or a corporation may increase prices for water services to unaffordable levels (WHO.2002, accessed April 23, 2010).

The duty to protect requires that governments should diligently take all the necessary feasible steps to prevent others from interfering with the right to water. This will usually require a strong regulatory regime that is consistent with other human rights. The Committee on Economic, Social and Cultural Rights has stated that this should include independent monitoring, genuine public participation and imposition of penalties for non-compliance with standards. Comprehensive regulatory measures will be needed with respect to pollution, disconnection of water supplies, land use and access to water supplies (WHO 2002, accessed April 23, 2010).

States Parties should adopt comprehensive and integrated strategies and programs to ensure that there is sufficient and safe water for present and future generations. Such strategies and programs may include, for example, reducing depletion of water resources, reducing and eliminating contamination of watersheds and water related eco-systems, increasing the efficient use of water by end-users, and reducing water wastage in its distribution (WHO 2002, www.who.int/water-wanitation-helath/rtw4.pdf; accessed April 23, 2010).

Countries also have international obligations to cooperate with other states to ensure that the right to water is achieved everywhere. This means countries must make certain that their actions do not deprive individuals of the right to water in other parts of the world. Examples include cooperating with respect to transboundary watercourses, preventing pollution, and refraining from imposing sanctions on goods and services needed to ensure the right to water. Steps should also be taken to ensure that sufficient financial and other aid is given to other countries, to accelerate coverage improvement beyond that possible with limited domestic resources.

Finally, States Parties should ensure that the right to water is given due attention in international agreements (WHO 2002, accessed April 23, 2010).

Responsibilities of local governments

Local governments are often at the front line in providing water and sanitation services. They are frequently given responsibility by national governments to ensure access to these services as well as the power to determine who receives the services, and under what conditions. General Comment 15 on the right to water states that national government must ensure that local authorities "have at their disposal sufficient resources to maintain and extend the necessary water services and facilities."

However, local authorities must also respect the right to water of everyone in their jurisdiction and the General Comment states that States Parties "must further ensure that such authorities do not deny access to services on a discriminatory basis" (WHO 2002, accessed April 23, 2010).

3.7.2.2 Water as a Human Right in 2010

On July 28, 2010, the United Nations General Assembly overwhelmingly agreed to a resolution declaring the human right to "safe and clean drinking water and sanitation." The resolution, presented by the Bolivian government, had 122 countries vote in its favour, while 41 countries including Canada, abstained (Council of Canadians e-Newsletter and Action Alerts, July 30, 2010).

While Canada abstained from the critical vote, Meera Karunananthan, National Water Campaigner for the Council of Canadians, said it does not mean our country can sit idly by. It is crucial now that communities in Canada use this opportunity to hold our government accountable to the international commitment to recognize water and sanitation as human rights. We must demand legislation at home to ensure that these rights are enjoyed by all peoples of Canada without discrimination. It is time for Canada to do something about the deplorable condition on First Nations reserves that have lacked access to safe drinking water and adequate sanitation for generations (Council of Canadians e-Newsletter and Action Alerts, July 30, 2010).

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Part 4 Water Supply—Water Systems—Water Needs in the Alberni Valley

4.0 Introduction

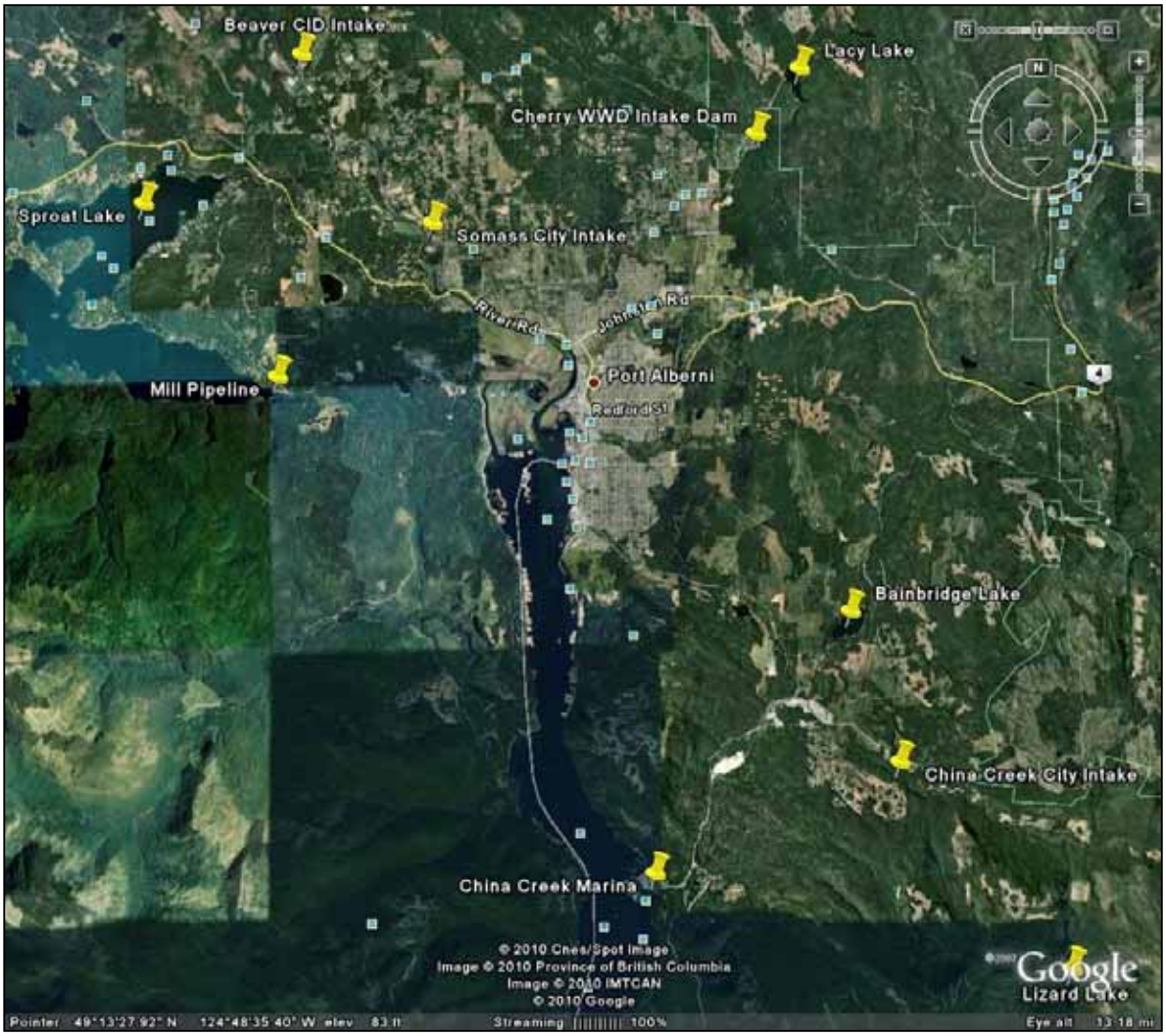
Information was gathered from personal interviews throughout the course of this project. Wherever possible, the interviewee's name and date of contact have been listed within the body of the text.

Alberni drinking water comes from a number of different sources (see Figure 17). There are several different water systems in the Alberni Valley, ranging from the larger surface water systems of the City, Beaver Creek, Cherry Creek, and Sproat Lake to small single-family wells or springs. It is not clear whether the majority comes from surface or groundwater (as there is no clear classification for karst groundwater systems at this time). However, much of the drinking water in the Alberni Valley Watershed originates from karstified limestone (North West Hydraulics 1999; R. Robinson, personal interview, May 2009).

The karst groundwater systems of the hydrological cycle are complex, making classification of water from springs challenging. The author was not aware of this challenge until a field trip with staff from VIHA and the Ministry of Environment, Water Stewardship Division. While visiting one of the Alberni Valley water supplies from a karst cave, the staff were asked whether this was a surface or groundwater source. There was confusion among the staff about the definition with regard to where groundwater ends and surface water begins for a spring. [International standards of the caving community define the cave entrance dripline to be the point of differentiation between surface and subsurface zones. A dictionary definition reads as follows: "A line on the ground at a cave entrance formed by drips from the rock above. Useful in cave surveys to define the beginning of the cave" (Jennings 1997-2009)]. Later, VIHA concluded that the water from the cave spring was considered to be flowing surface water. This was an intriguing definition because, at the point of extraction, the water was flowing underground. A specific definition is required to determine where groundwater ends and surface water begins in order to have clear guidelines to manage this complex water resource from a spring.

The City of Port Alberni has surface water reservoirs at Bainbridge Lake and at Lizard Lake. Cherry Creek Waterworks District (CCWD) has a surface water reservoir at Lacy Lake, as well as a small dam located slightly upstream of the water treatment plant. Beaver Creek Improvement District's (BCID) source is the Stamp River, including its many tributaries. Figure 17 shows the water supply sources for the City of Port Alberni, Cherry Creek, and Beaver Creek.

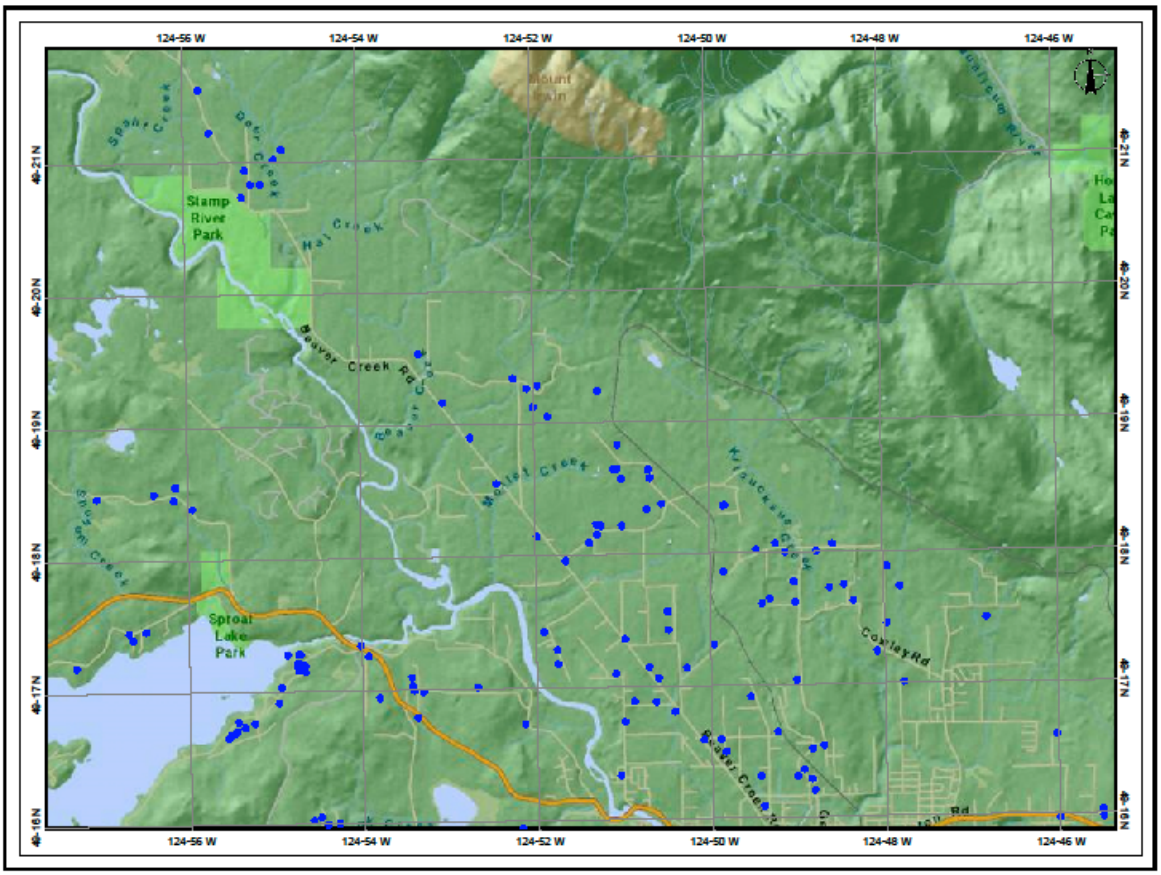
Figure 17. The City of Port Alberni, Beaver Creek Improvement District, Sproat Lake, and Cherry Creek Waterworks District's Drinking Water Supply sources



Reprinted from Google Earth Images 2010.

Not all residents of the Alberni Valley receive their drinking water from the main water purveyors. The drinking water sources for approximately 4000 residents of the Alberni Valley (including 2,347 Sproat Lake and 900 Beaufort residents) are Sproat Lake, Great Central Lake, groundwater wells, springs, and streams (personal interviews with Area D Regional Director Penny Coté, April 2010; and Area B Regional Director Mike Kokura, January 2010).

Figure 18. Registered Wells in the Alberni Valley in 2009

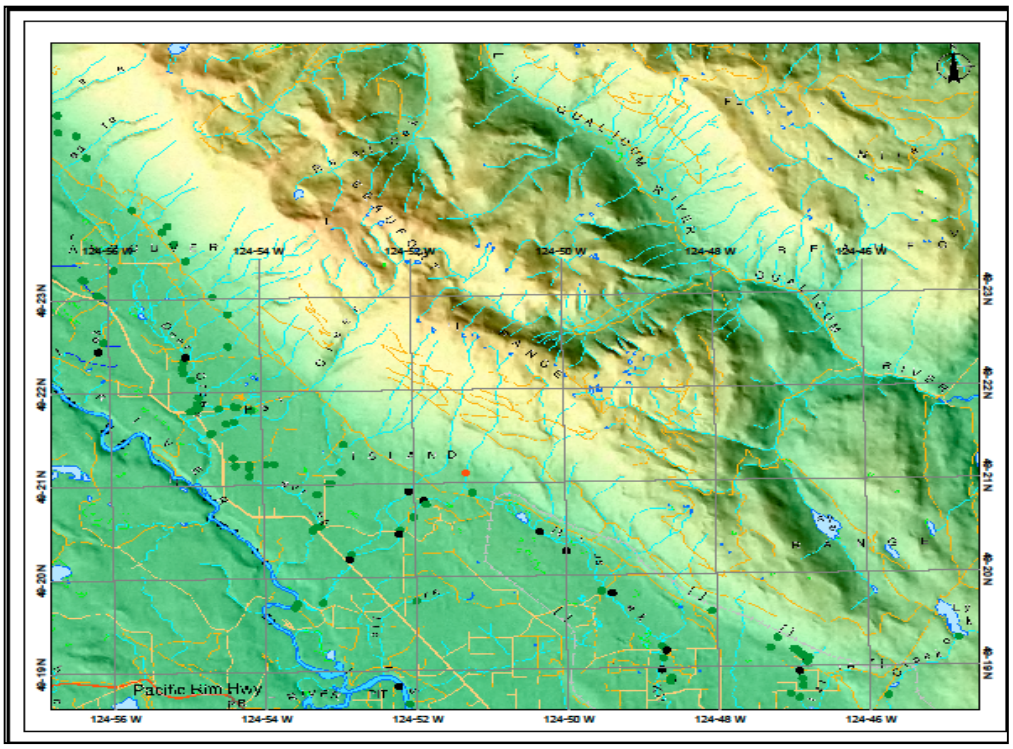


From Ministry of Environment (2009). Copyright Government of British Columbia.

Currently, there are 70 active water licences for water extraction from streams originating mainly in the Beauforts. Other water licenses in the Alberni Valley include 151 registered domestic wells, and 90 registered water licenses at Sproat Lake. There are no registered drinking water licences at Great Central Lake. Numerous unregistered extraction sites for wells, springs, and streams also exist in the Alberni Valley (BC Environment September 2009).

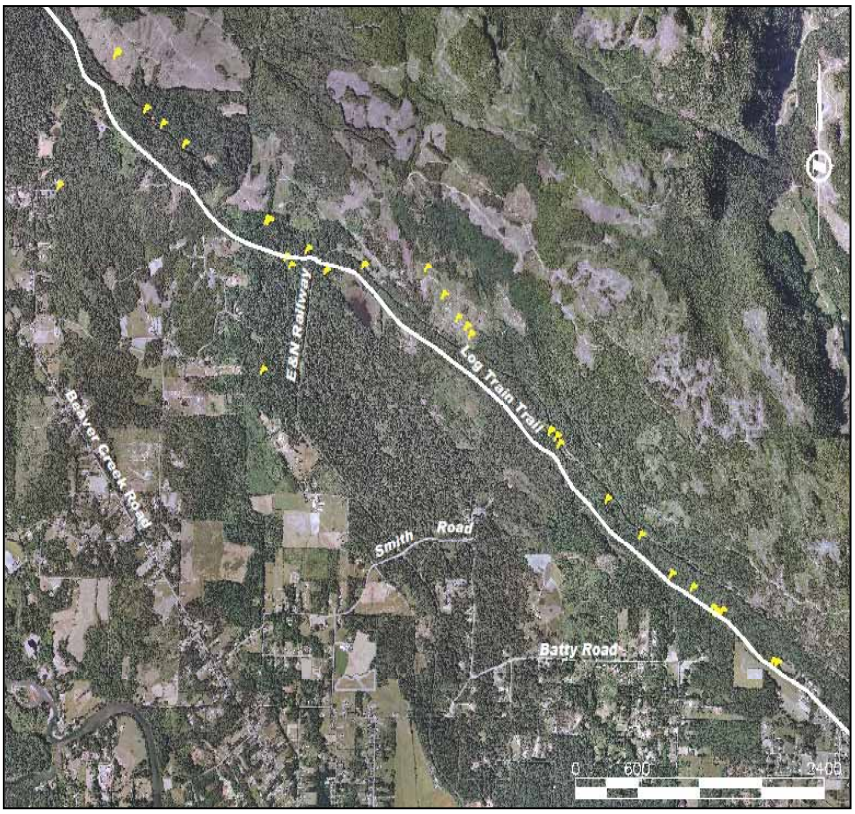
The origins of these water sources are unknown. The streams, springs, and creeks depicted in Figures 19 and 20 are an anomaly, according to Ministry of Environment Regional Geomorphologist Richard Guthrie. The characteristics expected of a coalescing colluvial fan during summer typically would be hot water temperatures and low flow, not what was observed (personal interview, May 26, 2010). This data further supports the proposition that the Alberni Valley watersheds [ground-water/surface water drainage systems] are complex and need specific guidelines for managing their water resources.

Figure 19. Registered Water Licenses for streams and springs in the Alberni Valley



From Ministry of Environment (2009) © BC Government

Figure 20. Inventory of springs and creeks along the Beaufort Range between Cherry Creek and Beaver Creek located along the Log Train Trail in Aug 2009.



A GPS (Garmin eTrex HC series) was used and data transferred to (NR Can Topographic maps)

4.1 The City of Port Alberni Water Supply System

The city's water supply system has been publicly owned since 1912. Over the years, the city has used a number of different sources, including Roger Creek, Kitsuksis Creek, and Yellow Creek.

The first China Creek water diversion began in 1896, with the Duke of York Hydraulic Mining Company to supply water to the mine. The City of Port Alberni built a dam below the mine's dam in 1912, and conveyed water to the city through a 16-inch wire-wrapped wood-stave pipe (Gray 1993). In 1931, the current concrete intake and dam were built downstream from the old wood crib dam of 1912, and a manual screening system was added. The new pipeline was steel and was delivered in 18-foot lengths, hauled into the bush with horses and specially built carts. In 1937, a 1.5 million gallon open earth fill concrete-lined reservoir was built at Cowichan Street and 14th Avenue. Ten years later, because of the demand for more water on the north east side of Port Alberni, a new earth fill concrete-lined open reservoir was constructed at Burde Street and 18th Avenue (Gray 1993).

In 1957, after two successively dry summers, an impounding dam that could be released into Williams Creek and down to China Creek during dry hot summers was built at Lizard Lake. In 1962, Bainbridge Lake dam was built. Before the City of Port Alberni could use Bainbridge Lake for a water supply, it had to buy the lake from a Mr. Blower. In 1963, chlorination became mandatory, so a chlorinator was installed in the Bainbridge pumphouse to treat both sources of supply (Gray 1993).

In 1973, improvements were made to the China Creek intake involving a new automatic screening house and level recorder, and modifications were made at the Bainbridge pumphouse. Also, a fully automatic central panel system operated using BC Telephone rental lines to monitor and control most of the supply system functions from a central control. In 1992, this system was replaced by computer (Gray 1993).

Figure 21, on the following page, is a photo of China Creek taken during a watershed tour in spring 2008.

Figure 21. China Creek, City of Port Alberni drinking water supply

Reprinted with permission by Gail Morton 2008

In 1985, a new earth fill dam was constructed at Lizard Lake to replace the old dam, which was replaced for safety reasons. In the same year, the City of Port Alberni connected the last link in combining the China Creek/Bainbridge Lake system to the Somass River system . This permitted the amalgamated cities of Alberni and Port Alberni to remain supplied with gravity-fed water for most of the year. The Somass River system was cost-prohibitive because water had to be pumped. Therefore, the Somass River system is only retained as a backup in case of damage to the China Creek/Bainbridge systems or watersheds (Gray 1993).

In 1986, the Burde Street and Upper and Lower Cowichan reservoirs were covered, utilising floating synthetic covers that rise and fall with the depth of the water (Gray 1993).

The City of Port Alberni obtains water from two surface coverage courses: China Creek (shown in Figure 21) and Bainbridge Lake (shown in Figure 22). There is also an intake on the Somass River for use during peak demands. Within the city, there are five water storage reservoirs, 23 pressure regulating valves, 150 km of water main, 715 hydrants, and 3 dams. Water is disinfected via chlorination (City of Port Alberni Engineering Department 2007).

Figure 22. Bainbridge Lake, City of Port Alberni drinking water supply

Reprinted with permission by Gail Morton 2008.

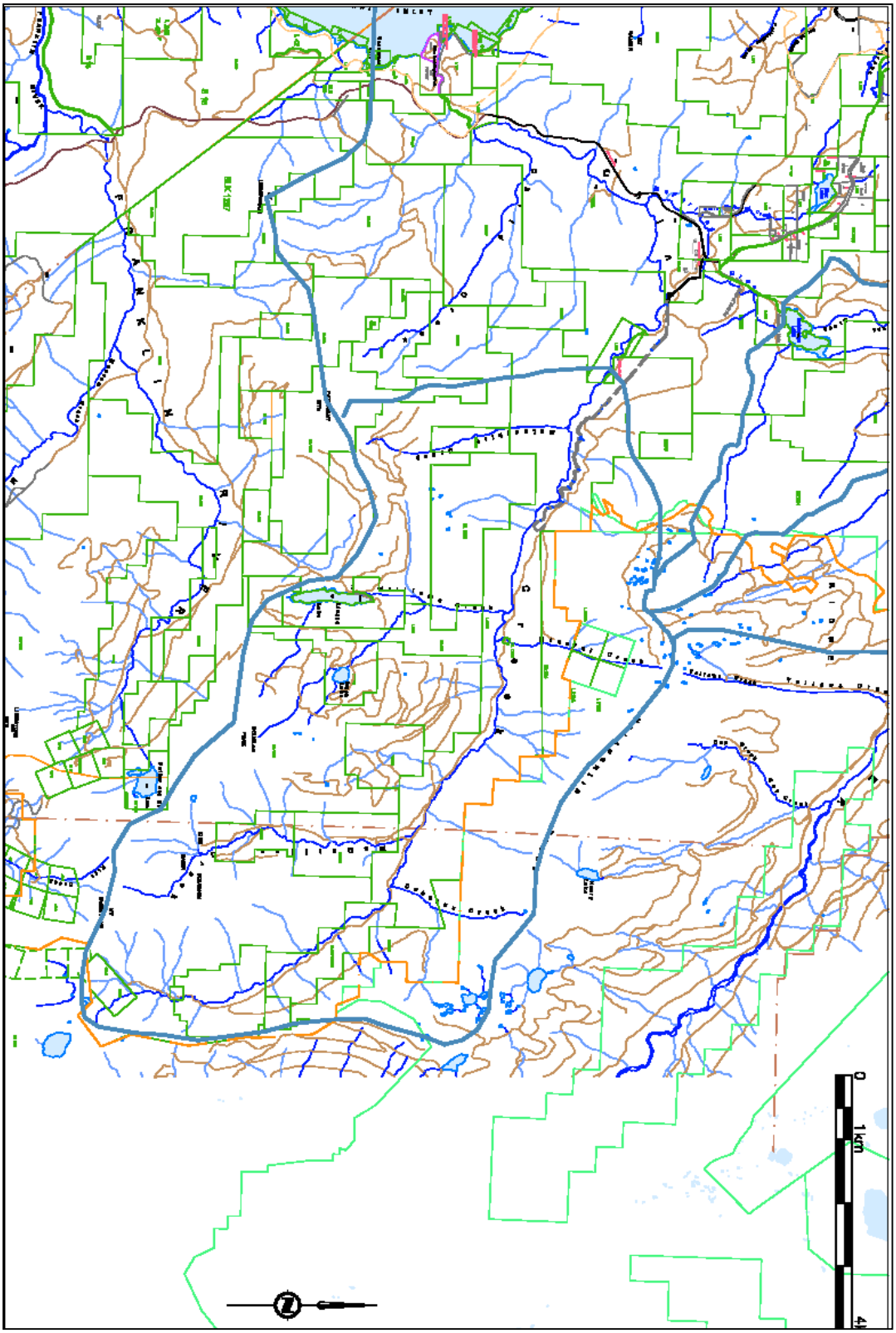
4.1.1 Assets inventory

Watersheds:

- China Creek Watershed: 62,020 hectares (ha)
- Bainbridge Lake (McFarland Creek) watershed: 1,310 ha
- Somass Basin Catchment area: 142,600 ha

China Creek watershed is a Designated Community Watershed (T. Pobran, Ministry of Environment, personal communication April 2010). China Creek Watershed is also listed as a Watershed Reserve (Koop 2006), and may still have that designation (T. Pobran, personal communication). The City of Port Alberni does not own the China Creek watershed. Figure 23 is a map showing the China Creek Designated Community Watershed boundaries.

Figure 23. China Creek Designated Community Watershed Boundaries



The China Creek Designated Community Watershed has several owners, see Table 7. Data used for Table 7 was provided by South Island Forest District and Alberni Clayoquot Regional District.

Table 7. China Creek Designated Community Watershed Ownership

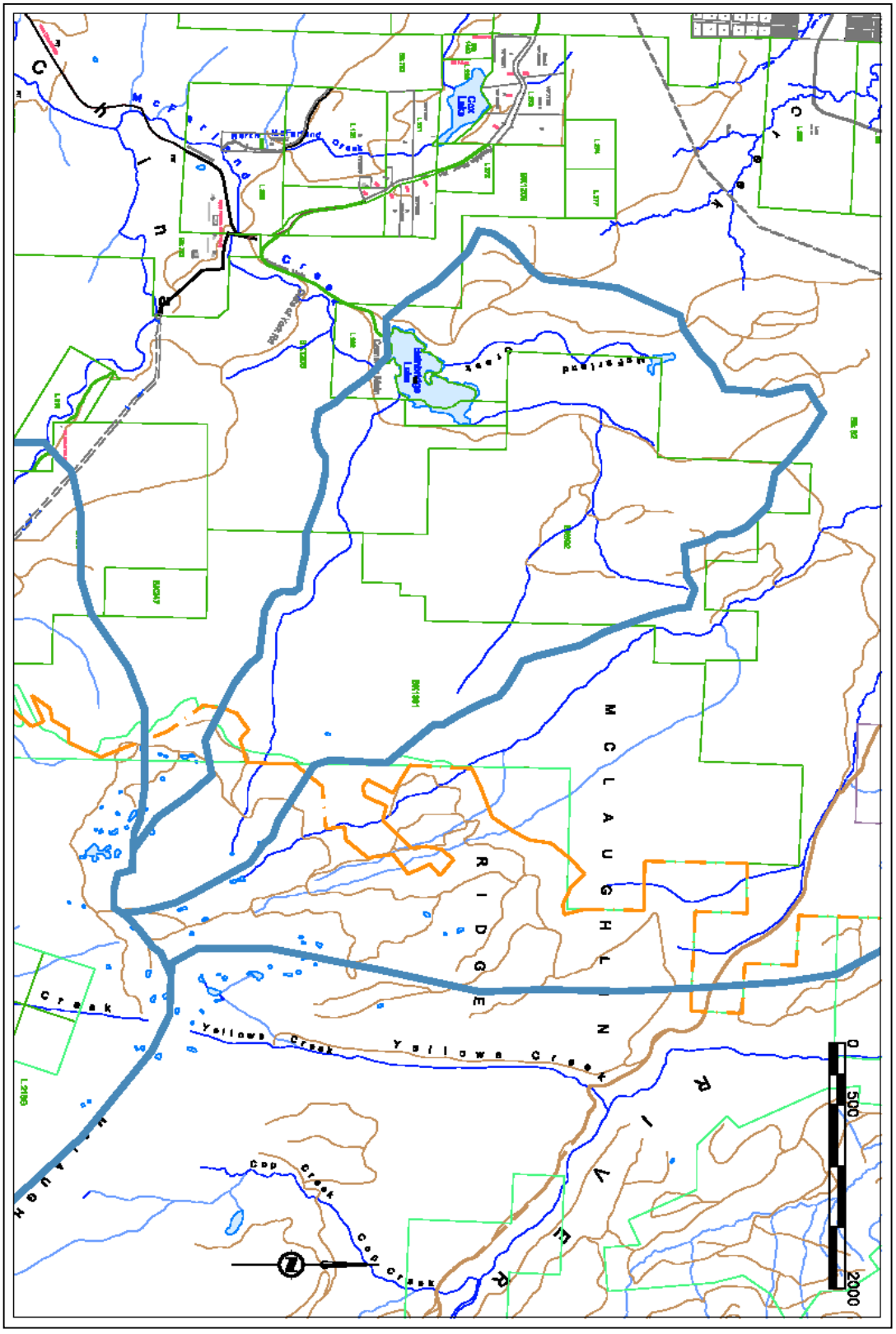
Site	Owner	Area
Blk 268	Island Timberlands	49 ha – 120 ac
DL 1382	Timber West	280 ha – 692 ac
Blk 286	Crown	Unknown
Blk 633	Island Timberlands	139 ha – 343 ac
Blk 822	Island Timberlands	101 ha – 250 ac
Blk 1318	Island Timberlands	3340 ha – 8254 ac
Blk 824	Island Timberlands	110 ha – 272 ac
Blk 285	Unknown	Unknown
Blk 936	Island Timberlands	74 ha – 182 ac
Blk 1152	Island Timberlands	160 ha – 394 ac
DL 2000	Island Timberlands	132 ha – 327 ac
Blk 1118	Island Timberlands	154 ha – 380 ac
Blk 1288	Island Timberlands	346 ha – 856 ac
Blk 198 G	Unknown	Unknown
Blk 199 G	Unknown	Unknown

Bainbridge Lake (McFarland Creek) watershed:

Bainbridge Lake (McFarland Creek) watershed is a Designated Community Watershed (T. Pobran, Ministry of Environment, personal communication April 2010). Bainbridge watershed is also listed as a Watershed Reserve (Koop 2006) and may still have that designation (T. Pobran, Ministry of Environment, personal communication April 2010).

The City of Port Alberni owns 38 acres of Bainbridge Watershed. See Figure 24 for a map of Bainbridge (McFarland Creek) Designated Community Watershed and Watershed Reserve boundaries.

Figure 24. Bainbridge Lake (McFarland Creek) Designated Community Watershed Boundaries.



Bainbridge Lake (McFarland Creek) Designated Community Watershed has several owners, see Table 8. Data used for Table 8 was provided by South Island Forest District and Alberni Clayoquot Regional District.

Table 8. Bainbridge Lake Designated Community Watershed Ownership

Site	Owner	Area
Blk 82	Island Timberlands	579 ha - 1431 ac
Blk 692	Island Timberlands	504 ha - 1246 ac
Blk 1381	Timberwest	894 ha - 2210 ac
L292	City of Port Alberni	15 ha - 38 ac
L227G Not in Alberni	Unknown	Unknown

Primary activities in the watersheds are forestry and recreation. The China Creek water resource is shared with Upnit Power Corporation (a micro-hydro utility in which the City is a 5% owner) and Dolan's Concrete, both located downstream of the City's water intake (City Engineer, personal communication, April 2009).

Currently, no Watershed Protection Plan is in place. However, Island Timberlands commissioned a Watershed Assessment Plan in February 2007, prepared by Streamline Environmental Consulting Ltd. and Ostapowich Engineering Services Ltd. The report is the property of Island Timberlands and is not a public document. The City refused to give us adequate time to review the Watershed Assessment report. Island Timberlands does not acknowledge that the document exists.

According to City staff, when a problem in the watershed is reported, the owners respond quickly. However, it appears that the problem must be first reported by the City and it is the responsibility of City staff to monitor the owner's activity (City of Port Alberni, Waterworks Dept, personal interview 2008). Therefore, due to recent funding cuts to City services, it is unclear how the city will maintain its monitoring responsibilities.

Watershed Recharge:

It is unknown how the system is recharged, according to City Engineering staff. However, the lake levels do respond to rainfall. Therefore, it is believed that rain fills the lakes. No hydrological study conducted in the area indicates how water moves through the watershed aquifers. According to Engineering Staff, there are no aquifer monitoring sites for this system.

It is also unknown how dependent the watershed is on snowpack for recharge. According to an article in the *AV Times*, in the winter of 2008-9, "snow levels in the China Creek Watershed continue to worry city engineering staff" (Shayne Morrow, March 10, 2009). Snowpack, according to the BC River Forecast Centre, advised that the snowpacks at indicator sites on the Central Island are at about 60% of seasonal normal. Although not in the Alberni watershed, Mount Cokely in Mount Arrowsmith Park provides the closest snowpack measurement. In 2009, Mount Cokely recorded about 55% of average snow levels. As of January 2010, the Mt Cokely snowpack is no longer being surveyed (Chapman, Ministry of Environment, River Forecast

Centre, personal communication, Jan 2010). During summer 2009, the City went to Stage One water restrictions.

Water Needs in this Watershed:

City Engineering staff believe that the City water supply system in use at present is a secure water supply—secure from drought but not from terrorist acts. They believe that the system is capable of supplying sufficient water quantity and quality for current and future generations. Possible increased urban food production is not included in the City's projected water estimates (City Engineer, personal interview, Oct 2009).

Water Supply Sources:

1. China Creek is a Gravity fed system with a 24, 451 m3/day license. A caretaker's home is located 300 m downstream of the intake dam. Two locked gates restrict access to the dam. China Creek Dam is a concrete dam/spillway with a wet well channel made of concrete that leads to a trash rack which leads into a travelling screen chamber to filter out large debris before water enters pipe (City Engineering Dept. 2007).
2. Bainbridge Lake intake uses two 50 HP gas-powered engine to transport 10.9 m3/min (2400 gpm), of water into the city system and has a 9,763 m3/day licence. (City Engineering Dept. 2007).
3. Somass River intake uses two 60 HP pumping 3.4 m3/min (750 gpm) each and one 125 HP to pump 6.3 m3/mi (1390 gpm). Both are gas-powered engines that pump the water into the city system (City Engineering Dept. 2007).

The annual cost for running the pumps and generators is not itemised by the City, therefore no expense value was given.

The City holds a 13,564 m3/day licence for the Somass River. The City also holds other water licenses, including one for East Lugrin Creek and Kitsuksis Creek.

The total volume of water permitted for the City system is 47,778 m3/day (City Engineering Dept. 2007).

Water Storage:

The City uses three dams:

1. China Creek Dam is a concrete dam at an elevation of 184 m. The storage capacity of this dam is 5000 m3.
2. Lizard Lake Dam is a combination of concrete and earth fill at an elevation of 732 m. Stream name of Lizard Lake is Williams Creek. This dam has the storage capacity of 545,000 m3.
3. Bainbridge Lake is an earth fill construction at an elevation of 150 m with a storage capacity of 1,230,000 m3 (City Engineering Dept. 2007).

Reservoirs:

The city uses 5 reservoirs:

1. Upper Cowichan has an 11,250 m3 holding capacity and is located at the end of Anderson Ave. at an elevation of 158 m. The water is protected by a floating rubber cover.

2. Lower Cowichan has a holding capacity of 6,750 m3 and is located near the end of Anderson Ave at an elevation of 146 meters. The water is protected by a floating rubber cover.

3. Burde has a 6,750 m3 holding capacity and is located near the top of Burde St at an elevation of 86.8. The water is protected by a floating rubber cover.

4. Johnston is composed of two concrete cells with a 9,000 m3 holding capacity and is located at the top of Johnston near Chances Casino at an elevation of 66.8 m.

5. Arrowsmith Heights Reservoir is a one-cell steel tank with a storage capacity of 250 m3 and is located at the top of Burde Street at an elevation of 173.6m.

The total reservoir storage capacity is 34,000 m3, enough for three days water supply (City Engineering Dept. 2007).

Pump Stations:

There are five pump stations for the City's water system.

1. Bainbridge pump station is located on Bamfield Road.
2. Somass is located above Paper Mill Dam picnic area.
3. Cowichan is located at the end of Anderson St and uses two 60 HP pumps pumping 10.9 m3/min (2400 gpm) and one 5 HP pumping 0.30 m3/min (65 gpm). Both are gas-powered engines that transport water within the system.
4. Johnston is located near the Chances Casino and uses four 60 HP engines pumping 3.64 m3/min (800 gpm) each, one 7.5 HP that pumps 0.55 m3/min (120 gpm), and two 145 HP diesel engines that pump 9.6 m3/min (2100 gpm) each.
5. Arrowsmith Heights use two 5 HP gas-powered engines, pumping 0.30 m3/min (65 gpm) each.

The total pump station horsepower is 1018 HP. The annual cost for operation of the pump stations is unknown (City Engineering Dept. 2007).

Water Treatment:

The City has three chlorination stations. All use chlorination gas injection. The three stations are Bainbridge pump station, located on Franklin River Road intersection; Somass pump intake station above Paper Mill Dam; and the Johnston pump station near the Chances Casino.

There are nine chlorine residual test points found along the system, which are tested daily, and 21 bacterial test locations are tested monthly (City Engineering Dept. 2007).

System Materials:

Supply mains have 400 mm and 600 mm steel pipe. Distribution mains are between 150 mm – 300 mm pipe made of a variety of materials. The majority of the distribution mains are made of asbestos cement (77.5 km). Cast iron mains make up 32.8 km. Plastic (PVC) mains cover 23.5 km. Ductile iron, galvanised iron, and steel make up another approximately 8 km. The remaining 9.5 km are made of unknown material.

The current system is in fair condition. Much of the old wood stave pipe has been replaced and some cast iron pipes and asbestos remain. The infrastructure is funded by water rates and therefore, in theory, self-sustaining. A new treatment plant is needed to upgrade the system to meet VIHA requirements. It is hoped that a UV treatment system to supplement the chlorine treatment will be adequate (City Engineer, personal communication, Oct 2009).

Water Meters:
There are 6,700 active meters within the City jurisdiction, of which 6,300 are residential, 310 are commercial, and 13 are industrial meters. The City has 62 meters for parks, swimming pool, ice arena, library, city hall, etc. Meter reading occurs three times a year; 310 commercial and 6,300 residential meters are read (City Engineering Dept. 2007).

Routine Maintenance:
Dams Maintenance
1. Lizard Lake Dam
    - Monthly visuals, level recording
    - Yearly vegetation and road maintenance

2. China Creek Dam
    - Sluice gates are opened to flush gravel build-up as needed

3. Bainbridge Lake Dam
    - Daily level recording
    - Bi-monthly visual of discharge chamber and spillway
    - Brush control and perimeter inspection of the lake (City Engineering Dept. 2007)

Reservoir Maintenance:
Visual inspection of reservoirs occurs at a minimum of three times per week. Reservoirs are cleaned and disinfected at the following intervals:
- Cowichan reservoirs; once every two years
- Burde Street reservoir; once every two years
- Arrowsmith Heights; once every two years
- Johnston reservoir; both cells once every 5 years (City Engineering Dept. 2007)

Pumphouses:
- Visual checks three times per week
- Somass pump station once a week when in use (City Engineering Dept. 2007)

Other system maintenance activities
- SCADA system: Maintenance as required
- Water Treatment System: Visual checks 5 days per week, change chlorine cylinders as require. (City Engineering Dept., 2007)
- Equipment Maintenance: As needed; water flushing spring and fall (City Engineering Dept 2007)

The City of Port Alberni has an Emergency Response Plan for a variety of situations, including contamination, loss of water, water main break (distribution), chlorine gas leak, tsunami flood conditions, earthquake, cross-connection or backflow incident, chlorinator failure, spills of chlorinated water into fish-bearing streams, power outages, water advisory (City Engineering Dept. 2004). Emergency contact information: City of Port Alberni City Engineer. After hours, emergency contact is the City Fire Station at 250 724 1351.

According to Vancouver Island Health Authority (VIHA) guidelines for water purveyors, there are three types of drinking water advisories.

1. Water Quality Advisory:
    - Issued as a precautionary measure when a health risk assessment determines that the risk to drinking water users is low (Turbidity greater than 1)
    - Requires identification of cause and response.
    - May require re-testing of drinking water.
    - Requires emergency response plan implementation and review.
    - Public Notification is at the discretion of the Drinking Water Officer.

2. Boil Water Advisory:
    - Issued when a health risk assessment determines that an identified threat is a biological risk to drinking water.
    - Requires immediate inspection by operators
    - Requires identification of cause and response.
    - Requires additional testing of drinking water.
    - Requires activation of emergency response plans.
    - Requires public notification.

3. Do Not Use Water Advisory:
    - Used in those situations where there is an immediate threat.

4.1.2 Water quality

Unknown threats to water quality include terrorist acts, vandalism, acts of nature, sewage contamination, chemical threat or contamination.

- Requires public notification
- Requires an alternate water supply
- Plus all of the same steps for boil water advisory

Public notification must be given when a monitored parameter in relation to the drinking water exceeds an established standard, or there is, was, or may be a threat to the drinking water (City Engineering Dept. 2004).

The Ministry of Health requires that samples of raw supply water and treated distribution water in the water system are gathered and tested to monitor water quality (City Engineering Dept. 2004).

Water Supply Tests

The following tests occur at Bainbridge, China Creek, and Somass twice a year:

- Conventional limnology parameters: pH, turbidity, hardness, true colour, nitrate and nitrite, fluoride, cyanide, etc.
- Metal analysis
- Total Coliform and Fecal Coliform
- Giardia and Cryptosporidium (Bainbridge and China Creek only)
- Samples are periodically taken from Lizard Lake (City Engineering Dept. 2004)
- City Waterworks Dept. collects the water samples for testing by designated laboratory

Distribution System Tests:

- Total Coliform and Fecal Coliform at 20 points throughout the system. Five tests are to be taken each week.
- Conventional limnology parameters at 10 points along the system are to be taken twice a year.
- Metal analysis at 9 points to be taken twice a year.
- Chlorine residual tests at 9 locations three or four times per week.

Miscellaneous tests can be arranged to test for specific elements as desired. For instance, tests can be conducted to detect Glyphosate, a herbicide found in Roundup and commonly used in forestry activity. The test is conducted after application and after a rain event. However, according to City staff, this test has not occurred for several years because it is cost-prohibitive (Norm Meunier, City Waterworks Dept, personal interview, May 2008).

4.1.3 Chemical analysis

Chemical analysis identifies the composition of the water and gives important information about its origins. See Appendix A for chemical analysis of China Creek, Appendix B for Bainbridge Lake, Appendix C for Somass River. Chemical analysis of China Creek shows high levels of calcium and magnesium, a high rating of hardness, and an alkaline pH, all of which indicate that the water source is influenced by a karst system.

4.1.4 Water usage inventory

Figures for 2005 are:

- Average volume served is 6.5 million m3.
- Peak day usage is 22 000 m3.
- Minimum day usage is 7500 m3.
- Average day usage is 12 000 m3.

Water usage of 12,000 m3, as compared to water storage of 34,000 m3, leaves less than three days water capacity.

Consumption Rates:
Canada is among the largest per capita users of residential water among the developed nations (Marsalek et al. 2004). In 2004, the average BC resident's water usage was 426 litres per person per day. The Canadian national average was 329 litres per person per day (BC Stats 2009).

In 2009, the consumption rate for residents of the City of Port Alberni was 986 litres per person per day during the dry summer period, and 735 litres per person per day during the spring months, which is considerably higher than the rest of Canada.

Figures for 2008-2009 are:

- Spring day usage was 13,000 m3/day.
- Summer day usage was18,000 m3/day (City Engineer, personal interview, Oct 2009).

Water rates for city residents have been 37 cents per m3 (1000 litres) from 2005 to 2010. Engineering staff predict that these rates are due to increase (City Engineer, personal interview, Oct 2009). There are no concession rates available for extreme circumstances. The cost for new residential hookups requiring mains extension is estimated to be $2,500 (Mosley, City Waterworks Dept., personal interview, April 210).

Water Restrictions
There are four stages of water restrictions used by the City of Port Alberni:

Stage 1: Watering can only occur between 6–10 a.m. and 6-10 p.m. Saturday, Monday, and Thursday for odd-number addresses. Even number houses get the same times, but different days: Sunday, Tuesday, and Friday.

Stage 2: Watering can only occur between 6–10 a.m. and 6-10 p.m. Saturday and Tuesday for odd-numbered addresses, and Sunday and Thursday for even-numbered addresses.

Stage 3:Watering can only occur between 6–10 a.m. and 6-10 p.m. Saturday only for odd-number addresses and Sunday only for even-numbered houses.

Stage 4:All lawn watering is prohibited.

There are no exceptions to these restrictions (City Engineer, personal communication, Oct 2010).

Water Treatment:
Chlorine gas injection is used in varying amounts depending on turbidity levels (City Engineer, personal interview, Oct 2009).

4.1.5 Identified threats to water supply

SOVA's Public Education Committee, as well as the author's research, have identified a number of real and potential threats to the City's water supply. These include, but are not necessarily limited to, the following:

1. Climate change.
2. There is no watershed protection plan in place.
3. Lack of zoning bylaws to protect the watershed, as engineering staff "beg for development" (City Engineer, personal interview, Oct 2009).
4. Lack of community involvement (City Engineer, personal interview, Oct 2009).
5. Industrial operations: During a tour of the City's water system, staff reported that the effects of storm events (such as turbidity) that once took take several days to move through the system now take only a few hours (Norm Meunier, personal interview, May 2008). For a water systems operator, this is good news as the high risk time for contamination generally lasts for only a short time. However, changes to the watershed due to forestry have left the watershed without vegetation cover to reduce peak flow effects. Road building diverts water into specific routes reducing retention of water within the watershed and therefore ground water storage is compromised. In terms of hydrology and aquifer recharge this means that the water that used to take several days to be absorbed within the watershed now flows into the sea and out of the watershed within a few hours.

4.1.6 Public education

Public education strategies are in place. City Engineering staff acknowledge that more effort needs to be made in this area. Brochures for public distribution are available at City Hall.

Water system tours can be arranged upon request. (City Engineer, personal interview, Oct 8,2009)

Accountability:
All documentation and records of the day to day activities of this system are available to the public, except the Watershed Assessment Plan which is the property of Island Timberlands.

If a member of the public has a problem with the water system, City Council should be contacted (City Engineer, personal interview, Oct 8,2009).

4.1.7 Regional water supply

In September 2010, Koers & Associates Engineering Ltd. submitted its final report, titled *Alberni Valley Regional Water Study Update*, to the Alberni-Clayoquot Regional District. The text of the letter accompanying the final report details the dates when the first and second drafts were presented "to a committee comprising regional board members, members of the two improvement districts, members of the City of Port Alberni, and representatives of the Tseshaht and Hupacasath First Nations." The committee also invited feedback from VIHA. A public open house was held on July 28, 2010, at the Echo Centre in Port Alberni. The ACRD has published the second draft report on its website in July 2010. The letter also states the following:

> The City and both improvement districts must make water treatment improvements to meet the new (2008) VIHA water treatment requirements, mandated under the Drinking Water Protection Act.
>
> The report presents and compares regional options and individual water supply and treatment upgrading options to meet these requirements. It is now urgent that an early decision is made on whether there can be agreement on a regional approach. If a regional approach is not considered feasible, each party needs to provide VIHA with a plan and schedule to become compliant with the new water treatment requirements on a timely basis.

The executive summary states (on pages i and ii) that there is an urgent need to act:

> The existing water supply systems all have surface water supplies: China Creek and Bainbridge Lake (gravity) for the City of Port Alberni, Stamp River (pumped) for BCID, and Cold Creek (gravity) for CCID [Author's note: CCID represents the Cherry Creek Waterworks District]. All water supplies have sufficient capacity for growth to 2050. The City of Port Alberni has a licenced emergency water supply source on the Somass River (pumped), which is able to supply about 50% of the projected City demands.
>
> Each water supply is chlorinated, but none meet the new VIHA surface water treatment requirements. BCID has been issued with a new Operating Certificate requiring compliance with the new VIHA treatment requirements by April 30, 2011. CCID has been issued with a new Operating Certificate requiring compliance with the new VIHA treatment requirements by September 1, 2013, with preliminary design having been completed by April 2011. The City of Port Alberni has not yet been issued with a new Operating Certificate, pending the

completion of the current regional water study update and the submission of a plan for compliance.

Unless water treatment improvements are made in each jurisdiction, the systems will be in contravention of the B.C. Drinking Water Protection Act.

The 13-page executive summary (as well as the report) contains 18 conclusions and 12 recommendations, and can be downloaded from the ACRD website at http://www.acrd.bc.ca/cms/wpattachments/wpID249atID830.pdf. The whole report can be downloaded at http://www.acrd.bc.ca/cms/wpattachments/wpID249atID804.pdf

4.2 Beaver Creek Improvement District

The Beaver Creek Improvement District (BCID) is located within Alberni Clayoquot Regional District Area E. Its overall watershed, in the Somass Basin Catchment area is 1,426 km^2.

4.2.1 Assets inventory

This inventory list is incomplete, although, according to Beaver Creek Improvement District (BCID) staff, by 2010, all water systems are required to have an Assets Inventory on record as part of the government's Asset Management Plan. (At present, not all water systems have one or make it available to the public.)

Water Intake Site: Stamp River

Pump House: Sportsman Road, originally built in 1959 using steel and concrete construction. It houses one wet well, 3 electric pumps and one chlorination plant. A new back-up generator has been installed in the new extension of the facility.

Property: The BCID leases the land at the intake pump house but there is an easement allowance. BCID owns the land at the two reservoirs.

Truman Creek Bridge: It is uncertain who owned or built the original bridge (Watts 2008). It is the only access to the intake pump house. The bridge was replaced by BCID in 2008 after the original bridge was declared unsafe (Holmes 2008).

Pipes Asset: Table 9 is a list of pipe materials and lengths that were made available by BCID.

Table 9. Inventory of BCID's pipe materials and lengths

Type of Material	100 mm pipe length	150 mm pipe length	200 mm pipe length	300 mm pipe length	450 mm pipe length
Asbestos Concrete	12,655 metres (m)	8,845 m	8, 170 m	3, 820 m	
PVC	23 m	8,593 m	27 m		
Ductile	1 m			1 m	
Steel	10 m	9 m	8 m		29 m

Estimated Infrastructure Spending Needed: Upgrade to piping of $1 million is needed to make loops at dead ends to create a flow through system (BCID staff, personal communication Nov, 2009). A secondary treatment facility is being recommended by VIHA to implement its 4-3-2-1 mandate for BCID. The estimated cost is $3.5 million plus $500.000 for a new storage tank (BCID staff, personal communication Nov 2009). Emergency connection to the City would cost $400,000 to upgrade pumps to increase the pressure from city lines to residents of BCID (BCID staff, personal communication Nov 2009).

Hydrants: 106 Fire Hydrants. Chlorinated water is used for fire protection; 60% of the treated water must be made available for firefighting purposes at all times. Fire protection is the responsibility of Alberni-Clayoquot Regional District.

Water Reservoirs:

- 1 Concrete 1136 m3 (250,000 Imp gal) on Kitsuksis Rd.
- 1 Steel 390 m3 (85,800 Imp gal)) on Beaver Creek Rd.

The reserve capacity in the present system is nine hours. BCID staff suggest that a minimum of 4550 m3 (1 million Imp gal) is needed to give a 3-4 day reserve (BCID staff, personal communication Nov 2009).

Water Pumps: There are three newly installed 35hp electric pumps at the pumphouse. Backup generator for the pumps and chlorination system is to be operational by the end of Nov 2009. The cost of running the pumps is not calculated separately (BCID staff personal communication Nov 2009).

Test Well

In 2007, a test well was commissioned by the Board of BCID, to be drilled near the intake site to ascertain whether an alternative water source may be available for the residents of BCID. The well was drilled on private property.

The test well was completed in 2007. The chemical analysis indicated that Total Dissolved Solids (TDS) and chloride were at concentrations above the Guidelines for Canadian Drinking Water Quality (Wendling 2008).

In October 2008, an 8-day pumping test was completed by Fyfe Well and Water Services. The water table was found at a relatively shallow depth of less than 2 m below ground. Test results in 2008 showed that water samples did meet the Canadian Drinking Water Guidelines at that time (Wendling 2008). According to BCWWA (BC Water and Waste Association), new guidelines concerning GWUDI (Ground Water Under the Direct Influence) of surface water may require changes to water quality requirements to meet Canadian Drinking Water Guidelines (BCWWA 2009).

Demographics

According to BCID, the population was 4,000 residents in November 2009.

4.2.2 Water quality

BCID has been under a Boil Water Advisory several times over the last few years. This advisory is usually issued after a large rain event. According to staff, BCID is required by VIHA to issue an advisory when turbidity is above 5 NTU. This is the provincial standard (BCID staff, personal communications Nov 2009 and February 2011).

Turbidity in Truman Creek has been identified as a potential cause for boil water advisories. Truman Creek joins the Stamp River near the intake pump house (see Figure 25). After a storm event, Truman Creek enters the Stamp River highly turbid and a dark brown colour. Once this occurs, a boil water advisory must be called as the increased turbidity exceeds the Guidelines for Canadian Drinking Water Standards. In order to cancel a boil water advisory, the water must test less than 5 NTU for three consecutive readings over three consecutive testing periods, requiring nine days for completion. The boil water advisory remains in effect until the testing period is complete even if turbidity has returned to acceptable levels (BCID staff, personal interview Nov, 2009).

The source of Truman Creek is unknown. Truman Creek begins its journey down to the Stamp River in the Beaufort Range (see Figure 25).

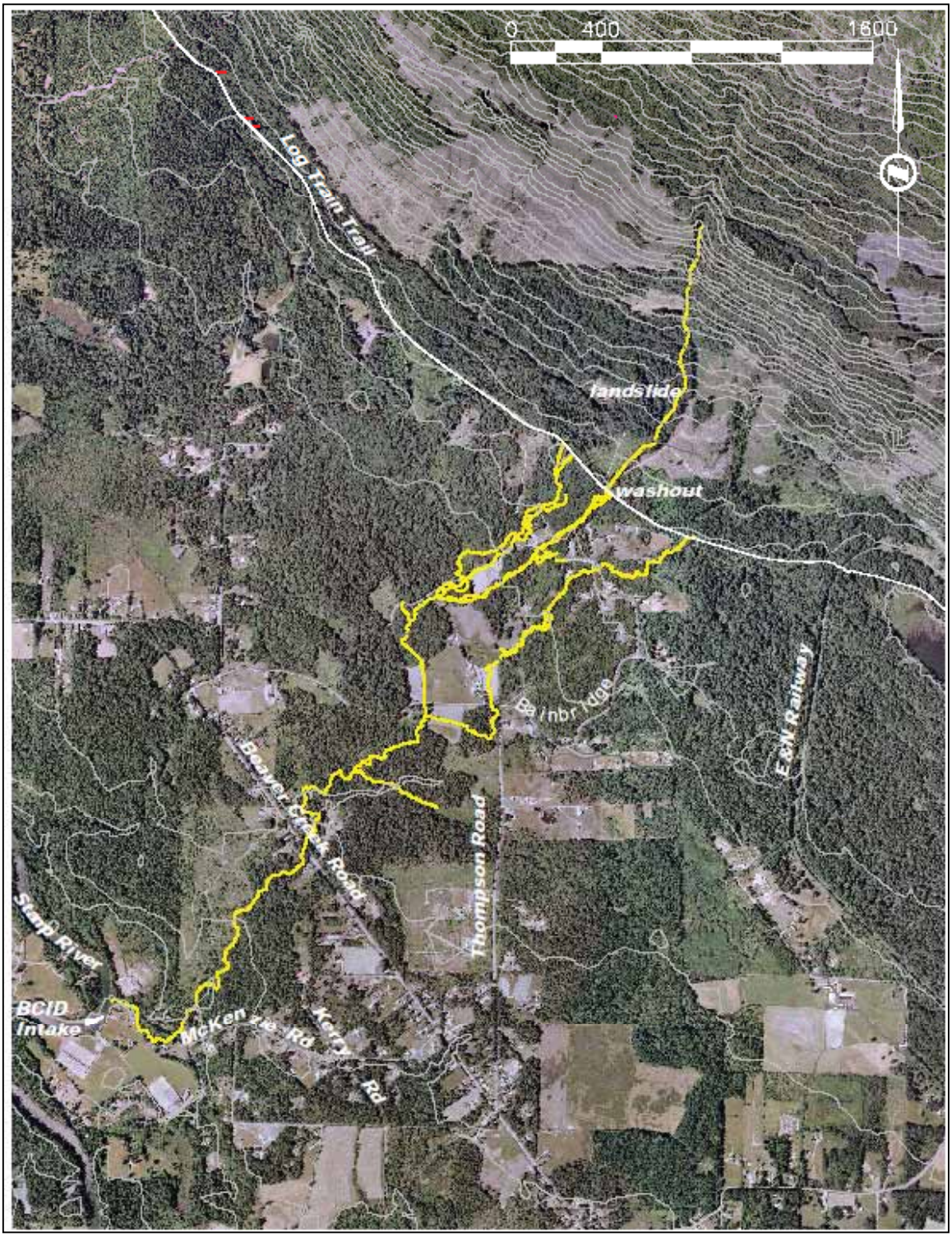
Truman Creek was surveyed to 1220 m (4000 ft) elevation. It courses down the Beauforts, travelling above and below ground. It crosses under a number of logging roads and the Log Train Trail, as well as Bainbridge, Thompson, Beaver Creek, and Sportsman roads.

Truman Creek starts out as a crystal-clear stream, its water quality changes as it travels down through forestry and farm land. It is difficult to say where the turbidity levels change as this stream travels above and below ground. However it is clear that turbidity levels in Truman Creek are heavily influenced by storm events. Whether this is an above ground or underground occurrence is unclear. Further investigation into this would be recommended.

Local knowledge confirmed that Truman Creek has transported gravel into residents' properties for a number of years. The topography of Truman Creek is moderate steepness until 460 m (1500 ft) from where it becomes very steep. There are steep cliffs on either side from 460 m (1500 ft) to 610 m (2000 ft). The stream above 460 m (1500 ft) appears to be undisturbed. The topography changes above this altitude and two logging roads cross through the creek bed. Below 460 m (1500 ft) down to the log train trail, the stream bed has been washed out on both banks. The stream bed width expands from its natural boundary width of approximately 2.4 m (8 ft) to 12 m (40 ft). The water flows mainly underground at this width.

Where the stream crosses the Log Train Trail, a 1 meter diameter culvert has been installed. Since the culvert was placed, the stream flow has at times expanded considerably, as evidenced by the erosion upstream and downstream of the culvert. At other times, the culvert is 3m (10 ft) above the stream bed on the downstream side and 1m (3 ft) above the upstream side. Debris flow during storm events continually changes this. Visual inspection at different points along Truman Creek have shown that the stream is continuously flowing, but rarely does it flow through the culvert.

Figure 25. Truman Creek from the Beaufort Range to BCID intake site at the Stamp River



A GPS (Garmin eTrex HC Series) was used and data transferred to (NR Can Topographic maps). Surveyed 2009-2010.

The main industrial activity in the Truman Creek watershed is forestry. Clear cut logging occurred in the last 30-40 years, the most recent in the last 5 years. Local long term residents report considerable deterioration of their water quality and quantity since 2005 (local residents, personal interviews, 2009).

A report from Northwest Hydraulic Consultants (NHC) commissioned by the Hal Creek and Mount Hal Watershed Protection Society in July 1999 reported the following:

> [P]otential impacts of forest harvesting on downstream values will result from altering the hydrologic regime or increasing course sediment supply. Landslides from roads or harvested areas are thought to be the main potential source of increased coarse sediment supply. The impacts of forest harvesting may appear quickly or not for a number of years. Harvesting generally must exceed about 20% of the watershed area before increases in peak flows become significant. Consequently, this risk may not become apparent for a number of years. Forest harvesting has increased the frequency of landslides in the area between Kitsuksis and Wolf Creeks by 425% over the past 40 years, with landslides observed on slopes as low as 30% in harvested areas that have similar bedrock geology to Hal Creek.

The NHC report of 1999 identified that Truman Creek was one area that had a landslide. In 2009, there was still evidence of this landslide. The landslide marked on Figure 25 is a more recent phenomenon, as that area was not mentioned in the hydrological assessment of 1999.

4.2.3 Chemical analysis

Chemical analysis identifies the composition of the water and gives important information about its origins. See Appendix D for chemical analysis of at the Stamp River intake.

4.2.4 Water usage inventory

Two water licenses for the Stamp River were issued by the Ministry of Environment for BCID. One is for 539 744 m3 (118,625 000 Imp gal); the second is for 597 870 m3 (131,400 000 Imp gal) annually from the Stamp River.

BCID has 1,165 residential connections and one private health facility. According to BCID staff, the health facility will be the largest water user for this system (BCID staff, personal communication, Nov 2009).

- Maximum annual daily demand 3426 m3 (753,000 Imp gal).
- Minimum annual daily demand 521 m3(114,400 Imp gal).

The residents of BCID use 856 litres drinking water per person per day maximum and 130 litres of drinking water per person per day minimum. Canada is among the largest per capita users of residential water among the developed nations (Marsalek et al. 2004). In 2004, the average BC resident water usage was 426 litres per person per day. The Canadian national average was 329 litres per person per day (BC Stats 2009).

4.2.5 Public education

Monthly Beaver Creek Improvement District meetings are open to the public. All real time water data is available on the Beaver Creek Water website (http://beavercreekwater.ca/). Staff and Board members were open, helpful, and very cooperative during the duration of this study.

4.2.6 Regional water supply

BCID was one of the participants of the Regional Water Study (1995) conducted by Koers and Associates Engineering.

Regional water supply studies were conducted in 1963, 1971, 1995, and again in 2010. [See section 4.1.7 for information about the 2010 study.] We were unable to obtain copies of the two earliest studies. From the 1995 study, it appears that Great Central Lake was usually considered as the source of this regional water supply. However, at no time was a Watershed Protection Plan put in place.

On March 31, 2009, BCID received a letter from VIHA notifying it of the proposal to modify their operating permit to require implementation of the 4-3-2-1 Drinking Water Treatment for Surface Water Policy by April 30, 2011.

On Oct 5, 2009, a meeting was held to discuss options for residents of BCID. In a summary report by BCID, it was concluded that Beaver Creek must improve its water quality. The residents of BCID must fund this or consider sharing water improvement costs. It was suggested that one means of sharing costs was a regional water supply. At this time Tom Reid of Sussex Consultants concluded that the future is unclear but could change, depending on the outcome of the regional water study currently in progress by Koers and Associates Engineering, contracted by ACRD (Reid 2009). [This has now been submitted to the ACRD and is available on their website; see section 4.1.7.]

The Board of Trustees concluded, with support from residents in attendance, to wait until the results of the of the regional water study were made public (BCID 2009).

It would take ten years or more to have BCID residents join a regional water supply, regardless of whether Sproat Lake or Great Central Lake is used (BCID Board of Directors, personal communication, April, 2010). That time frame is longer than the compliance date of May, 2011, imposed by VIHA to meet the 4-3-2-1 regulations (BCID 2009).

According to an article in the Alberni Valley Times, BCID trustees said the district is stuck. If the deadline expires and there is no water filtration in place, no one is entirely certain what the health authority will do (AV Times, Winks, Dec. 2009).

4.3 Sproat Lake “Area D”

Area D is comprised of all the area past the “Orange Bridge” crossing the Somass River on first River Road, then on Highway #4 up to the end of Sproat Lake (with the exceptions of Tseshaht and Hupacasath reserve lands). It includes Great Central Lake and McCoy Lake.

Interviews with Area D Regional Director Penny Coté provided information about residents around Sproat Lake itself and the Stuart and Bell Rd areas. In order to obtain a broader information base, personal interviews were also conducted with residents outside the above mentioned areas.

In 2010, there were 2028 homes in Area D. Water licenses are not required to draw water from Sproat Lake. Water usage in the area is not monitored (Area D Regional Director, personal communication, Jan 22, 2009). There is no water board for Area D, but there is a Sproat Lake Community Association. An Area D Regional Director is on this committee (Area D Regional Director, personal communication, Jan 22, 2009).

Sproat Lake watershed is a Designated Community Watershed (T. Pobran, Ministry of Environment, personal communication April 8, 2010). Sproat Lake watershed is also listed as a Watershed Reserve (Koop 2006) and may still have that designation (T. Pobran, Ministry of Environment, personal communication April 8, 2010).

The City of Port Alberni has two Community Forests within the watershed boundaries.

See Figure 26 for Sproat Lake Designated Community Watershed and Watershed Reserve boundaries, including the City of Port Alberni's two Community Forests within the watershed boundaries.

4.3.1 Assets inventory

Water source

There are a variety of different sources of drinking water within Area D: Sproat Lake, Great Central Lake, private wells, and springs.

Sproat Lake is the second largest lake in the Somass River watershed with a surface area of 4,300ha (43 km2), and a drainage area of 350 km2. The mean water level elevation of the lake is 28m, with normal level fluctuations within 1 m above and 1 m below full storage level (FSL) and extreme high level of 3 m above FSL. The outlet into Sproat River is controlled by a small stoplog weir maintained by Catalyst. The paper mill supply main has its intake at Stirling Arm, from where the water is pumped into a 1200mm diameter wood stave supply main. Pressure at the mill is maintained at 45 PSI. Sproat Lake serves as the water supply for Catalyst's paper mill, as well as many individual residences along the eastern shores. Water levels cannot be allowed to fluctuate greatly because of the residential development along the lake shore (Koers 1995).

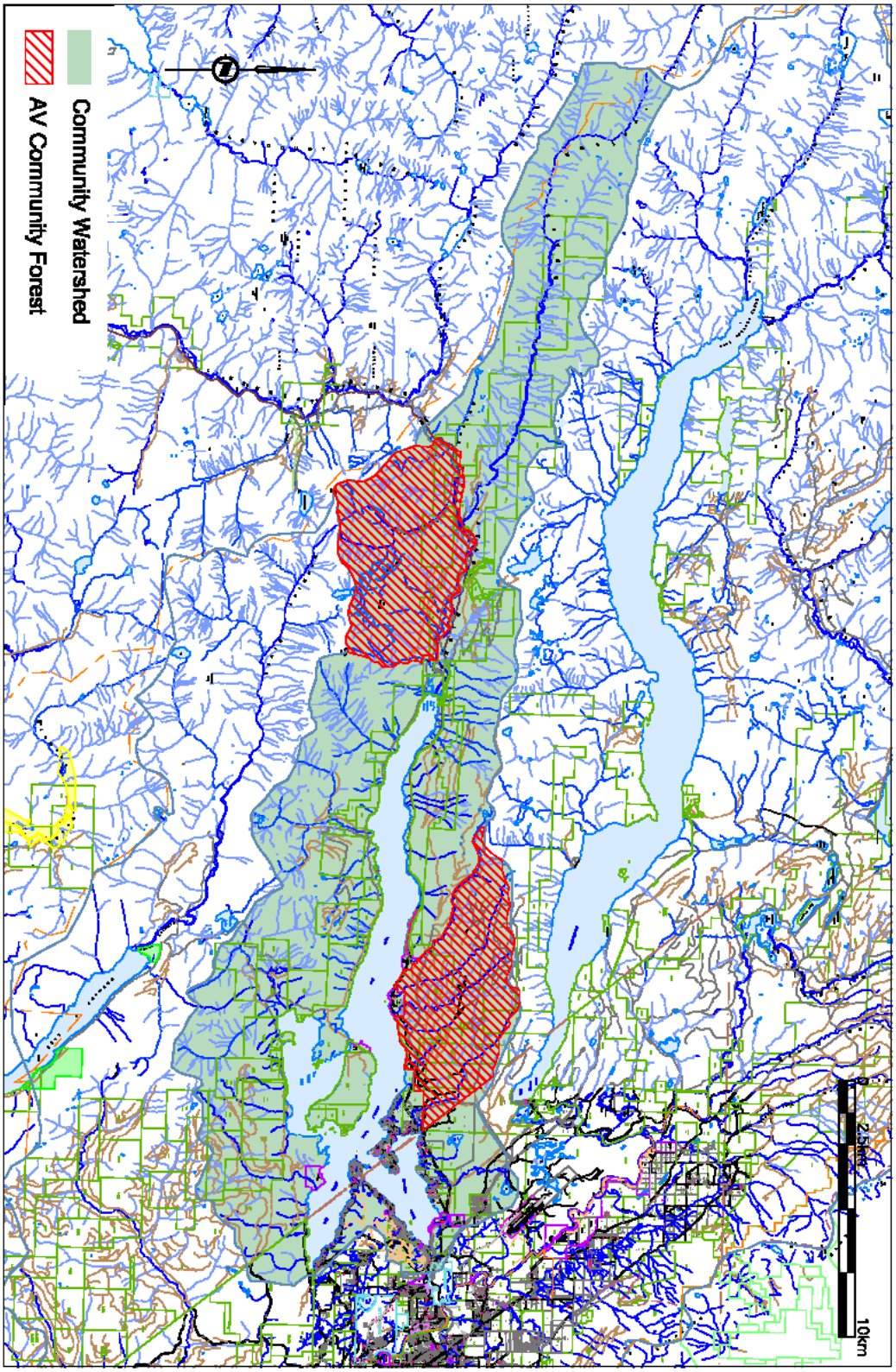
Catalyst holds a licence to divert 260,000 m3/day of water from Sproat Lake for industrial purposes and to store 25,000,000 m3 (Koers 1995).

Watershed

The watershed has a drainage area of 350 km2. The land around Sproat Lake itself is privately owned.

There are two Community Forests managed by the City of Port Alberni in the watershed. Area D Regional Director believes that this might be good as it gives residents personal control of what happens in their watershed (Area D, Regional Director, personal communication Oct 8, 2009).

Figure 26. Sproat Lake Designated Community Watershed and Watershed Reserve boundaries, including the two City of Port Alberni Community Forests located within the watershed



The majority of land within the watershed is Crown Land. Land use within the watershed is primarily forestry and some recreation. See Table 10 for watershed ownership.

Table 10. Ownership of Sproat Lake Designated Community Watershed

Total Hectares	Private ha	% Private	TFL ha	% TFL
35247.8	4136.6	11.7	30547.1	86.7

Note: Data for this table is from South Island Forest District.

There is no watershed protection plan in place. Penny Coté, Area D Regional Director, said that lake residents act as lake stewards. At the end of summer, residents clean up campsites. Several truckloads (pickups) were collected in summer 2009 (Area D Regional Director, personal communication Oct 8, 2009).

Water Treatment.
Regional Director Coté says that there are 50% absentee owners around the lake, some of whom were unaware that their drinking water was from a raw source (Area D Regional Director, personal communication Oct 8, 2009).

Many people do not treat their water. Some local residents now boil water if it's murky. Other residents do not believe the water needs treatment now as it was not required in the past. (Area D Regional Director, personal communication Oct 8, 2009)

The residents who do treat their water use a variety of different kinds of systems. Some use a filtration system followed by UV treatment. Filters must be changed once a year. The cost of an individual filtration system was approximately $1000 in 2009. (Area D Regional Director, personal communication Oct 8, 2009)

4.3.2 Water quality

The Sproat Lake Community Association conducts water quality assessments twice a year for residents who take their water directly from Sproat Lake. These water samples are collected at the Sproat Lake Community Hall. Residents were concerned about their water quality since the landslides of 2007 into Sproat Lake. (Area D Regional Director, personal communication Oct 8, 2009)

A Boil Water Alert was advertised after the slides in 2007. Area D Regional Director Cote said that there is no financial assistance from VIHA or other government sources for residents who purvey their own water. (Area D Regional Director, personal communication Oct 8, 2009)

In 2007, 100 tests were taken, the results confirming the presence of Total Coliform in 89 samples and *E. coli* 29 samples. However, Penny pointed out that it is important to remember that there had just been two recent large landslides into Sproat Lake. There have been more group water tests since then with fewer participants but still representing all areas of Sproat Lake, with various results. In 2008, 20 tests were submitted. Test results showed positive for 3 with E-coli and 15 with Total Coliform. (Area D Regional Director, personal communication Jan 6, 2009).

Water sample bottles and requisition forms for Total Coliform and *E. coli* are available to Area D residents at the ACRD office. Tests are conducted on a voluntary ad hoc basis (Area D Regional Director, personal communication Jan 6, 2009).

It has also been a priority of the Association to make residents aware that water drawn from Sproat Lake or any other lake, river or well is a raw water source and is susceptible to contaminants. The Association conducted a Water Fair in 2007. Information on different water filtration systems was made available (Area D Regional Director, personal communication, Jan 6, 2009).

4.3.3 Threats

Residents report that there has been increased gravel and silt in the water in Lakeshore Road area, believed to be a result of forestry activity. Residents are reporting changes to water courses, such as creeks running across their sidewalks. Residents have noticed new impurities in their water (Area D Regional Director, personal communication Oct 8, 2009).

Residents report having increased salty and sulphurous water (personal interview with local residents of Area D residents, 2009). Residents in the Bell Rd area report diminishing well supplies (Area D Regional Director, personal communication Jan 6, 2009).

Other threats include failing septic systems and farm animal contamination (Area D Regional Director, personal communication, Jan 22, 2009).

The Kleehkoot Reserve (Hupacasath First Nation), located at the top of Sproat River near Sproat Lake, has been on a boil water advisory for ten years (D. Watts, personal communication, Oct 9, 2010).

4.3.4 Regional water supply

Sproat Lake residents were not in favour of a regional water supply in 1995, largely because they did not want to pay for infrastructure necessary to make this change and were happy with their water quality at that time. Area D gave financial support to the latest regional water study, not necessarily with the intention of joining a regional system, but more as an information-gathering exercise. The only way to have a say in what happens in the Sproat Lake Watershed is to participate in discussions and consultations (Area D Regional Director, personal communication Jan 22, 2009).

Interviews with residents in Area D who do not obtain their water directly from Sproat Lake indicated they would support a regional system as they wanted access to a clean dependable water supply (personal interview with random sample of Area D residents, 2009-2010).

A conclusion reached by the 1995 Regional Water Study concerning Sproat Lake as a regional water supply reads as follows (Koers & Associates Engineering Ltd. 1995):

> Given the residential development on Sproat Lake in the area of the MacMillan Bloedel [now Catalyst] intake, this source would require similar treatment as the Somass River source.

We are also concerned about the reliability of supply from this main, as it would be controlled by private interests, and would be shut down and not available for municipal water supply under power failure at the Sproat Lake pump station, to safeguard against negative pressures in the wood stave supply main. There would also be concern about responsibility for pipeline maintenance and remaining useful life of the supply main.

We have concluded that there would be no significant financial advantage of using the Sproat lake main over the Somass River source, whereas there is a high potential for serviceability problems related to power failures and possible private interests over which the regional district would have no control. For these reasons, use of the Sproat Lake supply main has not been considered as a viable alternative for regional supply.

4.3.5 Water export

At the spring at the end of Taylor Arm, people from Tofino, Ucluelet, and the Valley stop and fill up their water containers. A brewer also gets its water from this spring. Water quality testing has shown that Total Coliform is low and there have been no *E. coli* (Area D Regional Director personal interview, Oct 8, 2009).

4.4 Cherry Creek "Area F"

Cherry Creek is in Electoral Area F of the Regional District.

4.4.1 Assets inventory

Water Source

Cold Creek (see Figure 27) is the water supply for Cherry Creek Waterworks District. Cold Creek flows out of Lacy Lake (see figures 28 and 29), but the source of Lacy Lake is unknown. Geological Survey of Canada (1947-1951) identified calcareous deposit (now known as VANISL 76 ck) on the Beaufort Range in the Cherry Creek area (Terra Firma Geoscience Services, 1999).

According to local knowledge, Lacy Lake is recharged by a karst spring located under the lake and fed by a karst system originating in the Beaufort Range (R. Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, personal communication, 2009).

Calcareous Deposit VANISL 76 (see Figure 10 on p. 68 in Part_3) has two major karst groundwater systems that flow in opposite directions. One of these groundwater systems appears to flow towards Lacy Lake. A submerged resurgence within Lacy Lake provides the primary recharge for the Lake, downstream reservoir and Cold Creek. Dye tracing would eliminate the element of uncertainty (Robinson 2008).

In May 2010, several karst formations were confirmed in the Cold Creek Watershed. One of which is shown in Figure 27 (R. Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, personal communication, May 2010).

Figure 27. Cold Creek, photo taken April 2009

Figure 28. Lacy Lake, taken 13 June 2008

Reprinted with permission of Gail Morton

Figure 29. Lacy Lake taken March 24, 2009

Water Licences
5,145 m3/day for diversion and 616,750 m3 for storage (Koers and Associates 1995).

Watershed
Cold Creek Watershed is 443.4 hectares (South Island Forest District 2007).

Cold Creek Watershed is mainly contained within the Nanaimo Regional District Boundaries (see Figure 30). Cold Creek (Figure 26) flows from Lacy Lake (figures 27 and 28) through private lands into a reservoir where water is then diverted into the Cherry Creek water intake.

Cold Creek has a number of tributaries, some of which have been recorded (see Figure 29). Cold Creek and its tributaries travel through karst terrain, one of which has been identified in Figure 29. Cold Creek's tributaries have been intersected by logging roads, a natural gas pipeline, hydroelectric power lines and a train line. In Figure 30, the orange markings show the Alberni Clayoquot Regional District and Nanaimo Regional District boundaries. The yellow markings indicate stream tributaries to Cold Creek. Other tributaries need to be mapped. Cold Creek Watershed is privately owned by Island Timberlands and a local resident, see Table 11.

Table 11. Ownership of Cold Creek Designated Community Watershed and Watershed Reserve

Total Hectares	Private Hectares	% Private	TFL Hectares	% TFL
443.4	443.4	100	0	0

Note data from South Island Forest District (2007)

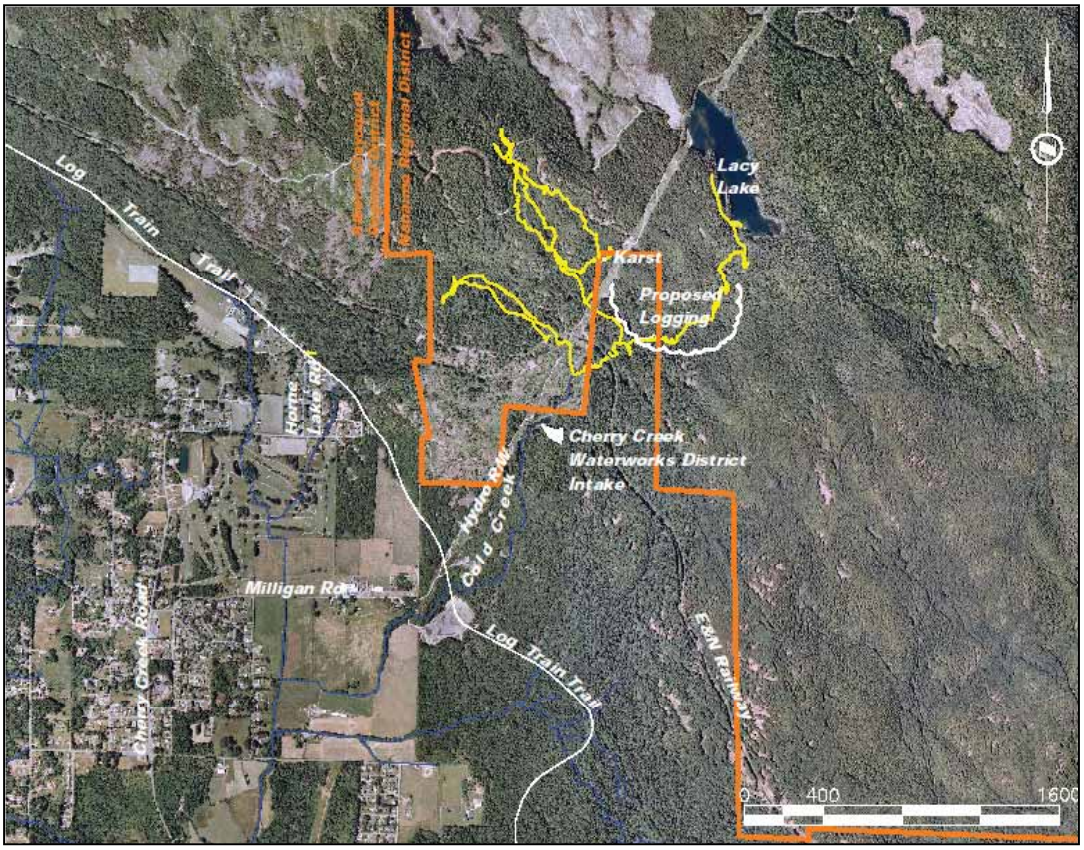
Cold Creek Watershed is a Designated Community Watershed (T. Pobran, Ministry of Environment, personal communication April 8, 2010) (see Figure 31). Cold Creek Watershed is also listed as a Watershed Reserve (Koop 2006) and may still have that designation (T. Pobran, Ministry of Environment, personal communication, April 8, 2010).

Apparently, the relationship between CCWD and Island Timberlands is positive, but they do not appear to have any formal agreements. Informal notification is provided to the CCWD when forestry activity occurs in the watershed (CCWD Board personal communication, 2009).

Island Timberlands did not confirm or deny whether there was a Watershed Protection Plan in place (Island Timberlands, Leine, personal communication, Dec 17, 2009). However, according to CCWD trustees, there is no plan in place (CCWD Board of Trustees personal communication, 2009).

CCWD Board does not know the size of the watershed, making it unclear when they should be notified (CCWD Board of Trustees Chitty and Haggard, personal communication 2009). When CCWD Board and staff were notified in spring 2009 of forestry activity (demarcation of cut blocks and roadways, including crossing Cold Creek and its tributaries), CCWD was unaware of this activity (CCWD Board of Trustees Chitty, personal communication 26 March 2009).

Figure 30. Cold Creek Watershed showing some of its tributaries in 2009.



A GPS (Garmin eTrex HC series) was used and data transferred to NR Can Topographic maps. Surveyed 2009.

Cold Creek watershed is mainly within the Regional District of Nanaimo (RDN). Correspondence with the RDN (Jan 2010) concerning Cold Creek Watershed reads as follows:

> Cherry Creek Waterworks District, while located in the Alberni Valley, is supplied via Lacy Lake, which is located in the Regional District of Nanaimo. The RDN is focused on issues related to the supply and protection of the water resource for residents within the region. As such, it will be difficult to pursue issues outside of our mandated service area to any great extent. Having said that, an opportunity to bring issues related to water quality in your area exists via the Vancouver Island Watershed Protection Steering Committee. This committee works with VIHA and various provincial ministries and many of Vancouver Island's regional districts to mutually work on issues related to water quality and watershed protection. Concerns regarding the Cherry Creek Water Service water source and the dual Regional District aspect of that system lends itself to discussion within this committee.

The primary land uses in Cold Creek watershed are as standing forest and recreation. It is not known what percentage of logging activity occurs in the watershed (CCWD Board of Trustees personal communication, 2009). Figure 31 on the next page is a map of Cold Creek Designated Community Watershed and Watershed Reserve Boundaries.

Watershed Recharge

There are several explanations on how the watershed is recharged. According to CCWD Board, approximately 2% of recharge comes from surface runoff and snow pack (Trustees Chitty and Haggard, personal communication, 2009). According to McGill & Associates engineers, rainfall accounts for 100% recharge of Lacy Lake (A. McGill, personal communication, Nov 30, 2009).

According to local knowledge, a karst system within Calcareous Deposit VANISL 76 (see Figure 10, p. 68) has two major karst groundwater systems that flow in opposite directions. One of these groundwater systems appears to flow towards Lacy Lake. A submerged resurgence within Lacy Lake provides the primary groundwater recharge for the lake, downstream reservoir and Cold Creek. Dye tracing would eliminate the element of uncertainty (R. Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, personal communication, 2009).

No aquifer monitoring sites for the Cold Creek Watershed exist (CCWD Board of Trustees personal communication, 2009).

Inventory of operations

CCWD financial summary is shown in tables 12 and 13 below.

Table 12. Summary of Cherry Creek Waterworks Assets.

	2009	2008	2007
Capital Assets	$ 1,823,485	$ 1,889,267	$ 1,966,137
Financial Assets	$ 2,756,182	$ 2,711,061	$ 2,665,727
Revenue	$ 605,498	$ 558,045	$ 532,769
Expenses	$ 560,377	$ 512,711	$ 441,466

Data obtained from Auditor's Reports 2008 and 2009; public documents dated April 4. 2009, April 12, 2010.

Figure 31. Cold Creek Designated Community Watershed and Watershed Reserve boundaries

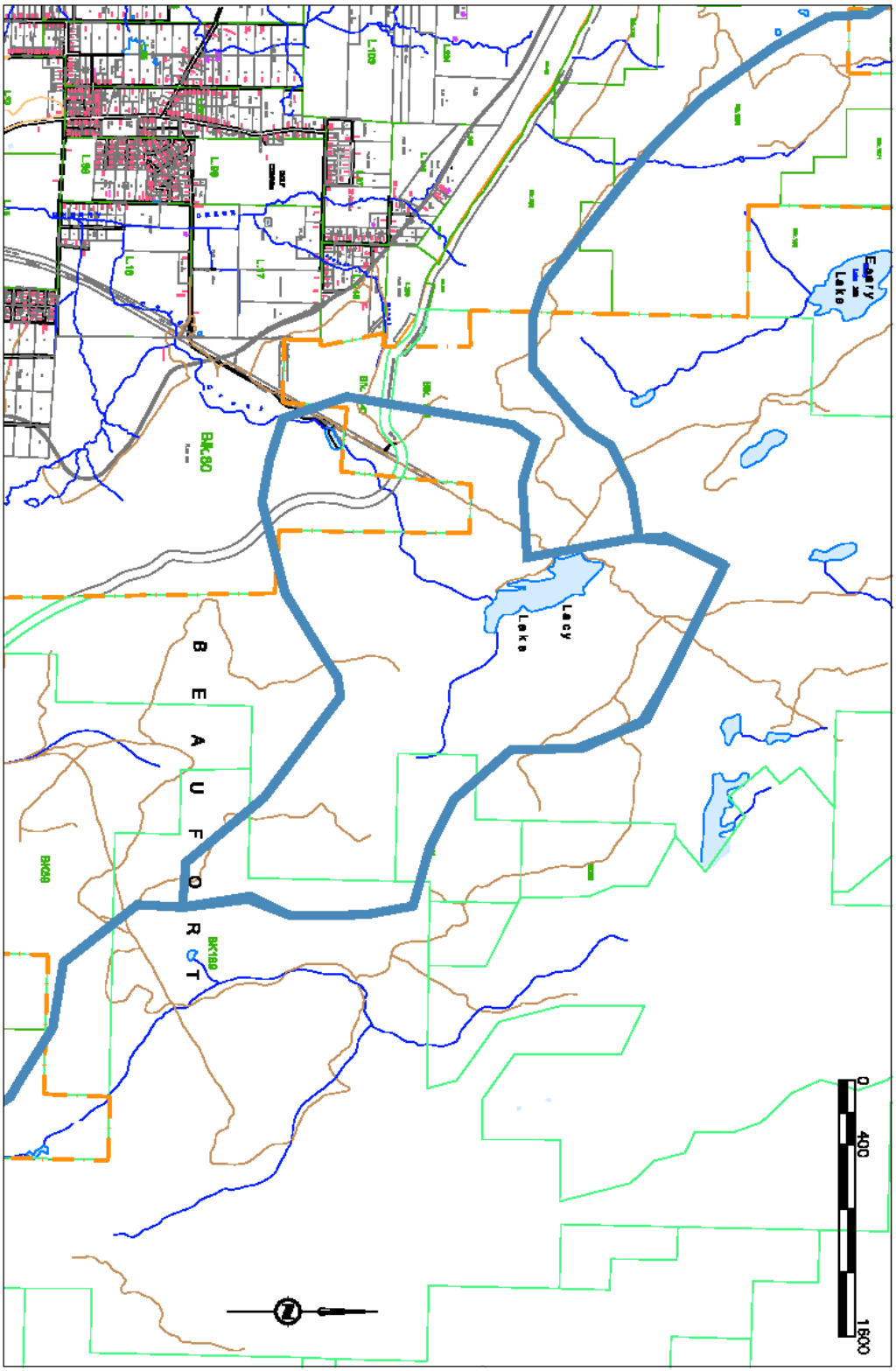


Table 13. Summary of Cherry Creek Waterworks District of expenses.

	2009	2008	2007
Maintenance of System	$ 156,588	$ 98,168	$ 94,963
Administration	$ 124,875	$118,054	$ 86,751

Data obtained from Auditor's Reports 2008 and 2009; public documents dated April 4. 2009, April 12, 2010.

Water Storage

There are two dams in the CCWD system: Lacy Lake Dam and the Cold Creek Dam.

1. Cherry Creek Waterworks was started in the early 1950s with the building of Lacy Lake Dam. The storage capacity was increased in 1968 (McGill A. personal communication, Nov 30, 2009). Lacy Lake catchment area is 2.43 km2 (608 ac) (McGill A., personal communication, Nov 30, 2009). At the outlet, the elevation is 241.1 m above sea level; the storage volume is 0. When the water is 1.2 m above the spillway, the elevation is 249.3 m above sea level; the storage volume is 750,000 m3. When the water is .6 m above spillway, the elevation is 247.8 m above sea level; the storage volume, 675,000 m3. When the water is at the spillway crest, the elevation is 247.8 9 m above sea level; the storage volume is 600,000 m3 (McGill and Associates 2005).
2. The dam along Cold Creek is a flow-through system with no holding capacity. However, it helps deal with peak flows (McGill, A. personal communication, Jan 12, 2010).

Water Supply Infrastructure

Cold Creek water system is a 100% gravity fed system. Water from the intake is pressure-reduced into the distribution system, which is divided into two pressure zones. Water is chlorinated and metered at the intake by a hypochlorination system. All water services are metered (McGill and Associates 2005).

An emergency connection exists to the City of Port Alberni distribution system at the Alberni Highway and Broughton Street (Koers and & Associates 1995).

Lacy Lake has an overflow control drain and a controlled discharge downstream. A diversion dam captures the water downstream and diverts it to the gravity pipe system (McGill and Associates 2005).

Water Treatment

Water is treated with liquid chlorine and started in 1988. The maximum amount of treatment is not always needed (CCWD Board of Trustees personal communication 2009).

Assets Maintenance

In 2009, CCWD Board reported that the infrastructure is in good to perfect condition, because maintenance and upgrading occur continually. Costs for maintenance vary according to circumstance and have been adequate. New spending needs are unknown. They are dependent on VIHA's 4-3-2-1 policy, which the current system does not yet satisfy. While 100% of the infrastructure work is privatised, the Water Board trustees oversee all operations, and

maintenance is performed by staff (CCWD Board of Trustees, personal communication 2009). Table 14 below is a summary of maintenance costs.

Table 14. Summary of Maintenance Costs for Cherry Creek Waterworks District in 2008 and 2009

Maintenance of System	2009	2008	2007
Chlorinator Operation	$634	$844	$963
Contractor	$ 103,377	$58,017	$69,770
Materials and Equipment	$25,704	$23,803	$9.543
Miscellaneous	$22,081	$10,166	$8,945
Vehicle	$4,792	$5,338	$5,742
Total Cost	$156,588	$98,168	$94,963

Data obtained from Auditor's Reports 2008 and 2009 created April 4, 2009 and April 12, 2010 (Mollon Tyler-Mollon 2009, 2010).

4.4.2 Water quality monitoring

Water samples are taken from five locations to be sent to the provincial laboratory. Information on the frequency of these tests was not given (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

According to McGill & Associates, water quality shows little seasonal variation, with the exception of temperature (A. McGill, personal communication, Nov 30, 2009). According to local knowledge, algae blooms have occurred in Lacy Lake over the past few years.

4.4.3 Chemical analysis

Chemical analysis identifies the composition of the water and gives important information about its origins. See Appendix G for chemical analysis of Cold Creek/Lacy Lake. See Appendix I and Appendix J for chemical analysis of unnamed springs that serve as the water supply for residents along the Beaufort Range. Chemical analysis shows high levels of Calcium and Magnesium; with a high rating of hardness, and an alkaline pH; indicating the water sources are being influenced by a karst system.

4.4.4 Water usage inventory

800 connections in CCWD serve approximately 2500 residents. Water metering occurs in CCWD. Water rates are $ 54.00 per quarter, without concession rates for extreme circumstances. New hookups cost the property owner $20,000 (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

In 2003, the total annual consumption was 377,415 m3 (McGill and Associates, 2005) which equates to 413 L /person /day. During the drought sensitive period of May 1- Oct 15, consumption was 214,789 m3, (McGill and Associates, 2005) which equates to 511 L person /day.

In 2009, the annual usage was 404,940 m3 (88,977,735 Imp Gal) (CCWD staff, personal communication, Feb 12, 2010) which equates to 444 L /person /day.

During the drought sensitive period of 2009, the maximum day usage was 9,172,800 L / day (1400 gal/min) on July 31 (CCWD staff, personal communication, Feb 12, 2010).

This is a peak demand of 3669 L/person/day. Minimum day usage was on Apr 15; usage was 450 L/min (100 gal/min) (CCWD staff, personal communication, Feb 12, 2010). This is a minimum demand of 256 L/ person/day. The major water users of this watershed are identified as public and residential (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

This system is considered to be a secure water supply and capable of supplying sufficient water quantity and quality for this and future generations (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

Climate change and changes to agricultural demands have not been considered for the system at this time (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

Water Restrictions

According to CCWD Board, there are no water restrictions. However, according to the Drought Management Plan (2005), there are times when restrictions will be initiated. There is a bylaw for water restrictions to be enforced when needed in the CCWD.

Supply is managed by storing water in the late spring and releasing it through the summer in a controlled manner. They monitor the lake level throughout the summer and, if water consumption appears to be high versus the lake level and projected water requirements, water restrictions are implemented. (McGill and Associates, 2005).

4.4.5 Threats

One threat identified by the CCWD Board was “irresponsible logging” (CCWD Board Trustees, Chitty and Haggard, personal communication, 2009). In 2002, 34 residents perceived a threat and petitioned the Ministry of Forests to act to protect their water supply from proposed logging and road building on Carbonate Unit VANISL76 karst lands (Robinson 2008).

Lack of local knowledge is also a threat. On May 26, 2010, Ministry of Environment Geomorphologist R. Guthrie (personal communication) said that he is not aware of much karst in the Beaufort Range, but conceded that karst identification in the form of maps for the area is woefully inadequate. He further stated that the water source of a karst system needs to be protected. However, he claimed that looking into karst in the Beauforts is not a good use of resources. It would be apparent from these comments that lack of resources to further local knowledge is also a threat.

Figure 32. Lacy Lake Drinking Water Reservoir pollution, photo taken April 2009.

The CCWD Board of Trustees have considered it advantageous to have a closed watershed to protect the source (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009). No protective barrier is located around Lacy Lake. Figure 32 is a photo that was taken at Lacy Lake shoreline. In the foreground, there is evidence of human excrement and toilet paper.

4.4.6. Regional water supply

According to CCWD Board, a regional water supply is not applicable. There are no problems with the system in place that would require joining a regional system. However, there are concerns due to the political nature of water management. If a regional water board is run politically rather than by water professionals, the ultimate goal of protecting and serving the public with clean water may get lost (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

4.4.7 Public education

Information for the public, such as newsletters and water conservation strategies, are available in the office. Signage to make the public aware of the drinking water source are not in existence except at Lacy Lake and Cold Creek Dam (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

Accountability

To ensure accountability, all documentation and records of the day to day activities of this system are available to the public in the CCWB office during office hours (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009). However this was not our experience when trying to access information. A report about Cherry Creek water supply was commissioned in 1992 by CCWD from McGill and Associates Engineering. The report was unavailable for review by us because CCWD was unable to locate a copy (CCWD Board of Directors, personal communication, Oct 2009) and the engineering firm said it is outdated and would not give an accurate description for today (McGill, A., personal communication, Nov 30, 2009). The Board has commissioned several reports but when we asked to review them they could not be located. (CCWD Board of Directors personal communication, Oct 2009).

There are no water systems tours open to the public in CCWD because it was claimed that resources do not allow it (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009)

According to the Board, there is no formal complaints committee, but the public is welcome to communicate with the Board. There is no formal training to fulfil the duties of the board. (CCWD, Board Trustees, Chitty and Haggard, personal communication, 2009).

4.4.8 Drought plan

CCWD board commissioned a study by McGill & Associates Engineering Ltd.

The purpose of this plan was to provide a process for monitoring water supply; anticipating potential drought problems; providing information to the public; providing water supply and use information so as to minimise the overall impact of drought on the residents of Cherry Creek Waterworks District (McGill and Associates 2005). A review of the plan revealed the following information:

In 2005 the Department of Fisheries and Oceans required that a 1 ½ inch diameter hole be cut through the diversion dam spillway one meter below the crest to maintain flow in Cold Creek. If the water level drops below this, all water would be available for Cherry Creek Waterworks District residents (McGill and Associates 2005).

Lacy Lake Drought Analysis was modelled using a simple water balance approach with 22 years of precipitation data from the Atmosphere Environment Service near Port Alberni. The following assumptions were applied:

- May 1: the lake level was assumed to be at the level of the spillway.
- Water supply season was defined as May 1 to October 31.
- Precipitation input to the watershed was de-rated by a run-off coefficient of 0.3, which is appropriate for the terrain and vegetation in the watershed.
- Evaporation from the lake was accounted for.
- Fish conservation flow was assumed to be continuous at 130 imp gal/ min [592 L /min]. (McGill and Associates 2005).

Drought water storage levels are in Table 15 below.

Table 15. Lacy Lake Water Storage Levels modelled for selected drought events (percentage full at meters above sea level).

	Normal	Dry	Very Dry	Ext. Dry	Crisis
May 1	247.8	247.8	247.8	247.8	247.8
Oct 29	244.8	244	243.2	242.4	241.6
Oct 29	55%	43%	31%	19%	7%

Data taken from public document created by McGill and Associates, February 2005).

4.5 Mountain View (within "Area F")

Mountain View refers to the area surrounding and including the Mountain View Mobile Home Trailer Park, on the Alberni Highway going east out of the city.

4.5.1 Assets inventory

Water Source: Karst spring above Mountain View Trailer Park

Designated Community Watershed and Watershed Reserve
Some of Mountain View's watershed was included in the Rogers Creek Watershed Reserve. The holder of the water licence was Sahara Heights Waterworks District and Designated Community Watershed (# 930.018), until 2001. In 2001, the Community Watershed status was cancelled (see Appendix K). The watershed is owned by Island Timberlands. Located in the Beaufort Range, the boundaries include Calcareous Deposit VANISL 76.

Water Storage: None

Pump Stations: Gravity-fed

4.5.2 Water treatment

Trailer park residents use a system of ultra-violet and filter purification.

Assets Maintenance is on a personal basis.

Emergency Response Plan: None

4.5.3 Water quality

There is no monitoring; however, a chemical analysis was conducted in May 2008. Total Coliforms and *E. coli* were less than 1, and turbidity was less than 0.1 (R. Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, personal communication, May 2010).

Water Restrictions: None

Demographics

There are approximately 31 residents, as well as a number of businesses served by this system (R. Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, personal communication, 2009).

4.5.4 Chemical analysis

Chemical analysis identifies the composition of the water and gives important information about its origins. See Appendix H for chemical analysis unnamed spring that serves as the water supply for Mountain View area. Chemical analysis shows high levels of Calcium and Magnesium; with a high rating of hardness; and alkaline pH; indicating the water sources being influenced by a karst system.

4.5.5 Regional water supply

The residents of Mountain View would not be included in a regional water supply with the present infrastructure (CCWD staff, personal communication, 2009).

4.5.6 Threats

In 2002, 34 area residents petitioned the Ministry of Forests "to act to protect our water supply" from "proposed logging and road building on Carbonate Unit 76 Karst Lands" (Robinson 2008).

Calcareous deposit VANISL 76 probably has two major karst groundwater systems that flow in opposite directions. One of these groundwater systems appears to flow towards Lacy Lake, while the other recharges the Cascade Cave/Hobbit Hole system. Its downstream resurgence is the primary water supply for residents of the Elkford Road, Mountain View Mobile Home Trailer Park, Export Road, Alberni Highway, and Alberni Veterinary Clinic (Robinson 2008).

The complex geology of the Beaufort Range plays a major role in catchment, recharge, storage and release of large quantities of groundwater that resurface as numerous springs from the Alberni Highway to the Ash River Valley, a distance of about 22kms (Robinson 2008).

Field observation of karst terrain features, (including an unusual deposit of precipitated calcite in a surface stream) personal communication, topographic and karst mapping and chemical analysis of various water supplies, STRONGLY suggest that major karst drainage systems have developed in the limestone bedrock deposits. These karst systems play a major role in the catchment of surface water, storage and lateral distribution of groundwater intersecting geologic faults, fractures and non-karst sedimentary bedding planes (Robinson 2008).

Our field observation identified garbage dumping as a threat to water quality in the Mountain View watershed. Figure 33 shows residential garbage being dumped into a cave entrance that is upstream of Mountain View water intake.

Figure 33. Pollution at cave entrance in Mountain View Watershed, photo taken June 2009.

Note reprinted with permission from R. Robinson.

4.6 Beaufort "Area B"

The Beaufort "Area B" Electoral District is located at the far northern end of the Alberni Valley.

4.6.1 Assets inventory

Water Sources

- Karst springs
- Wells
- Surface streams

Most people have their own water licences to extract water from different sources along the Beaufort Range (see Figures 17, 18, and 19 on pages 118, 119, and 120).

Watershed

The size of the Beaufort Range watershed area is unknown.

Demographics

There are about 500 residents in the Beauforts "Area B." The area is a mix of rural residential and working farms.

Assets Maintenance

No study has been conducted concerning what property owners have invested individually or collectively in infrastructure for residents of the Beauforts. However, individual property owners have invested considerable amounts in their water supply infrastructure. Personal interviews with local residents of Area B in 2009 revealed the following:

Upkeep for a small dam in 2009 was $3000.00, but the initial cost of the dam construction would have been considerably more. There are also consultant fees for a fisheries biologist for fish sensitive streams. Pipes and pumps cost $50,000.00. A well is estimated to cost over $100,000. Annual water licence fees vary, depending upon water quantities used.

Emergency Response Plan

No emergency response plan exists. Residents themselves are responsible for any emergency that may arise. Ministry of Environment sells licences but does not guarantee the quality or quantity of water. If it is a fish bearing stream, residents may be asked to remove their intake pipe if water levels are too low for fish habitat (Mike Kokura Area B Regional Director, personal communication, January 2010).

4.6.2 Water quality

No local water committee monitors water issues in the Beauforts, but there is a Regional Water Committee, consisting of three regional district directors, that occasionally meet. They have met with the forestry companies from time to time (Mike Kokura Area B Regional Director, personal communication, January, 2010).

Water History

"Years ago, the Beauforts were logged extensively. There weren't so many problems with the consequences of logging back then because there wasn't so many people around" (Mike Kokura Area B Regional Director, personal communication, January 2010).

Local knowledge affirms a long history of landslides, silting up of streams, and more recently water quantity and quality changes in the Beaufort area (interviews with local residents, 2009).

4.6.3 Chemical analysis

Chemical analysis identifies the composition of the water and gives important information about its origins (see Appendix E for Spaht (Bear) Creek and Appendix F for Deer Creek). Chemical analyses of Deer Creek and Spaht Creek show high levels of calcium and magnesium; with a high rating of hardness and an alkaline pH, indicating the water sources are influenced by a karst system.

4.6.4 Threats

Irresponsible logging, lack of logging road upkeep, and, in particular, culvert maintenance, public activity in the watershed, and lack of upkeep of the Log Train Trail are identified threats (Mike Kokura Area B Regional Director, personal communication, January, 2010).

In years past, the railroad workers used to conduct culvert maintenance, but it no longer happens. They would unplug log jams that had washed down after forestry activity. Flash floods would occur if the logs weren't removed (Mike Kokura Area B Regional Director, personal communication, January 2010).

Hal Creek and Mt. Hal Watershed Protection Society

In 1999, there was a Hal Creek and Mt. Hal Watershed Protection Society. Interviews with former members revealed that they had fought for many years to protect the water sources. The results were that some members were fed up, stressed out, and disgusted; some moved away, others pursued legal channels, and some simply gave up. The issue was so heated that some Society members were forced off the road while driving. Others were threatened with bodily harm as well as damage to residents' property (local residents, personal communications, 2009).

Members spent considerable time and personal finances trying to raise awareness about activities within their watershed. Their countless attempts at involving government officials led to much lip service, but little changed (local residents, personal communications, 2009).

In 1999, the Society commissioned a water study called the Hydrological Analysis of the Hal Creek Watershed by Northwest Hydraulic Consultants (NHC) (local residents, personal communications, 2009). The study brought to light the following information (NHC 1999):

- The bedrock geology of the Hal Creek Watershed is of the Karmutsen Formation, composed of volcanic rocks. Basalt and andesite are the major rock types. Weathering of the Karmutsen bedrock produces more silt and clay than weathering of intrusive bedrock.
- Hal Creek upper watershed is well defined until it reaches its fan at an elevation of 250 m. After this point, the watershed becomes less defined due to a complicated channel network and possible groundwater inflows. Hal Creek splits at the head of its fan, with part of the water from the upper watershed flowing west to Beaver Creek.
- Soils in the Hal Creek area are generally unconsolidated, stony and coarse-textured, and are well drained with fines and with a very thin to non-existent humus layer.
- The Hal Creek watershed is dispersed with several springs. Little Hal Creek is an example of one of these springs. These springs provide important fish habitat, as they have low and constant water temperature, relatively constant flow, and their channels are stable.
- The soils on the lower hill slopes and on the fan are very permeable, and much water appears to infiltrate to groundwater. The size or residence time of the aquifer is not known, but it supplies the spring creeks.
- The Water Survey of Canada (WSC) reports seasonal flows from Hal Creek (also known as Fawn Creek) for eight years (1982-1989). Flow records are from a manual gauge that was installed at Beaver Creek Road from April to September. The drainage area of the gauge was not estimated. Winter flows are not recorded for Hal Creek and the WSC does not report year-round flows for other similar watersheds in the Alberni Valley. There are no unregulated streams in the Alberni Valley that have more than five years of winter records.
- The nearest similar-sized stream with an extended record of year -round flows was Nile Creek, near Bowser, which drains to the eastern side of the Beaufort Range. Rosewall Creek, which lies near Nile Creek, has been gauged at the station located at the mouth of Rosewall Creek. The headwaters of both Nile and Rosewall creeks lie near upper Hal Creek. The Nile

Creek gauge has been in operation since 1959. Nile Creek has karst topography that is thought to contribute to its consistent, high baseflow. Nile Creek maintains consistent and higher summer flows, likely due to the groundwater inputs from its limestone aquifer.

- It is expected that the flow regime for Hal Creek is similar to that of Rosewall and Nile creeks, with a minor snowmelt peak in May and June, and summer baseflows that vary along the fan, depending on groundwater inflows and losses, and flow splitting and high flows from October through March. However, it is expected that greater rainfall exists over the Hal Creek watershed, firstly because it is on the windward side of the Beaufort Range, and secondly because water flows from the Hal Creek watershed to Beaver Creek and peak flows are expected to decline down the fan from this loss and losses to groundwater.
- NHC predicted a runoff of 2,500 mm at the head of the Hal Creek fan.
- Low flows occur both in late summer and early fall, and during the winter. Low flows may vary considerably over short reaches, as flows disappear into permeable materials. For example, Hal Creek, on its fan, likely dries during the summer as flows infiltrate into the porous bed material.
- Sediment is generated in the source zone of Hal Creek watershed and is delivered to the fan by Hal Creek through either fluvial or debris-torrent processes. In the upper portion of Hal Creek basin, the main sediment sources appear to be ravelling, rockfall, and debris slides; in the lower portion, the main sediment source is landslides. Gullies appear active and appear to be charged by continual bedrock ravelling. Bank erosion along Hal Creek fan re-mobilises gravel, which is then carried downstream. This erosion appears to be the main source of the gravel that is delivered to the creek below the marine clay canyon.
- Clearcuts adjacent to Hal Creek, with similar slope and surficial materials to those in Hal Creek, were investigated to help predict the possible effects of forest harvesting on slope stability. Thirty-four logging-related landslides on the west side of the Beaufort Range between Wolf and Kitsuksis creeks had occurred over the period of 1951-1999. Seventy-three percent of these logging-related landslides were associated with roads and most appeared within five years after first appearance of the roads and clearcuts. Most slides appear to have occurred in materials derived in the local bedrock or in-road fill; parent material appears to be coarse blocky rubble or stony till-like material with an appreciable content of fines.
- Of the 42 landslides inventoried, 19% were natural, 81% were in clearcuts; 60% of all landslides occurred at logging roads on slopes ranging from 30% to 100%. Landslides in open slopes on clearcuts occurred on slopes ranging from 50 to 80 %. Landslides on clearcut gullies occur on slopes ranging from 40% to 60%. Natural landslides occurred on slopes ranging from 70% to 90%. The landslides have a poor vegetative recovery, and several landslides that initiated in the 1960s are still unvegetated.
- Future harvesting on the Timberwest lands has the potential to alter both flows and sediment supply in Hal Creek. Harvesting also has the potential to alter a number of flow characteristics; however, the primary concern is often peak flows. The effect on peak flows is tied to the clearcut area, or equivalent clearcut area, in the upper Hal Creek. Typically, when harvesting exceeds some critical value, which is thought to be about 20% of the watershed area, peak flows are usually increased significantly above those from an unharvested watershed. Peak flows continue to increase as clearcut area or equivalent clearcut area

increases. Following harvesting, sediment supply could be increased by surface erosion from roads and exposed soils, by stream erosion from increased peak flows, and by landslides.

Potential consequences of harvesting in Hal Creek (NHC 1999):

- Reduced low flows
- Increased peak flows
- Increased sedimentation
- Channel avulsion (*tearing away; sudden removal of land by flood*) and water diversion on fan
- Temperature changes in spring creeks
- Turbidity in spring creeks
- Poor re-growth

4.6.5 Riparian protection

In 2001, the Alberni Valley Enhancement Association (AVEA) commissioned a study by LGL Limited, Environmental Research Associates. The study was called Stream Corridor Management Plan for Beaver and Big Hal Creeks.

The AVEA identified problems and opportunities affecting fish, wildlife, and agricultural production within the Beaver and Big Hal Creek basins. Drainage problems have been identified in both watersheds, particularly upstream of the Beaver Creek Road crossing. Since settlement, many of the wetlands have been ditched and drained, and the natural channels have been channelized extensively (Gaboury 2001).

The purpose of the study was the development of a stream channel and corridor management plan incorporating specific Best Management Practices (BMP) to guide land and stream management. This was seen as fundamental to maintaining and rehabilitating habitats and water quality within these watersheds (Gaboury 2001).

Recommendations from this report included (Gaboury 2001):

1. Protect, maintain and restore the creek by establishing and adhering to a Stream Corridor Management Plan.
2. Maintain and restore a diverse stand of riparian vegetation a minimum of 20 m wide along each bank of the stream corridor.

Benefits of following the recommendations (Gaboury 2001):

- Improved conveyance of low and moderate discharges and reduced flooding of adjacent public and private lands
- More agricultural production from adjacent crop, pasture and hay lands
- More functional stream channels with meanders, pools and riffles
- Improved rearing habitat for coho and cutthroat trout
- Stable banks that reduce erosion and release of sediment that can cover spawning habitat and suffocate fish eggs.

- Improved water quality as a result of sediment and nutrients being filtered by the riparian zones
- Increased shading that cools the water, increases the amount of dissolved oxygen, and reduces instream vegetative growth
- Preservation and improvement of habitat for a variety of bird species
- Improved riparian zones with functional and diverse vegetative communities

4.7 Overview of Water Requirements

4.7.1 Food-water connection

According to the Agricultural Land Commission, there are 7700 hectares of farm land in the Agricultural Land Reserve(ALR) in the Alberni Clayoquot Regional District (see Figure Thirty One). All of it would be considered capable of producing some type of crop, with some lands having a wider range of potential crops due to increased fertility or fewer limiting factors. Not all ALR land is currently under agricultural production. The ALR includes forestry land as well as lands with agricultural potential. Therefore some lands in TFLs may also be in the ALR. Production and harvesting of trees is considered a farm activity in the ALR (Agricultural Land Commission, G. Bednard, personal communication, Sept 29, 2010).

Statistics are kept for land within regional district or municipal boundaries only, so it was not possible to get an agricultural land size for the Alberni Valley specifically (G. Bednard, personal communication, Sept 29, 2009). However, ACRD staff say that no land is considered as usable agricultural land in the rest of the ACRD, therefore the figure of 7700 hectares is for the Alberni Valley (ACRD staff, personal communication, 2009).

The Alberni Farmers Institute says that there are four different classes of soil in the Alberni Valley. The class of soil controls what can be grown in the given area. A key factor in maintaining the class of soil is water. Without adequate irrigation, the quality of soil drops dramatically and the quantity of food production declines. As well, the type of food capable of growing in that soil changes or becomes impossible (Alberni Farmers Institute, A. Collins, personal communication, Jan 7, 2010).

Each acre of land needs one foot of water per growing season. This equates to one-quarter of a million gallons per acre per season on an average year for agriculture in the Alberni Valley to be viable. An acre is 43,560 sq feet; therefore each acre will require 43,560 cubic feet of water. Each cubic foot contains 6.25 gallons; therefore each acre will require 272,250 gallons, which is 1,238,738 litres of water per acre. The acre foot measurement is used when agricultural water licences are granted. Depending on the type of crop grown and the amount of rainfall during the growing season, the total acre foot might not be utilised (Alberni Farmers Institute, B. Collins, personal communication, Jan 7, 2010).

According to the Farmers Institute, no new water licences are being issued for the Somass River. Therefore they say that if a Regional Water supply comes to fruition, there needs to be a 2 – 4 inch larger pipe to include water for agriculture to support local food production (Alberni Farmers Institute, B. Collins, personal communication, Jan 7, 2010).

There are no substitutes for water. We need vast amount of it to produce food. It takes 2000 litres of water per day to produce the food we consume each day. Since food is such an extraordinarily water-intensive product, it comes as no surprise that 70 percent of world water use is for irrigation. Although it is now widely accepted that the world is facing water shortages, most people have not yet fully understood that a future of water shortages will also be a future of food shortages (Brown 2004).

Biodynamic farming and gardening practices look upon the soil and the farm as living organisms. They regard maintenance and furtherance of soil life as a basic necessity, if the soil is to be preserved for generations (Biodynamic Farming and Gardening Association, accessed July 30, 2010).

The maintenance of soil life is vital in order to protect the soil from erosion and to create, improve, and augment the humus content [which will decrease water usage] (local knowledge, personal communication, July 30, 2010). The result will be a fine, crumbly structure containing the necessary organic colloids. This leads to the production of high-quality crops, which in turn means better feed for livestock and better food for human beings (Biodynamic Farming and Gardening Association, accessed July 30, 2010).

Experts using biodynamic intensive farming practices say it takes 2000 sq feet of land for one adult vegetarian diet for one year. It takes considerably more than that for non-vegetarians (Jaevons 2006).

Research at the University of Nebraska indicates that a cow requires 2 gallons of water per day per 100 pounds of body during the hottest weather (Rasby 2002).

Research at North Dakota State University identified that one cow (1501 pounds) needs 12.68 acres per cow in western North Dakota to obtain 1,101 forage of dry matter intake and/or needs 2 tons of dry matter food during a four-month summer shut-in period. There is little we can do to change nutritional requirements, stocking rates and plant biology. How cattle perform given individual production scenarios will vary, but one thing is for sure, do not assume what you see fits. The actual collection of data is essential to guide local changes in management (Ringwall, 2008). Local knowledge says that these figures would be applicable in the Alberni Valley (B. Chase, local farmer, personal communication, March 28, 2010).

In the Alberni Valley, with an estimated population of 25,300 residents, 5,060,000 Litres (50,600 m3) of water per day (18 469 000 m3 / year) would be required to grow most of the food for the residents of the Alberni Valley.

There are 46 farms listed in the Alberni Valley Farmer's Directory. There are many small family farms producing a significant amount of food for themselves and extended family and friends that are not listed in the Alberni Directory (Alberni Valley Farmer's Directory 2009). Figure 34 shows land within Agricultural Land Reserve in the Alberni Valley.

Figure 34. Agricultural Land Reserve in the Alberni Valley in 2009

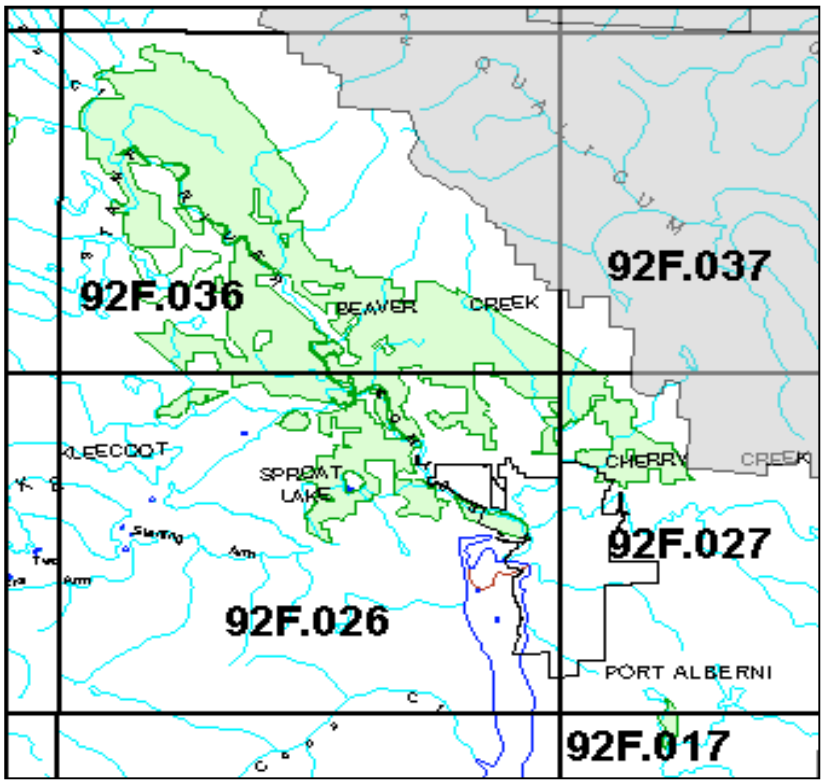


Image reprinted with permission from ACRD.

4.7.1.1 Agricultural water conservation

There is no substitute for water. We need vast amounts of it to produce food. At the personal level, we drink roughly four litres of water a day. It takes 2,000 litres of water – 500 times as much – to produce the food we consume each day. Food production consumes 70% of the world water use for irrigation (Brown 2004).

Over much of the earth, the demand for water exceeds the sustainable yield of aquifers and rivers (Brown 2004).

Land productivity is measured in tons of grain per hectare, or bushels per acre, but there are no universally used indicators to measure and discuss water productivity. The indictor likely to emerge for irrigation water is kilogram (kg) of grain produced per tonne (T) of water. Worldwide, that average is now roughly 1 kg of grain per T of water used (Brown 2004).

Raising Irrigation Efficiency

The first challenge is to raise the efficiency of irrigation water, since this accounts for 70% of world water use. Irrigation water efficiency is affected not only by the mode and condition of irrigation systems, but also by soil type, temperature, and humidity. Steps suggested to boost irrigation water efficiency are raising the price of water, providing incentives for adopting more efficient irrigation technologies, and developing local institutions to manage this process (Brown 2004).

When attempting to raise the water efficiency of irrigation, the trend is to shift from the less efficient flood, or furrow, system to overhead sprinkler or drip irrigation. Drip irrigation provides a steady supply of water with minimal losses to evaporation. Because drip systems are both labour-intensive and water-efficient, they are well suited to countries with under-employment and water shortages (Brown 2004).

Anything that raises the productivity of irrigated land typically raises the productivity of irrigation water. Anything that increases the efficiency with which grain is converted into animal protein increases water productivity (Brown 2004).

Reducing water use to a level that can be sustained by aquifers and rivers, worldwide, involves a wide range of measures not only in agriculture but also throughout the economy. Among some of the more obvious steps are shifting to more water-efficient irrigation practices and technologies, planting more water-efficient crops, adopting more water-efficient industrial processes, and using more water-efficient household appliances. Recycling urban water supplies is another obvious step to consider (Brown 2004). The fast-unfolding water crunch has not yet translated into food shortages, but if unaddressed, it may soon do so (Brown 2004).

Climate Change and Agriculture

Earth's rising temperature affects food security in many ways. In the long run, when glaciers melt, the available water supply (for drinking and for irrigation) is eventually reduced. This is because when temperatures rise to the point of causing glaciers to melt, there are direct effects of high temperature on crop yields, more evaporation, and thus more rainfall. Elevated temperatures can lead both to more extreme drought and to more severe flooding. Drought can be caused by below-normal rainfall or above-normal temperature. Most often the two combine to create crop-withering droughts. Increased temperatures also mean more powerful, more destructive storms. Rising sea levels due to melting glaciers would inundate Asia's rice-growing river deltas and floodplains (Brown 2004).

Higher temperatures can also worsen or create new crop disease and insect problems. The combination of heat and humidity make it impossible to grow grain in the tropics. Higher temperatures would simply expand the area that is inhospitable to growing grain, especially wheat. A warmer earth means that agricultural zones in the northern hemisphere would move northward within Canada and Russia (Brown 2004).

Raising Urban Efficiency

It is time to rethink the typical urban water use model, one where water flows into the city, is used once, and then leaves the city – usually becoming polluted in the process. This flush-and-forget model that so dominates urban water systems is not sustainable over the longer term. In many countries, the irrigation water supply is shrinking as aquifers are depleted. But even as rural wells are going dry, irrigation water is being diverted to fast-growing cities. Farmers are getting a smaller share of a diminishing supply (Brown 2004).

Food-Water security needs an integrated approach by governments

Rising food prices could be the first economic indicator to signal serious trouble in the deteriorating relationship between the global economy and Earth's ecosystems. A doubling of

grain prices, which is a distinct possibility if we cannot accelerate the growth in grain production, could impoverish more people and destabilise more governments than any event in history. Everyone has a stake in stabilising the agricultural resource base. Everyone has a stake in securing future food supplies. We all have a responsibility to work for the policies – whether in agriculture, energy, population, water use, cropland protection, or soil conservation that will help ensure future world food security (Brown 2004).

Future food security depends on stabilising key agricultural resources: cropland, water, rangeland, and the earth's climate system. Food security is affected not only by the food-population equation, but also by the water-population equation and the efforts of water resource ministries to raise water productivity (Brown 2004).

There is a remarkable lack of data on the status of the world's underground water resources. Few countries systematically gather and report data on changes in water table levels. Even fewer data are available on the thickness of aquifers. And there are almost no projections that tell us when aquifer depletion is likely to occur (Brown 2004).

Ensuring future food security can no longer be left to ministries of agriculture alone. Food security is now directly dependent on policy decisions in government departments that deal with health, family planning, water resources, transportation, and energy. This dependence of food security on an integrated effort by several government departments is relatively new. Because it has emerged so quickly, governments are lagging far behind in their efforts to coordinate these departments and their agendas (Brown 2004).

4.8 Water Inventory for the Alberni Valley

4.8.1 Water Survey of Canada

The Water Survey of Canada (WSC) is a joint federal-provincial government initiative. Table 16 shows summarised data from the WSC for British Columbia in 2009.

Table 16. Water Survey of Canada information for BC.

Province/Territory	Hydrologic Setting	Water Issues
British Columbia	Climate and physiography highly variable: perhaps the most hydrologically complex region	Quantity: water rights licensing, flooding, irrigation, hydro power
	Elevations from sea level to >4000 m	Quality & waste management
	Precipitation extremely variable: potential annual runoff of >3000 mm in coastal basins but <100 mm in some interior basins	Resource development: forestry, fisheries, mining
	Population concentrated in the SW, in the lower Fraser Valley	Integrated watershed management, erosion

Note: Data taken from Water Survey of Canada website 2009.

Table 17 below shows a list of stations where water level and stream flow statistics have been recorded in the Alberni Valley. Stations 08HB008 Sproat River near Alberni and 08HB023 Ash River below Moran Creek are still active (Environment Canada, Water Survey of Canada, Campo, personal communication, Jan 20, 2010).

Table 17. Stream Flow stations in the Alberni Valley (active and inactive). Data recorded included time period, drainage area and sediment data.

Station	Location	Record Period	Sediment Data	Drainage Area
08HB008	Sproat River	1913-2007	None	347 km2
08 HB010	Stamp River	1914-1978	None	899 km2
08HB015	Sproat Lake	1913-1996	None	Unknown
08HB017	Somass River	1957-2003	None	1280 km2
O8HB019	Cameron River	1958-1959	None	81 km2
08HB023	Ash River	1959-2005	None	378 km2
08HB036	Beaver Creek	1969-1981	None	Unknown
08HB059	Deer Creek	1977-1981	None	6.48 km2
08HB068	McCoy Creek	1980-1985	None	Unknown
08HB070	McCoy Lake	1981-1985	None	Unknown
08HB072	Fawn Creek	1982-1989	None	Unknown
08HB 073	Bear Creek	1987-1990	None	Unknown
08HB077	China Creek	1990-1995	None	Unknown

Printed with permission, Watery Survey of Canada, January 20, 2010.

The other stations were discontinued because the funding ceased. (Environment Canada, Campo, personal communication, Jan 20, 2010).

4.8.2 Snow survey (BC)

BC Ministry of Environment's River Forecast Centre is responsible for conducting and recording snow surveys on Vancouver Island.

2009 Snow Survey:

Snow surveys on Vancouver Island are very limited. The Jump Creek automated snow pillow (3B23P) is located on the divide between the Nanaimo and Cowichan River basins. BC Hydro operates the Wolf River automated snow pillow (3B17P) in the upper Campbell River Basin. Data (temp, precipitation, snow-water equivalent) are available in "near-real-time," with a historic record. You can access the real-time and historic data through the River Forecast Centre (Ministry of Environment, Chapman, personal communication, Jan 23, 2009).

The manual snow survey closest to Port Alberni is at Mount Cokeley (3B02A) (elevation 1267 metres at lat 49 14, long 124 35). There are no other snow measurements anywhere near (Ministry of Environment, Chapman, personal communication, Jan 23, 2009).

2010 Snow Survey
In 2010, the Ministry of Environment cancelled the Mt. Cokely snow survey. The only information available for the south Island is the Jump Creek snow pillow (Ministry of Environment, Chapman, personal communication, Jan 19, 2010).

Jump Creek was at 105% of normal or average snow water at January 1, 2010. Since then, the two warm and wet storms that blew through resulted in a lot of melt on the south Island, particularly below about 1600 metres elevation. Jump Creek is currently (Jan 19, 2010) only 55% of normal or average. Last year at this time, the Jump Creek pillow was 76% of normal, only slightly higher than its current level. By mid-January, typically about 45% of the winter's snow has accumulated. There is still lots of winter left to build up a decent snow pack on the south island, but we need a sustained period of cool and snowy weather to do that. In 2009, Jump Creek stayed below normal for the last half of the winter, peaking at only 71% of normal at April 1 (Ministry of Environment, River Forecast Center, Chapman, personal communication, Jan 19, 2010).

In summary, there are only two active stream flow monitoring stations left in the Alberni Valley; Sproat River and Ash River. There is no longer a snow survey station for monitoring snow pack and snow water equivalent data for the Alberni Valley; the closest left is Jump Creek near Nanaimo Lakes.

4.9 Outside Factors

4.9.1 Climate change

The executive summary of the Alberni Valley Climate Change Committee's report (2008) says:

> Extreme weather and weather-related events pose the greatest climate risk for the Valley and these are expected to increase in intensity and frequency over time. If recent changes in Arctic ice are any indication, the pace of climate change may be faster than current thinking allows, and may require a level of flexibility in our responses that our society is not currently set up for. Here in the Alberni Valley, we can expect the following conditions into the future:
>
> - winds to increase in intensity and turbulence
> - more intense rainfall events
> - more intense snowfall events
> - more unusual types of weather like hail, thunder and lightning
> - more unseasonable weather
> - more hot spells

The current regional predictions for coastal areas of BC are that most change will occur in winter rainfall, with little change in summer precipitation, or perhaps longer periods of drought.

Increased temperature in summer will result in the ground drying more rapidly. Increased temperatures in winter mean that snow pack will not be as reliable as in the past to supplement summer stream flow.

Impacts on current and future water supplies, hydroelectric power generation, fisheries and river ecosystem integrity are also significant concerns for BC. Most of BC's alpine glaciers are retreating rapidly and many may disappear in the next 100 years. Coupled with reduced snow pack and warmer spring temperatures, this will result in earlier spring freshets (a small sudden flood or rise in the level of a river, caused by heavy rainfall or a rapid thaw, especially after a period of dry weather), warmer river temperatures, declining summer flows and increasing peak flows in many of BC's watersheds. The City water supply on China Creek could be negatively affected by these changes. Water quality issues arise around heavier and more prolonged rainfall, especially where other stress factors exist, such as logging.

4.9.2 Air quality

When it comes to polluted air, human health is negatively impacted primarily from breathing it. The main concern at the air/water interface is that anything falling out of the air into lakes and streams could potentially affect that water quality for both aquatic life and for those that drink the water (Air Quality Council, B. Wyton, personal communication, Jan 12, 2010).

Of key concern is the huge category of air contaminants known as PM 2.5 (particulate matter that is of a size 2.5 microns and less). The very size of the particles poses problems to health because they are small enough to pass from our lungs into our bloodstream, and can lodge in many tissues other than the lung. If the particles are not expelled, and if they happen to be toxic, they can become the seeds of diseases such as cancer. Even if they do not carry toxins, their size and number can lead to various reactions, including changes to lung and heart tissues and, in a worst case scenario, cause death (B. Wyton, personal communication, Jan 12, 2010).

Historically in the Alberni Valley, industry was a big contributor to air pollution from PM 2.5. Today, however, the main sources of PM 2.5 in the Alberni Valley are residential wood stove burning, back yard burning, and forestry wood waste burning (B. Wyton, personal communication, Jan 12, 2010).

PM 2.5 is considered to be one of the Criteria Air Contaminants (CAC), along with SOx (sulphur oxides), NOx (nitrogen oxides), CO (carbon monoxide), several VOCs (volatile organic compounds), NH_3 (ammonia), and 0_3 (ground-level ozone) (B. Wyton, personal communication, Jan 12, 2010).

CACs are produced from a number of sources, including the burning of fossil fuels. It is because of these shared sources that they are grouped together. Information on annual CAC emissions, along with hundreds of other substances released by industrial, institutional, and commercial facilities, is listed on the National Pollution Release Inventory (NPRI). Of the substances listed, 31 of them are of particular concern because they are toxic as defined in the Canadian

Environmental Protection Act (CEPA). There are additional hazardous air pollutants included in a list produced by the US Environmental Protection Agency (EPA) (B. Wyton, personal communication, Jan 12, 2010)

The concern over PM 2.5 is different for water than air not only because of the dilution factor, but also because particles tend to settle out of the water over time and become bound to sediments at the bottom. Some of the pollutants to be aware of are:

- SO_2 (sulphur dioxide): constant emissions from industry can lead to acid rain, which affects all systems, including water.
- Heavy metals: these can fall out directly into water systems, or enter via runoff, leaching, etc.
- Bioaccumulating endocrine disrupters, PCBs, etc., but especially dioxins and furans

Currently in the Alberni Valley, the largest source of the latter category is backyard garbage burning. This is a common, but unacceptable, practice because the emissions are extremely toxic and are produced at ground level, where people are living and breathing. They settle out in nearby gardens, creating another exposure pathway through ingestion. Burning plastics and driftwood also produces dioxins and furans. These are among the most toxic substances known (B. Wyton, personal communication, Jan 12, 2010).

While, globally, there can be hotspots with regard to water quality impacts from air emissions, there is no documented evidence that this is the case in the Alberni Valley. Water quality assessments and monitoring data collected by the Ministry of Environment for Sproat Lake, Great Central Lake, and the City of Port Alberni water supply (China Creek and Bainbridge Lake) show water quality to be of a high standard for both aquatic life and drinking water (B. Wyton, personal communication, Jan 12, 2010).

Another area of concern is the application of herbicides, pesticides, and fertilisers. These chemicals, used in forestry, agriculture, and by residential homeowners, can lead to water contamination.. The main concerns for water quality include contamination of water sources in and adjacent to where these chemicals are applied, nutrient enrichment through fertilisers, aging and failing septic systems, and run-off. If water systems, particularly small lakes, become nutrient rich, for example, contaminants that are normally bound in sediments can be re-released back into the water column and have the potential to cause water quality concerns (B. Wyton, personal communication, Jan 12, 2010).

4.9.3 Watershed real estate

According to Timberwest, it is uniquely positioned as western Canada's largest private land management company. The company owns approximately 322,000 hectares (796,000 acres) of private land on Vancouver Island. Approximately 54,000 hectares (17% of the land base) have been identified as having greater value as real estate properties and will progressively be made available for higher uses over the next 10 to 15 years. In July 2009, Timberwest announced its intention to divest up to four discrete timberland properties on Vancouver Island, including in the Beauforts and China Creek areas (Timberwest, www.timberwest.com, accessed Dec. 14, 2009).

4.9.4 Forest industry views

Timberwest, South Island Forest District, Private Managed Forest Land Council, Western Forest Products, Island Timberlands, and the Ministry of Forests and Range were asked about their plans for the Alberni Valley watersheds.

Island Timberlands and Timberwest were asked for input in December 2009. The questionnaire they received was similar to the questionnaire sent in April 2010 to the Private Managed Forest Land Council, South Island Forest District, Western Forest Products, and the Ministry of Forests and Range.

Following are the survey questions and Timberwest's responses:
(Note: all of Timberwest's responses were made by Sue Handel on February 18, 2010 on behalf of Timberwest.)

1. Are there Drinking Water Protection Plans in place for the watersheds of Alberni Clayoquot, Areas B, D, E, F and China Creek/Bainbridge Lake/Lizard Lake to ensure an ecologically sustainable drinking water resource for the residents of these areas?

   Response: Drinking Water Protection Plans, implemented through the Drinking Water Protection Act, are used if there is an imminent threat to drinking water and no other existing legal mechanism is available to correct the threat.

   No formally ordered drinking water protection plans exist in British Columbia because there are several other legislative mechanisms to protect water. Additionally, drinking water protection plans are not related to ecological planning activities. Ecological planning and sustainable forest management fall to many other pieces of legislation, including professional statutes. Timberwest also voluntarily combines many aspects of its certification program requirements with additional corporate policies to plan activities that are ecologically sensitive and contribute to maintaining water quality within its natural range.

2. What measures are taken to ensure drinking water quality when conducting forestry activity (i.e., logging, fertilisation, and invasive plant species control) within a watershed used as a drinking water source?

   Response: Visit www.timberwest.com.

3. What measures are taken to ensure drinking water quality when conducting forestry activity (i.e., logging, fertilisation, and invasive plant species control) on karst terrain within a watershed used as a drinking water source?

   Response: A major component of the watershed review program outlined in the attached brochure is management of terrain stability. Bedrock types and terrain mapping, completed across all of our land, informs professionals of possible consequences of proposed activities before final plans are made. All crews conducting the activities are trained on our Environmental Management System (ISO 14001-EMS) as well as our SFI Sustainable Forest Management certification. Both of these voluntary certification programs cover all of our lands and are additional to any legal requirements.

4. What should be expected from Timberwest by the community if Timberwest's activity in the watershed interferes with quantity and quality of drinking water?

Response: Any person or entity (e.g., a company) that disrupts another person's licensed water supply would have to restore it, just like if you disrupted your neighbour's water supply.

5. After Timberwest's activity in the watershed has ceased, how long is Timberwest responsible for the ensured water quality and quantity to the residents who are dependent on the drinking water sources in that watershed?

   Response: Timberwest owns the forest lands it manages in the Alberni Valley and has ongoing processes in place to ensure its practices do not materially alter the quantity and quality of drinking water beyond natural values.

6. Whose responsibility is it to ensure aquifer water quality and quantity on Timberwest's property?

   Response: Timberwest is responsible to ensure its activities on its properties do not materially alter aquifer water quantity and quality on its properties.

7. What is the view of Timberwest having the watersheds that serve Area B, C, E, F, and the City of Port Alberni expropriated for drinking water protection?

   Response: Timberwest invites anyone to contact us with possible interest in acquiring our land for preservation instead of our current sustainable forest management. Please visit www.timberwest.com for more information.

8. If the general public has concerns about forestry activity by Timberwest adversely affecting their drinking water supply, who should they contact and what should they expect in response?

   Response: Visit www.timberwest.com.

Following is Island Timberland's response:

Island Timberlands did not answer the specific questions of the questionnaire; instead, their response was submitted as follows:

> Island Timberlands maintains its land and conducts forest management activities in accordance with applicable Federal and Provincial regulation and forest management standards set by the Sustainable Forestry Initiative. Referencing and understanding these laws and standard will answer your questions. There are many regulations private managed forest land owners must adhere to related to the protection of water quality (Mackenzie Leine, Manager of Sustainability and Community Affairs, personal communication Dec 17, 2009).
>
> The following statutes and associated regulations would be a logical starting point:
>
> - Private Managed Forest Land Act
> - Fisheries Act
> - Water Act
> - Integrated Pest Management Act
> - Forester's Act

You can find the Sustainable Forestry Initiative 2005-2009 Standard at www.sfiprogram.org, reference Objective 3 (Mackenzie Leine, personal communication Dec 17, 2009).

In addition to our regulatory and certification requirements, Island Timberlands conducts voluntary watershed assessments. A part of this process is working closely with stakeholders, Registered Professional Biologists, engineers, and foresters with extensive experience in watershed-related studies to gain an understanding of the system (Mackenzie Leine, personal communication Dec 17, 2009).

In conjunction with the assessment and regular business practice, we work with local government, provincial government, water purveyors, and enhancement groups on communications, strategies, and initiatives associated with water quality. We would encourage your organisation (s) to coordinate with initiatives already underway (Mackenzie Leine, personal communication Dec 17, 2009).

Following is the Private Managed Forest Land Council's response:

I am not in a position to answer the questions as they touch outside the responsibility of the Private Managed Forest Land Council (PMFLC). The Council is an independent provincial agency mandated to regulate the forestry practices of private owners on their land. As such, it does not have involvement in designation of Community Watersheds and administration of water licences, or the setting of water quality objectives. The Council is not involved in the monitoring of water quality or in the preparation of watershed or hydrological impact studies. The topics outlined in your questionnaire would most likely be within the mandate of the Ministry of Environment, Water Stewardship Division (PMFLC, Macpherson, personal communication, April 26, 2010).

There are sections in the Private Managed Forest Land Council Regulations that require a private forest landowner to protect licensed waterworks intakes and to take mitigation action if their activities cause a reduction in water quality for a holder of a licensed waterworks intake. In the circumstance where there may have been an impact, we work closely with VIHA and the Ministry of Environment and, depending on the nature of the problem, decide who would the lead role from a regulatory viewpoint (Macpherson, personal communication, April 26, 2010).

Following is the Ministry of Forest and Range's (MFR) response:

Your questions cover a wide range of topics, and the Ministry of Forests and Range has no input or jurisdiction for many of them. For instance, MFR has no jurisdiction over private land. MFR does not designate Community Watersheds. Other questions are purely legislative and can easily be looked up on government internet pages. Still other questions are better answered by someone with local knowledge. I would suggest contacting the South Island Forest District for those questions relating to MFR (Ministry of Forest and Range, Dunkley, April 9, 2010).

Following is South Island Forest District's (DSI) response:

The majority of questions are beyond the scope and mandate of the Ministry of Forests and Range. The Ministry of Environment is the best source of information for technical details

related to domestic water management, regulation, and administration (South Island Forest District, Richir, personal communication, May 27, 2010).

I can provide information for the following questions:

e) Was the South Island Forest District aware that when the land was taken out of TFL 44 (Forest and Range Practices Act Regulation) and placed under Private Managed Forest Regulations it could pose a threat to drinking water quality and quantity for the residents of Area F?

> No. The District was not aware of the existence of any potential threat to drinking water posed by the withdrawal of private land from TFL 44. The process to remove private land was not conducted by the District (Richir, personal communication, May 27, 2010).

k) Have any studies been conducted by the South Island Forest District in relation to source protection and climate change for this District?

> The District has not conducted any studies of this nature as the subject matter is beyond the scope and mandate of the Ministry of Forests and Range. We are not aware of any such work by any other agency (Richir, personal communication, May 27, 2010).

Following is Western Forest Products response:

Western Forest Products did not respond.

4.9.5 Privatisation

Maude Barlow, National Chairperson of the Council of Canadians and former advisor to the United Nations 2009, says there is no better example of a "runaway market engine" than the corporate cartel now being created to own and profit from water. Private sector interest in the world's dwindling water resources has been building for two decades and has dramatically increased in recent years. Transnational corporations view water as a saleable and tradable commodity, not a Commons, and are set to create a cartel resembling the one that now controls every facet of energy, from exploration to production to distribution (Barlow 2009).

Private, for–profit water companies now provide municipal water services in many parts of the world; put massive amounts of fresh water in bottles for sale; control vast quantities of water used in industrial farming, mining, energy production, computers, cars, and other water-intensive industries; own and operate many of the dams, pipelines, nanotechnology, water purification systems and desalination plants [because] governments are looking to the technological panacea to water shortages; provide infrastructure technologies to replace old municipal water systems; control the virtual trade in water; buy up groundwater rights and whole watersheds in order to own large quantities of water stock; and trade in shares in an industry set to increase its profits dramatically in the coming years (Barlow 2009).

A major player in the promotion of a private water services model has been the World Water Council (WWC), formed in 1997 by the World Bank, the big water transnationals, the United Nations and the development agencies of a number of wealthy countries. WWC members have been dubbed "the lords of water" for their powerful role in promoting a private water model to governments that attend the WWC's huge World Water Forums held every three years (Barlow 2009).

However, the privatisation of water services has been a terrible failure in almost every community where it has been tried, and it is far from certain that privatisation of the water Commons will accelerate at the same rate. Water commodification has left a legacy of corruption, sky-high water rates, cut-offs of water to millions of people, reduced water quality, nepotism, pollution, worker lay-offs and broken promises (Barlow 2009).

Perhaps there is no better example of the enclosure of the water Commons than bottled water. Humans take free flowing water from its natural state, put it in plastic bottles and sell it to one another at exorbitant prices. In the early 1970s, about one billion litres of bottled water were sold globally. In 2007, more than 200 billion litres (50 billion gallons) were consumed, and the bottled water industry is growing at over 10 percent a year. Because bottled water costs anywhere from 240 to 10,000 times more than tap water, depending on the brand, profits are very high in this sector (Barlow 2009).

A more recent form of water Commons enclosure is the practice of relying on high technology solutions to the global water crisis instead of protecting the source waters of the water Commons. Far more attention is being paid (and billions of dollars annually invested) in cleaning up dirty water using expensive high water-reuse technology, than in stopping pollution and the destruction of the water Commons itself (Barlow 2009).

There are very serious questions to be asked about this industry, not the least of which is: Who will own the water these large corporations clean? No doubt the companies think they own it. Who is to say differently? (Barlow 2009).

There are three major problems with the abandonment of water as a Commons and the adoption of water as a commodity:

1. There is no incentive to conserve water or stop water pollution.

   Even if individual corporate leaders do not take pleasure in the global water crisis, it is exactly this crisis that is driving profits in their industry (Barlow 2009).

   Further, with governments, industries, and universities investing so heavily in the burgeoning water clean-up technology industry, there is less and less incentive at every level to emphasise source protection and conservation. Once a massive and expensive clean-up industry is in place, economic and political pressure will come to bear on governments and global institutions to protect it. Technology, controlled by corporations, will drive policy (Barlow 2009). As high quality sources of water become depleted, municipalities are increasingly using lower quality source water requiring more treatment. However, depending on the causes of lower source water quality, this approach may increase human health risk in drinking water supply by increased reliance on technology and safe operation in drinking water supply. Equipment and/or operator failures may lead to serious consequences (O'Connor 2002 in Marsalek et al. 2004).

   Another shortcoming of using lower quality source water arises because more complex treatment systems tend to consume more water in the treatment process, mostly in the form of wastewater and sludge products in various treatment processes (Marsalek et al. 2004).

2. The second major concern around the commodification of water is that with no regulatory oversight or government control, there will be no protections for the natural world, and a need to safeguard integrated ecosystems from water plundering (Barlow 2009).
3. The commodification of water has the result that water, and water infrastructure – from drinking water and sanitation utilities services, to bottled water, clean-up technologies and nuclear-powered desalination plants – will flow where the money is, not where it is needed. No corporation is in business to deliver water to the poor (Barlow 2009).

Public-Private Partnerships (P3s)

Public-Private Partnerships (P3s) are spreading across Canada. Yet the international and domestic evidence shows that the claims of P3 proponents deserve close and careful scrutiny (Mehra, Ontario Health Coalition, 2005). Given how often privatised water systems have failed across Canada and been rejected by B.C. communities, it's amazing that proposals to privatise water still come forward (CUPE 2005). P3s have proven time and time again to result in higher costs, reduced accountability, increased risks for the public partner, construction delays, lower quality, and higher fees (CUPE 2008).

While P3 proponents claim that projects come in "on time" and "in budget," the evidence does not bear out these assertions. Many projects are late and serious cost overruns are frequent. The bifurcation of management or ownership of public services entailed in these deals leads to serious conflicts of interest between corporations that seek to maximise profits and public services that seek to meet community needs and contain budgets, leading to costly legal disputes and quality issues. Moreover, in the negotiation of P3 deals, the public sector has not been able to achieve P3 proponents' claims of value for money or risk transfer (Mehra, Ontario Health Coalition, 2005).

P3s have also increased inequality, boosting salaries for executives and remuneration for expensive consultants and lawyers while decreasing pay and working conditions and reducing access to services (Mehra, Ontario Health Coalition, 2005).

Democratic control has been sacrificed to commercial secrecy and private for-profit management. High costs have led to service cuts and diminished access. Long term commitment of large revenue streams to lease deals has an unmeasured impact on government flexibility and public policy decision making (Mehra, Ontario Health Coalition, 2005).

A list of P3s gone wrong known as the "The Horrid 100," identified the City of Port Alberni as one its contenders (CUPE 2008).

4.9.6 Lack of local knowledge to manage resource

When asked specific questions concerning water resource protection in the Alberni Valley, the Ministry of Forests and Range told us that our questions are best answered with local knowledge (Ministry of Forests and Range, Dunkley, April 9, 2010).

However, the Ministry of Environment says it is taking a "wholistic approach" to drinking water source protection in the Alberni Valley (Ministry of Environment, Source Protection, Epps, personal communication, April, 13, 2010).

When VIHA (under the Ministry of Health Services) was asked specific questions about water resource protection in the Alberni Valley (see section 3.6.3), it was evident VIHA is also taking a wholistic approach (VIHA, Magee, Feb 18, 2010).

Do the responses of these authorities—"taking a wholistic approach"—equate to lack of knowledge about the specific characteristics of water resources in the Alberni Valley? Quite possibly.

An example of this lack of local knowledge concerns karst. On May 26, 2010, the Ministry of Environment Geomorphologist R. Guthrie said that he is not aware of much karst in the Beaufort Range. He said that karst identification in the form of maps for the area is woefully inadequate. He went on to say that looking into karst in the Beauforts is not a good use of resources (meaning time and money). However, he said that, with a karst system, what is occurring is largely underground, and that is what needs to be protected.

A second example is the perceived effects of agriculture. On May 26, 2010, the Ministry of Environment Geomorphologist R. Guthrie and Source Protection Officer B. Epps (personal communications, April 13, 2010) said that agriculture is a major contributor to water issues in the Alberni Valley. However, according to the Ministry of Agriculture and Lands, there is very little agriculture in the Alberni Valley. The Ministry has not received any calls concerning water contamination as a result of agricultural activity in the Alberni Valley. It is recommended, if there is a concern, to do a source point test to identify the contaminant (Ministry of Agriculture and Lands, Hatfield, personal communication July 9, 2010).

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Part 5 Recommendations and Local Concerns

5.0 Introduction

Part 5 is based on the data collected for this project and presents recommendations for water-management.

Throughout the course of our research, it became apparent that there are five obvious challenges to water management in British Columbia:

1. lack of accountability
2. legislative continuity
3. lack of adequate regulation and enforcement
4. lack of funding for maintenance and upgrading of existing systems
5. unsustainable water use

The breadth of jurisdictions with responsibility for water-management established during the development of Canada has led to a water-management structure that includes local governments, seven provincial ministries, and numerous federal departments. In addition, there are a growing number of non-governmental organizations, streamkeeper groups, labour representatives, and coalitions that have formed that have a focus on watersheds and/or drinking water quality.

Shifting government ministries and responsibilities along with amendments to legislation create an atmosphere of uncertainty that leaves the public unable to clearly identify who is accountable to Canadians for the provision of clean and adequate drinking water. As legislation and ministries change, or are inadequately prepared to solve issues at hand, it becomes difficult to monitor when a violation occurs and who is responsible for enforcing the regulation.

The current provincial results-based approach to the enforcement of legislation allows for the self-monitoring of regulations, which means that those who are supposed to be limited by an Act are also left to enforce it (Jenssen 2007).

Water management needs to engage the entire community. The objective of this report has been to provide a synthesis of water-management legislation and drinking water supply systems in the Alberni Valley. The report included discussion about factors such as karst, forestry, climate change, air quality, agriculture, food- water connection, and watershed real estate, as it pertains to the Alberni Valley.

5.1 Recommendations

Recommendations and rationales pertaining to the improvement of water-management in the province, and in particular in the Alberni Valley, are discussed in the following order:

Recommendation 1	Adopt water as a human right.
Recommendation 2	Create a "Ministry of Water" and regional advisory panels, and restore the role of improvement districts.
Recommendation 3	Form a public, local, ecologically informed water management team.
Recommendation 4	Make long-term infrastructure maintenance mandatory.
Recommendation 5	Establish long-term distinct legislation for Community Watersheds, including mandatory watershed protection.
Recommendation 6	Adopt new water usage values.
Recommendation 7	Adopt a standardised language in relation to water and watersheds.
Recommendation 8	Fully document the ecology, geology, and hydrogeology of the Alberni Valley.
Recommendation 9	Conduct a public review of the Ministry of Environment's draft plan "Interim Guidelines and Procedures on the Designation, Amendment and Cancellation of Community Watersheds under the Forest and Range Practices Act," Appendix 2, Section 2 (a) (ii) and Section 3.
Recommendation 10	Conduct (and publish) research on the effects of water treatment methods on human health and the environment.
Recommendation 11	Legislate (and enforce) complete protection of karst drinking water sources.
Recommendation 12	Permanently establish Real Time Flow and Snow Pack stations in Alberni Valley watersheds in order to obtain data for drinking water resource management.
Recommendation 13	Include the water-food connection in water resource management.
Recommendation 14	Enact zoning bylaws with a "water-centric" approach.
Recommendation 15	Set enforceable water quality objectives for all Community Watersheds on a local basis.
Recommendation 16a	Require the Ministry of Agriculture to create, adopt, and enforce legislation that protects drinking water in rural areas and be proactive in public education for managing farming activities around water on farms, including hobby farms.
Recommendation 16b	Conduct point source testing of streams that contribute to drinking water sources in agricultural areas.
Recommendation 17	Launch a public education campaign on comprehensive watershed protection in the Alberni Valley.

Recommendation 18	Adopt a format for water bills to reflect actual water usage in litres per person per day as compared to BC and Canadian seasonal averages.
Recommendation 19	Conduct research on the value and environmental impacts of rainwater harvesting.
Recommendation #20	Re-establish public service values and practices within the public service.

5.2 Discussion of Recommendations

Recommendation 1

Adopt water as a human right.

On 28 July 2010, the United Nations General Assembly declared safe and clean drinking water and sanitation a human right essential to the full enjoyment of life and all other human rights (http://www.who.int/water_sanitation_health/recognition_safe_clean_water/en/index.html; accessed 26 February 2011).

Human rights are protected by internationally guaranteed standards that ensure the fundamental freedoms and dignity of individuals and communities. Human rights principally concern the relationship between the individual and the State. Governmental obligations with regard to human rights are (World Health Organisation [WHO] 2002):

Respect: The obligation to respect requires that States Parties (that is, governments ratifying the treaty) refrain from interfering directly or indirectly with the enjoyment of the right to water.

Protect: The obligation to protect requires that States Parties prevent third parties, such as corporations from interfering in any way with the enjoyment of the right to water.

Fulfil: The obligation to fulfil requires that States Parties adopt the necessary measures to achieve the full realisation of the right to water.

Regardless of their available resources, all States Parties have an immediate obligation to ensure that the minimum essential level of a right is realised. In the case of water, this minimal level includes ensuring people's access to enough water to prevent dehydration and disease.

This means paying attention to these rights also in processes, ensuring the right of beneficiaries to participate in decision-making that affects them, and guaranteeing transparency so that individuals have access to information and are able to understand, interpret, and act on the information available to them.

A central feature of a rights-based approach is the notion of accountability, which, in practice, requires the development of adequate laws, policies, institutions, administrative procedures and practices, and mechanisms of redress. This calls for the translation of the internationally recognised right to water into locally determined benchmarks for measuring progress, thereby enhancing accountability.

> A rights-based approach may deliver more sustainable solutions because decisions are focused on what communities and individuals require, understand, and can manage, rather than on what external agencies deem is needed.
>
> The duty to protect requires that governments should diligently take all the necessary feasible steps to prevent others from interfering with the right to water. This will usually require a strong regulatory regime that is consistent with other human rights. The Committee on Economic, Social, and Cultural Rights has stated that this should include independent monitoring, genuine public participation, and imposition of penalties for non-compliance with standards. Comprehensive regulatory measures will be needed with respect to pollution, disconnection of water supplies, land use, and access to water supplies.
>
> States Parties should adopt comprehensive and integrated strategies and programs to ensure that there is sufficient and safe water for present and future generations. Such strategies and programs may include, for example, reducing depletion of water resources, reducing and eliminating contamination of watersheds and water-related ecosystems, increasing the efficient use of water by end users, and reducing water wastage in its distribution.
>
> Countries also have international obligations to cooperate with other States to ensure that the right to water is achieved everywhere. States Parties should ensure that the right to water is given due attention in international agreements.

Local governments are often at the front line in providing water and sanitation services. They are frequently given responsibility by national governments to ensure access to these services, as well as the power to determine who receives the services and under what conditions. The World Health Organisation's General Comment 15 on the right to water states that national governments must ensure that local authorities "have at their disposal sufficient resources to maintain and extend the necessary water services and facilities."

However, local authorities must also respect the right to water of everyone in their jurisdiction and the General Comment says that "States Parties must further ensure that such authorities do not deny access to services on a discriminatory basis."

The United Nations General Assembly overwhelmingly agreed to a resolution declaring the human right to "safe and clean drinking water and sanitation" on July 28, 2010. The resolution, presented by the Bolivian government, had 122 countries vote in its favour, while 41 countries—including Canada—abstained (Council of Canadians eNewsletter and Action Alerts, July 30, 2010).

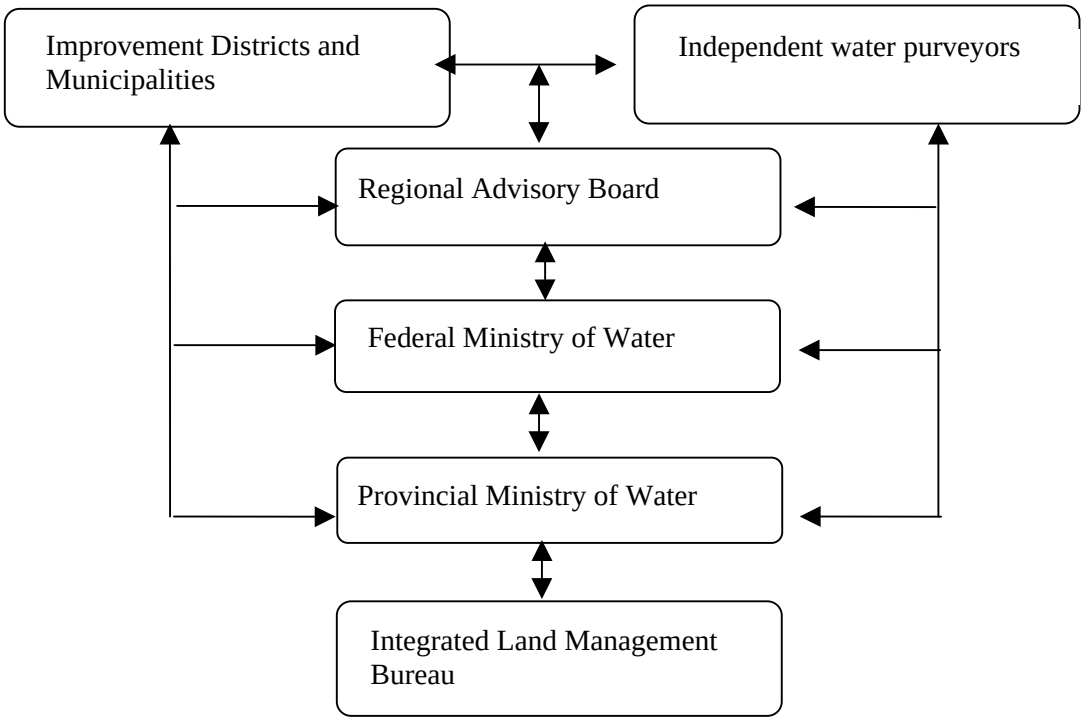
While Canada abstained from that critical vote, Meera Karunananthan, National Water Campaigner for the Council of Canadians, said it does not mean our country can sit idly by. It is crucial now that communities in Canada use this opportunity to hold our government accountable to the international commitment to recognise water and sanitation as human rights. We must demand legislation at home to ensure that these rights are enjoyed by all peoples of Canada without discrimination. It is time for Canada to do something about the deplorable condition on First Nations reserves that have lacked access to safe drinking water and adequate sanitation for generations (Council of Canadians July 30, 2010).

Recommendation 2

Create a "Ministry of Water" and regional advisory panels, and restore the role of improvement districts.

A Ministry of Water would adopt water as a human right (see Figure 35 for proposed model). This ministry would be a federal body and the lead agency pertaining to all issues concerning drinking water. Its primary purpose would be the protection of drinking water. It would operate with a generational focus, not a political one. Its objective would be to ensure drinking water is kept in public trust forever through legislating watershed protection.

Figure 35. Model for a proposed Ministry of Water



A Ministry of Water would integrate all the fragmented pieces of water governance into one jurisdiction. Although, currently, seven provincial ministries work together on committees, the accountability to protect drinking water is made more difficult when the responsibilities are scattered among so many different ministries.

A functioning regional water advisory panel would have a broad representation of all local water user groups. The advisory panel would be comprised of representatives from improvement districts and independent water purveyors, all with an extensive local knowledge of their watershed and water system operations.

A regional water advisory panel would form a SAC (Single Advisory Committee) requiring 20 people on the committee and would include 10 members from the public. The SAC group must be truly representative of the interests of all stakeholders. To fulfil the roles of the SAC, the following criteria must be required:

- Develop selection criteria and job descriptions for SAC.
- Create an application format.
- Share the names of applicants with staff and elected officials.
- Meet with each applicant.
- Design a successful process for community-based input in environmental planning decisions.
- The process must be complete and meaningful.
- There must be timely and consistent two-way communication.
- There must be serious consideration of all stakeholders.
- Residents must be educated (focus groups) before being consulted (survey).
- Provide project updates at each milestone.
- Produce a newsletter connected to the mail-in survey (80% of people came with newsletters in hand to the public meeting).
- Hold an open house with sufficient free time to view all displays as well as hear any formal presentations (J. De Vries, G. Holte 2009).
- Restore the role of improvement districts.

Improvement districts are the most localised form of government to purvey water; the districts are funded by local property taxes and water billing.

In 1979, the legislative provisions relating to improvement districts were removed from the Water Act and responsibility for all improvement districts was transferred from the Ministry of Environment to the Ministry of Municipal Affairs [now the Ministry of Community, Sport and Cultural Development (MCSCD)]. From 1979-1989, the focus of the Ministry of Municipal Affairs was on creating a strong foundation for regional district government in the province (Ministry of Community Services 2006).

In 1989, the report of the Task Force on Rural Services and Governance proposed that improvement districts would continue, but ministry efforts would be focused on reinforcing the role of regional districts as the primary local government for rural areas. The report was never published, nor did it receive widespread media attention. However, the report had a significant impact on ministry decision making. In fact, the ministry has followed the Task Force's recommendations since 1989, discouraging the creation or expansion of improvement districts and encouraging the use of regional districts as the primary rural area servicing vehicle. Also as a consequence of the report, the management responsibility of the Ministry of Municipal Affairs was reshaped to reflect a similar management strategy as used by all other local governments. Emphasis was placed on providing advice, direction, and assistance to maintain the viability of improvement districts in the province (Ministry of Community Services 2006).

The "vision of the Ministry of Municipal Affairs is to encourage the conversion of improvement districts to regional district service areas. Consistent with that direction, it is important to maintain the existing financial incentives for conversion. Specifically, the ministry will restrict water infrastructure grants to regional district service and municipalities" (Ministry of Community Services 2006).

Recommendation 3

Form a public, local, ecologically informed water management team.

To be successful, this would include the following actions:

1. Form a Water Watch Coalition for the Alberni Valley

The City of Port Alberni has signed up to pilot a water conservation project that is uniquely linked to infrastructure grants. The POLIS Project on Ecological Governance through the University of Victoria is a tool designed to bring all relevant stakeholders to the table to facilitate the creation of an integrated water management plan on a local level. The ACRD ought to be the facilitator of this project in the Valley so as to represent the interests of all local stakeholders. However, at present, this is not possible because the ACRD does not have staff to facilitate this water-centric planning.

An expanded definition of urban water infrastructure is needed, one that goes beyond the existing physical infrastructure of pipes, pumps, and reservoirs. This new infrastructure includes innovative physical components, water-sensitive urban design, and conservation programs designed to complement existing water supply networks. It emphasises decentralised technologies and lasting local programs that inspire behavioural change. Most importantly, this new infrastructure relies heavily on building and maintaining social infrastructure: the planning processes, education programs, and financial and human resources needed to liberate the full potential of water efficiency and conservation and to foster sustainable water use at the community level (Brandes 2006). A water watch coalition would ensure that these needs are met.

2. Promote public participation in local drinking water management.

Community-based conservation planning promotes the involvement of local communities in order to decentralise decision making, draw on local knowledge, and foster residents' interest in conservation plans (Larson & Lach 2008).

Watershed councils have emerged with the shift from top-down, command-and-control public policies toward bottom-up and grassroots management approaches. Place-based groups are well-positioned to empower residents to undertake and participate in resource protection (Larson & Lach 2008).

3. Encourage public ownership of water resources and delivery systems

Private, for-profit water companies now provide municipal water services in many parts of the world; put massive amounts of fresh water into bottles to sell; control vast quantities of water used in industrial farming, mining, energy production, and manufacturing computers, cars, and other water-intensive industries; own and operate many of the dams, pipelines, nanotechnology, water purification systems, and desalination plants that governments are looking to for the technological panacea to water shortages; provide infrastructure technologies to replace old municipal water systems; control the virtual trade in water; buy up groundwater rights and whole watersheds in order to own large quantities of water stock; and trade in shares in an industry set to increase its profits dramatically in the coming years (Barlow 2007).

However, the privatisation of water services has been a terrible failure in almost every community where it has been tried, and it is far from certain that privatisation of the water Commons will accelerate at the same rate. Water commodification has left a legacy of corruption, sky-high water rates, cut-offs of water to millions of people, reduced water quality, nepotism, pollution, worker lay-offs, and broken promises (Barlow 2007).

4. **Ensure arm's length relationship between those responsible for water stewardship and the dominant industry in the area.**
5. **Ensure all board/trustees volunteers rotate positions and use a democratic process of governance.**
6. **Adopt a process whereby all water board/trustees volunteers apply for service position with applications, followed by an interview and follow up reference checks.**

Recommendation 4

Make long-term infrastructure planning and maintenance mandatory.

The Alberni Valley Regional Water Study may well not be enough to convince the Ministry of Community, Sport and Cultural Development that the Alberni Valley is serious about water conservation, and would, therefore, qualify for infrastructure grants (Edwards and Wright, BCWWA Annual Conference 2009). Grant programs are geared to the following:

- create leverage to promote long-term planning
- promote sustainable development
- promote integration
- promote water conservation

The cost of water must increase. At present, the average cost is $22.75 per month. It must increase to $75.00 per month to meet Canadian Drinking Water Standards (Johnson, BCWWA Conference 2009, presenter abstract).

Municipalities build, own, and maintain the majority of Canada's infrastructure—infrastructure that supports our economy and quality of life. During the past 20 years, Canadian municipalities have been strangled by increasing responsibilities and reduced transfer payments from other levels of government. Lack of funding has had direct and negative consequences for Canada's infrastructure. Unlike other levels of government, municipalities are not allowed to run deficits on their operating budgets. Lack of funding, in turn, has put tremendous pressure on municipal capital budgets, delaying capital investments. This has fuelled the growth of a substantial deficit in national municipal infrastructure (Saeed 2007). According to Saeed (2007) "if the federal government launches a new $4.5 billion to repair aging water infrastructure, there will be a short-fall because municipalities have estimated they need about $31 billion in public investments to bring water and waste water infrastructure back up to acceptable levels."

The National Benchmarking Initiative compared operational requirements and costs for water delivery between BC and the Canadian average. They found that BC's average was considerably lower than the Canadian average in operating costs and maintenance charges. However, BC's costs for cleaning of mains pipes, turbidity, and water usage was higher than the Canadian

average. Recommendations put forward from the Benchmarking Initiative (Main & Dallaire 2009) are:

- Water rates are too cheap.
- Changes must be made in the value of water.
- Universal metering is required.
- Sustainable water use is necessary.
- Environment must be protected to minimise environmental impacts.
- Water infrastructure planning needs to include 166-250 year's renewal plans.
- Performance measurements (PM) add context to issues.
- Start dealing with facts supported with numbers.
- Get away from anecdotal examples.
- PM allows stakeholders to provide quality input.

Recommendation 5

Establish long-term, distinct legislation for Community Watersheds, including mandatory watershed protection.

British Columbia is a unique province in that 86% of the population uses surface water as its drinking water supply. Most Community Watersheds in BC are quite small in area. A small watershed area usually means the intake is close to potential contaminants, stream response times are short, and opportunities for dilution or settling are small. Therefore, these watersheds are sensitive, and the application of Community Watershed Guidelines are essential to maintain water quality and quantity (Ministry of Forests 1996).

The Alberni Valley has four Designated Community Watersheds, which are also listed as Watershed Reserves. The City of Port Alberni has two Community Forests located within the boundaries of one watershed.

Refer back to section 3.6.5 for the history of Watershed Reserves and background information on Community Watersheds, TFL44 lands, and Private Managed Forest Lands.

Community Watershed Models

Surface water comes with inherent risks from wildlife and other naturally occurring hazards. The source-to-tap management model is intended to monitor water quality from source to treatment to storage to distribution. However, on privately owned lands, there could be problems for this approach. There is no provincial legislation to prohibit human activity on land surrounding Community Watersheds. Nonetheless, the drinking water sources for Victoria and Vancouver are located in fairly remote closed Community Watersheds. There is no public access other than on annual guided watershed tours (Jenssen 2007).

Establishing closed Community Watersheds in the Alberni Valley would require land transfers from private land owners to municipal water purveyors, full participation of all land holders, and provincial legislation or municipal bylaws that would limit access and activities in Community Watersheds as legally binding.

There are a few options for Community Watersheds. A community-managed watershed philosophy, backed by provincial legislation that actually monitors and enforces the legislation, was one suggestion. Unfortunately, the ability to adequately and properly enforce legislation does not exist in the province; this would require the financial means to hire monitoring and enforcement personnel. As of the time of writing this report, the current provincial Liberal government has not earmarked funds for this purpose (Jenssen 2007).

A softer version of the Community Watershed model is to limit access to the watershed and support public education programs that promote an understanding that a Community Watershed is a drinking water source needing protection. Health risks in unprotected watersheds are considered to be greater than those in protected watersheds (Davies and Mazumder 2003).

Local zoning bylaws could establish the type of planning and development that occurs in a watershed, while provincial legislation could limit activities through watershed protection plans (Jenssen 2007).

Community protection of watersheds could also be established through municipal purchase of the land surrounding the watershed or by the donation of large landholders to the local communities. This is currently underway in some areas. In Ladysmith, for example, the Council is buying land surrounding their community watershed from Timberwest (Jenssen 2007).

Legislate mandatory watershed protection and planning

BC lags behind other provinces in terms of legislated watershed planning. Entrenched watershed management plans exist in Ontario and Manitoba, but in BC, there is no policy to support mandatory watershed management plans and no funds allocated to support planning processes (Jenssen 2007).

Watershed protection plans are not required for drinking watersheds. Some barriers to achieving a sound water plan include the apparent philosophy of our current provincial government in that they are not allocating funds for this purpose, citing the high cost of planning processes and the continued importance they seem to place on the economy over the environment (Jenssen 2007).

To date, the Alberni Valley has not been nominated for a drinking water protection plan by VIHA. In correspondence with VIHA concerning watershed protection, the response reads as follows (VIHA, Magee, personal communication, Feb 18, 2010): “A Drinking Water Protection Plan is intended to address a drinking water health hazard. The need for a Drinking Water Protection Plan has not been identified for the Alberni Valley.”

There are sections in the Private Managed Forest Land Council regulations that require a private forest landowner to protect licensed waterworks intakes and to take mitigation action if their activities cause a reduction in water quality for a holder of a licensed waterworks intake. In the circumstance where there may have been an impact, we work closely with VIHA and the Ministry of Environment and, depending on the nature of the problem, decide who would take the lead role from a regulatory viewpoint (Macpherson, personal communication, April 26, 2010).

Recommendation 6

Adopt new water usage values.

The current Supply Management model's traditional response to water scarcity is simply to develop more supply. Unfortunately, this response has many adverse consequences for our environment. Rivers that used to run free are now sluggish; water tables are sinking; and natural habitat is disappearing. The promise of a safe, abundant supply of fresh water can no longer be guaranteed (Brandes & Brooks 2007).

Demand management of water usage recognises limits and searches for cost-effective measures to cut water use. Common demand management measures include volume-based pricing, low-flow faucets and toilets, drip irrigation, and recycling and reuse (Brandes & Brooks 2007).

The Soft Path strives for efficiency in water use, but goes beyond efficiency by fundamentally challenging today's patterns of freshwater consumption. By focusing on "why" the soft path greatly increases the number of possible solutions (Brandes & Brooks 2007). The four principles of the Soft Path are:

1. Treat water as a service rather than an end in itself.
2. Make ecological sustainability a fundamental criterion.
3. Match the quality of water delivered to that needed by the end-use.
4. Plan from the future back to the present ("back casting").

Water soft paths depend on changing patterns of water use, the adoption of conservation attitudes, and building different water institutions and infrastructure. These changes require careful analysis, planning, public consultation, and strategic implementation (Brandes & Brooks 2007).

The Soft Path scenario promotes dry sanitation, extensive xeriscaping, widespread water re-use practices, and rainwater harvesting. It is projected that these practices would lead to an annual water use that is only half of the current summer use (Brandes & Brooks 2007).

Conservation-yellow lawns

Lawn sprinkling continues to be the largest user of water during the summer months, when rainfall is limited. Although restrictions on lawn sprinkling are in place in many communities in BC, roughly 50 percent of residents claim to not be aware of the days and times when they can water their lawns.

Community-based social marketing (CBSM) theory suggests that behavioural change is promoted by first learning what are the barriers to adopting change and then designing specific, responsive strategies that make it convenient and logical for people to adopt the change. CBSM techniques include door-to-door surveys, reminders, having residents pledge to conserve water, and an attempt to build a social norm through mild peer pressure (Bailey 2009).

Recommendation 7

Adopt a standardised language in relation to water and watersheds.

Consistency in usage of measurement units is required to make meaningful comparisons and conclusions from data provided by government departments and water utilities.

Recommendation 8

Fully document the ecology, geology, and hydrogeology of the Alberni Valley.

Well-documented information on the ecology, geology, and hydrogeology of the Alberni Valley is needed, both as a benchmark for monitoring the effects on drinking water sources caused by water usage, forestry activities, and climate change, but also as a baseline for land use planning.

The Ministry of Environment's geomorphologist concedes that karst maps are woefully inadequate for the Beauforts. The ministry says that, concerning karst in the Beauforts, "there probably is some, but we don't know" (Ministry of Environment, Guthrie, personal communication May 26, 2010). However the Ministry of Forests produced karst potential maps as early as 1996 that identified known major karst and caves including the Beauforts Carbonate Unit 76.

Local knowledge suggests that the complex geology of the Beaufort Range plays a major role in catchment, recharge, storage, and release of large quantities of groundwater that resurface as numerous springs from the Alberni Highway to the Ash River Valley. Field observations of karst terrain and features (including an unusual deposit of precipitated calcite in a surface stream), topographic and karst mapping, and chemical analysis of various creeks and water supplies strongly suggest that major karst drainage systems have developed in the limestone bedrock deposits. The VANISL 76 karst system appears to provides the primary recharge to Lacy Lake. Dye-tracing would eliminate the element of uncertainty. Chemical analysis, plus personal communication, topographic and karst mapping, indicate a hydrologic connection to calcareous deposit VANISL 129 for China Creek. Preliminary evidence suggests there are at least two major karst systems associated with VANISL 129 as well; one recharges Duck Lake, while the other recharges Lizard Lake (Robinson 2008).

Watershed Mapping

Obtaining comprehensive mapping information—even getting access to—private land to conduct data collection can prove to be difficult, especially with logging companies, as evidenced in the following paragraph:

> Timberwest denied our request for their forest harvesting plans in the Hal Creek Watershed and the surrounding area. A terrain mapping overview assessment has been completed for Hal Creek and the Timberwest private lands within MF 7, Beauforts, Port Alberni. Our request to view this map was not granted. Instead, we were provided with a derivative map from the terrain map, showing unstable and potentially unstable polygons, but not the criteria table used to prepare the map. We compared their map with our own air photograph interpretation, where practical (NHC 1999).

Access for conducting work, such as surveys, is also not permitted on Island Timberlands property without permission and appropriate safety and environmental certification, training, and clearance (Island Timberlands, personal communication, Dec 2009).

Groundwater Mapping:
The Vancouver Island University's Water Resources Vulnerability Mapping Project initiative has been going for a few years now. To date, they report they have mapped the intrinsic vulnerability of groundwater aquifers in the CVRD "Cowichan Valley" and RDN "Nanaimo" regions using the DRASTIC methodology of the US EPA. This mapping is now complete and will be released shortly (Gilchrist, VIU, personal communication, May 2009). The Alberni Valley is included in the maps from the head of the inlet (Clutesi Haven Marina) upstream 20km (based on where they have well data in the provincial WELLS Database). They further report (Gilchrist, VIU, personal communication, Jan 28, 2010):

> With government cutbacks last year, we are near the end of our funding and so the maps will be completed in the next couple of months and, after a technical review, will be available. Unfortunately, although there are about 300 wells in the WELLS database in the Alberni Valley, only about 25 are suitable for mapping the depth to water for a variety of reasons, for example, in some cases no water depth is reported in the database or the well is drilled below the uppermost aquifer (our concern in this study) into a lower aquifer. Depth to water is one of the key parameters we need to assess and if we're unable to, then we can't determine aquifer vulnerability. All of the data has now been collected and is being analysed and incorporated into the maps. It is anticipated that the final maps will be competed in spring 2010.

However the report is not comprehensive or representative of the Alberni Valley as it does not include high elevation karst aquifers. The objectives of the Vancouver Island Water Resource Vulnerability Mapping Project were not met in the Alberni Valley as there is no important data for the major water supplies (Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, personal communication, Oct 12, 2010).

Recommendation 9

> **Conduct a public review of the Ministry of Environment's draft plan "Interim Guidelines and Procedures on the Designation, Amendment, and Cancellation of Community Watersheds under the Forest and Range Practices Act," Appendix 2, Section 2(a) (ii) and Section 3.**

Under the Forest and Range Practices Act, the cumulative hydrological effects of primary forest activities within a community watershed resulting in (a) a material adverse impact on the quantity of water or the timing of the flow of the water from the waterworks, or (b) the water from the waterworks having a material adverse impact on human health that cannot be addressed by water treatment required under (i) an enactment, or (ii) the licence pertaining to the waterworks…are only applicable to the extent that enforcement, or stopping forestry activity to protect the drinking water source, does not unduly reduce the supply of timber from British Columbia's forests (BC Laws 2010). This Act makes source protection impossible.

Recommendation 10

Conduct (and publish) research on the effects of water treatment methods on human health and the environment.

Understanding pathogen ecology and identifying watershed sources remains a priority because of the associated acute risks. Surface water quality changes resulting from inputs of human and agricultural (livestock) waste, nutrients (fertilisers), and chemicals (e.g., pesticides and herbicides) are associated with higher drinking water risks.

Nutrient input can increase primary production. The resultant increase in organic matter results in greater disinfection by-product formation or requires greater treatment intensity. Many drinking water disease outbreaks have resulted from breaches in treatment facilities; therefore, even with greater treatment intensity, poor source water quality has greater associated health risks. Government and international agencies play a critical role in developing policy. The goal of maintaining water supplies whose availability is maximised and risks are minimised (i.e., sustainable) should be a vital part of such policy. A multi-barrier perspective is necessary for sustainability (Davies and Mazumder 2003).

Understanding the reasons for human disease outbreaks include knowing the human infectious dose of an organism required to produce a disease; knowing the morbidity (or mortality) associated with an infection of the organism; understanding how immunity develops within a population; knowing that if population immunity develops there is less likelihood of disease occurring; and understanding the lifecycles and ecology of human pathogens (Davies and Mazumder 2003).

The goal of water disinfection is to inactivate waterborne pathogens. Treatments primarily used are chlorine, ozonation, or ultra-violet radiation, with filtration used to remove particles prior to disinfection (Davies and Mazumder 2003).

All water purveyors contacted in this study use chlorine, which is the least expensive and most effective treatment for microbiolgical pathogens. Despite the benefits of disinfection, several pathogens are resistant to traditional chlorination processes. Two of these pathogens are Cryptosporidium and Giardia (Davies and Mazumder 2003).

The disinfectant reacts with organic compounds in water, producing secondary compounds known as disinfection by-products (DBPs) that may cause deleterious toxic, carcinogenic, or genotoxic effects. DBPs can stimulate bacterial growth in distribution systems, and objectionable taste and colour (Jenssen 2007).

The provincial government needs to take a wholistic perspective on water management that looks beyond whether or not microbes are present in the water source. The first line of defence in a multi-barrier approach is “watershed-based, locally organised source protection planning” (Justice O’Connor in de Loe and Kreutzwiser 2007).

With the current focus on the end product, achieving a quality drinking water is a consequence of water source, treatment, and distribution (Davies and Mazumder 2003).

One recommendation from the Ombudsman to VIHA is that a 5 NTU water safety limit be set. This is merely for administrative fairness and is not scientifically based (Ombudsman, June 2008, Special Report # 32).

No single source indicator for source water or unfiltered treated water is by itself a reliable criterion for issuing a water quality notice, unless there is an empirically demonstrated relationship between turbidity and microbial load for the specific system in question" (Ombudsman, June 2008, Special Report #32).

One of the proposed hypotheses was that aggregates and particulates could afford protection to microorganisms. While numerous papers have described the effects of aggregation, this still remains a question to be answered and remains an unproven hypothesis in terms of public health risk (Ombudsman, June 2008, Special Report # 32).

In relatively unpolluted source waters, turbidity is not an indicator of the presence of pathogens (Ombudsman, June 2008, Special Report # 32).

As high quality sources of water become depleted, municipalities are increasingly using lower quality source water requiring more treatment. However, depending on the causes of the lower source water quality, this approach may increase human health risk in drinking water supply by increased reliance on technology and safe operation in drinking water supply. Equipment and/or operator failures may lead to serious consequences (Marsalek et al. 2004).

Recommendation 11

Legislate (and enforce) complete protection of karst drinking water sources.

G.G. Runka's 1992 report to the Ministry of Forests titled "Stewardship of Cave and Karst Resources in British Columbia" advises against using problematic terms such as "significant" and "important" (Robinson, personal communication, Jan 2010).

The South Island Forest District Manager established a Government Actions Regulation (GAR) Resource Feature Order effective Jan 15, 2010. The Order identifies "important" and "significant" surface karst features including karst caves as resource features. The use of such terms without any well-defined definition may prove to be problematic with respect to enforcement. The Order doesn't remove karst lands from the district's forest inventory, but instead provides a measure of protection for specific karst resource features and related ecosystems. In addition, the Order does not apply to privately owned forest lands (Robinson, personal communication, Jan, 2010).

However, if the GAR order is effective in protecting key public environmental resource values (such as water sources) on public land, then it could be used as helpful tool (by setting boundaries) to enforce amendments by the Private Forest Land Management Council to the regulation for private forest land management (Robinson, personal communication, Jan, 2010).

Any, including isolated, outcropping carbonate bedrock exposure is of significant importance to local drinking water supply. That includes high and very high vulnerability karst terrain, not just the important or specific surface karst features within the epikarst zone (as the karst order may

suggest and Government Actions Regulation tests direct) (Robinson, personal communication, Jan, 2010).

Most registered professional scientists are not karst or cave experts; there are only a few in Canada. The government recognises only registered professionals (e.g., RPBio, RPF), but there are karst and cave experts who are not registered professionals that, over the years, have driven government agencies to protect karst systems and related resources (Robinson, personal communication, Jan 2010).

The GAR provides all Forest District Managers with the opportunity to protect "a surface or subsurface element of a karst system." So far, out of 26 forest districts in BC, only five protection orders have been issued since 2004. Most of those are on Vancouver Island (Robinson, personal communication, March 27, 2010).

Recommendation 12

Permanently establish Real Time Flow and Snow Pack stations in Alberni Valley watersheds in order to obtain data for drinking water resource management.

At present, there are two local rivers that have flow rates being monitored; Sproat River (08HB008) and Ash River (08HB023) below Moran Creek are still active stations. Station 08HB023 Ash River is a realtime station and you can see a graph of the water levels and discharges on our realtime website. The other 11 stations that were being monitored in the Valley have been closed, apparently due to funding cuts (Campo, Environment Canada, Water Survey Branch, personal communication, Jan 2010).

The snow surveys on Vancouver Island are very limited. The manual snow survey closest to Port Alberni was at Mount Cokeley (3B02A) (elevation 1267 metres at latitude 49' 14", longitude 124' 35"). There are no other snow measurements taken anywhere near [Port Alberni]. In 2010, the BC Ministry of Environment cancelled the Mt. Cokely snow survey (Chapman, Ministry of Environment, River Forecast Center, personal communication, Jan 2009).

Recommendation 13

Include the water-food connection in water resource management

Vast amounts of water are needed to produce food. At the personal level, we drink roughly four litres of water a day. It takes 2,000 litres of water—500 times as much—to produce the food we consume each day. Food production consumes 70% of the world water use for irrigation (Brown 2004).

Over much of the earth, the demand for water exceeds the sustainable yield of aquifers and rivers. Land productivity is measured in tons of grain per hectare, or bushels per acre, but there are no universally used indicators to measure and discuss water productivity. The indictor likely to emerge for irrigation water is kilograms of grain produced per ton of water. Worldwide, that average is now roughly 1 kilogram of grain per ton of water used (Brown 2004).

To protect drinking water resources, there are at least six considerations we need to make (Brown 2004) :

1. Raising Irrigation Efficiency

Among some of the more obvious steps are shifting to more water-efficient irrigation practices and technologies; planting more water-efficient crops; adopting more water-efficient industrial processes; and using more water-efficient household appliances. Recycling urban water supplies is another obvious step to consider.

2. Raising Diet Efficiency:

For people consuming excessive amounts of livestock products, a modest move down the food chain would result in a reduction in grain use of 30 million tons and the use of water to produce grain by 30 billion tons.

3. Urban - Farm – Food Connection

In many countries, the irrigation water supply is shrinking as aquifers are depleted. But even as wells are going dry, irrigation water is being diverted to fast-growing cities. Farmers are getting a smaller share of a diminishing supply.

4. Global Food – Water Connection

Canada is among the countries building grain-fed ethanol plants for car fuel. The competition between affluent motorists and low-income food consumers is thus not only for the land used to produce food, but also for the food itself.

5. Food-Water Security needs an integrated approach by government

Future food security depends on stabilising the key agricultural resources: cropland, water, rangeland, and the earth's climate system. Food security is affected not only by the food-population equation, but also by the water-population equation and the efforts of water resource managers to raise water productivity.

6. Climate Change and Agriculture:

Higher temperatures can worsen or create new crop diseases and insect problems. The combination of heat and humidity make it impossible to grow most grains in the tropics. Higher temperatures would simply expand the region that is inhospitable to wheat from the equator toward the higher latitudes.

Recommendation 14

Enact zoning bylaws with a water-centric approach

In the Alberni Valley, neither the City of Port Alberni nor the ACRD have a Regional Growth Strategy. The ACRD Official Community Plan's primary focus is on development but it "…may have some measure of watershed protection" (ACRD staff, personal communication, 2010). It needs to be looked at to see if this is indeed the case.

OCPs need to delineate protection of natural areas based on ecological values and connectivity requirements. This is a baseline, or fundamental, condition from which all planning can occur, particularly in this era of climate change and the requirement for more rapid species adaptation (Environmental Law Centre, University of Victoria, 28 Sept 2009).

Many local governments include measurable performance-based targets in each chapter of an OCP or corporate plan that allow policies and practices to be evaluated and revised if objectives are not being met. Examples of performance-based measures could include such things as no net loss of forest land or ALR land; no net loss of sensitive ecosystems (Environmental Law Centre, University of Victoria, 28 Sept 2009).

The impact of development on water quantity and quality is on the forefront of many minds and requires a water-centric planning approach. An example of such an approach exists in Okotoks, a town south of Calgary. Water is central to the town's concept of sustainability. The Sheep River is regarded as a finite resource; thus, the development of the town is curtailed to the capacity of the river. In 2003, a Sheep River Valley Management plan was adopted as a tool to provide comprehensive direction for protection, maintenance, and rehabilitation of the watershed. One of the first steps was to develop a GIS-based Watershed Information Management Support System that layered a number of different pieces of information. Partnerships were formed with neighbouring communities in the watershed and local residents were engaged by way of water quality monitoring of the watershed by local students, media, and town councillors. In addition, workshops were held to train residents, staff, and decision-makers about the local issues in sustainability management (Jenssen 2007).

Include Buffer Zones

In 2001, the Alberni Valley Enhancement Association commissioned a study by LGL Limited Environmental Research Associates. The study was called "Stream Corridor Management Plan for Beaver and Big Hal Creeks." The purpose of this study was "the development of a stream channel and corridor management plan incorporating specific Best Management Practices (BMPs) to guide land and stream management. The plan was seen as fundamental to maintaining and rehabilitating habitats and water quality within these watersheds" (Gaboury 2001).

Recommendations from this report included (Gaboury 2001):

1. Protect, maintain, and restore the creek by establishing and adhering to a Stream Corridor Management Plan.
2. Maintain and restore a diverse stand of riparian vegetation a minimum of 20 m wide along each bank of the stream corridor.

Benefits of following the recommendations:

- improved conveyance of low and moderate discharges and reduced flooding of adjacent public and private lands;
- more agricultural production from adjacent crop, pasture, and hay lands;
- more functional stream channels with meanders, pools, and riffles;
- improved rearing habitat for coho and cutthroat trout;
- stable banks that reduce erosion and release of sediment that can cover spawning habitat and suffocate fish eggs;
- improved water quality as a result of sediment and nutrients being filtered by the riparian zones;

- increased shading that cools the water, increases the amount of dissolved oxygen, and reduces instream vegetative growth;
- preservation and improvement of habitat for a variety of bird species;
- improved riparian zones with functional and diverse vegetative communities.

All of these practices and effects work synergistically to increase and protect the quality of drinking water sources, as well as help conserve the local ecology of the Alberni Valley and insert a degree of resilience to future challenges to providing adequate drinking water sources in the face of climate change.

Recommendation 15

Set enforceable water quality objectives for all Community Watersheds on a local basis.

Water quality objectives for Community Watersheds need to be entrenched in regulations that are relevant for each local area.

Community Watersheds are areas identified for the purpose of protecting water quality, quantity, and timing of water flow, and for preventing cumulative hydrological impacts caused by forest and range activities in watersheds where water is diverted for human consumption. Pursuant to section 8(2) Government Actions Regulation, the Minister of Environment may also establish water quality objectives for a community watershed (MOE, WSD, 2008). This language is somewhat weak. The minister "may" establish water quality objectives needs to be changed to something like "The minister shall establish…"

The Ministry of Forests is responsible for ensuring that the results and strategies in licensee Forest Stewardship Plans are consistent with Community Watershed designations and any associated water quality objectives (MOE WSD 2008).

With greater understanding of how a particular watershed functions, managers will be better equipped to answer questions of what must be measured, what frequency is required, and where measurements must be taken to ensure that they have confidence in knowing the status of intake water quality and how it may change when various manipulations may be occurring upstream (Trent et al. 1993).

Water quality objectives are prepared by the MOE Environmental Protection Division (EPD) for waterbodies and for water quality characteristics that may be affected by man's activity, now or in the foreseeable future (MOE-EPD 2001). Objectives are set on a site-specific basis, with due regard for the water quality, water uses, including aquatic life, water movement, waste discharges, and socio-economic factors at a given location (MOE 2001, 2006).

Water quality objectives and criteria are set after a five-step review process, each new draft incorporating appropriate corrections reflecting the review comments made (MOE-EPD 2001). It's important to note that public consultation is not included in the review process.

The objectives are policy guidelines for resource managers to use in protecting water users in specific waterbodies (MOE 2001). These guidelines and procedures only apply to lands held by holders of agreements within a community watershed established under the Forest and Range

Practices Act [Crown land]. MOE staff will endeavour to utilize other available legislation and regulations to ensure that other [private] lands within a community watershed are managed in a manner consistent with the Community Watershed water quality objectives (MOE WSD 2008).

The objectives have no legal standing and their direct enforcement would not be practical. This is due to the difficulty of accurately measuring contaminants in receiving waters and attributing to particular sources for legal purposes contamination exceeding an objective, and thus of proving violations and their causes (MOE-EPD 2001).

Assimilative capacity is the ability of a waterbody to receive contaminants without impairing the use of the water by man, plants, and animals. The concept is controversial. It is difficult to define the assimilative capacity as it is different for each contaminant. Interrelated measurements of water quantity and quality, sediments, and aquatic life must be made. The pressure to use assimilative capacity can be high, especially in cases requiring costly pollution control measures to maintain water quality (MOE-EPD 2001).

Assessing whether objectives are being met can be difficult because of the temporal and spatial variability of water quality (MOE-EPD 2001).

The BC Water Quality Index is based on the attainment of water quality objectives (MOE-EPD 2001). Limitations with the index are that it provides a general statement about water quality that cannot always show the effect of local variations or random short-term events, such as a spill, unless it occurs more frequently or for a longer time. Also, water quality on which the index is based does not always account for habitat changes, such as low water levels, high stream velocities, or disruption of gravels. These factors would be incorporated into an ecosystem index, the development of which remains a challenge for the future (MOE-EPD 2001).

In the Alberni Valley, "the MOE is taking a wholistic approach rather than specific; therefore, it is difficult to answer specific questions" (MOE, Epps, personal communication, April 13, 2010).

VIHA is taking the same position: "The MOE Water Quality Objectives are near completion for China Creek. This information may be transferable to other streams in the region" (VIHA, Magee, personal communication, Feb 18, 2010).

Recommendation 16a

Require the Ministry of Agriculture to create, adopt, and enforce legislation that protects drinking water in rural areas, and be proactive in public education for managing farming activities around water on farms, including hobby farms.

"The Ministry of Agriculture does not have acts and regulations specific to drinking water source protection. Factsheets and information on how to manage farming activities around water and other environmental attributes are available via electronic publication" (Hatfield, personal communication July 9, 2010).

A spokesperson for the Ministry says it is very difficult to enforce adoption of factsheet information on hobby farms because there is no leverage since the farm is not a business and adoption of managing farming activities around water is on a voluntary basis (Hatfield, personal communication July 9, 2010).

Recommendation 16b

Conduct point source testing of streams that contribute to drinking water sources in agricultural areas

During the field portion of this study, Beaver Creek, Truman Creek, and Woodward Creek in the Beaver Creek Improvement District were viewed, with the most intensive investigation being in the Truman Creek area. We saw that it was possible for farm effluent to drain directly into streams that contribute to drinking water.

The MOE says that the only issues from the Alberni Valley that have come to their attention are in the Beauforts and in the China Creek watersheds where the "farming community is a major contributor to water issues" in the Alberni Valley (MOE-WSD, Guthrie, personal communication, May 26, 2010). "People want to blame forestry. If you want to address water quality issues, you should look at agriculture; it's right in front of you. I would look there first in the Alberni Valley" (MOE-WSD, Epps, personal communication, April 13, 2010). However, according the Ministry of Agriculture: "There are very few farms left in the Alberni Valley. I would be very surprised to find agriculture to be the cause of water quality issues in the Alberni Valley. Nothing has been reported" (Hatfield, personal communication July 9, 2010).

To confirm scientifically if agriculture is causing water quality issues in the Alberni Valley, "Point source testing is needed to identify contaminants in farming areas" (Hatfield, personal communication July 9, 2010).

Recommendation 17

Launch a public education campaign on comprehensive watershed protection in the Alberni Valley.

A successful community-based social marketing campaign would be part of a multi –barrier approach to source water protection "from source to tap."

Campaign objectives would be to reduce the risks to water quality for water supplies in the Alberni Valley watersheds, to increase understanding of where drinking water comes from, and to promote steps to ensure its source water quality. The campaign would include formative research tools, engage public media and events, an innovative school program, and have signage posted throughout the watershed. Other key features of the campaign would include careful consideration of goals, audience, messages, and the use of watershed monitoring and other data to ensure scientific accuracy (adapted from Blair-Whitehead and Associates, BCWWA 2010 conference).

Recommendation 18

Adopt a format for water bills to reflect actual water usage in litres per person per day as compared to BC and Canadian seasonal averages.

As discussed in section 3.1.5 of this report (pages 40-43), British Columbians use water, particularly in domestic usage, at an unsustainable rate. In locations where household metering has been employed, water use has been significantly reduced. Having people pay for their domestic water usage is a good way to make them more aware of how much they use. In order for

people to know how much they are using, however, they need to have this shown on their water bills. This is a proven and effective mechanism for helping people to change their behaviour.

Recommendation 19

Conduct research on the value and environmental impacts of rainwater harvesting.

Globally, there are many communities that rely on rainwater as their principal water source. Historically, throughout Canada and especially in rural areas, families used cisterns to hold collected rainwater to supplement other sources. In coastal British Columbia, a number of Gulf Islands communities have been looking into the values and methods of using rainwater. "Household water conservation is becoming crucial to sustaining our natural water supplies, and the use of alternative water sources, such as rainwater, is one effective water conservation technique" (Watershed Sentinel, Jul-Aug 2004).

> Rainwater is a renewable, sustainable, and quality water source for your cottage or home. It is soft, neutral in pH, and has no minerals to cause staining, pipe corrosion or smell. As well as being "nature's watering agent" for gardening, disinfected, treated rainwater is an excellent water source for general household use – either on its own or as a supplement to other water sources. Today, rainwater harvesting is popular in parts of Europe, Hawaii, and Japan, and mandatory in Bermuda, parts of Australia and New Zealand (Watershed Sentinel, Jul-Aug 2004).

While local governments are beginning to encourage a number of water conservation programs, they have not given a high profile to the potential of rainwater collection. We recommend that more research and public education be done in order to determine whether this is a viable and safe—both environmentally and for human health—method of water conservation.

The nature of rainwater harvesting encourages personal responsibility, resulting in conservation of a valuable and diminishing resource. The immediate result of a rainwater collection installation, even if it is only a rain barrel, is that the homeowner becomes a conserver. He/she is now connected to his water supply…where it is coming from and where it is going (Stubbs 2006).

Rainwater is generally quite pure, but there are a number of human activities that could introduce contamination: wood burning appliances, pulp mills, cement plants, other industrial activities. Areas where it may not be appropriate to harvest rainwater should be identified (Stubbs 2006).

Applied research into rainwater harvesting exposed the many myths and assumptions about the quality of rainwater. Significantly, a sparseness of knowledge about the microbial processes in rainwater tanks was revealed. Ongoing analysis…has revealed that biofilms do exist in rainwater tanks and that a core group of environmental bacteria, such as *Bacillus* spp., are likely to form biofilms in rainwater tanks (Coombes and Dunstan 2006).

Results from research on Salt Spring Island, BC suggested that a house could run entirely on rainwater from November through January each year, but will require a total of 95,500 litres (21,300 gallons) of stream water to supplement the rainwater supply and to keep water in the cistern over the dry summer months (Burgess 2006).

Recommendation 20

Re-establish public service values and practices within the public service.

The current work culture among some public servants is that of serving government rather than the public. Many departments at various levels of government merely pay lip service to the concept of public consultation. Often, meetings are scheduled at times when it is difficult for most people to attend. Notices and necessary information either are not sent out to the public, or are not sent out in time for concerned citizens to give them adequate consideration. Often, open houses are scheduled, rather than bona fide two-way consultations. Having civil servants refer to the public as a "special interest group" and seemingly in a derogatory way, does not foster meaningful public consultation.

We recommend the following concepts be entrenched into the public service:

- Take pride in public service work; it is a valuable commodity.
- Maintain a clear focus on creating positive outcomes for citizens.
- Encourage public participation in water resource management.
- Seriously consider recommendations from citizens who have valuable local knowledge.

5.3 Local Concerns

All Alberni Valley watersheds are privately owned, open, and subject to multiple uses. Among the uses are forestry, agriculture, sport and recreation, railway, garbage dumping, cottage industry uses, industrial, mining, gravel quarry, BC Hydro, natural gas pipeline. There are a number of local concerns about these activities, all of which have the potential to adversely affect water quality. Following are a number of photographs, some taken during the field portion of this project that highlight the need for better protection of our Community Watersheds. Figure 32 on p. 154 shows pollution (from human excrement) adjacent to the Cherry Creek water source.

Figure 36. Road construction in watershed; photo taken May 2009.

Figure 37. Forestry Activity (ribbons demarcating future road allocation) directly through Cold Creek, photo taken April 2009

The images shown throughout this section are images periodically reported in the majority of watersheds in the Alberni Valley. Recreational picnics with campfires and human waste deposits are common. Garbage dumping is a continuous concern in Sproat Lake and in China Creek Designated Community Watersheds (N. Meunier, City of Port Alberni Waterworks Dept., personal communication, May 2008; and P. Coté, Area D Regional Director, personal communication, Oct 8, 2009).

Figures 37 through 43 all show examples of industrial activities that have the potential to cause changes in water quality and quantity. The photos also highlight the need for a dedicated Ministry of Water to ensure comprehensive source-to tap-drinking water protection.

Figure 37 above shows Cold Creek running horizontally across the center of the photo. The red ribbon highlighted in the image is a road allocation ribbon that directly crosses through Cold Creek and continues several hundred meters further along.

Figure 38 shows where a gas pipeline was laid in an underground spring water system above the tracks in the Cold Creek watershed, located above the Cherry Creek Waterworks water intake.

Figure 38. Gas pipeline laid through a spring.

Figure 39. Forestry Activity (clearcut) in upper Cold Creek Watershed.

Figure 39 shows clearcut logging in the Cold Creek Watershed.

Figure 40 shows creosote railway sleeper debris at the base of a culvert in a tributary of Cold Creek above the Cherry Creek Waterworks intake, the drinking water source for approximately 2,500 residents.

Figure 41 is an image of the City of Port Alberni's water intake on China Creek. Clearcut logging can be seen through the sparse riparian zone of protection. Trees and debris have fallen into China Creek. The clearcut zone extends above the water intake site as well as on both sides of China Creek.

Figure 40. Railway pollution in tributary above drinking water intake.

Figure 41. China Creek Drinking Water Intake.

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Figure 42. The results of clear-cut harvesting on a well-developed karst landscape followed by a fire.

Reprinted with permission of P. Griffiths.

Figure 42 shows the results of clearcut harvesting on a well-developed karst landscape followed by a fire (natural fire caused by a July 2009 lightning strike). The location is the Tahsish River drainage in northwestern Vancouver Island (P. Griffiths, personal communication, March 19, 2010).

Figure 43 is an example of how water moves above ground then disappears into a cave of a karst system.

Upon review of the Vancouver Island Water Resource Vulnerability Mapping Project (see Review of Phase 1, Technical Summary of Intrinsic Vulnerability Mapping Methods in the Regional Districts of Nanaimo (RDN) and Cowichan Valley (CVRD) 2010 and, Phase 2, Vancouver Island Water Resource Mapping Project 2010 at this website: http://web.viu.ca/groundwater/), a number of concerns came to light. The project failed to meet the steering committee's key objectives set out in Phase 1 "to map the regional intrinsic aquifer vulnerability of the RDN and CVRD study area and to fine tune the assessment to the characteristics of Vancouver Island before the methodology is applied to the remainder of Vancouver Island" (R. Robinson, May 2010).

None of the karst aquifers in the RDN and CVRD were mapped and the method used to assess aquifer vulnerability (DRASTIC) was not fine-tuned to characterise Vancouver Island karst" (Robinson, May 2010).

The Nanaimo River drainage, for example, has two known karstified carbonate bedrock units which contain aquifers that contribute to surface water supply (Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, Submission to Vancouver Island Region Watershed Protection Steering Committee, May 2010).

Other water supplies within the RDN receive karst waters from carbonate unit aquifers including trans-boundary groundwater transfers from one region to another. For example, karst aquifers located within the RDN boundaries provide groundwater (resurfacing from springs) to residents within the Alberni Clayoquot Regional District. The origin of many surface streams on Vancouver Island, karst aquifers and their inherent high vulnerability to surface contaminants were not assessed or mentioned (Robinson, Central Island Caving Club, Karst and Cave Assessment Chair, Submission to Vancouver Island Region Watershed Protection Steering Committee, May 2010).

Figure 43. Nebular swallet and cave near Lacy Lake in 2009.

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In the Phase Two document under Aquifer Delineation, the following statement is noted:

> Because this study represents aquifer vulnerability on a regional scale, many specific aquifer types, including karst aquifers, are not identified in the upper-most aquifer map. Modelling studies indicate that the DRASTIC method is not as accurate as some other vulnerability mapping methods for karst aquifers (Neukum et al. 2008). Therefore, the results of this study should be treated with caution where karst aquifers exist, and further work should be done to confirm the results. However, on Vancouver Island, karst aquifers represent only 2.4 % of the area mapped by this study, and many of them are in remote locations" (R. Robinson, personal communication, May 2010).

It appears that part of the time and money allotted for the Phase 2 study was used to identify karst aquifers (2.4 % of the area mapped) and yet no map or other specific evidence is provided to identify the known area of pre-determined karst aquifers (Robinson, submission to Vancouver Island Region Watershed Protection Steering Committee, May 2010).

In addition, Phase 2 fails to propose a best management model to assess the intrinsic vulnerability of Vancouver Island's karst aquifers. As a result, continuity of management tools remain a major concern as there are a number of methods with varying results, strengths, and weaknesses that may be used (other than DRASTIC) to assess karst aquifer vulnerability; e.g., EPIC, PI, SINTACS, IRISH, COP, EUROPEAN, or the Simplified method. Regardless, the document does warn that the Phase 2 study should be treated with caution where karst aquifers exist (Robinson, May 2010).

In the Alberni Valley, at least five individual karstified limestone bedrock units play host to more than six karst systems. Each system has its own aquifer that feeds into most water supply systems serving approximately 20,000 Alberni Valley residents. Robinson states that most karst aquifers in the valley are accessible by road" (Robinson, May 2010).

Figures 44 and 45 show forestry activity in the Beaufort Range where there is extensive road building across water courses and no riparian setbacks.

Figure 44. Beaufort Range, Block 141, photo taken in 2007.

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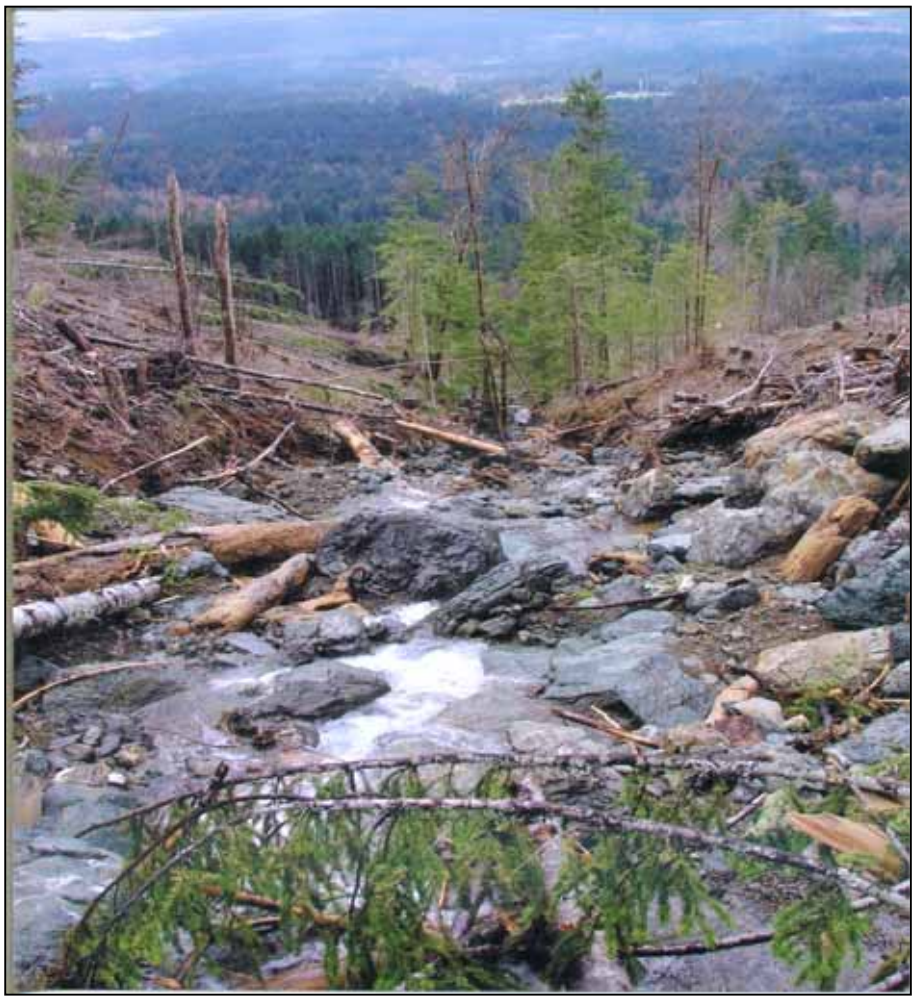
Figure 45. Beaufort Range Stream in Block 141, photo taken in 2007.



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All seven regional districts on Vancouver Island have karst systems that recharge, store, and release karst waters from associated aquifers. Some karst aquifers are interconnected to subsurface non-karst geology (faults, fractures, sedimentary bedding planes) and may resurface many kilometres from their recharge zone (surface area) as springs. In a few cases, springs are out of sight and submerged beneath the surface of reservoirs used by suburban and rural communities as a drinking water supply (Robinson, May 2010).

Figure 46 on the next page shows contamination entering Woodward Creek due to activities in the Watershed. Woodward Creek enters Stamp River above Beaver Creek Improvement District's water intake.

Figure 46. Woodward Creek on Cameron Rd. Drainage area below Block 141.

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Appendices

Appendix A. Raw Water Quality Parameters—China Creek

CITY OF PORT ALBERNI - ENGINEERING DEPT.					
RAW WATER QUALITY PARAMETERS - CHINA CREEK ANNUAL AVERAGES					
Parameter	Units	Allowable Limit	Typical Range	Average China Creek	2008 China Creek
pH	units	6.5-8.5	6.5-8.1	7.68	7.82
Conductivity (det lim 1)	uS/cm	--	40-150	113	94
True Color (det lim 0.9)	co/pt	15	0-10	3.1	0.8
Turbidity (det lim .015)	NTU	5	0.1-5.0	0.69	0.08
Hardness (CaCO3)	mg/l	0-75	16-60	52	40
Total Dissolved Solids	mg/l	500	17-130	72	54
Total Suspended Solids(det lim 1.2)	mg/l		0-1	2.9	5.0
Alkalinity Total (det lim 0.1)	mg/l	--	15-76	57.6	65.00
Chloride(det lim 0.015)	mg/l	250	1-5	3.0	2.0
Sulfate (as SO4)(det lim 0.075)	mg/l	500	0.5-5	2.4	2.6
Nitrate and Nitrite(as N)(lim 0.16)	mg/l	10	0.003-0.1	0.07	0.022
Fluoride (det lim 0.007)	mg/l	1.5	0-0.15	0.044	<
Total Organic Carbon C(lim 1.0)	mg/l			1.4	<
Cyanide (det lim 0.005)	mg/l	0.2	<0.005	0.005	<
Total Coliform (pre disinfection)	MPN/100ml	10	0-200	100	0
Fecal Coliform (pre disinfection)	MPN/100ml	0	0-50	2	0
Giardia Cysts viable	#/700l		0	<	
Cryptosporidium Cysts viable	#/700l		0	<	
Aluminum (det lim 0.065)	mg/l		<0.15	0.195	0.130
Antimony (det lim 0.0005)	mg/l	0.006	<0.15	<	<
Arsenic (det lim 0.0005)	mg/l	0.025	<0.3	0.0009	<
Barium (det lim 0.009)	mg/l	1.0	0-.013	0.010	0.0120
Beryllium (det lim 0.003)	mg/l		<0.003	<	<
Boron (det lim 0.05)	mg/l	5.0	0-.03	0.06	0.3590

Cadmium (det lim 0.0001)	mg/l	0.005	<0.025	0.0001	<
Calcium (det lim 0.01)	mg/l	200	5-25	19.15	14.60
Chromium (det lim 0.01)	mg/l	0.05	<0.03	0.01	0.02
Cobalt (det lim 0.02)	mg/l		<0.02	0.03	<
Copper (det lim 0.008)	mg/l	1.0	<0.015	0.016	<
Iron (det lim 0.01)	mg/l	0.3	.03-.150	0.02	0.02
Lead (det lim <.0005)	mg/l	0.01	<0.004	0.0018	<
Magnesium (det lim 0.01)	mg/l	50	0.5-1.3	1.18	0.81
Manganese (det lim <.004)	mg/l	0.05	.005-.05	0.004	<
Mercury (lim <.0001)	mg/l	0.001	<0.00005	<	<
Molybdenum (det lim 0.02)	mg/l		<0..04	0.02	<
Nickel (det lim 0.05)	mg/l		<0.025	0.05	<
Phosphorus (det lim 0.065)	mg/l		<0.4	0.10	<
Potassium (det lim .01)	mg/l		0.1-0.3	0.28	0.08
Silicon (det lim <.08)	mg/l		1-4	2.6	1.70
Silver (det lim 0.01)	mg/l	0.05	<0.03	<	<
Sodium (det lim 0.1)	mg/l	200	1-3	2.10	2.08
Strontium(det lim <.001)	mg/l		<0.001	0.039	0.030
Tin (det lim 0.02)	mg/l		<0.03	0.385	<
Titanium (det lim 0.01)	mg/l		<0.006	0.015	<
Vanadium (det lim 0.01)	mg/l		<0.01	<	<
Zinc (det lim 0.006)	mg/l	5.00	<0.015	0.013	0.015
Zirconium (det lim 0.001)	mg/l		<0.015	<	

Appendix B. Raw Water Quality Parameters— City of Port Alberni

CITY OF PORT ALBERNI ENGINEERING DEPT.					
RAW WATER QUALITY PARAMETERS - BAINBRIDGE LAKE SCREEN CHAMBER ANNUAL AVERAGES					
Parameter	Units	Allowable Limit	Typical Range	Average	2008
pH	units	6.5-8.5	6.5-8.1	7.16	7.48
Conductivity (E.C.)	uS/cm	--	40-150	54	57
True Color	co/pt	15	0-10	7	5.0
Turbidity	NTU	5	0.1-5.0	0.73	0.78
Hardness (CaCO3)	mg/l	200	16-60	23	25
Total Dissolved Solids	mg/l	500	17-130	35	33
Total Suspended Solids	mg/l		0-1	1.1	1.7
Alkalinity Total (det lim .1)	mg/l	--	15-76	27.8	40.0
Chloride(det lim .015)	mg/l	250	1-5	1.8	1.9
Sulfate (as SO4)(det lim .075)	mg/l	500	0.5-5	1.451	2.2
Nitrate and Nitrite(N)(det lim .16)	mg/l	10	0.003-0.1	0.03	<
Fluoride (det lim 0.007)	mg/l	1.5	0-0.15	0.033	<
Total Organic Carbon C(det lim 1)	mg/l			2	1.55
Cyanide (det lim 0.002)(CN)	mg/l	0.2	<0.005	0.000	<
Total Coliform (pre disinfection)	MPN/100ml	10	0-200	39	18
Fecal Coliform (pre disinfection)	MPN/100ml	0	0-50	5	0
Giardia Cysts viable	#/700l		0	0	<
Cryptosporidium Cysts viable	#/700l		0	0	<
Aluminum (det lim 0.065)	mg/l		<0.15	0.166	0.195
Antimony (det lim 0.0005)	mg/l	0.006	<0.15	<	<
Arsenic (det lim 0.0005)	mg/l	0.025	<0.3	0.0008	<
Barium (det lim 0.009)	mg/l	1.0	0-.013	0.007	0.0130
Beryllium (det lim 0.003)	mg/l		<0.003	0.005	<
Boron (det lim 0.05)	mg/l	5.0	0-.03	0.05	0.50
Cadmium (det lim 0.0001)	mg/l	0.005	<0.025	0.00	<
Calcium (det lim 0.01)	mg/l	200	5-25	8.13	8.51

Chromium (det lim 0.01)	mg/l	0.05	<0.03	0.01	<
Cobalt (det lim 0.02)	mg/l		<0.02	0.02	<
Copper (det lim 0.008)	mg/l	1.0	<0.015	0.011	<
Iron (det lim 0.01)	mg/l	0.3	.03-.150	0.08	0.11
Lead (det lim <.0005)	mg/l	0.01	<0.004	0.002	<
Magnesium (det lim 0.01)	mg/l	50	0.5-1.3	0.78	0.85
Manganese (det lim <.004)	mg/l	0.05	.005-.05	0.005	0.012
Mercury (lim <.0001)	mg/l	0.001	<0.00005	<	<
Molybdenum (det lim 0.02)	mg/l		<0..04	<	<
Nickel (det lim 0.05)	mg/l		<0.025	<	<
Phosphorus (det lim 0.065)	mg/l		<0.4	0.09	<
Potassium (det lim .01)	mg/l		0.1-0.3	0.30	0.18
Silicon (det lim <.08)	mg/l		1-4	2.2	1.99
Silver (det lim 0.01)	mg/l	0.05	<0.03	<	<
Sodium (det lim 0.1)	mg/l	200	1-3	1.80	2.39
Strontium(det lim <.001)	mg/l		<0.001	0.022	0.023
Tin (det lim 0.02)	mg/l		<0.03	0.39	<
Titanium (det lim 0.01)	mg/l		<0.006	0.012	<
Vanadium (det lim 0.01)	mg/l		<0.01	0.01	<
Zinc (det lim 0.001)	mg/l	5.0	<0.015	0.015	0.012
Zirconium (det lim 0.015)	mg/l		<0.015	<	

Appendix C Raw Water Quality Parameters—Somass River

CITY OF PORT ALBERNI - ENGINEERING DEPT.					
RAW WATER QUALITY PARAMETERS - SOMASS RIVER ANNUAL AVERAGES					
Parameter	Units	Allowable Limit	Typical Range	Average Somass	2008 Somass
pH	units	6.5-8.5	6.5-8.1	7.35	7.47
Conductivity (det lim 1)	uS/cm	--	40-150	41	47
True Color (det lim 5)	co/pt	15	0-10	4	4.0
Turbidity	NTU	5	0.1-5.0	0.53	1.27
Hardness (CaCO3)	mg/l	200	16-60	19	20
Total Dissolved Solids	mg/l	500	17-130	24	27
Total Suspended Solids(det lim .4)	mg/l		0-1	3	1.3
Alkalinity Total	mg/l	--	15-76	21.8	15.00
Chloride	mg/l	250	1-5	1.4	1.7
Sulfate (as SO4)(det lim .075)	mg/l	500	0.5-5	1.3	2.3
Nitrate and Nitrite(as N)(lim 0.16)	mg/l	10	0.003-0.1	0.029	0.045
Fluoride (det lim 0.007)	mg/l	1.5	0-0.15	0.035	<
Total Organic Carbon C(det lim 1.0)	mg/l			1.4	1.56
Cyanide (det lim 0.005)	mg/l	0.2	<0.005	<	<
Total Coliform (pre disinfection)	MPN/100ml	10	0-200	366	1,200
Fecal Coliform (pre disinfection)	MPN/100ml	0	0-50	6	2
Giardia Cysts viable	#/700l		0	<	
Cryptosporidium Cysts viable	#/700l		0	<	
Aluminum (det lim 0.065)	mg/l		<0.15	0.208	0.206
Antimony (det lim 0.0005)	mg/l	0.006	<0.15	<	<
Arsenic (det lim 0.0005)	mg/l	0.025	<0.3	<	<
Barium (det lim 0.009)	mg/l	1.0	0-.013	0.003	<
Beryllium (det lim 0.003)	mg/l		<0.003	0.005	<
Boron (det lim 0.05)	mg/l	5.0	0-.03	0.169	0.69
Cadmium (det lim 0.0001)	mg/l	0.005	<0.025	0.021	0.0001
Calcium (det lim 0.01)	mg/l	200	5-25	6.67	6.86
Chromium (det lim 0.01)	mg/l	0.05	<0.03	0.01	<

Cobalt (det lim 0.02)	mg/l		<0.02	0.02	<
Copper (det lim 0.008)	mg/l	1.0	<0.008	0.030	<
Iron (det lim 0.01)	mg/l	0.3	.03-.150	0.074	0.05
Lead (det lim <.0005)	mg/l	0.010	<0.004	0.077	<
Magnesium (det lim 0.01)	mg/l	50	0.5-1.3	0.60	0.71
Manganese (det lim <.004)	mg/l	0.05	.005-.05	0.004	<
Mercury (lim <.0001)	mg/l	0.001	<0.00005	0.00025	<
Molybdenum (det lim 0.02)	mg/l		<0..04	0.02	<
Nickel (det lim 0.05)	mg/l		<0.025	<	<
Phosphorus (det lim 0.065)	mg/l		<0.4	<	<
Potassium (det lim .01)	mg/l		0.1-0.3	0.17	0.17
Silicon (det lim <.08)	mg/l		1-4	1.7	2.00
Silver (det lim 0.01)	mg/l	0.05	<0.03	<	<
Sodium (det lim 0.1)	mg/l	200	1-3	1.04	1.87
Strontium(det lim <.001)	mg/l		<0.001	0.010	0.011
Tin (det lim 0.02)	mg/l		<0.03	0.130	<
Titanium (det lim 0.01)	mg/l		<0.006	0.014	<
Vanadium (det lim 0.01)	mg/l		<0.01	<	0.011
Zinc (det lim 0.001)	mg/l	5.0	<0.015	0.010	0.004
Zirconium (det lim 0.015)	mg/l		<0.015	<	

Appendix D. Raw Water Quality Parameters—Stamp River Intake (Beaver Creek Improvement District)

Raw Water at Stamp River Intake	Date: Aug 19, 2010		
Test	Results	Units	Drinking Water Guidelines
Alkalinity	17	mg/L	
Colour – Apparent	<5	Colour Units	15 AO
Conductivity	39.7	uS	
Hardness (CaCO3)	18	mg/L	80-100
pH	7.6	pH Units	6.5 - 8.5
Total Dissolved Solids	16	mg/L	500 AO
Turbidity	<0.5	NTU's	5 AO
Chloride	<2.0	mg/L	250 AO
Fluoride	<1.0	mg/L	1.5 MAC
Nitrate (N)	<o.1	mg/L	10 MAC
Nitrite (N)	<0.1	mg/L	1 MAC
Sulphate	<2.0	mg/L	500 AO
T- Aluminum	0.021	mg/L	0.1 Operational Std.
T- Antimony	<0.0002	mg/L	0.006 MAC
T- Arsenic	<0.002	mg/L	0.010 MAC
T- Boron	0.009	mg/L	5IMAC
T- Cadmium	<0.00001	mg/L	0.0005 MAC
T-Calcium	6.19	mg/L	
T-Chromium	0.001	mg/L	0.05 MAC
T-Copper	0.004	mg/L	1.0 AO
T-Iron	0.02	mg/L	0.3 AO
T-Lead	0.0002	mg/L	0.010 MAC
T-Lithium	<0.001	mg/L	
T-Magnesium	0.62	mg/L	
T-Manganese	0.0021	mg/L	0.05 AO
T-Mercury	<0.00001	mg/L	1ug/L MAC
AO = Aesthetic Objective; MAC = Max. Allowable Concentration;			
IMAC = Interim Mac; >= Greater than; < = Less than			
Results relate only to samples as submitted.			
Canadian Drinking Water guidelines as listed on Dec 5th, 2005			

Appendix E Raw Water Sample Beaufort Range/Spaht (Bear) Creek

Beaufort Range/Spaht (Bear) Creek, Raw Water Sample, Date July 27, 2006			
Elements	Sample	Units	Maximum Limits Permissible
Aluminum	0.384	mg/L	no limit listed
Antimony	<0.500	ug/L	6
Arsenic	1.7	ug/L	10
Barium	<0.010	mg/L	<0.010
Beryllium	<0.003	mg/L	no limit listed
Boron	<0.010	mg/L	5
Cadmium	<0.100	ug/L	5
Calcium	26.5	mg/L	200
Chromium	<0.010	mg/L	0.5
Cobalt	<0.020	mg/L	no limit listed
Copper	0.012	mg/L	1
Gold	<0.040	mg/L	no limit listed
Iron	0.211	mg/L	0.3
Lanthanum	<0.020	mg/L	no limit listed
Lead	0.714	ug/L	10
Magnesium	4.25	mg/L	50
Manganese	0.009	mg/L	0.05
Molybdenum	<0.020	mg/L	no limit listed
Nickel	<0.050	mg/L	no limit listed
Phosphorus	0.022	mg/L	no limit listed
Potassium	0.098	mg/L	no limit listed
Scandium	<0.050	mg/L	no limit listed
Silicon	10.4	mg/L	no limit listed
Silver	<0.040	mg/L	0.05
Sodium	3.29	mg/L	200
Strontium	0.32	mg/L	no limit listed
Titanium	<0.010	mg/L	no limit listed
Tungsten	<0.010	mg/L	no limit listed
Vanadium	<0.010	mg/L	no limit listed
Zinc	0.007	mg/L	5
Hardness (CaCO3)	83.7	mg/L	75 - 150
pH	7.91	units	6.5 - 8.5
>= Greater than; < = Less than			
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Appendix F. Raw Water Samples—Beaufort Range, Deer Creek

Date; October 26, 2006			
Elements	Sample	Units	Maximum Limits Permissible
Aluminum	0.229	mg/L	no limit listed
Antimony	<0.500	ug/L	6
Arsenic	<0.500	ug/L	10
Barium	<0.009	mg/L	<0.010
Beryllium	<0.003	mg/L	no limit listed
Boron	0.239	mg/L	5
Cadmium	<0.100	ug/L	5
Calcium	27.7	mg/L	200
Chromium	<0.010	mg/L	0.5
Cobalt	<0.020	mg/L	no limit listed
Copper	0.012	mg/L	1
Gold	<0.040	mg/L	no limit listed
Iron	0.194	mg/L	0.3
Lanthanum	<0.020	mg/L	no limit listed
Lead	3.34	ug/L	10
Magnesium	3.1	mg/L	50
Manganese	0.009	mg/L	0.05
Mercury	<0.100	ug/L	1
Molybdenum	<0.020	mg/L	no limit listed
Nickel	<0.050	mg/L	no limit listed
Phosphorus	<0.065	mg/L	0.05
Potassium	0.093	mg/L	no limit listed
Scandium	<0.050	mg/L	no limit listed
Selenium	0.5	ug/L	10
Silicon	3.96	mg/L	no limit listed
Silver	<0.010	mg/L	no limit listed
Sodium	3.3	mg/L	200
Strontium	0.036	mg/L	no limit listed
Tin	0.43	mg/L	no limit listed
Titanium	<0.010	mg/L	no limit listed
Tungsten	<0.050	mg/L	no limit listed
Vanadium	<0.010	mg/L	no limit listed
Zinc	0.023	mg/L	5
Hardness (CaCO3)	86.1	mg/L	75 - 150
pH	7.91	units	6.5 - 8.5
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Appendix G Cherry Creek Waterworks District

Date: Sept 1. 2010			
Elements	Sample	Units	Maximum Limits Permissible
Aluminum	<0.065	mg/L	no limit listed
Antimony	<0.500	ug/L	6
Arsenic	0.54	ug/L	10
Barium	0.011	mg/L	1
Beryllium	<0.003	mg/L	no limit listed
Boron	<0.050	mg/L	5
Cadmium	1.09	ug/L	5
Calcium	25	mg/L	200
Chromium	<0.010	mg/L	0.5
Cobalt	<0.020	mg/L	no limit listed
Copper	<0.008	mg/L	1
Gold	<0.040	mg/L	no limit listed
Iron	0.023	mg/L	0.3
Lanthanum	<0.020	mg/L	no limit listed
Lead	<0.500	ug/L	10
Magnesium	1.96	mg/L	50
Manganese	<0.004	mg/L	0.05
Molybdenum	<0.020	mg/L	no limit listed
Nickel	<0.050	mg/L	no limit listed
Phosphorus	<0.065	mg/L	no limit listed
Potassium	0.063	mg/L	no limit listed
Scandium	<0.050	mg/L	no limit listed
Silicon	0.266	mg/L	no limit listed
Silver	<0.010	mg/L	0.05
Sodium	1.78	mg/L	200
Strontium	0.047	mg/L	no limit listed
Titanium	<0.010	mg/L	no limit listed
Tungsten	<0.050	mg/L	no limit listed
Vanadium	<0.010	mg/L	no limit listed
Zinc	0.004	mg/L	5
Hardness (CaCO3)	70.5	mg/L	0-75 mg/ L= soft
pH	7.79	units	6.5 - 8.5
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Appendix H Mountain View Unnamed Spring (May 26, 2008)

Conventional Parameters	Units	Sample
pH Laboratory	pH units	8.14
Conductivity	uS/cm	228
True Color	CU	<5
Turbidity	NTU	<0.1
Hardness	mg/L	94.7
Total Dissolved Solids	mg/L	123
Total Alkalinity CaCO3	mg/L	103
Bicarbonate Alkalinity HCO3	mg/L	126
Carbonate Alkalinity CO3	mg/L	<0.5
Hydroxide Alkalinity OH	mg/L	<0.5
Dissolved Fluoride F	mg/L	<0.05
Dissolved Chloride Cl	mg/L	2.28
Nitrate and Nitrite N	mg/L	0.06
Dissolved Nitrate N	mg/L	0.06
Nitrite N	mg/L	<0.002
Dissolved Sulphate SO4	mg/L	3.14
Metal Analysis		
T –Aluminum	mg/L	0.003
T- Antimony	mg/L	<0.0002
T- Arsenic	mg/L	0.0005
T-Barium	mg/L	0.018
T- Boron	mg/L	<0.01
T- Cadmium	mg/L	<0.00004
T-Chromium	mg/L	0.0002
T-Copper	mg/L	0.0003
T-Iron	mg/L	<0.0002
T-Magnesium	mg/L	3.4
T-Manganese	mg/L	<0.0002
T-Mercury	ug/L	<0.02
T-Selenium	mg/L	<0.0002
T-Uranium	mg/L	<0.0001
T-Zinc	mg/L	<0.001
Dissolved Calcium Ca	mg/L	33.2
Dissolved Magnesium Mg	mg/L	28.4
Dissolved Manganese Mn	mg/L	<0.0002
Dissolved Potassium K	mg/L	0.09
Dissolved Silicon Si	mg/L	2.21
Dissolved Sodium Na	mg/L	1.56
Microbiological Analysis		
Total coliforms (Confirmed)	Col./100 mL	<1
E. coli	Col./100 mL	<1
Reprinted with permission ACRD.		

Appendix I Unnamed Spring in the Beaufort Range

Date: May 12. 1983		
Test	Results	Units
pH	8	unit
Specific Conductance	175	UMHO/CM
Alkalinity: Total	81.7	mg/L
Hardness	81.5	mg/L
Nitrogen as Nitrite (NO2)	0.009	mg/L
Residues filterable	102	mg/L
Turbidity	0.8	mg/L
Fluoride	0.1	mg/L
Nitrogen as Nitrate (NO3)	0.1	mg/L
Coliforms: total	0.16	M.P.N.
Boron total	0.03	mg/L
Chromium total	0.01	mg/L
Iron total	0.03	mg/L
Manganese total	0.01	mg/L
Barium total	0.01	mg/L
Calcium total	29.2	mg/L
Copper total	0.01	mg/L
Magnesium total	2.08	mg/L
Zinc	0.01	mg/L
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Appendix J Unnamed Spring in the Beaufort Range

Date: 25 Nov 2003			
Test	Results	Unit	Drinking Water Guidelines
T-Aluminum	<0.005	mg/L	0.05
T-Antimony	<0.0002	mg/L	
T-Arsenic	<0.0002	mg/L	0.025
T-Barium	0.014	mg/L	1
T-Beryllium	<0.0001	mg/L	
T-Bismuth	<0.0005	mg/L	
T-Boron	0.083	mg/L	5
T-Cadmium	<0.00001	mg/L	0.0005
T-Calcium	36.6	mg/L	
T-Chromium	<0.0005	mg/L	0.05
T-Cobalt	<0.0001	mg/L	
T-Copper	0.033	mg/L	1
T-Iron	<0.1	mg/L	0.3
T-Lead	0.0002	mg/L	0.01
T-Lithium	<0.001	mg/L	
T-Magnesium	3.5	mg/L	
T-Molybdenum	<0.001	mg/L	
T-Nickel	<0.0005	mg/L	
T-Potassium	<0.4	mg/L	
T-Selenium	<0.0002	mg/L	0.01
T-Silicon	3.57	mg/L	
T-Silver	0.0007	mg/L	
T-Sodium	2.3	mg/L	200
T-Strontium	0.052	mg/L	
T-Sulphur	1.57	mg/L	
T-Thallium	<0.00005	mg/L	
T-Tin	<0.001	mg/L	
T-Titanium	<0.0005	mg/L	
T-Zinc	0.009	mg/L	
Hardness (CaCO3)	110	mg/L	
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Appendix K

Order to Cancel a Community Watershed
Rogers Creek (930.018)

Pursuant to section 41(11) of the Forest Practices Code of British Columbia Act Rogers Creek, located in the South Island Forest District, has been cancelled by the Regional Manager of the Vancouver Forest Region, with the agreement of a Designated Environment Official of the Province of British Columbia.

The holder of the water licence, Sahara Heights Waterworks District, no longer use Rogers Creek as a community watershed. The waterworks district has abandoned their water licence and is in the process of decommissioning their intake works.

After review of the water licence information, the Province of British Columbia has determined that Rogers Creek no longer meets the definition of a community watershed as defined under section 41(8) of the Forest Practices Code of B.C. Act.

This area is no longer subject to the regulations of the Forest Practices Code of B.C. Act that pertain to community watersheds.

The boundaries of the Rogers Creek community watershed are shown on the 1:75000 scale map dated April 9,2001 attached as Exhibit A. [The quality of the Exhibit A was not adequate therefore it is not included in its original form, however on Oct 18, 2010 a new copy was created by South Island Forest District for the purpose of this study and is included as Appendix L.]

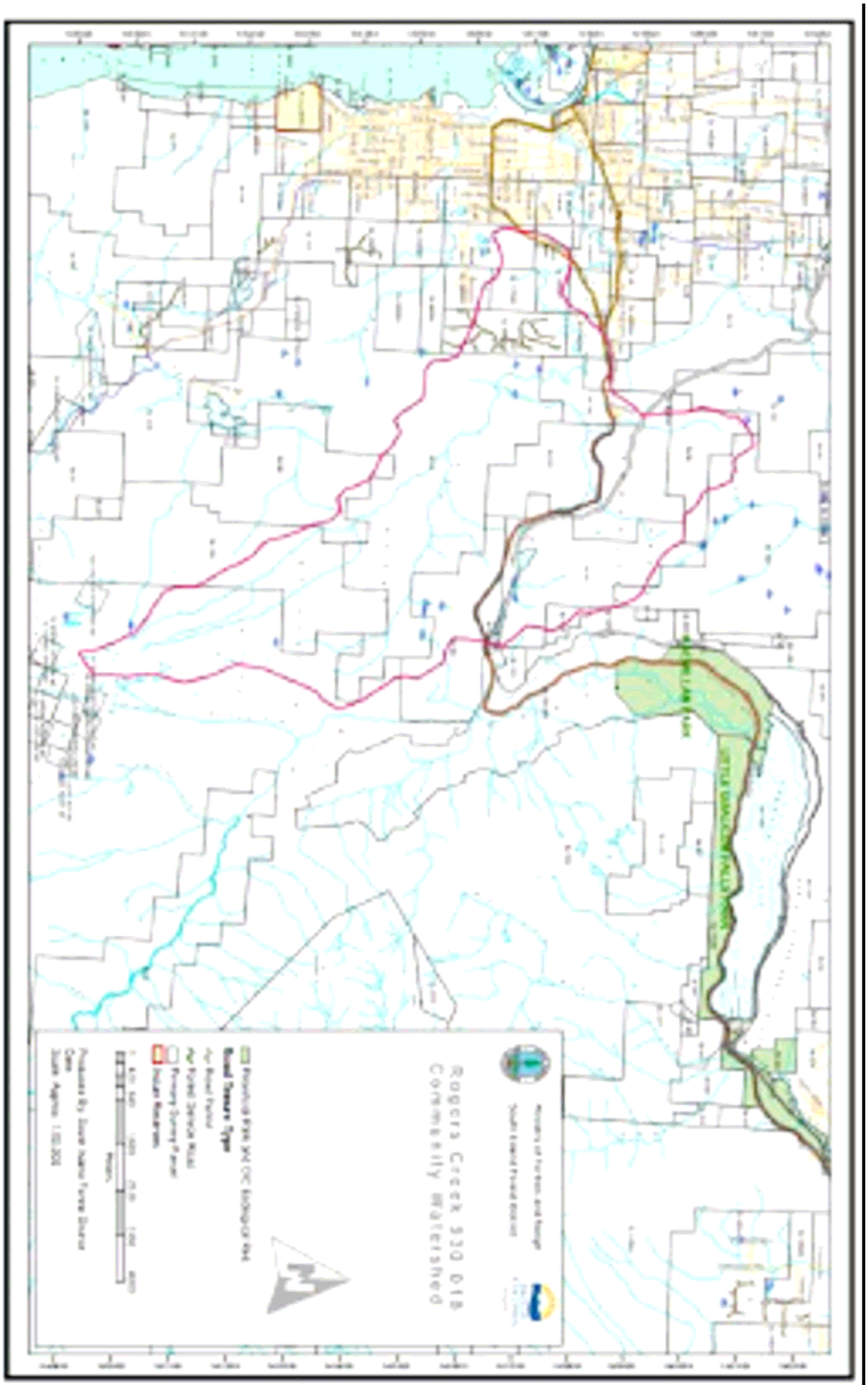
This order takes effect September 10, 2001.

(originally signed by) September 4, 2001

K.A. Collingwood, R.P.F.
Regional Manager
Vancouver Forest Region

File: 12290-20/Rogers Creek

Appendix L. Map of Rogers Creek Community Watershed



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