Cowichan Basin

WATER MANAGEMENT PLAN

Water Issues

October 2005

WESTLAND

RESOURCE GROUP INC.

Executive Summary

A partnership of local, provincial, and federal governments, the Cowichan Tribes, and Catalyst Paper Corporation Crofton Division (formerly NorskeCanada) began working on a Water Management Plan for the Cowichan Basin in December 2004. Based on work undertaken since then, this *Water Issues* report summarizes the ecological conditions, water supply, water demand, and related issues affecting water management in the Cowichan Basin. This *Water Issues* report is accompanied by *Water Facts*, an addendum with more detailed information about water in the Basin.

During public open houses and in completing survey response forms, interested members of the public identified the following main water issues:

- Sufficient water for household supply,
- Sufficient water for fish and fishing,
- Managing growth and development, and
- Reducing the demand for water by individuals, municipalities, and industry.

The public also suggested the following water management actions:

- Develop a Water Management Plan with public input, based on solid research and science.
- Manage growth and development in the Basin.
- Implement demand management (water conservation) through education, regulation, metering, pricing and incentives.
- Investigate alternatives to raising the weir. Some respondents felt that raising the weir is a solution, whereas others adamantly opposed this action. Some people suggested creating additional storage reservoirs elsewhere in the Cowichan Basin or even outside the Basin.
- Protect water quality and quantity through management of effluent discharge and reduction of non-point pollution sources (e.g., failed septic fields, agricultural runoff, sedimentation).
- Manage logging in the watershed to retain water and avoid erosion and sedimentation.

The Water Management Forum, created to support the Watershed Management Plan process, identified some important issues to be resolved, including:

- Developing a plan that has broad public and government support,
- Managing water use and demand,

- Protecting fisheries and other values in the Cowichan River,
- Resolving issues related to regulation and jurisdiction,
- Maintaining sufficient water storage to supply river needs during summer,
- Controlling population growth and urban development in the Basin,
- Managing the basin ecosystem as a whole, not focusing on charismatic species (such as salmon),
- Improving public and decision maker awareness of water and its management,
- Long-term planning water to replace "crisis management,"
- Knowing the difference between water "needs" and "wants," and
- Planning in the midst of conflicting water interests in the Basin.

As a result of the extensive data collection, review, and analysis conducted in preparing the *Water Issues* report, the following issues have been identified. These issues will form the basis of future stages in preparing the Water Management Plan.

Water supply and demand

- On an annual basis, the Cowichan system appears to have sufficient water to sustain human use and ecological integrity. Examining annual averages can disguise short-term or seasonal water supply-demand imbalances.
- Even in average years, water is in limited supply during summer, and careful water management is needed to ensure that human uses (domestic, irrigation, effluent dilution, economic, recreational) do not harm the Basin ecosystem.
- In low-flow summers, fisheries and ecological functioning of the river are stressed, partly as a result of withdrawals of water for human use. Water stress on the system is particularly acute in at the end of summer, when water is removed from Cowichan Lake and River at twice the rate of inflows. Were it not for storage of spring runoff in Cowichan Lake, river flows would virtually cease by September of a dry year.
- Future growth in water demand will increase summer stress on the Cowichan system, particularly in low-flow summers. Action will be needed to balance demand for withdrawals and for instream human and ecological purposes.
- Summer drought and extreme low flows were common prior to construction of the weir, even though human use of water was much lower. Today's water demands, altered Basin hydrology, climate change, and expectations of multiple uses of water in the Basin require a higher level of management than was considered when the weir was built.

- Agriculture in the Cowichan Basin would generally benefit from availability of higher volumes of irrigation water at affordable prices.
- In the Somenos and Quamichan drainages, water drainage and removal are commonly cited issues. Poor drainage affects spring and early summer access to fields and reduces crop yields.

Property issues

- Lakeshore property owners would experience changes in lake level associated with water storage proposals. The effects on assessed value and taxation would be property-specific, and would require detailed lakeshore surveys to document.
- Present values of properties around the lake reflect effects of existing water level fluctuations. Lakeshore properties typically sell at a premium because of their location.

Regulatory issues

- The Water Act and other resource legislation emphasize economic development over ecological protection.
- Many agencies are involved in the management of water in the Cowichan Basin; coordinating their efforts in support of a Watershed Management Plan will be important.
- New stewardship guides and Official Community Plan policies support sustainable use of water, but these guidelines may not be supported by resource legislation and regulations.

Ecology

- Fish in the Cowichan Basin require a continuous flow of clean, cool water throughout the entire year. They are stressed when water temperatures increase or other habitat characteristics are altered by low river flows.
- Fish need sufficient water in the river during the late summer and fall to travel upstream to spawn.
- Fish need enough cool water to cover incubating eggs, provide rearing areas, allow movement between side channels and the river, and enable downstream migration during the spring.
- Sediment deposition from natural sources and human disturbance harm spawning gravels and overall fish health.
- River flows during the driest periods of the year may not allow enough mixing to dilute sewage waste, resulting in reduced oxygen levels and lowered habitat quality.
- Climate change could affect the snow pack in the Cowichan Basin, seasonal water flows, and water temperatures.

- Riparian vegetation along lake edges, streams and river corridors relies on water in order to fulfill its role as a filter for pollutants, as wildlife habitat, and as a source of food. The removal of riparian vegetation leads to changes in water flows.
- Drainage and water storage management is important to maintain rearing and wintering habitat for fish and waterfowl in the Somenos and Quamichan sub-basins.
- Introduced species can affect water flows in the Cowichan Basin by potentially altering the native plant composition and function, impeding flood control, drainage and irrigation.
- Beaver dams and other channel impediments slow drainage in the Quamichan sub-basin, affecting water flows, and affecting farmer's fields.
- Growth in paved areas has resulted in higher rates of runoff, altering the natural hydrologic cycle.

Flooding

- Dyking has created a restricted area for the river to flow, resulting in more severe flooding events.
- High spring water levels in the Somenos and Quamichan sub-basins delay planting and reduce the economic viability of farming.

Tourism and recreation

- Low lying campgrounds, recreation sites, trails or other infrastructure would be affected by changes in lake water levels.
- Access to some fishing areas is limited during periods of low lake and river levels.
- Target fish populations for anglers are affected by high water temperatures.
- Drift boat anglers need enough river flow to avoid rocks while fishing in the spring.
- Kayakers, canoeists and tubers need a reliable river flow during the dry summer period.
- Most tourism and recreation in the Cowichan Basin is focused on natural features, which rely heavily on water as a key input.

Waste water

- Effluent from sewage treatment plants released into the Cowichan River must be adequately mixed to avoid potential health and aesthetic concerns.
- Human health issues near IR 1 are related to effluent discharge and agricultural runoff.

Caveats

The following caveats were identified during the preparation of the *Water Issues* report:

- Information on future growth and development is rudimentary. Official Community Plans provide limited information on long-term development potential. Virtually no information is available on future commercial, industrial, park, or institutional development.
- There is a general lack of information on water use—surface or ground water. No information was found on water consumption by land use in the CVRD (except for Catalyst Paper). Information on the use of water from wells was particularly poor.
- Aquifer capacity, recharge rate, and relationship of ground water pumping to base flow in the Cowichan River (or other nearby streams) are unknown. Without this information, it is not feasible to understand the effects of ground water use in the Cowichan Basin.
- Future agricultural development is unplanned, so forecasts of future water use is based on assumptions regarding expansion of farming onto all Agricultural Land Reserve land and the level of irrigation required.

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1.0 Introduction

1.1 A history of change in the Cowichan Basin

Water shaped the Cowichan Basin. The basin we see today is the product of the working of the hydrologic cycle (Figure 1) over thousands of years of geologic and climatic processes, and decades of human activity. About 29,000 years ago, a climatic event known as the Fraser Glaciation began. Most precipitation fell as snow, and glacial ice accumulated in the mountains of Vancouver Island. The ice flowed into valleys, and gouged deep depressions like the one that now holds Cowichan Lake. By 15,000 years ago, the ice was hundreds of metres thick, and so heavy that all of Vancouver Island was depressed by more than 150 metres. The climate then warmed, and by 10,000 years ago, meltwater was carrying glacial debris toward the sea. These gravels, sands, and clays were deposited in the Cowichan estuary, the Somenos and Quamichan sub-basins, around Duncan, and other flatter portions of the Basin. Relieved of the weight of ice, Vancouver Island rebounded to its previous elevations, causing rivers and streams to cut further through the Cowichan Basin's rocks.

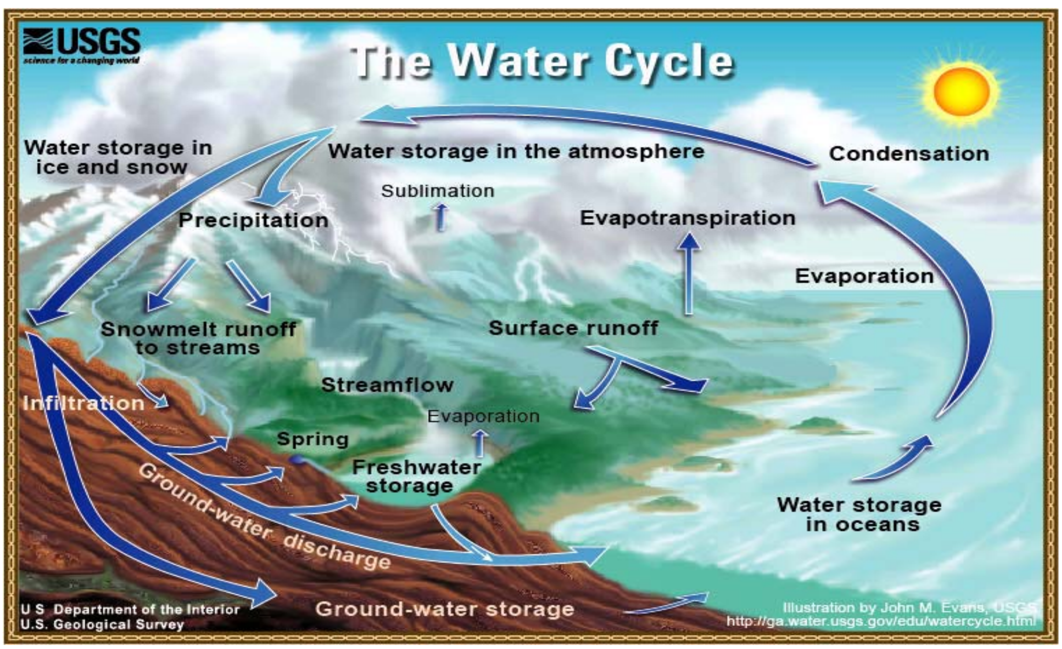


Figure 1. Managing water requires an appreciation of the hydrologic cycle, which explains the timing, amounts, and movement of water in the Cowichan Basin.

Plants recolonized the land, aided by a mild, moist climate. Forests of conifers grew on the young soils of the Cowichan Basin. The forests were watered by winter rains and snow, and withstood summer droughts. As it does today, water evaporated from the Pacific Ocean was carried eastward by prevailing winds. Rising over the peaks of the Vancouver Island Range, the air cooled and moisture condensed, dropping up to 5 m of water yearly on the peaks west of Cowichan Lake. Much of this precipitation would percolate into forest soils, where it would slowly flow toward streams or enter aquifers. Deep snow would accumulate on the peaks, mainly north of Cowichan Lake, slowly melting to provide a flow of water in early summer.

The annual floods of this hydrologic cycle carried soil and gravels into the lower Cowichan Basin. During annual flood events, the waters would spread out in the flatter reaches of the Cowichan River. The soil gradually accumulated in fertile pockets.

Salmon were attracted to the gravels deposited on the bed of the Cowichan River, which were ideal for spawning. Lakes and channels in the river and estuary provided excellent rearing habitat for fish. Gradually, other animals filled the ecological niches of the Cowichan Basin--worms and insects, ducks and eagles, bears and elk. The web of life in the Cowichan Basin became complex and resilient.

Aboriginal people reached the Cowichan Valley not long after the glaciers receded. The people adapted themselves to the seasonal pattern of weather, fish, and plants. A rich culture flourished on the banks of the Cowichan River for centuries. The Cowichan people recognized and appreciated the seasonal patterns in the Basin; winter flood and summer drought; erosion and deposition; spawning and rearing.

Then, in the early 1800s, Euro-Canadian settlers arrived, bringing a different view of the Cowichan Basin. Explorer Robert Brown wrote of Douglas-fir forests as far as the eye could see, constituting "an easy fortune for any man of moderate means" (Drushka 1992).

By the 1860s, logging and land clearing were well underway. The lower part of the Basin was being settled by farmers. By 1884, Cowichan Lake saw its first logging operation, set up by W.A. Robertson, who ran logs down the Cowichan River during the spring freshet (Gaunt 1990). In 1913, Canadian Pacific extended a rail line to Lake Cowichan. By 1920, eighteen logging companies employed 1,200 men in the removal of the Cowichan Basin's ancient forests.

The new residents of the Cowichan Basin made big changes to the hydrologic system, and not only by logging. Winter floods threatened investments in road, railroads, and the growing settlement at Duncan. Dykes were the answer. The dykes greatly narrowed the Cowichan River's flood plain. The demand for water led to the extraction of water from aquifers and from streams. Farmers capitalized on the rich soils that were a gift of water in the Cowichan Basin. They straightened and deepened streams to hasten drainage, drilled wells, and extracted water for irrigation. With settlements came pavement, storm drains, septic fields, and sewage treatment plants, all affecting the Basin's water.

Industry, too, needed water. In the mid-twentieth century, the government agreed that the new pulp mill at Crofton could divert substantial quantities of water from the Cowichan River. A weir was built at the outlet of Cowichan Lake to store water to support the endeavour.

In the past 150 years, the face of the Cowichan Basin has changed more than in the preceding 5,000. The old growth forests are nearly gone, replaced by young trees that are cut when they mature. The river has been channelized. Water has been diverted from streams and pumped from aquifers. The Basin is home to many times the number of people that lived here 100 years ago. Thousands of visitors come to play in the waters of the Cowichan Basin. The rate of change is accelerating.

Residential and commercial development increases the demand for water and changes the hydrology of the Basin through its very presence. Wishing to be near to the water, people build houses on the banks of rivers and lakes, removing riparian vegetation to improve access and views. Hundreds of licences have been issued to divert water from streams and lakes in the Basin, and more than 1,300 wells have been drilled to pump water from the aquifers.

Global factors, both economic and climatic, affect the Cowichan Basin. Little precipitation comes as snow any more. Instead, it comes as rain, which runs off quickly. Forest soils are thinner, their water holding capacity reduced. Summer dry periods are growing longer, jeopardizing the ecological health of the river and the economic health of those who depend on its water.

Federal, provincial, and local governments have passed laws, set regulations, and adopted plans to stimulate development of the Cowichan Basin. To protect the flow of water and all that it supports, these governments—and the residents of the Basin—may now need to establish a new relationship between people and water. A water management plan can help to define this relationship. Can water be managed better in the next century than in the past one? The answer will be determined by the people of the Cowichan Basin.

1.2 Background to the Water Management Plan

The first step in solving a problem is to understand the nature of the issues involved. When the Cowichan Basin Water Management Plan project began in December 2004, the partners in the project[1] set out to identify the issues associated with water and watershed management that need to be considered and resolved. A Water Management Forum was created, with members drawn from business, government, and a cross section of residents. The Forum quickly began to guide the planning process and to identify their views of important issues. The public was then asked to familiarize themselves with conditions in the Cowichan Basin, and to express their views about issues that need to be addressed in the Water Management Plan. The consultants retained to support the project reviewed past studies and examples from elsewhere, and have assembled this *Water Issues* report.

The *Water Issues* report is intended to provide an overview of conditions in the Cowichan Basin, and to summarize the important issues affecting the supply of, and demand for, its water. Most of the report contains facts or generally accepted information about the surface and ground water in the Basin—where it comes from, how it is used, and how much is needed. Today's needs and those of the next 25 years are forecast, using specified assumptions when factual data proves inadequate. The issues affecting water use raised by the public and the Forum are summarized.

The *Water Issues* report provides a basis for the next steps in the water management planning process. Once a vision and goals for water in the Cowichan Basin have been developed, alternative management recommendations will be formulated. This information will be taken to the public for review and comment, and tradeoffs among the options will be assessed. A preferred management option will form the basis of a draft plan for water in the Cowichan Basin. The public will be asked to review the draft plan prior to its completion.

The Cowichan Basin and the issues surrounding water are complex. This report presents information in a way that is intended to clarify and logically organize the issues. It is important that the parties involved in making decisions about water—and that means those who use Cowichan Basin water—understand the nature of the Basin and of its water. This report is one step in that process of building understanding.

[1] Partners in the Water Management Plan include the Cowichan Valley Regional District, Fisheries and Oceans Canada, Catalyst Papers Corporation, the Cowichan Tribes, Ministry of Environment, and the Pacific Salmon Commission.

2.0 Biophysical Setting

2.1 Physical geography

The Cowichan Basin, which has a total catchment area of 930 km^2, stretches east from its headwaters in the Insular Mountains of Vancouver Island across the coastal lowlands near Duncan to the estuary in Cowichan Bay (Figure 2). The Basin displays significant variations in topography and geology.

The upper half of the Basin, which drains into Cowichan Lake, is mountainous, with steep slopes and rounded mountain tops. The mountains to the north of the lake rise steeply to an elevation of 1,520 m at El Capitan Mountain, the highest point in the Basin. The Seymour Ranges to the south of the lake are lower and more rounded than those to the north, with a maximum elevation of 1,260 m at Townicut Mountain. The mountains of the upper Cowichan Basin are composed of volcanic and sedimentary rocks usually overlain by thin layers of stony soil. The mountains were created by of uplift caused by subduction, and valleys were formed through glacial erosion and faulting. The Cowichan Valley was once occupied by a valley glacier that moved eastward during the last glaciation. The glaciers' retreat left the distinct U shape of the Cowichan Valley. Faulting was also important, particularly in forming the steep valley wall to the north of the lake above Youbou.

The eastern half of the Basin is mostly situated in the coastal lowlands, with some small streams flowing from mountain valleys to the north. This area typically lies below the 150 m elevation contour and is made up of alternating low ridges and narrow valleys. The lowlands have experienced post-glacial rebounding after melting of the glacial ice. Rebound was followed by down cutting of river channels in the lower part of the Basin. These areas are underlain by soft sedimentary rocks with areas of glacial till, glacial-fluvial deposits, alluvium, and marine deposits making up the surficial soil layers, which can be up to several tens of metres thick in places.

Cowichan Lake, in the upper portion of the Basin, has a surface area of 62 km^2 and stretches about 31 km to the west of its mouth at the Village of Lake Cowichan. It is a relatively deep lake, with an average depth of 50 m and a maximum depth of 150 m. For the most part, the lake bottom drops quickly from the shore except for some isolated shallows formed by the alluvial fans of tributary streams. The lake basin was formed by glacial overdeepening, and was filled with glacial melt water and, more recently, rainfall runoff.

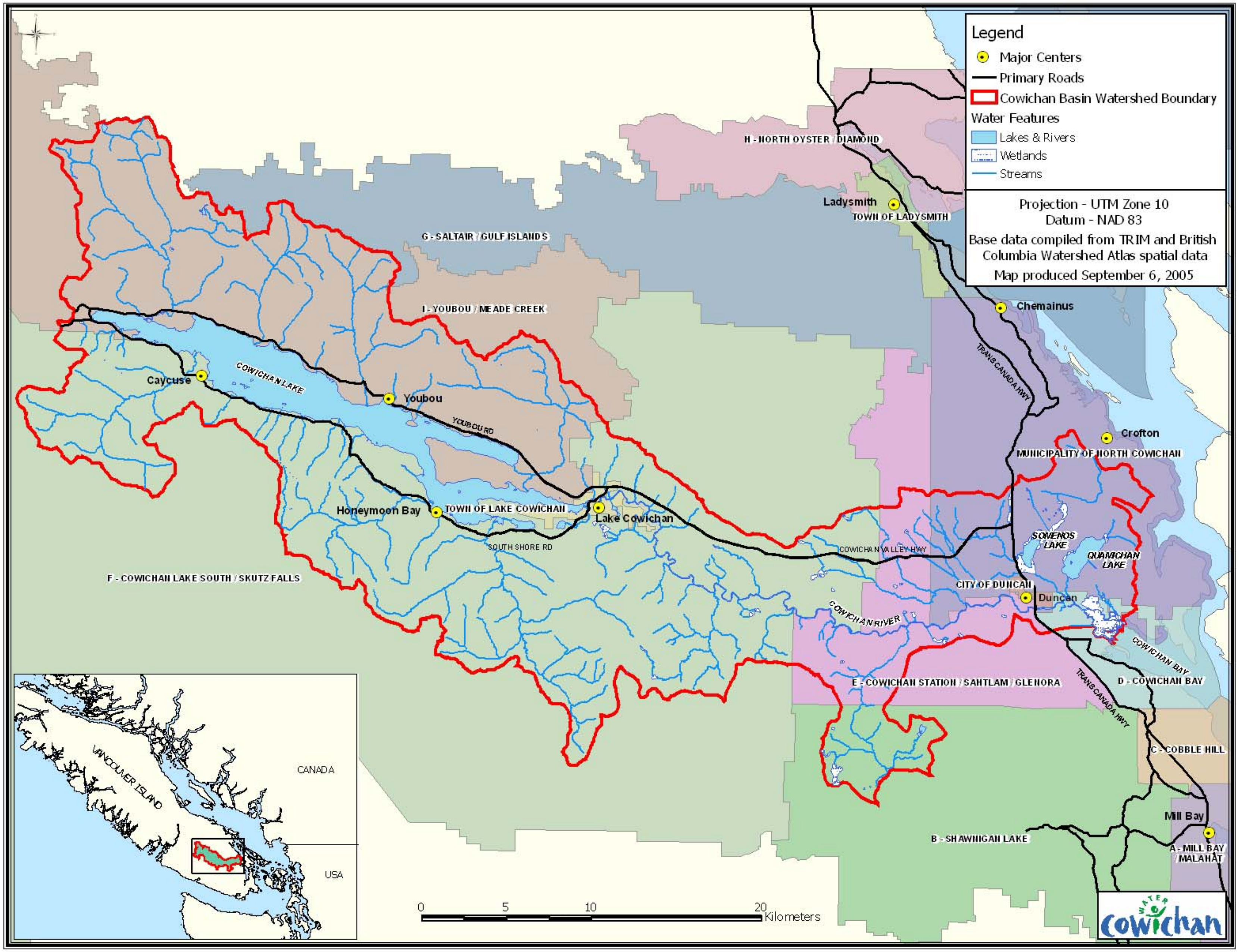


Figure 2. Overview map of the Cowichan Basin.

The Cowichan River flows from Cowichan Lake near the Town of Lake Cowichan through the valley for nearly 45 km to the estuary in Cowichan Bay, at an average gradient of about 4 m per km. The river has five distinct reaches, each with its own characteristics.

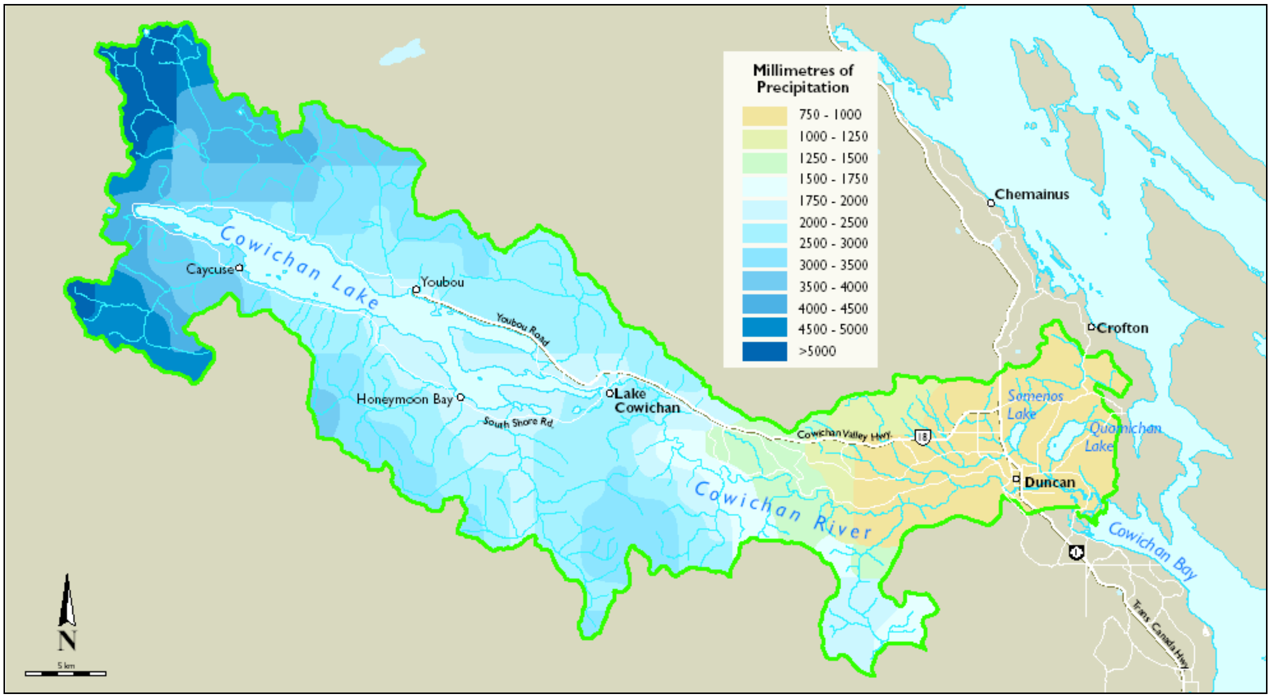
- The upper reach of the river from Cowichan Lake to Skutz Falls has a width of between 30 m to 60 m, with low banks consisting of unconsolidated till and a gravel and boulder bed.
- From Skutz Falls to the lower end of Marie Canyon, the river steepens to an average gradient of 15 m per km and is incised into a shale bedrock canyon. This reach of the river has high, steep banks up to 30 to 45 m high at Marie Canyon.
- Below Marie Canyon to Holt Creek, the river is similar to the reaches above Skutz Falls with low banks in unconsolidated till with gravel and boulder bed material.
- Once below Holt Creek the river flows between steep banks from 15 m to 30 m high. These banks are mainly rocky; but there are locations where the river has cut into glacial moraine deposits. One notable location where this has occurred is known as the Stoltz Creek Slide, where significant amounts of fine silty material is being washed into the river by undercutting and piping holes.
- From Duncan to the mouth of the river at Cowichan Bay the banks become very low and the gradient of the river drops to less than 2 m per km. The drop in flow velocity causes deposition, creating gravel bars and log jams along the lower sections of the river. Somenos and Quamichan Creeks flow into the Cowichan River in the lower part of the river below Duncan. They have a combined catchment area of 86.3 km^2, which drains the lowland valleys to the north of the Cowichan River. Both Quamichan and Somenos Lakes are in this catchment.

2.2 Climate and hydrology

Climate in the Cowichan Basin is influenced by the mountainous topography of the Basin and the seasonal patterns typical of Canada’s west coast.

2.2.1 Precipitation and temperature

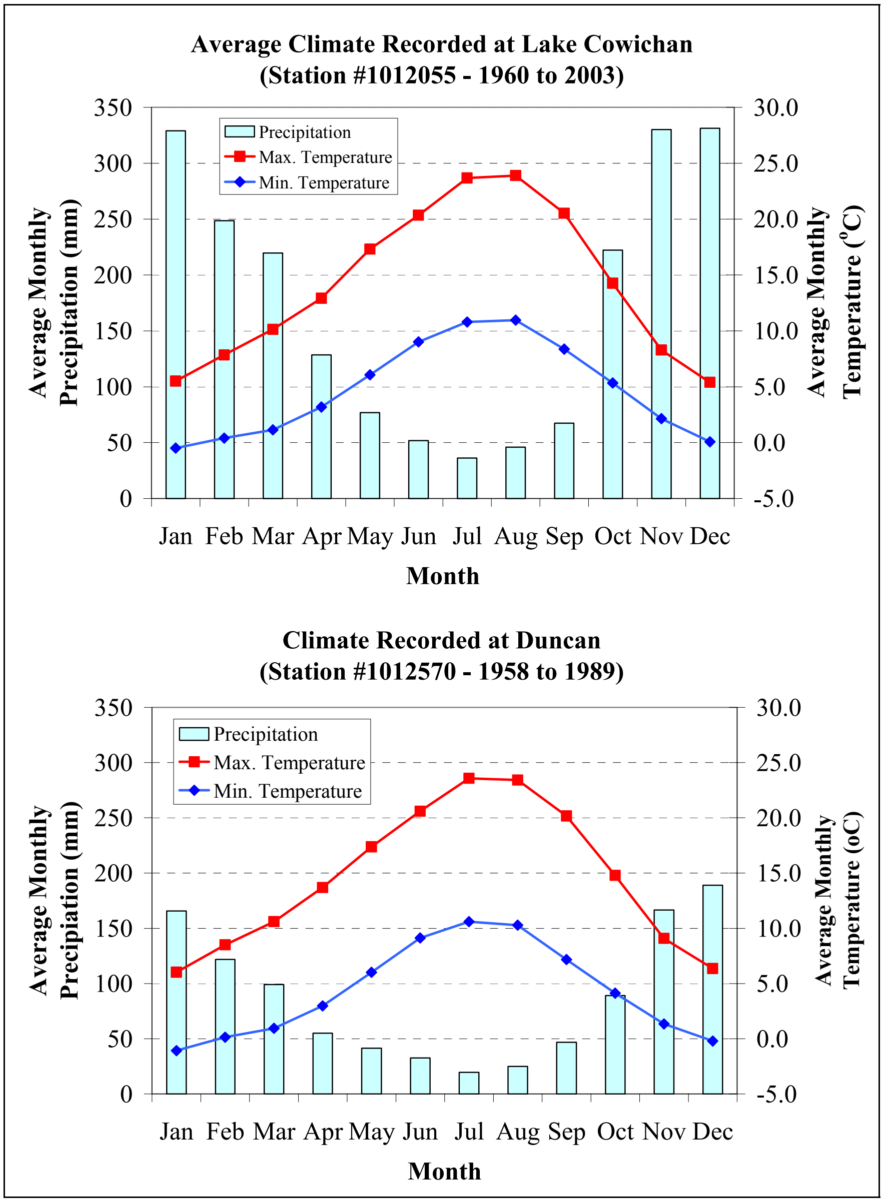
Figure 3 shows the average annual distribution of rainfall across the Basin. This map shows a distinctive west to east gradient, with the upper catchment receiving an average of 2,800 mm of precipitation per year, more than double the 1,100 mm that falls at Duncan. This pattern is due to the rain shadow effect of the Insular Mountains to the west of the catchment. As storms travel east from the Pacific, moist air rises over the mountains, releasing most precipitation on the western face of the mountains. As the air moves east, down the valley, less rain falls.



Source: Daly 2002

Figure 3. Distribution of precipitation in the Cowichan Basin, based on climate normals from 1961 to 1990.

Across the lower elevations of the Basin, temperatures vary from the coastal lowlands to the upper Basin (Figure 4). Average temperatures in Duncan are 2.5 °C in January and 17.1 °C in July. This range compares with average temperatures recorded at Cowichan Lake of 1.5 °C in January and 17.3 °C in July. The high elevation station at Jump Creek is located in the Nanaimo River catchment to the north of Cowichan Lake, but it nonetheless indicates how temperature drops with an increase in elevation. The average recorded temperatures at an elevation of 1,160 m above sea level are 0.5 °C In January and 10.5 °C in July. A list of the long term climate stations in the Basin and their average precipitation and average maximum and minimum temperature records can be found in Section 1 of *Water Facts*.



Source: Environment Canada Online Climate Database
http://www.climate.weatheroffice.ec.gc.ca/ClimateData/canada_e.html

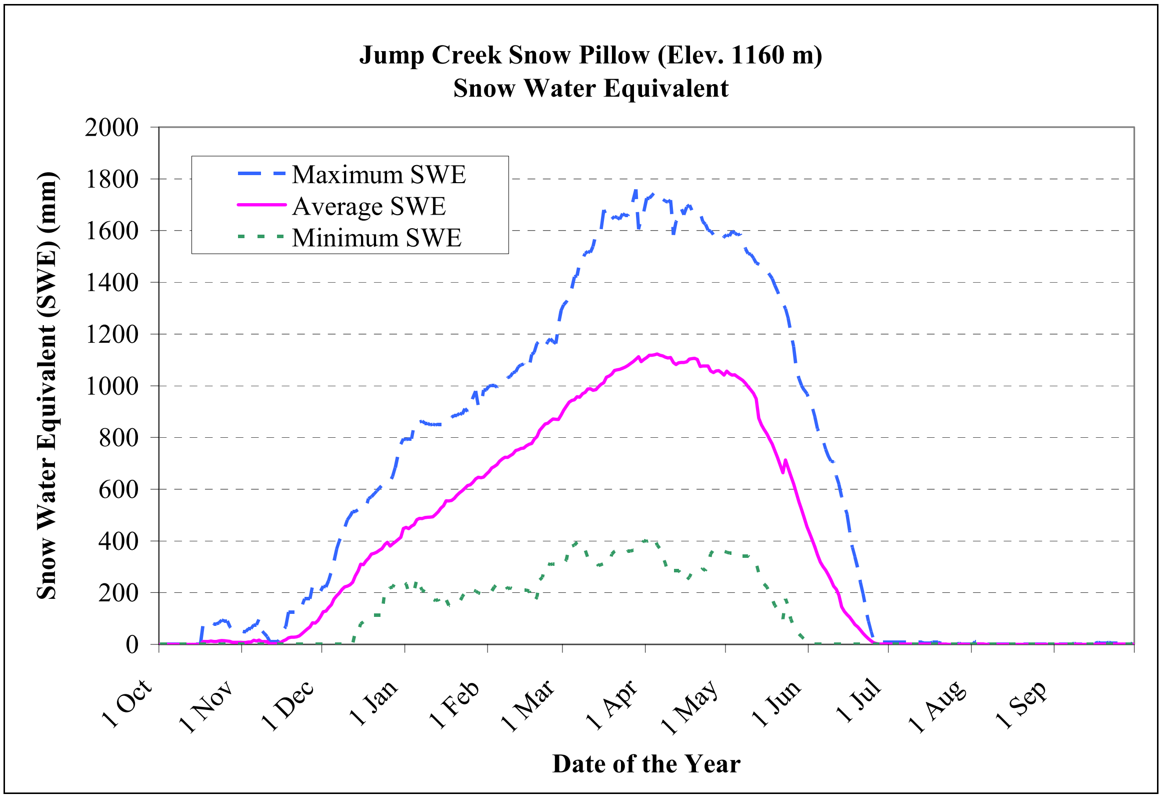
Figure 4. Monthly temperature and precipitation records recorded at Lake Cowichan and Duncan.

The seasonal pattern in the Cowichan Basin is typical of the marine climate of the southwestern coast of British Columbia, with mild wet winters and cool dry summers (Rue 1978). This seasonal variation is the result of air mass movement. In winter, the weather is influenced by frontal storms moving from the Pacific. Often these systems arrive in series, bringing periods of sustained rainfall to the Basin. Through the summer months, these frontal systems tend to pass further to the north because of high pressure systems building over the southern coast. This high pressure leads to drier warmer weather experienced in the summer.

In addition to the spatial and seasonal variation in climate, the Basin also experiences relatively large fluctuations in total rainfall from year to year. This variation is due in part to the random nature of local weather and climate but can also be influenced by the cyclic changes in large scale atmospheric and oceanic circulation. One of these changes is the El Niño-Southern Oscillation, which results in a more southerly flow of mild Pacific air, increasing winter temperatures and precipitation (Shabbar and Khandekar 1996). The opposite phase, known as La Niña, typically brings colder, drier winters. On longer time scales, the Pacific Decadal Oscillation has a similar influence on the climate as El Niño and La Niña, but it tends to persist in one phase or the other for many years (Trenberth and Hurrell 1994).

2.2.2 Snowfall and snow pack accumulation

Records at Duncan and Cowichan Lake indicate that snowfall in the lower parts of the Basin is intermittent, with one or two snowfall accumulations recorded every year. However, with higher precipitation amounts and lower temperatures, the parts of the Basin at higher elevations tend to receive prolonged snowfall for at least part of the winter. Snow pillow records at Jump Creek and snow course data at Sno-Bird Lake track snowfall accumulations in the upper parts of the Basin. Unlike other parts of Canada, where temperatures remain below freezing for most of the winter, intermittent freezing and thawing at high elevation in the Basin leads to the release of water from the snowpack throughout the winter. The average peak snowpack water equivalent (SWE), or the amount of water available in the snow pack, is 1,120 mm and 1,330 mm at elevations of 1,160 m and 1,400 m, respectively. The records also indicate that the period of peak snow accumulation is in late-April or early-May, followed by rapid melting of most of the snowpack by early to mid June (Figure 5).



Source: Ministry of Environment, River Forecast Centre. Automatic Snow Pillow Database
http://wlapwww.gov.bc.ca/rfc/index.htm

Figure 5. Average snowpack accumulation at Jump Creek.

2.2.3 Climate change and the Cowichan Basin

Variability of climate in the southern coastal region of British Columbia is well known. As previously discussed, cyclical climatic processes such as El Niño, La Niña, and the Pacific Decadal Oscillation affect patterns of precipitation and temperature. However, climate records in the region indicate the presence of possible long term trends that cannot be explained by the cyclical nature of the regions climate. Records indicate that over the past 100 years, average annual temperature in the Georgia Basin Region has increased by 0.5 ^{o}C, with notable increases of 0.8 ^{o}C in the spring and 0.5 ^{o}C in the fall (MWLAP, 2002). MWLAP has not yet identified trends in annual or seasonal precipitation in the Georgia Basin. Other research by Environment Canada (2004) indicates that annual snowmelt is 10 days earlier in 2000 than it was in 1950.

These regional trends are similar to changes occurring on a global scale, which have been attributed to increases in greenhouse gas concentrations in the atmosphere, most notably carbon dioxide CO_2. An analysis of global climate records by the Intergovernmental Panel on Climate Change (IPCC) concluded that over the past century global temperatures have risen by 0.6 ^{o}C with an increase of greenhouse gas concentrations of around 30% for the same period (IPCC, 2001). Assuming a doubling of CO_2 concentrations over the next 50 to 70 years, global circulation models indicate that the mean global temperature could increase by between 1.4 to 5.8 ^{o}C (IPCC, 2001).

At a local level, both global and regional climate models predict likely continued changes in precipitation and temperature. Some recent studies show future increases in average annual temperature of between 1.5 to 2.5 ^{o}C over the next 50 years with no significant change in average annual precipitation. Other forecasts, however, predict wetter winters and drier summers.

Changes in temperature and precipitation are likely to alter the hydrologic regime of the Cowichan Basin. Although the average total runoff is unlikely to change significantly, change is likely in the seasonal distribution of runoff, and in the likelihood of extreme high and low flow events. In 2003, the hydrologic response of several watersheds in the Georgia Basin to forecast changes in climate was modeled (Whitfield et. al. 2003). The study concluded that in systems where rainfall is the dominate process, such as the Cowichan Basin, the frequency of winter flood events are projected to increase, though their magnitude and duration would remain within today's range of extremes. In other words, floods and droughts may not get worse, but they will occur more often. The same study also concluded that low flow periods are likely to begin earlier in the spring and extend later into the fall.

Besides impacts to water supply, changes in climate are also likely to affect water demand. Higher temperatures through the summer will increase demand for both residential and agricultural irrigation. Growing seasons are likely to lengthen, leading to longer periods when agricultural and residential users will irrigate. In the Okanagan Valley, agricultural demand is likely to increase by between 20 to 40%, based on climate forecasts and crop water demand models (Nielsen et al., 2005). Although the Okanagan's climate and crops differ from the Cowichan Basin, changes in irrigation demand could be similar.

Substantial uncertainty is associated with climate change modeling and impact on regional water resources, so forecasts of the magnitude of changes to water supplies and demands in the Cowichan Basin should be approached with caution. However, given both the recorded and forecast trends in climate and their potential impacts on water supply and demand it is likely that climate change will amplify many of the water management issues in the Cowichan Basin. Some of these effects could be:

1. Reduced summer runoff, increasing the risk that water supply and storage will be insufficient to meet demand through the critical period.
2. Reduced snow pack leading to reduced water supply through the spring and early summer.

3. Warmer drier summers leading to increase demands for water through the critical low flow period.
4. Reduced flow and increased water temperature leading to degraded aquatic habitat.
5. Changes in vegetative cover in the Basin leading to changes in the hydrological response of the Basin.
6. Increased frequency of winter flood events leading to higher economic and social costs to residents in the Basin.

2.2.4 Surface water

The trends in precipitation and temperature recorded in the Basin affect the amount and flow of water throughout the year. The distribution of runoff generally decreases from west to east, similar to rainfall in the Basin (Figure 6). Most of the Basin's runoff, about 80% on average, comes from the upper Basin surrounding Cowichan Lake. This pattern is a product of both the higher precipitation in the upper Basin compared with the lower valley, and greater runoff from snowmelt during the spring.

Although the total volume of runoff flowing down the Cowichan River is large, (the fourth largest on Vancouver Island), most of the water flows during the fall and winter. From the end of September to the end of March, an average of nearly 1.15 billion m^3 of water flows out of Cowichan Lake into the Cowichan River. This volume is nearly 80% of the total amount of water for the entire year. The amount of water supply in the Basin in any given year can vary dramatically. For example, the maximum inflow into Cowichan Lake was 2.05 billion m^3 in 1985, nearly double the average amount. The historical summer inflows (July to September) to Cowichan Lake have an even greater range, from a high of 155 million m^3 to as little as 3 million m^3. Figure 7 presents a chart showing both the average discharge and the range of recorded discharges over the year in the Cowichan River.

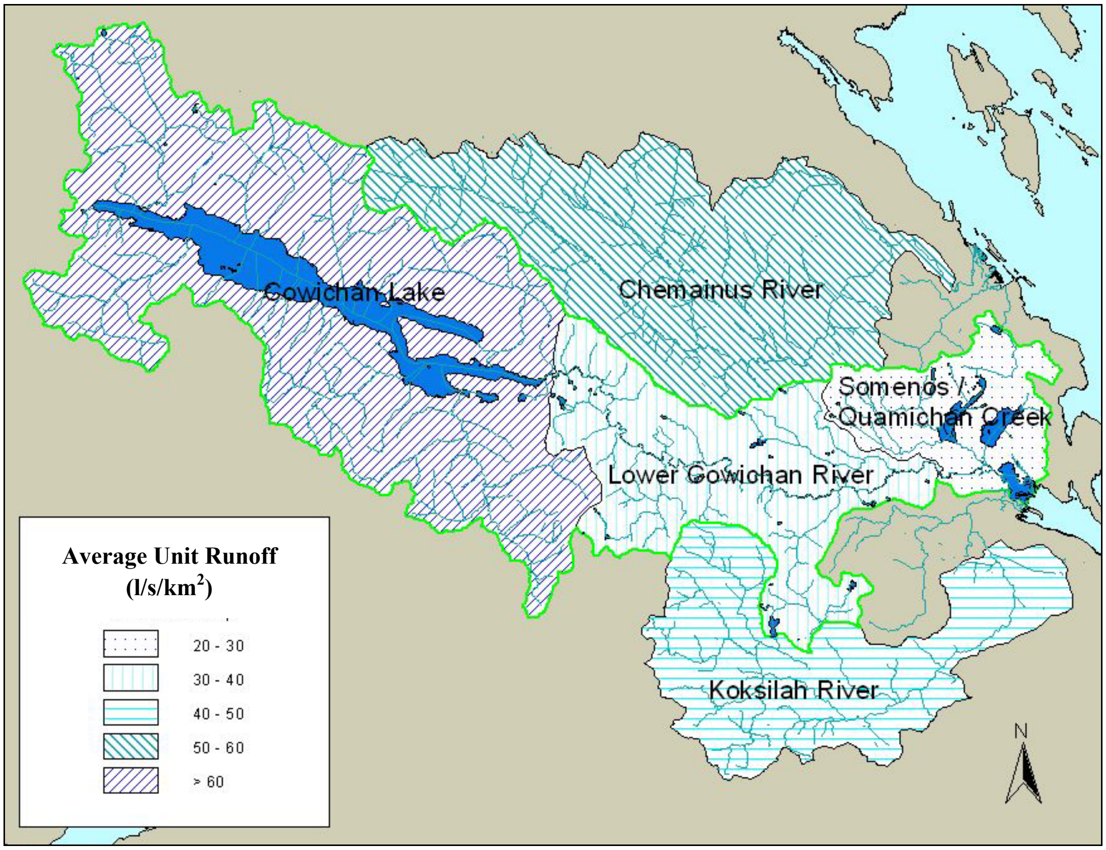
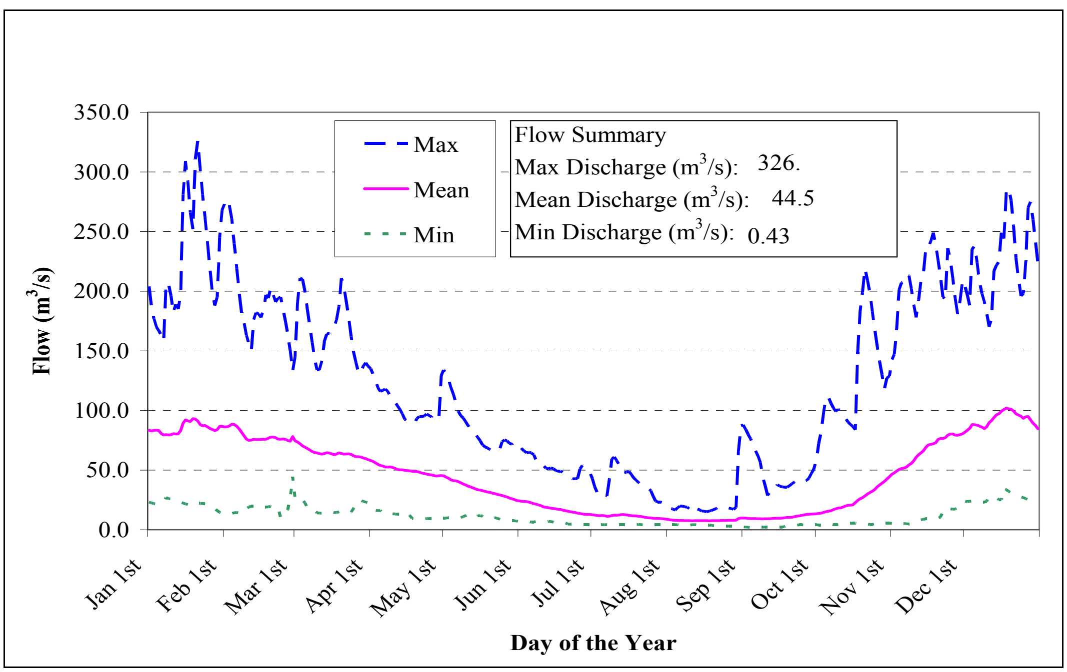


Figure 6. Distribution of runoff across the Cowichan Basin.



Source: Water Survey of Canada Online Archived Hydrometric Data
http://www.wsc.ec.gc.ca/hydrat/h20/

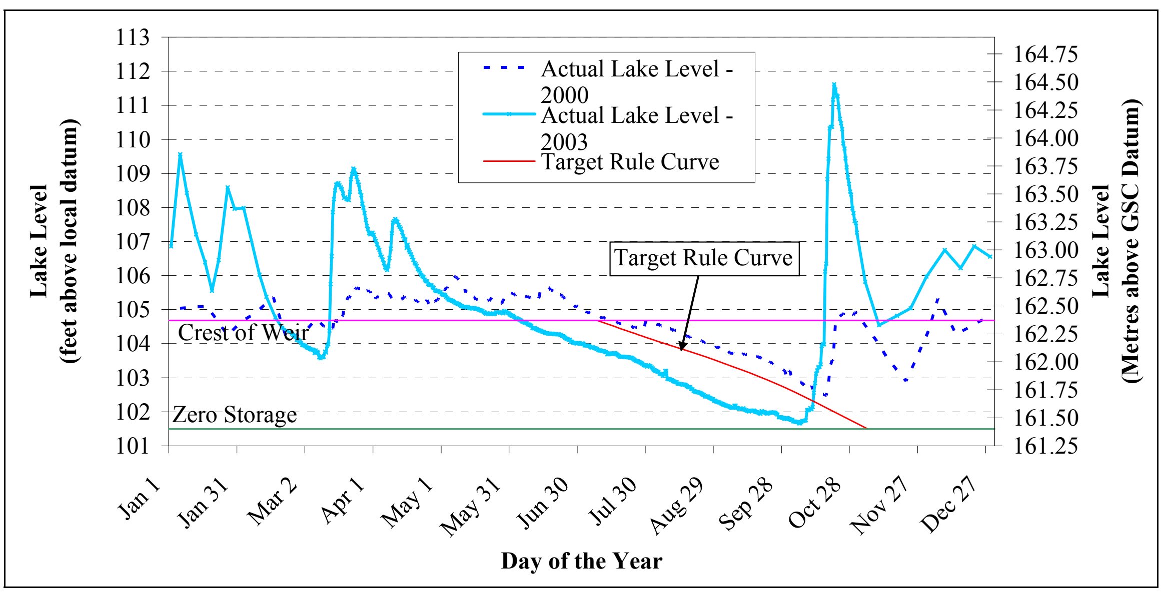
Figure 7. Annual discharge hydrographs for the Cowichan River at Lake Cowichan.

A low weir at the outlet of Cowichan Lake, owned and operated by Catalyst Paper under the authority of the Ministry of Environment, provides 0.96 m of storage in the lake, or approximately 59.5 million m^3. A series of four gates in the weir control flow in the river from the March 1 to the arrival of fall rains, typically in September or October. During this period, lake level and river discharge are controlled according to the provincially-approved storage "rule curve" and the release schedule (Figure 8).

The lake discharges to the river during the period of weir operation are scheduled as follows:

- 25 m^3/sec from March 1 to April 30,
- 15 m^3/sec from May 1 to June 15
- 7 m^3/sec from June 16 to September 30 (or until fall rains replenish lake supply).

These management tools are used by the weir operator to ration water stored in the spring season for release into the river during the summer. By using storage in the lake and following the rule curve, discharges in the river through the summer can be maintained at higher levels than they would be naturally. Before construction of the weir, river flows would often fall to 1 m^3/sec or less. With the weir, flows can be maintained at 7 m^3/sec during a normal summer. With approval of provincial water authorities, the release rate may be reduced to 4.5 m^3/sec if there are concerns about the ability of the level of lake storage to sustain 7 m^3/sec throughout the low flow season.



Source: Catalyst Paper Cowichan Lake Level and River Discharge Online Database
http://www.norskecanada.com/communities/communities_crofton_results_waterlevel.xml

Figure 8. Cowichan lake levels in 2000 and 2003 and the "rule curve".

When rainfall returns in the fall and the lake level rises above the weir, the gates are left fully open and the system goes into the "off-control" mode. During this period, lake levels typically rise well above the crest of the weir and are controlled by a natural narrowing of the river downstream of the weir (at the old railway trestle crossing) (KPA 1993).

Figures 9 through 12 schematically show the relationship between Cowichan Lake and Cowichan River. The drawings show the area near the Village of Lake Cowichan. The trestle (now footbridge) is shown as a point of reference. Before the weir was built (in 1957), water flowed freely out of Cowichan Lake into the river throughout the year. During summer, a narrow, shallow reach of the river roughly beneath the trestle impeded downstream flow during winter rains (Figure 9), and further limited flow during the summer (Figure 10). During dry portions of the year (generally late summer), flow in the river would nearly stop. Flows of as low as 1 m^3/sec occurred before the weir was built, including the lowest flow ever recorded, 0.4 m^3/sec.

With construction of the weir, water could be stored in the lake for release into the river during the summer. In the winter, the gates of the weir (and the boat lock) are fully open. The weir has no effect on water levels as water flows through and over the weir (Figure 11). Between November and April, lake levels and river flows are determined by precipitation and runoff in the upper Cowichan Basin, inflows into the lake, and the channel capacity at the trestle location. During the spring, the weir gates are closed, so that up to 0.96 m of water can be stored in the lake. From April to September, the weir gates are operated to regulate the release of the lake water so that, ideally, a minimum flow of 7 m^3/sec can be maintained until fall rains begin (Figure 12). This level of flow is still low compared to the 80-100 m^3/sec that flows downstream during the winter, but a constant flow of 7 m^3/sec throughout the summer is thought to be adequate to maintain the ecological health of the system in most years.

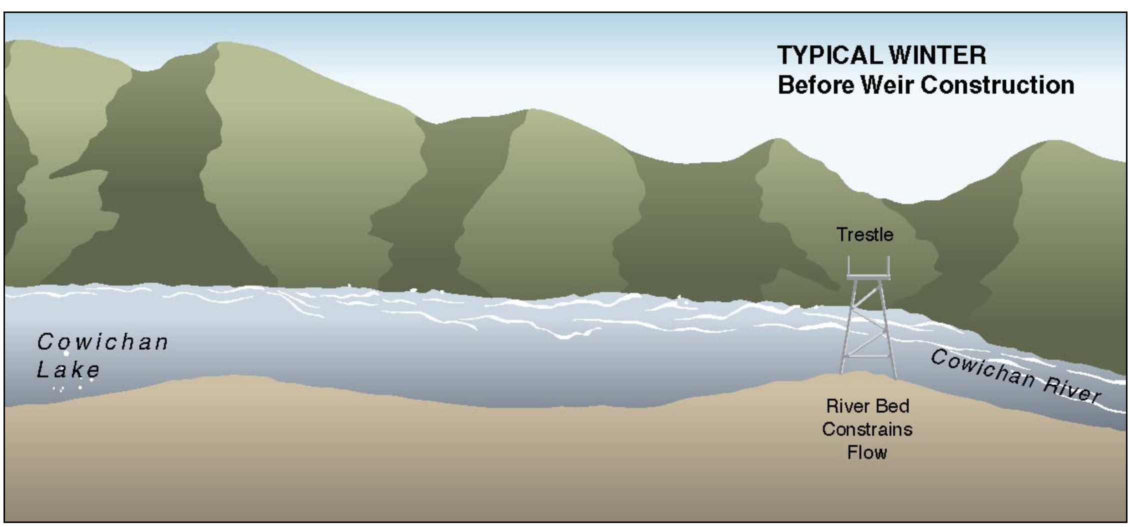


Figure 9. A narrow, shallow section of the river near the trestle footbridge regulates river flow and lake levels during the winter.

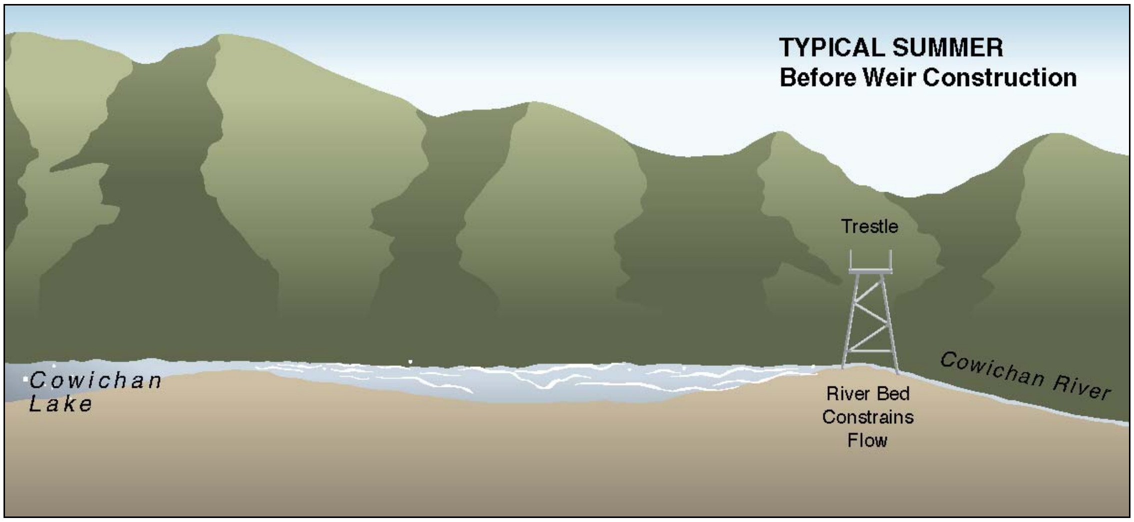


Figure 10. Before the weir was built, summer flows would fall to a trickle, as the trestle narrows was the only control on lake storage.

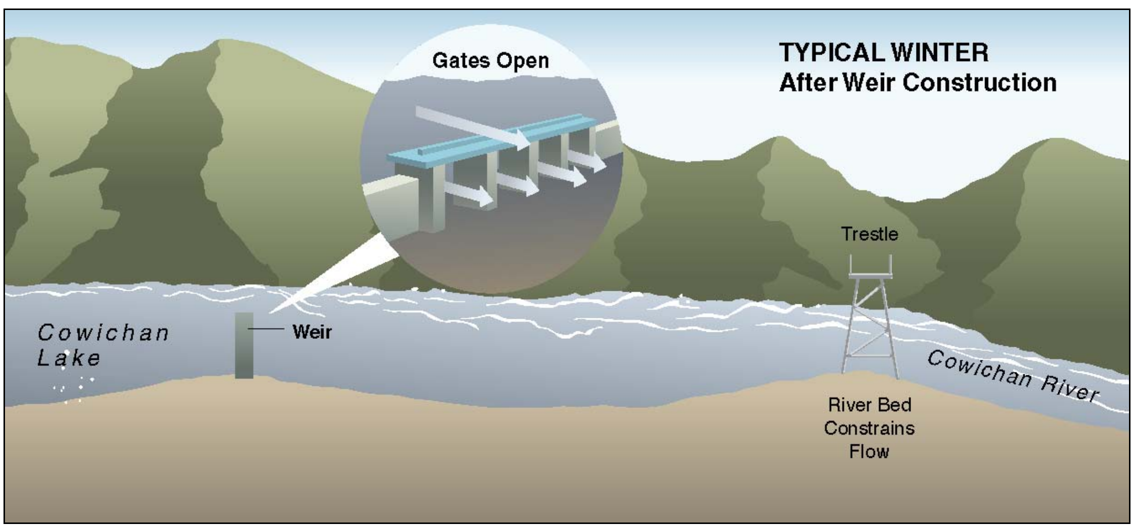


Figure 11. During the winter, the weir gates are opened and the lake and river systems operates as in pre-weir times, with inflow to the lake and the trestle narrows determining lake levels and river flows.

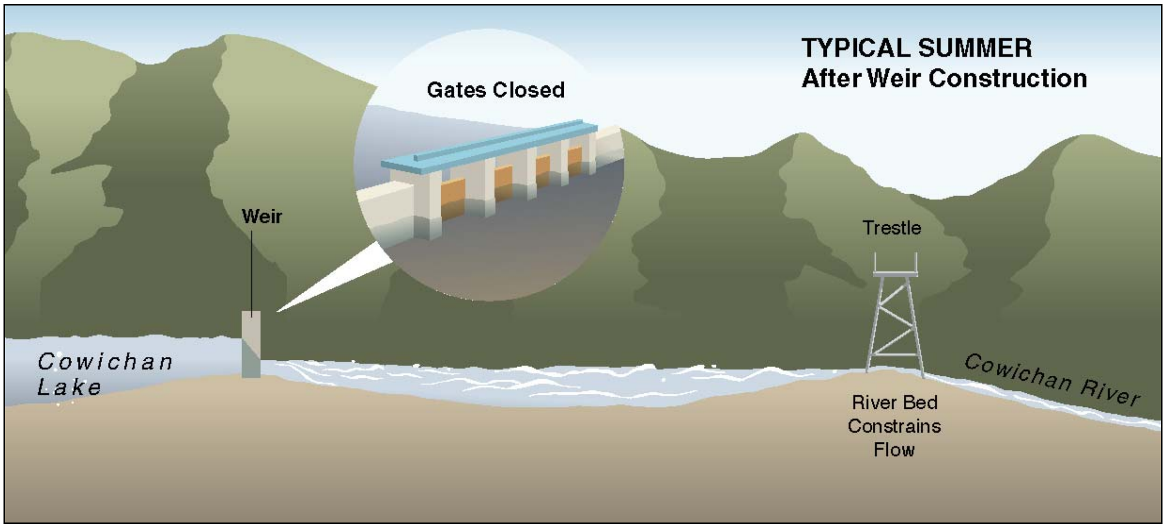


Figure 12. During the summer, the weir gates are operated to release measured amounts of water into the river and ensure reliable flow volumes during the dry season.

The weir helps to prevent extreme low flows in the Cowichan River. Figure 13 shows that under the present "rule curve," flows are kept above 7 m^3/sec throughout a typical summer. Without the weir, the river flows would decline to near zero by late summer, with severe potential effects on fisheries, streamside vegetation, and animals that depend on those fish and plants. Human use of the river would also be severely limited by very low summer flows. The weir has no effect on river flows during the rainy season.

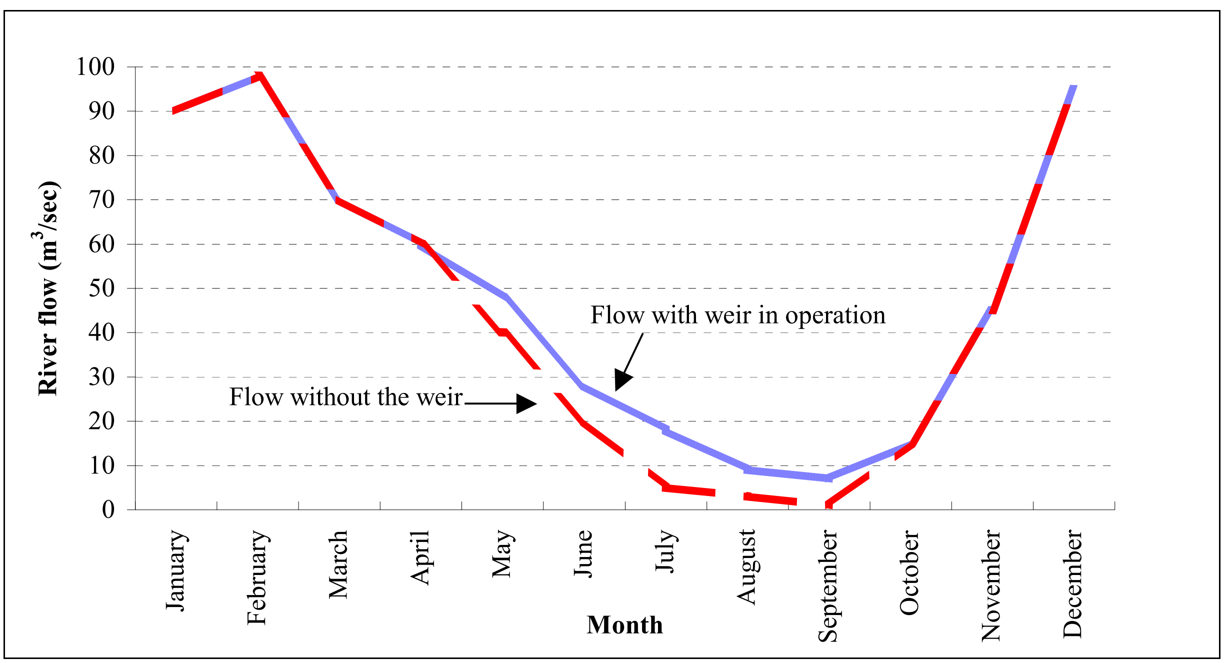


Figure 13. Effect of the Cowichan Lake weir on annual Cowichan River flows.

2.2.5 Ground water

Ground water is an important part of the hydrologic cycle, and most residents of the Basin obtain their water supply from ground water. Twenty aquifers in the Basin have been delineated by the Ministry of Environment as part of their *Aquifer Classification System* mapping program (Figure 14). The objective of the aquifer classification system is to inventory and prioritize aquifers for planning, management, and protection of the Province's ground water resource (Kreye *et al.* 1994). The system classifies aquifers based on their productivity, vulnerability to contamination, and level of development (water demand). Table 1 lists the aquifers in the Cowichan Basin identified by the Ministry of Environment classification system.

Table 1
Aquifers classified by the Ministry of Environment in the Cowichan Basin

Aq. No	Location	Materials	Size (km^2)	Productivity	Vulnerability	Demand
173	Maple Mountain, Crofton - Maple Bay	Bedrock	34	Low	High	Low
174	North Duncan	Sand	1.8	Moderate	Low	Moderate
175	North Duncan	Bedrock	42.3	Low	Moderate	Moderate
176	East Duncan - Maple Bay	Bedrock	15.8	Low	High	Low
178	Skutz Falls, Lake Cowichan, Paldi	Sand and Gravel	19	Moderate	Low	Low
179	Sahtlam	Sand and Gravel	9	Moderate	High	Low
180	Sahtlam	Sand and Gravel	8.7	Moderate	Low	Moderate
181	West Duncan	Bedrock	1.3	Low	Low	High
182	Paldi - Sahtlam	Bedrock	41.4	Moderate	Low	Moderate
183	West Duncan	Sand and Gravel	6.3	Moderate	Low	Moderate
184	West Duncan	Gravel	2.7	Low	High	Moderate
185	Deerholm, South Duncan	Sand and Gravel	14	Moderate	Low	Moderate
186	Duncan	Sand and Gravel	18.3	High	High	High
187	Duncan	Sand and Gravel	11	High	Moderate	Moderate
188	Duncan	Sand and Gravel	7.9	High	Low	Low
189	Honeymoon Bay	Sand	10.7	Moderate	High	Moderate
190	Youbou	Sand and Gravel	2.5	Moderate	High	Low
191	North Lake Cowichan	Sand and Gravel	3.2	Moderate	High	Moderate
192	North Lake Cowichan	Sand and Gravel	5.3	Moderate	Low	Low
196	Deerholm / Duncan	Bedrock	45.8	Low	Low	Low

Source: Ministry of Environment Aquifer Classification Database
http://wlapwww.gov.bc.ca/wat/aquifers/query/aquifers.htm

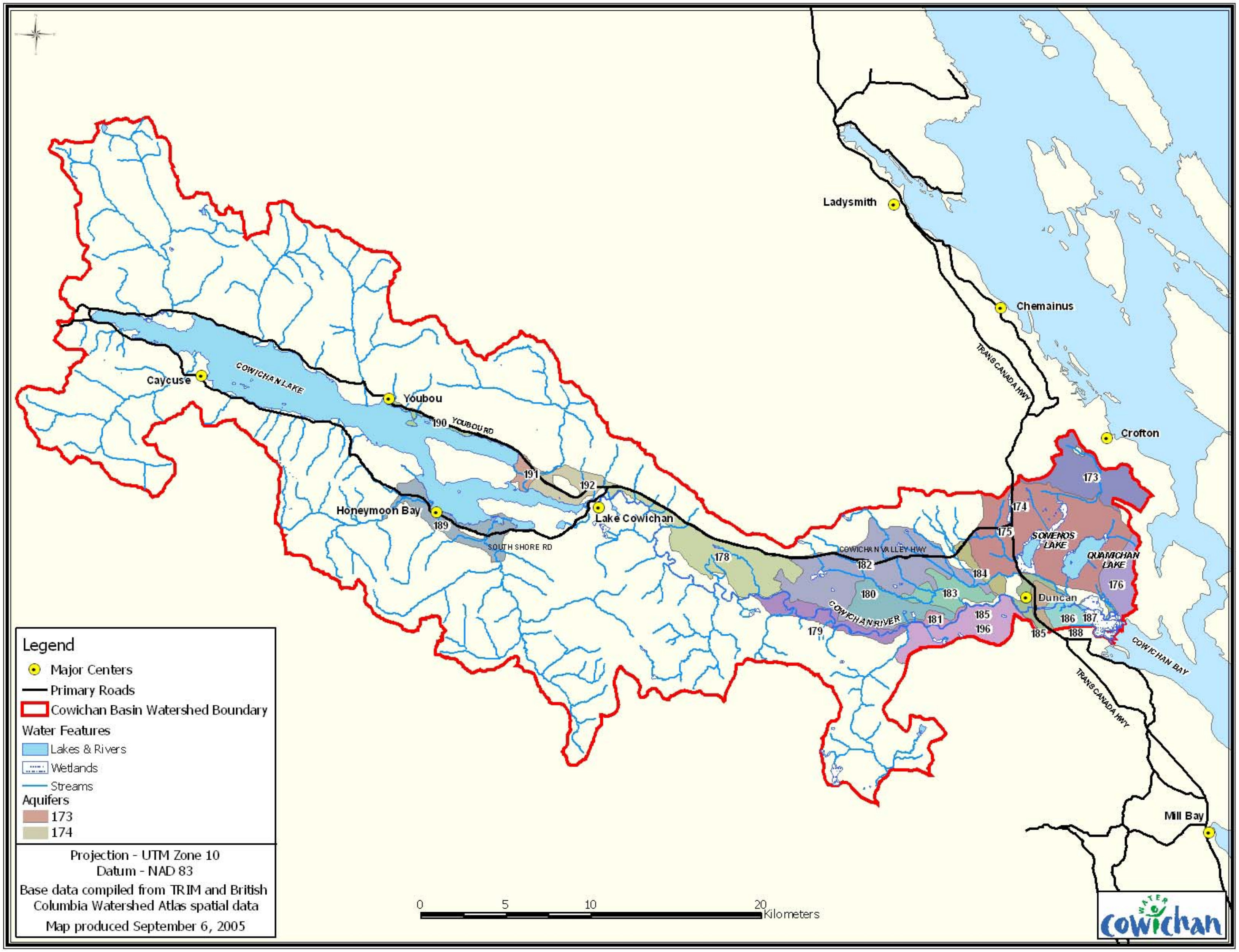


Figure 14. Mapped aquifers in the Cowichan Basin

Most of the mapped aquifers are found in the lower part of the Basin. Some of the largest sand and gravel aquifers on Vancouver Island can be found near Duncan and along the course of the Cowichan River. Most of these aquifers are unconfined, meaning layers of impermeable material do not overlie them. These unconfined aquifers are quite productive because they are easily recharged from precipitation and surface water sources. Unconfined aquifers are also vulnerable to being polluted, because the water table is close to the surface and pollutants can quickly enter the aquifer.

Aquifers in the Somenos and Quamichan sub-basins, which are underlain by more impermeable clays and silts, are less productive than the aquifers near Duncan. These aquifers also tend to be less vulnerable to pollution than the sand and gravel aquifers. In the upper part of the Cowichan Basin, the aquifers tend to lie in bedrock, and are less productive and less vulnerable than those aquifers in the lower part of the Basin.

2.3 Biological features

Ecosystems are interdependent communities of plants and animals, which have adapted to a specific set of environmental conditions. Changes in one component of an ecosystem may affect many species' habitats. The quality and abundance of water is an integral to ecosystem function. Climate, too, influences ecosystems; the dry Cowichan Basin summers are a major contributing factor in defining its ecology. Maintaining ecosystem integrity requires a comprehensive, long-term approach that manages for diverse values and uses (MELP 1999).

The streams, lakes, and rivers of the Cowichan Basin form the foundation of a complex ecological system, sustaining fish, wildlife, and plants. The Somenos and Quamichan sub-basins provide habitat for birds and fish in wetland complexes, the Cowichan estuary offers a staging area for fish during critical life phases and a stop for migratory birds, and many other areas of the Basin play important ecological roles. Many plants and animals are threatened or endangered on Southern Vancouver Island, and in the Cowichan Basin. Maintaining or improving habitat for these species and the linkages between ecosystem components is necessary to support these sensitive species.

The Cowichan Basin is known regionally and internationally for its high value, productive fishery (BC Parks 2003), and the Somenos and Quamichan sub-basins for their bird populations. In addition, wildlife species such as grey wolf, black bear, cougar, Roosevelt elk, bald eagle, osprey, hawks, owls, and a variety of amphibians and insects are key species in the region (BC Parks 2003).

The Cowichan Basin's physical and biological components do not function independently. The health of aquatic systems depends on functioning riparian zones; productive fish populations rely on suitable water temperatures, spawning beds, and food sources. Terrestrial wildlife rely on the availability of shelter, intact migration routes, and food. The natural function of the system relies on interactions between key components, including the transfer of nutrients of salmon into the forest by bears and birds.

2.3.1 Vegetation

Vegetation in British Columbia has been classified into three broad zones based on biological, geological, and climatic conditions. Three of these zones are found in the Cowichan Basin and reflect the precipitation patterns discussed in Section 2.2.1.

Most of the Cowichan Valley downstream of Cowichan Lake is in the Coastal Douglas Fir (CDF) zone (MEP 1986), characterized by a drier climate compared to the forests surrounding Cowichan Lake. Only small areas of CDF are found in the low elevation zones of Southeast Vancouver Island, but they provide some of the most diverse ecosystems in the region (MOF 1999a). In the CDF zone, Douglas fir trees dominate the landscape, standing above understorey vegetation such as salal and Oregon grape (MOF 1999a). Garry Oak ecosystems occur in this region, right up to the edge of the Cowichan River. Garry Oak ecosystems are rare and are home to more than 100 rare plants and animals (Fleming pers. comm.).

The Coastal Western Hemlock zone (CWH) covers much of the Cowichan Basin, primarily around Cowichan Lake. This zone occurs in some of Canada's wettest climates and supports highly productive forest areas (MOF 1999b). The CWH zone in the Basin is dominated by Douglas Fir. Western Hemlock and Western Red Cedar are less prevalent in the eastern parts of the Basin and increase towards the west side of Vancouver Island (Lorimer pers. comm.). The wet conditions around the lake encourage the growth of large trees and associated complex ecosystems. Much of the winter precipitation in the CWH zone falls as rain (Fleming pers. comm.).

The higher elevations around the lake are in the Sub-alpine Mountain Hemlock zone. Thus, the upper reaches and headwaters of the watershed are the only areas where the snow pack accumulates. This snow pack is critical to dry season water flows.

Riparian vegetation

The Cowichan Basin is well known for its fish and wildlife. Many of these species rely on the riparian zone, the land on the margins of lakes and streams. Maintaining a healthy riparian zone is important to the productivity and resilience of streams and lakeside habitats. Alteration to the natural succession patterns in the riparian zones, such as logging old growth trees, affects the complexity of the system and its overall function.

Riparian vegetation form distinct communities and serve a number of roles in the ecosystem, such as:

- **River bank stabilization and water quality protection:** The roots of trees, shrubs and other plants in the riparian zone reduce, and capture some of the pollutants and sediments that would otherwise enter the stream.
- **Fish habitat:** Trees, trunks, roots, and branches that fall into the stream serve to slow water flows, creating pools and riffles and enhancing spawning, resting, rearing, and refuge areas. Pools and riffles also provide habitat for the insects that are important in the diets of fish and birds.
- **Wildlife habitat:** Most animals in the Cowichan Basin use riparian areas during at least some portion of their life cycle. Riparian areas provide food, nesting, migration corridors, and security areas for animals.
- **Food chain function:** Salmon and trout consume insects during the freshwater portion of their life cycle. In a classic example of a food chain, riparian areas provide the leaves and wood that serve as food for plant-eating insects that are eaten by carnivorous insects that are, in turn, a major component of fish diets (Fleming pers. comm.).
- **Thermal cover:** Riparian vegetation helps to moderate water temperatures in summer and winter and protect fish from stress. Streams shaded by riparian vegetation have colder summer temperatures, less algae, and more dissolved oxygen than unshaded streams (King County 2005).

Flow rates of 7 m^3/sec, maintained during most summers, wet the Cowichan River channel from bank to bank, watering riparian vegetation that shades and cools the river (Tutty pers. comm.).

Introduced species

The introduction of invasive species to an ecosystem can displace native plants and animals and reduce biodiversity. In the Cowichan Basin, some of the species of concern include Japanese knotweed, yellow flag iris, bullfrogs, Canada geese, white clematis (CCLT 2004), purple loosestrife, gorse, scotch broom (Williams pers. comm.), bullfrogs, pumpkinseeds and sunfish (Fleming pers. comm.). Recent reports have also identified the presence of Eurasian water milfoil (Myriophyllum spicatum L.) near the Cowichan Lake outflow.

Introduced vegetation has the ability to:

- grow and spread rapidly,
- invade and replace native plant communities,
- obstruct swimming, boating, waterskiing, and fishing,

- reduce the appeal of beach areas due to the accumulation of plant debris,
- impede flood control, water conservation, drainage and irrigation works,
- reduce the economic benefits of tourism where dense growth limits recreation (MOE 1993), and
- reduce oxygen levels in water (Fleming pers. comm.).

2.3.2 Fisheries

The Cowichan River is one of the most valuable and productive salmon and trout streams on Vancouver Island (MEP 1986). In 2004, the value of the commercial, sport and First Nation fisheries was estimated to be $6 million to $10 million dollars.

The productivity of the Cowichan River is attributed to the quantity of accessible, low-gradient waterways, which provide suitable spawning and rearing habitat for salmon and trout that spend portions of their life cycles in freshwater and the ocean, and resident fish, which spend their lives entirely in freshwater (Lill, Marshall and Hooton n.d.).

Cowichan Lake functions as a regulator in the lake-river system by stabilizing stream flows, settling sediment from inflows, moderating summer and winter water temperatures, and controlling organic and inorganic nutrients (MEP 1986 and Lill, Marshall and Hooton n.d.).

The Cowichan system supports important native fish species including:

- Chinook salmon
- Coho salmon
- Chum salmon
- Kokanee salmon
- Cutthroat trout
- Rainbow trout
- Steelhead
- Dolly Varden char.

Several other species, including Atlantic salmon, brown trout, speckled char, pumpkinseed, and sun fish are also found in the system (Perrin et al. 1988 in Ho et al. 2003; Fleming pers. comm.).

There is a strong relationship between Cowichan River flows and fish life stages. Spawning, incubation, rearing, and migration success can are all linked to the flow patterns of the river. The life cycles of many of the fish in the Cowichan system are described briefly in Table 2.

Table 2
Role of the Cowichan system in supporting the life cycles of steelhead, resident rainbow, Chinook, and Coho

Species Life History Phase	Jan Early	Jan Late	Feb Early	Feb Late	Mar Early	Mar Late	Apr Early	Apr Late	May Early	May Late	Jun Early	Jun Late	July Early	July Late	Aug Early	Aug Late	Sep Early	Sep Late	Oct Early	Oct Late	Nov Early	Nov Late	Dec Early	Dec Late
Steelhead (winter)																								
Spawning (upstream mig.)	X	X	X	X	X	X	X	X													X	X	X	X
Incubation	X	X	X	X	X	X	X	X	X	X	X	X	X										X	X
Rearing (1-3 years in stream)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Migration (downstream)										X	X	X												
Smolt Migration							X	X	X	X														
Resident Rainbow																								
Spawning		X	X	X	X	X	X	X	X	X														
Incubation				X	X	X	X	X	X	X	X	X	X	X										
Rearing							X	X	X	X	X	X	X	X	X	X	X	X						
Overwintering	X	X	X	X	X	X													X	X	X	X	X	X
Lake-Stream Migration							X	X	X	X	X	X												
Juvenile Migration to Lake																X	X	X	X					
Chinook																								
Spawning (upstream mig.)																	X	X	X	X	X	X		
Incubation	X	X	X	X	X	X	X															X	X	X
Rearing							X	X	X	X	X	X	X											
Migration (downstream)							X	X	X	X	X	X	X											
Coho																								
Spawning (upstream mig.)																			X	X	X	X	X	X
Incubation	X	X	X	X	X	X	X	X	X															X
Rearing (1 year in stream)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Migration (downstream)									X	X	X	X												

In general, the river and lake systems support important components of the fish life cycle, including spawning. The lakes and rivers of the Cowichan Basin are important throughout the entire year, not only seasonally during the spring or fall.

Overall, the salmonids of the Cowichan River support several important fisheries, including a native food fishery, ocean sport fishery, commercial ocean fishery, and river sport fishery (Hop-Wo et al. 2003).

2.3.3 Wildlife

The Cowichan Basin provides habitat for many species of birds and wildlife. Small mammals found in the Basin include shrews, voles, bats, and red squirrels. Raccoons, mink, martens, and weasels are also common, and river otters and beavers inhabit the river. The riparian environment provides an important wildlife corridor and habitat for grey wolf, black bear, cougar, black-tailed deer, Roosevelt elk, bald eagle, osprey, herons, swans, hawks, owls, ducks, and a variety of amphibians and insects (BC Parks 2003). The Cowichan Basin supports the Vancouver Island ermine, a threatened species that inhabits mature riparian and shoreline forests and wetlands and requires coarse woody debris. The Basin also sustains at least 200 species of birds, including Trumpeter swans, dunlin, American widgeon, Canada Geese, western sandpipers, and Great Blue Herons. As a component of the Pacific Flyway for migratory birds, the Cowichan Basin is located along an internationally significant migration route for birds along the Pacific Coast of British Columbia.

Other species were once thought to inhabit the Basin such as the marbled murrelet, now considered a threatened species in British Columbia (Fleming pers. comm.). Their habitat would likely have included the old growth trees in riparian area.

2.3.4 Other areas of ecological interest

The Somenos sub-basin. Somenos Marsh is a wetland complex with exceptional wildlife, wetland, and fisheries values (Williams and Radcliffe 2001). Internationally significant populations of waterfowl, including Trumpeter Swans and Great Blue Herons, frequent the Somenos Marsh. Somenos Lake is eutrophic and has prime migration, over-wintering, and nesting areas used by Canada Geese, swans, diving ducks, and dabbling ducks.

Rare and threatened plants are found in the Somenos sub-basin, mostly in the relatively rare deep soil Garry Oak forest system on its southeast side (Williams and Radcliffe 2001).

The Somenos sub-basin also plays an important role in the life cycles of Cowichan River coho salmon, trout, and char. Coho and trout return to spawn in tributary creeks, and coho pre-smolts and trout from other parts of the Cowichan River system migrate to the Somenos sub-basin for winter habitat. During high winter flows, the flood plain provides refuge habitat for coho and trout.

Urban and agricultural development has altered the natural characteristics of the Somenos sub-basin. Some of the key wildlife management issues relate to declines in biodiversity as a result of simplification of habitats, the influence of non-native predators and competitors, reductions in migratory songbird populations (although an international phenomena), and displacement and other disturbance effects from human and pet activities. Another significant issue is the decline in carrying capacity for Great Blue Herons, wintering swans, geese and other waterfowl, which find the best feeding in the flooded fields of the Somenos sub-basin (Williams and Radcliffe 2004). Drainage and storm water management have long been concerns in the sub-basin.

The Quamichan sub-basin. Quamichan Lake is surrounded by sloping shorelines and wetland areas. Water from the lake drains to the south via Quamichan Creek to the Cowichan River. Agricultural, residential, and recreational development has occurred around the lake.

A resident cutthroat trout population spawns in Quamichan Creek. The fry emerge from small spawning areas at the outlet and return to Quamichan Lake before Quamichan Creek runs dry in May or June. In past years, the creek has run dry before the fry could migrate to the lake, resulting in significant losses. Quamichan Lake cutthroat are known to be particularly large and, together with stocked trout, provide fishing opportunities from the late fall to the early spring (Haddow 2005). Coho and chum are present below the falls (2 m rock migration barrier) that impedes further upstream movement.

Quamichan Lake, surrounding wetlands, and the drainage corridor to the Cowichan estuary provide some of the most important waterfowl habitat in the Cowichan Basin. Recreational opportunities include water sports, fishing, and scenic viewing.

The Quamichan sub-basin also supports agriculture. Although farming benefits from use of the lake for irrigation, high spring lake levels delay access to fields and reduce yields. The low gradients on both McIntyre and Quamichan Creeks, combined with obstructions in the creeks, play a role in delaying drainage. The problems are worsened by beaver dams that impound water and affect drainage, and likely by development that has hastened runoff around the lake.

Quamichan Lake is naturally eutrophic, meaning that high levels of nutrients are found in the water. This condition results in reduced oxygen levels during the summer, which can lead to fish kills. In addition to natural sources, nutrients from agricultural fields, septic tanks, and urban run-off contribute to eutrophication.

A low dam at the south end of the lake has been proposed. Reports suggest that fish would benefit from more spring flow and suggests that there may be an opportunity to utilize Quamichan Lake to increase coho production if flows were seasonally managed to assist out-migration of colonized coho (Haddow 2005).

Cowichan River Provincial Park. Cowichan River Provincial Park was established in 1995 to protect natural values, support recreational opportunities, and preserve cultural heritage features. The park protects important wildlife habitat, representative Douglas Fir and western hemlock forest communities, and rare wildflowers (BC Parks 2003).

Cowichan River Provincial Park contains many rare and endangered plants, many of which are contained in the Garry Oak ecosystem. This ecosystem may be the most westerly in Canada (BC Parks 2003).

Cowichan Estuary. The Cowichan Estuary is shared by the Koksilah and Cowichan Rivers. The shallow water, marshes, and tidal flats of the Cowichan Estuary provide biologically productive habitat that is essential to migrating waterfowl, anadromous fish such as salmon, and other wildlife species (CCLT 2004). The estuary is one of the best-known sites for wintering and migrant waterfowl along coastal British Columbia (Ducks Unlimited 2005). More than 200 species of birds, and 16,000 waterfowl use the estuary during peak migration, though even these numbers may be lower than historic levels (Fleming pers. comm.). The estuary also serves as a nursery for seaward-migrating juvenile salmon and trout adjusting to marine conditions, and as a staging area for mature salmon moving upstream to spawn.

The estuary has been affected by agriculture, residential development, saw mills, log booms, water pollution, and waste disposal. Upstream activities in the Cowichan Basin affect the estuary by introducing sediment and other pollution to the system (Williams pers. comm.). The Cowichan Estuary Environmental Management Plan (CEEMP) was completed in 1987 to provide a framework for future management of the estuary. Estuary conservation projects now involve 300 hectares of farmland and inter-tidal areas, or nearly 75% of the estuary (Ducks Unlimited 2005).

2.3.5 Conservation initiatives

Conservation efforts have been initiated in the Basin to maintain and restore the natural state of the Cowichan River corridor (TLC 2005). Tools such as conservation covenants are being used to protect key values along the river corridor. Efforts in the lower basin focus on restoring eelgrass, managing introduced species, assessing ways to increase habitat for fish and wildlife, and employing fish hatcheries to increase fish populations. Habitat restoration on Cowichan River includes construction of seven side channels, primarily for coho and salmon (BCCF 2005).

These channels are used extensively for spawning by chum, and serve as winter refugia for other species. More than 150 channels could be rehabilitated (Tutty pers. comm.). The variety of conservation initiatives in the Cowichan Basin highlights the broad support for protecting the Basin's ecosystem.

Fisheries enhancement. Two fishery enhancement projects are presently functioning on the Cowichan River:

- **Cowichan Fish Hatchery.** The Cowichan Fish Hatchery is a Salmonid Enhancement Facility operated by Cowichan Tribes under contract to Fisheries and Oceans Canada. The focus of the operation is to increase wild salmon stock populations through a combination of brood stock and salvage strategies. The facility has a 3.5 million-egg capacity, but is limited by well water supply and governed by federal policy that limits annual brood stock collection to 30% of returning salmon escapements. The facility uses only ground water. Since 1979, the hatchery has released almost 36 million Chinook fry and other fish (Cowichan Tribes website).

- **Vancouver Island Trout Hatchery.** The Vancouver Island Hatchery raises rainbow trout, and anadromous and resident cutthroat trout. The hatchery also supplements the Cowichan River steelhead population with 50,000 smolts each year (Wightman pers. comm.). The facility uses ground water for its operations.

Two private aquaculture operations are on the Cowichan River, both of which use ground water. A small fish hatchery is also located on Cowichan Lake (Tutty pers. comm.).

3.0 Human and Cultural Setting

3.1 Human use

3.1.1 Forestry

The forest industry has long been a mainstay of the economy of the Cowichan Basin. The highly productive forest ecosystems of the region produce magnificent Douglas fir and other tree species. The forest lands in the Cowichan Basin are among the most productive in Canada. Much of the land in the Basin was granted to E & N Railway, and over time was sold and re-sold to a variety of land owners, most of whom continue logging and related forestry activities. Nearly all of the original old growth trees have been logged and the cutting of second growth trees is underway (Photo 1). Most logs are shipped outside the Basin for processing or export.

Photo 1. Cut blocks north of the Cowichan River provide evidence of continued forestry activity in the Cowichan Basin.

Official Community Plans for Cowichan Basin jurisdictions show that approximately 69,700 ha of land is designated for forestry, or nearly 75% of the area of the Cowichan Basin. Most of this land is privately held, although some Crown land is managed by BC Timber Sales, Community Forest Licences, Woodlot Licences, and Forest Licences.

3.1.2 Settlement

The benign climate and productive landscape of the Cowichan Basin have long drawn people to settle here. The Cowichan People lived on the banks of the Cowichan River and Cowichan Lake for generations prior to European contact, and continue to do so today. Non-aboriginal settlements have grown at Duncan, Lake Cowichan, and dozens of other small centres throughout the Basin. Settlements favour flat sites and access to water, so it is no surprise that most people live near to the Cowichan Lake and River.

Approximately 15,800 ha of land, or about 17% of the Cowichan Basin area, is designated in OCPs for settlement, including residential, commercial, or industrial use. Some of these settlement designations allow for mixed-use community development (primarily in Duncan, North Cowichan, and Lake Cowichan), and others are designated for low-density rural residential areas, including a strip that runs along the lower elevations of the Cowichan River valley. The implications of this residential development for water use are discussed later in this report.

3.1.3 Agriculture

The lower Cowichan Basin has some of Canada's most productive farmland. The extent of productive agricultural soils is limited to lowland depositional parts of the Basin, reflecting the influence of glaciers and rivers. The spread of urban and industrial development limits the land available for farming. Most farming occurs in the Somenos and Quamichan sub-basins, though other areas used for production of forage, vegetables, and livestock are found in the Cowichan River valley and around Cowichan Lake. Recently, vineyards have been established on slopes above the valley. In total, approximately 2,500 ha of land (3% of the Cowichan Basin area) is actively used for agricultural production, and 5,900 ha of land (6% of the basin area) is included in the Agricultural Land Reserve.

3.1.4 Recreation and tourism

The Cowichan Basin has provided the setting for a wide range of tourism and recreation activities for the past century. Local residents, other Canadians, and international travelers visit the area throughout the year. Many of the tourism and recreation activities are focused on the natural attributes of the region, including picturesque landscapes, camping, hiking, boating, kayaking, canoeing, rafting, fishing, and other experiences offered in Cowichan Basin communities.

Accommodation. More than 25 accommodation facilities operate in the Cowichan Lake and river corridor alone. Youbou, Duncan, Lake Cowichan, Honeymoon Bay, and other communities located in the Basin provide roofed accommodations. The facilities range from bed and breakfast to hotel and lodge operations. A company also offers house boating opportunities on the lake.

Parks and recreation features. The Cowichan Basin draws people from around the world for its natural resources, scenic beauty, diversity of outdoor recreation opportunities, particularly its high-quality trout and salmon fishing.

The mild winters and warm summers allow year-round recreation on lakes, rivers, and tributary streams. The relatively good access to much of the study area encourages tourists and residents to participate in activities such as camping, swimming, fishing, boating, hiking, tubing, rafting, kayaking, water-skiing, wind-surfing, and canoeing.

Two popular provincial parks are located in the Basin. Cowichan River Provincial Park is a 1,414-hectare protected area that stretches from Lake Cowichan east to Duncan (BC Parks 2005a). The park includes the Cowichan River footpath, which meanders along the banks of the river between Duncan and Skutz Falls, providing hiking and scenic viewing (BC Parks 2005b). The two campgrounds in the park include the Stoltz Pool campground with 43 year-round sites, and the Skutz Falls campground, which provides 33 sites from May 15 to September 10.

Gordon Bay Provincial Park is a 51-hectare park on the shores of Lake Cowichan. The park features sandy beaches and picnic sites set amid second growth Douglas fir (BC Parks 2005b). Hiking, wildlife viewing, water-skiing, windsurfing, and spring, fall and winter fishing opportunities are popular among residents and visitors. The campground provides 134 sites open from March 14 to October 31 (BC Parks 2005b). The Gordon Bay campground is the most popular campground on the lake, with more than 100,000 campers per year.

The Basin also includes other visitor attractions such as the Cowichan Valley Demonstration Forest, Honeymoon Bay Ecological Reserve, and parks in the communities of Youbou, Lake Cowichan, and Duncan. These parks and green spaces support a natural base for tourism and recreation activities in the Basin.

In addition to provincial campgrounds, there is one municipal, four private, and three South Island Forest district campgrounds (CLIAS 2005). Timberwest also operates campsites in the Lake Cowichan area including the Caycuse, Heather, and Kissinger Lake campsites. Many of the campgrounds are located along the lake and the river. There are at least nine boat launches located on Cowichan Lake. Unauthorized camping and associated garbage dumping are a problem in the Basin, raising health, safety and environmental concerns.

The Trans Canada trail passes through Lake Cowichan on the route between Nanaimo and Victoria, providing hiking and cycling opportunities along an old railway corridor and across numerous trestles. Bald Mountain, Mesachie Mountain and Hill 60 provide access to hiking trails, lake and alpine views, and historic sites.

Fishing. Freshwater sportfishing for steelhead, trout and salmon generated about 11,000 angler days in 1997. In that year, approximately 27,500 sport fish were caught. The total value of the Cowichan sport fishery in 1997 was estimated at $1.1 million based on direct angler expenditures (Burt and Wightman 1997). In 2004, the value of the Cowichan River's commercial, sport, and First Nations fisheries was estimated to be $6-10 million (Tutty 2004).

The Cowichan River supports excellent rainbow, cutthroat, and brown trout fishing throughout the year. The runs include winter steelhead (December to April), coho (October to November), chinook (September to November) and chum (October to December). Kokanee salmon are also caught in the Cowichan system. Popular fly fishing areas on the Cowichan River are from Stanley Creek near Lake Cowichan, downstream to the CNR bridge (70.2 Mile Trestle), plus Sandy Pool, Skutz Falls, and Stoltz Pool. Quamichan and Somenos Lakes are other popular fishing lakes that are easily accessible. Quamichan Lake has stocked rainbow and wild cutthroat, and Somenos Lake has stocked rainbow and cutthroat.

Changes in river and lake water levels affect angling. Licensed freshwater angling guides and some sport fishers have also expressed concern about reducing flows in the March to May period. They propose that flows of between 14 and 28 m^3/s are required through this period (Wightman pers. comm.). Higher water flows of 25 m^3/s in the spring allow better driftboat access for anglers and increase the opportunities for fresh water angling (Tutty pers. comm.). Dense riparian vegetation (such as willows) limits the ability of anglers to wade along the river bank in some places.

Water-based recreation. Cowichan Lake and River provide canoeing, kayaking, and tubing opportunities. Since the weir was constructed in 1957, the length of the season for these activities has been extended due to suitable river flows later into the season (MEP 1986).

Whitewater paddling is popular on the Cowichan River (Photo 2). One popular area is below Skutz Falls, with paddlers taking out at Marie Canyon. This section of the Cowichan is mostly Grade II and III, but at lower water levels some rapids are elevated to class IV. High river flows from November through the spring offer experiences for the more advanced kayakers (Barrie pers. comm.). High spring flows also extend the kayaking season. Advanced users require a minimum flow of 30 m^3/sec, with 100 m^3/sec being optimal. Use levels in the winter are estimated at 30 to 40 kayakers during the weekend days, and 10 kayakers per day during the week (Barrie pers. comm.). Summer flows of 7 m^3/sec are suitable for beginner kayakers, though flows of 10 m^3/sec reportedly would create a better experience and potentially increase the number of users. Guided groups of 7 or 8 kayakers and a small number of unguided kayakers use the river throughout the summer. Conflicts between users on the river are generally minor, although issues arise occasionally between tubers and kayakers. At the end of the summer, a local kayaking group organizes a cleanup to remove garbage along the river (Barrie pers. comm.). The Cowichan River Splash, organized by the Cowichan Community Land Trust in 2004 and 2005, also removes garbage from the river and adjacent areas (Williams pers. comm.).

Photo 2. Kayakers paddle down the Cowichan River.

Tubing (floating downstream on an inner tube) is popular throughout the summer months on the Cowichan River. The tubing season generally runs from June to September. An estimated 600 people per day tube the Cowichan River on summer weekends (Leger pers. comm.). The primary area of use for most tubers is from the Cowichan Lake weir to Little Beach, 2 km downstream, though other parts of the river such as Vimy Road to the White Bridge are also heavily used. Tubing tends to decrease with poor weather such as rain or colder water temperatures. According to one operator, water levels do not significantly affect tubing immediately downstream of the weir, although increased contact with exposed rock may occur and areas must be bypassed due to low water levels (Leger pers. comm.). Though some operators contend that the current level of use does not create crowding issues, newspaper articles and public comment express different views. The public has raised concerns about tubers trespassing on riverside properties, and garbage in the river and on property.

Predictable flow levels in the Cowichan River during the spring, summer, and fall support recreational boating opportunities. Increased flows during the same period would likely increase the opportunities for boaters.

Land-based activities. Hiking is a popular activity throughout the Cowichan Basin (Hignell pers. comm.). The Cowichan River Footpath is a prominent feature of this area, providing a scenic route along the winding Cowichan River from Glenora to Skutz Falls. The banks of the river provide habitat for a diversity of wildlife species. Wildlife viewing has become an important part of the hiking experience around the Cowichan area. In other regions of the Basin, such as Mount Tzuhalem, mountain biking is a popular and growing activity.

Scenic driving opportunities also exist along the 75 km of road that circles Cowichan Lake. Along the lake edge, campsites, picnic areas and boat ramps are important recreation features. The road west of Youbou and Honeymoon Bay is a private industrial logging road. Large machinery and forestry crews may be operating in the area, and the road can be shut down or access restricted with little warning to facilitate logging or road repairs, or due to fire risk.

3.2 Cultural values and uses

The Cowichan Basin is home to the Cowichan Tribes. The river and lake have cultural importance to the Cowichan People that is based on generations of occupancy and use of the Basin's water and biological resources, and extend to stories and spiritual values. The following section was provided by the Cowichan Tribes as a summary of their relationship to the Cowichan Basin.

Historical Context

Cowichan Tribes is one of six First Nations represented by the Hul'qumi'num Treaty Group that was founded in 1993 to jointly negotiate a comprehensive treaty with British Columbia and Canada in the BC Treaty Process. The six First Nations (Chemainus First Nation, Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation, Penelakut Tribe) share a common language *Hul'q'umi'num'* that connects them to their common traditional territory, culture and history. Figure 15 shows the core traditional territory of these people, the Hul'qumi'num Mustimuhw. The Cowichan Basin is part of the core traditional territory.

Source: Landsat 7 image circa 1990

Figure 15. Hul'qumi'num Treaty Group Core Traditional Territory.

As the original stewards of these lands and resources, the Hul'q'umi'num' Mustimuhw have known continuous occupation of s'aa'lh tumuhw, our land, for more than 9,000 years. Treaty maps show more than 500 Hul'q'umi'num' place names blanketing the landscape from southeast Vancouver Island, the Gulf Islands, and the Lower Fraser River, demonstrating an ongoing connection to local lands, waters, and resources.

> "The connection between our people and the land is fundamental to the Hul'q'umi'num' Mustimuhw's cultural identity and way of being. Our oral history and customary laws teach us that we are not of the land, we are the land and its resources. Our connection to our territory is based on our ongoing history of use, occupancy, and customary laws of land ownership and is deeply rooted in our cultural fabric. Our snuw'uy'ulh, Hul'q'umi'num' laws, tell us that our inalienable connection to the land and resources is not our right, it is our responsibility."

HTG, "Getting to 100%", , 2005

Cowichan People have a strong connection to the river system that sustains their livelihood and spirituality (Figure 16). Though their lives and landscapes were dramatically altered by the arrival of *Hwulunitum*, European explorers and settlers (HTG, 2005), the connection with the river has endured. Cowichan People continue to live in villages along the river *Kwa'mutsun* (Quamichan), *Qu'umiyiqun* (Comiaken), *Lhumlhumuluts'* (Clem Clem), *Xinupsum* (Khenipsen), *S'amuna'* (Somenos), *Xwulqw'selu* (Koksilah), *Tl'ulpalus* (Cowichan Bay), *Qul'i'lum* (Dougan Lake), *Ts'alha'um* (Riverbottom/Satlam), *Skuts* (Skutz). In 1888, the people from these villages amalgamated to form the "Cowichan Band" or "Cowichan Tribes" as they are now known.

> "From these village bases, our ancestors would travel to smaller villages or campsites to collect seasonally abundant resources, such as fish, sea mammals,

> berries, plants, deer, and elk. Some sites were sacred and reserved for special ceremonial uses. We had hundreds of sites spread throughout our territory, used by many generations of our people.
>
> Our territory covered the entire Cowichan valley, the surrounding region around Cowichan Lake and Shawnigan Lake, and extended into the Gulf Islands and the Fraser River. We would travel on water in hand-crafted canoes, and on land over an extensive network of trails.
>
> Every year we were assured great riches as the spawning salmon returned to the Cowichan, Koksilah, and other rivers and streams. Their capture and distribution was carefully managed by our Elders through the use of fish weirs, a gift from the First Ancestor, Syalutsa. The weirs ensured abundant fish for our people to eat, while allowing enough fish to reach the spawning beds to ensure future returns. Other resources were equally managed with an eye to future abundance (Figure 16).
>
> Our ancestors touched the lands, rivers, and oceans in our territory lightly and with respect. We used only what nature provided, and only what we needed. Today, you can walk on ancient village sites and see little evidence of our ancestors' presence because of this respect for the earth. (Cowichan Tribes website, http://www.cowichantribes.com/about/History/Pre-European%20Contact Accessed Sept. 2, 2005)

Traditional values and beliefs have been passed on through stories, myths and oral teachings. Stories "are not just entertainment. Stories are power. They reflect the deepest, the most intimate perceptions, relationships, and attitudes of a people. Stories show how a people, a culture, thinks" (Keeshig-Tobias 1990).

Among the important teachings of the Cowichan *sul'hween* (elders) are: the family is the heart of life, honour the Elders, each person is important, and everything in Nature is part of our family – we are all relatives. Within this context, nature, including the Cowichan River, is part of the family and has a spiritual connection.

Current Context

Cowichan People continue to rely on the riches of the Cowichan River valley to support a life with close ties to the environment. The stories, myths and oral teachings remember the ancient way of life and remind each person of our interconnectedness with the natural environment.

Water was and is integral to the Cowichan People's beliefs and values. Water is a medium for connection to the spiritual realm. The daily activities and ceremonies of the Cowichan People were influenced by their daily access to the river's spiritual power (Clewley, 2000). Therefore, when Cowichan people look after the water, they are looking after themselves.

Traditional ways of living incorporate the need to give thanks as part of an understanding that while taking something from the environment it is not taken lightly. Many ceremonies involve thanking the earth and giving something back. The Cowichan People's cultural connection to conservation stems from this commitment to caring for and looking after the earth.

Physical and spiritual health of the Cowichan People is intertwined with the health of the natural environment in which they exist and are a part. The Cowichan People still depend on certain foods, plants, and trees that exist in the Cowichan River territory. They have witnessed and been affected by the events that have threatened the health of the river. Over the years the salmon and other fish and shellfish have been mainstays of the Cowichan People's diet. Now they are faced with declining fish and shellfish populations. The Cowichan People have also seen a decline in many of the medicinal and ceremonial plants that are found around and in the river.

Cowichan Tribes Current Stewardship Goals

Building upon the teachings of the *sul'hween* (elders) the Cowichan approach to stewardship seeks to balance the four elements of sustainability: language and culture, environment, health, and economy. This position guides Cowichan Tribes environmental management activities.

The Cowichan Basin process is connected to a variety of current issues including: flow management, habitat alteration, fisheries decline, gravel deposition, maintenance of river dykes, flood control, water quality, agricultural potential, storm water management, health of the estuary and Cowichan Bay, as well as the overarching issue of growth management.

The river and the process in which we discuss it today is an integral part of the greater ecosystem and communities that surround it. Cowichan Tribes' stewardship goals are rooted in the cultural context and also look forward to a vision of how we, and the generations that follow, will interact with the thread of water that binds us.

Figure 16. Archival pictures show some of the ways that the Cowichan People used the resources of the river.

3.3 Policies affecting water and key water use issues

Water management in Canada is a complex patchwork of responsibilities of various departments in municipal, regional, provincial, and federal levels of government. Agencies with authority over water management have mandates that cover environment, natural resources, agriculture, health, engineering, and public works and infrastructure. Often, authority is shared among departments and levels of government.

3.3.1 Local government

The direct authority for local water management is typically delegated to local governments and water utilities under provincial legislation, with the federal government taking a less direct role. Generally, treated water is provided to residents and businesses by utilities operated by local government and private bodies. Local governments are also usually responsible for collecting and treating wastewater, managing stormwater, administering water conservation and demand management programs, determining water pricing and rate schedules, and managing land use and development through Official Community Plans. Private utilities that deliver water must comply with provincial and local regulations.

3.3.2 Official Community Plans

An official community plan (OCP) is a statement of objectives and policies to guide decisions on land use and development in the area covered by the plan (usually a municipality or electoral areas in a regional districts). An OCP is intended to provide guidance to municipal leaders and staff, developers, the public, and regulatory agencies on development and environmental issues.

Authority for a local government to prepare or revise an OCP is set out in the *Local Government Act* (formerly the *Municipal Act*). The Plan becomes designated as an OCP after a Public Hearing and adoption by a Council or Board. The *Local Government Act* specifies that an OCP shall include designations of land use policies regarding the proposed sequence of urban development and servicing, provisions of public facilities (schools, parks, etc.), preservation of significant natural, scenic or recreational areas, policies for residential densities, the provision of services, and the distribution of major land uses. All of these functions may affect water demand and supply

Six OCPs have been prepared in the Cowichan Basin: District of North Cowichan, Town of Lake Cowichan, City of Duncan, West Cowichan (Electoral Areas F and I), Cowichan-Koksilah (Electoral Area E and Part of F), and Cowichan Bay (Electoral Area D). The following section provides a brief summary of some of the goals, objectives, and policies relevant to water management that are contained in these OCPs.

District of North Cowichan OCP. The District of North Cowichan has the only OCP in the CVRD that discuses water demand management through conservation programs.

- Protect ground water aquifers, wells, and surface streams, lakes and rivers through the development of a Well Protection Plan.
- Protect aquatic areas and sensitive ecosystems by establishing Development Permit Areas for streams and sensitive areas.
- Address natural hazards by restricting inappropriate development in the flood plain of Cowichan River.
- Protect and conserve the municipal water supply through water conservation programs.
- Manage liquid waste and storm water appropriately.

Town of Lake Cowichan OCP. Enhance the environmental, amenity and aesthetic quality of watercourses and adjacent uplands by designating Watercourse Protection Areas.

- Address the threats of flooding in the Town and property damage caused by erosion along the Cowichan River by designating Hazard Land Protection Areas.

- Manage liquid waste, storm water, and the municipal water system, and consider tertiary treatment of the Town's sewage effluent as a long-term objective.

City of Duncan OCP.

- Protect environmentally sensitive and hazard lands by securing, maintaining, and rehabilitating a protective "green strip" along the Cowichan River.
- Manage liquid waste, stormwater, and municipal water appropriately.

West Cowichan Official Community Plan. The West Cowichan OCP includes Electoral Area F – Cowichan Lake South and Skutz Falls, and Electoral Area I – Youbou and Meade Creek.

- Encourage preservation, maintenance, and enhancement of natural areas by limiting or prohibiting development in hazardous or environmentally sensitive areas.
- Protect the environmental quality of Cowichan Lake and River through the Watercourse Protection Development Permit Area and Waterfront Subdivision Development Permit Area designations.
- Manage liquid waste, storm water, and municipal water appropriately and prevent contaminants from entering Cowichan Lake, which is considered a potential long-term supply of water for the Cowichan Valley.

Cowichan-Koksilah OCP. The Cowichan-Koksilah OCP includes Electoral Area E and the easterly portion of Electoral Area F.

- Identify, protect and enhance watercourse, lakes, rivers, marshes, wetlands and other environmentally sensitive areas to maintain their natural habitat, environmental quality, aesthetic appeal, and recreational value.
- Protect the natural environment and protect developed areas from hazardous conditions through the Cowichan River Development Permit Area designation
- Manage liquid waste and storm water to ensure disposal in a safe and healthful manner.
- Manage municipal water to ensure that adequate water supplies are available for domestic purposes during peak demand periods.

Cowichan Bay Settlement Plan. The Cowichan Bay Settlement Plan includes Electoral Area D. The Settlement Plan is a revision of the Official Community Plan adopted in 1976.

- Protect sensitive areas, including the estuary and floodplains of Cowichan River, from the impacts of development or uses that could be detrimental to plant and animal communities.

3.3.3 Provincial government

Water management in British Columbia is regulated by a series of Provincial acts, regulations, agreements and policies. The provincial legislation addresses a variety of topics including drinking water, fish, wildlife and waste management. The Water Act and the Ministry of Environment is described below. Other potentially relevant legislation is listed in Table 3.

Water Act and Ministry of Environment

All surface and ground water resources in British Columbia are owned by the Crown, which issues rights to use this water through the Water Act (1996). Under the Water Act, the provincial government issues water licences to extract water from surface water sources. Provincial staff define the amount of water that can be extracted, the time of year when extraction is allowed, and the location where water can be diverted for use. The rights to water under these licences are based on a "prior appropriation system," meaning that rights to water are based on the date when the licence was issued. In times of low water availability, the older water licence holders have priority over the new licences.

The Water Act provides limited influence over ground water resources. Section 5 of the Act requires that well drilling, closing, and related activities be performed by a qualified person. The Act also allows for the recording of well data to be input into the provincial well database.

The Ministry of Environment issues all licences for withdrawals of surface water. The Ministry is responsible for the issuance and management of water licences and the management of appeals under the Water Act, the development of water use plans that balance the demands of various water stakeholders, and the safe operation of dams and reservoirs in the province.

Other provincial legislation

A variety of other provincial acts, regulations, and policies apply to the management of water (Table 3).

Table 3
Provincial legislation and policies that govern water management in British Columbia

Water	
Fish Protection Act	The *Fish Protection Act* provides legislative authority for water managers to consider impacts on fish and fish habitat in reviewing application for new licences, amendments to licences or issuing approvals for work in or near streams identified as sensitive. **The Cowichan River is not designated as a sensitive stream.**
Drinking Water Protection Act	The amended *Drinking Water Protection Act* and regulations came into force on May 16, 2003 (replaces the Safe Drinking Water Regulation under the *Health Act*). The Act governs drinking water from "source to tap." The province's Drinking Water Program provides advice to Health Authorities, and develops legislation, guidelines, and policies on drinking water. The Act contains sections on drinking water supply, water assessments and plans, drinking water protection plans, and other general guidelines. The regulations provide detail on drinking water standards, treatment, water monitoring, and emergency response.
Water Protection Act	The Water Protection Act was designed to protect British Columbia's water resources by • re-confirming the ownership of surface water and ground water in the Province. • maintaining existing bulk water removal rights, within clearly defined limits. • prohibiting bulk removal of British Columbia's water to locations outside the Province; and • prohibiting large-scale diversion between major watersheds of the Province. The Act provides more specific direction on these topics, including regulations, fines, and licensing.
Dam Safety Regulations	Dam Safety Regulations provide guidance on the dam application process as well as reporting and inspection guidelines.

Land	
Environmental Management Act	The Environmental Management Act (EMA) was brought into force on July 8, 2004. The act replaces the *Waste Management Act* and the *Environment Management Act*. The EMA provides direction on environmental management tools such as area-based planning and fines. The Act addresses waste disposal, hazardous waste, municipal waste management, contaminated sites, and remediation. In addition to the Act, several regulations and regulatory amendments have been developed. The regulations cover exemptions, including domestic sewage releases and disposal systems that are below specified thresholds.
Forest Practices Code	The Forest Practices Code (FPC) guides forestry activities. By December 2005, the transition from the FPC to the Forest and Range Practices Act will be complete.
Forest and Range Practices Act	The *Forest and Range Practices Act* and its regulations govern the activities of forest and range licensees in B.C. The statute sets the requirements for planning, road building, logging, reforestation, and grazing. Water is one of the key forest and environmental values to be managed under the results-based code. The objective set by government for water, fish, wildlife and biodiversity in riparian areas is "without unduly reducing the supply of timber from British Columbia's forest, to conserve, at the landscape level, the water quality, fish habitat, wildlife habitat, and biodiversity associated with those riparian areas."
Land Act	The *Land Act* is the main legislation governing the disposition of provincial Crown (i.e. public) land in British Columbia. Crown land is any land owned by the Province, including land that is covered by water, such as the foreshore and the beds of lakes, rivers and streams.
Streamside Protection Regulation (under the Fish Protection Act)	On January 19, 2001, the Provincial government enacted the Streamside Protection Regulation (SPR), which meets the objectives of the 1997 Fish Protection Act. The purpose of the regulation was to bring clarity, consistency and certainty with a transparent process for the protection of streamside vegetation through the development process.
Riparian Areas Regulation (under the Fish Protection Act)	The Riparian Areas Regulation (RAR), enacted under Section 12 of the Fish Protection Act in July 2004, calls on local governments by March 31, 2005 to protect Riparian Areas during residential, commercial, and industrial development by ensuring that proposed activities are subject to a science based assessment conducted by a Qualified Environmental Professional.
Other Acts	
Ecological Reserve Act	Areas identified as possessing significant ecological values and where land use conflicts have been resolved are designated by provincial order-in-council under the Ecological Reserve Act.

Environmental Assessment Act	British Columbia's *Environmental Assessment Act* (the Act) requires that certain large-scale project proposals undergo an environmental assessment and obtain an environmental assessment certificate before they can proceed.
Park Act	The *Park Act* is the main legislation governing protected areas in British Columbia. It provides for the designation and administration of provincial parks, recreation areas, and nature conservancy areas.
Wildlife Act	The Wildlife Act provides management direction for wildlife species in the British Columbia. The *Act* was amended in May 2004 to enhance the Province's ability to protect and recover species at risk.
British Columbia Policies	
Freshwater Strategy for British Columbia	The provincial government released "A Freshwater Strategy for British Columbia" in November 1999. The document discusses the future direction of water management in British Columbia. The Ministry's strategic goals expressed through the document include: • ***Natural Diversity***: Protection, conservation and restoration of a full range of biological and physical diversity native to British Columbia. • ***Healthy and Safe Land, Water and Air***: Clean, healthy and safe land, water and air for all living things. • ***Sustainable Social, Economic and Recreational Benefits***: Provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment. • ***Responsive and Adaptive Organization***: Achievement of the ministry's three goals through innovative and responsive ministry programs and staff who seek the best results and service for the public. The Freshwater Strategy's goals are stated as "healthy aquatic ecosystems, assured health and safety, and sustainable social, economic, and recreational benefits of water." The initiatives and priorities are described in the strategy document.

3.3.4 Federal government

The federal government has jurisdiction over fresh water in a few broad areas, namely the release of toxic substances, managing activities that affect and potentially harm fish habitat, ensuring rivers remain navigable, and managing water on federal lands, including First Nations reserves. The federal government can directly influence water use and management through infrastructure funding policies and by supporting research and data collection (Brandes *et al.* 2005).

Table 4 displays federal legislation and policies that govern water and water management in the Cowichan Basin.

Table 4
Federal legislation and policies that govern water management in the Cowichan Basin

Government Authority	Act	Description
Fisheries and Oceans Canada	Fisheries Act	Ensure that sufficient flows are maintained in rivers and streams to protect fish and fish habitat. The Act prohibits the discharge of harmful substances into waters used by fish.
Environment Canada and Health Canada	Canadian Environmental Protection Act	Protects the environment and human health from the use and release of toxic substances, pollutants, and wastes.
Transport Canada	Navigable Waters Protection Act	Protects the public right of navigation. The Act requires that Transport Canada approve any works built in, on, over, under, through or across navigable water in Canada prior to construction of the work(s) and remove obstructions to navigation, including unauthorized works.
Environment Canada	Federal Water Policy	Objective is to encourage the use of freshwater in an efficient and equitable manner consistent with the social, economic and environmental needs of present and future generations. The policy addresses the management of water resources, balancing water uses with the requirements of the many interrelationships within the ecosystem. (Environment Canada 1987)

The Cowichan River has been designated a heritage river by the Canadian Heritage Rivers System (CHRS). The CHRS is a national river conservation program established in 1984 by the federal, provincial and territorial governments to conserve and protect the best examples of Canada's river heritage, to give the rivers national recognition, and to encourage the public to enjoy and appreciate them (CHRS 2005). The Canadian Heritage Rivers Board, comprised of members appointed by federal, provincial and territorial governments, administers the CHRS. The CHRS has no legislative authority, but is governed by a Charter, affirming the Board's role in overseeing the development and operation of the program.

4.0 Water Supply and Demand

Three principal approaches were used to estimate water use in the Cowichan Basin. The first approach (Section 4.1.) involved estimating water withdrawal from surface and ground water sources by utilities, individuals, and industry. Estimating agricultural water use (Section 4.2) required a review of the literature to determine water consumption by type of crop, interviews with government agency staff, and a survey of Cowichan Basin farmers. The third approach (Section 4.3) forecast water demand according to land use (i.e. residential, commercial and industrial, and agricultural) in the Cowichan Basin. Section 4.4 compares water demand with anticipated supply.

4.1 Estimates of present water withdrawal

A report compiled by Land and Water BC (now Ministry of Environment) lists 535 water licences that allow withdrawal of water in the Cowichan Basin (Barr 2005). Figure 17 displays the locations of the points of diversion of these licences. Licence information, such as the waterbody licensed, the owner of the licence, the allotted withdrawal volume, and the purpose of the water withdrawal, was included in the Land and Water BC report. Additional information such as licence documents, conditions, and location maps, if required, was obtained through the Land and Water BC water licence web query.

The Ministry of Environment well database identifies more than 1300 wells in the Cowichan Basin. Figure 17 displays the locations of these wells.

4.1.1 Major water systems

An analysis of actual water withdrawal from surface and ground water sources was completed for major water systems using data provided by CVRD and municipal employees and other water purveyors. Figure 18 shows the locations of these water systems and Table 5 provides a summary of the data. Many additional private water systems serve the Cowichan Basin. The eleven systems discussed in this report were identified as the major water systems based on a list provided by the Vancouver Island Health Authority. Detailed information on the water systems is included in Section 2 of *Water Facts*.

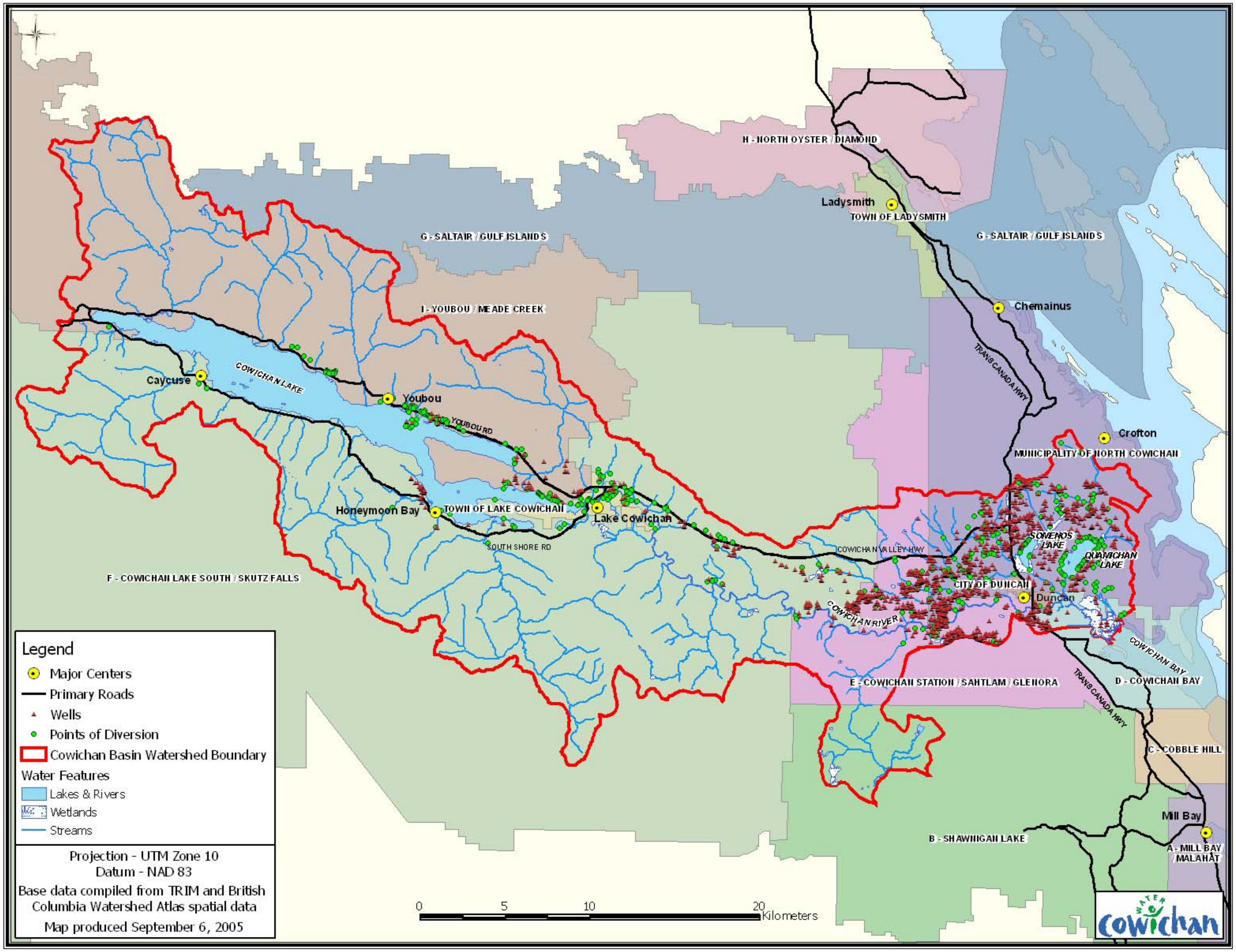


Figure 17. Location of points of diversion and wells in the Cowichan Basin.

Utilities withdraw water from surface water sources only in the upper Basin. An annual average of 1.2 million m^3 is withdrawn by the four utilities listed in Table 5. Ground water is the major source of water for systems in the Cowichan Basin. An annual average of 7.4 million m^3 of ground water is withdrawn from various aquifers throughout the Basin. The largest withdrawals are from the Lower Cowichan aquifer by the City of Duncan and the District of North Cowichan.

Table 5
Major water utilities in the Cowichan Basin

Water System	Source	Number of connections	Average annual withdrawal (m^3)
Utilities using surface withdrawals			
Town of Lake Cowichan	Cowichan Lake	1,359	929,575
Honeymoon Bay	Ashburnham Creek and Cowichan Lake	300 (180 are campsites)	80,799
Youbou Water Utility Corporation	Youbou Creek	115	104,108
Utility Waterworks Improvement District	Utility Creek and Ashdown Brook	55	73,600
Total surface water withdrawal			***1,188,082***
Utilities using ground water			
City of Duncan	Ground water	3552	2,730,990
South End Waterworks (North Cowichan)	Ground water	4019	4,500,680
Dogwood Ridge Improvement District	Ground water	33	20,600
Sutton Creek	Ground water	24	13,700
Mesachie Lake	Ground water	100	56,999
Pioneer	Ground water	26	22,400
Lakeside Estates	Ground water	61	21,179
Total ground water withdrawal			***7,366,548***
Total withdrawal by utilities			**8,554,630**

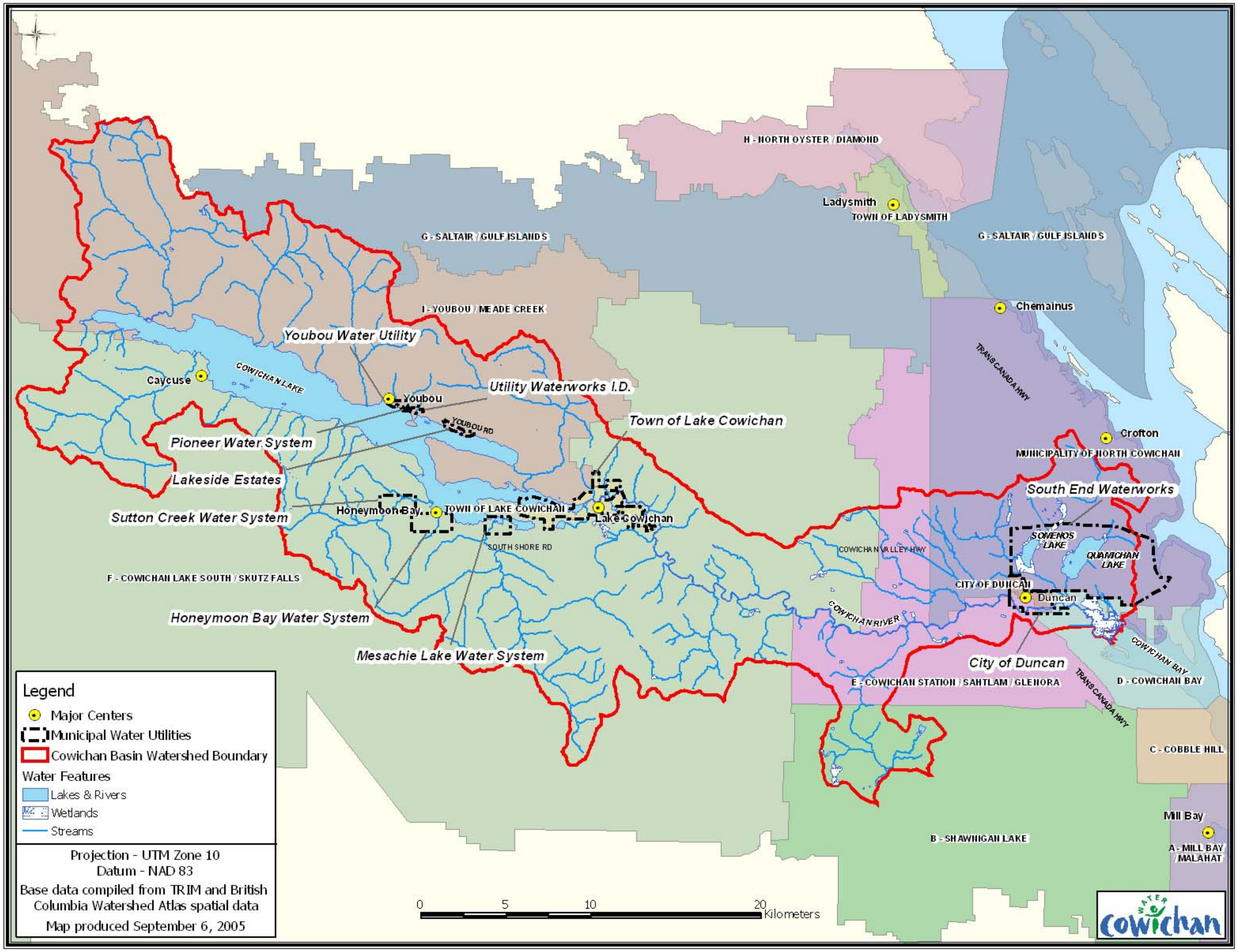


Figure 18. Locations of major water systems in the Cowichan Basin.

General trends

For each water system, past and present withdrawal data were tabulated and graphed to identify average annual water withdrawal, and average summer withdrawal compared to withdrawal during other seasons. Summer was identified as May to September because for all water systems, withdrawal rates increase in May, peak in July, and decrease in September (Figure 19). Water withdrawal by each system during the summer months is at least 50% greater than withdrawal during other seasons. This is most likely due to irrigation of lawns and gardens. In the upper Basin, water withdrawal also increases because the campgrounds and summer homes are occupied.

The average annual maximum and minimum water withdrawals by the systems over the data time period were also compared. For most of the water systems, there was a large difference between the average annual withdrawal and maximum and minimum withdrawals. Many factors may contribute to this difference, including weather patterns (temperature and precipitation), leakage in the system, and meter malfunctions.

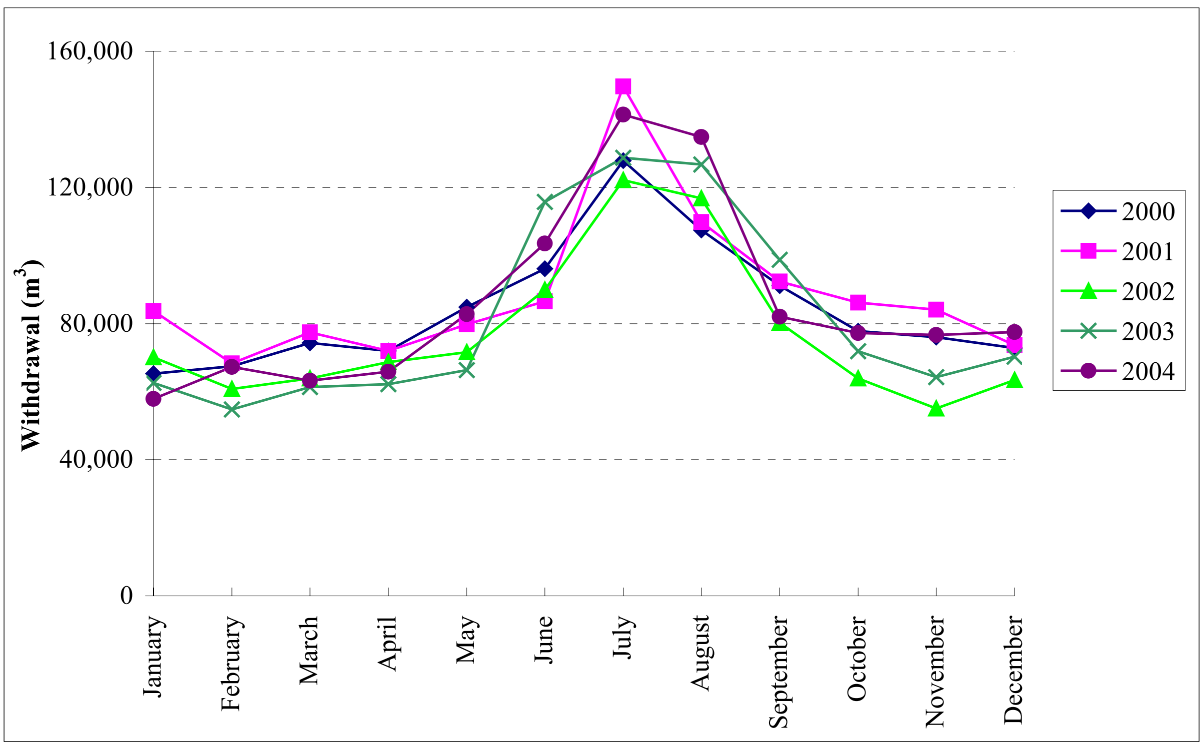


Figure 19. Typical trend of surface and ground water withdrawal by major water utilities in the Cowichan Basin.

4.1.2 Catalyst Paper Corporation Crofton Division

Catalyst Paper Corporation Crofton Division (formerly NorskeCanada) is an integrated paper and pulp manufacturing facility with three paper machines and two pulp lines. Major products include newsprint, directory paper, and northern bleached softwood kraft (NBSK) pulp, which is used in the manufacture of printing, writing, and tissue papers.

Water is integral to the operation of the Catalyst Paper pulp and paper mill, and is primarily used:

- to make steam for use in the pulp and paper mills,
- to wash pulp fibre as a means to recover and recycle process chemicals,
- to transfer heat from one process area to another to reduce energy use,
- to dilute the pulp in order to pump it between process areas, and
- to cool motors and pumps.

Catalyst Paper is licensed to withdraw 86.6 million m^3/year from Cowichan River to be used at the mill in Crofton. The water is pumped from the river upstream of Duncan, adjacent to Cliff's Road. Catalyst Paper also has two water licences to store a total of 61.3 million m^3/year at Cowichan Lake.

The licences require a minimum flow of 7.0 m^3/sec in the river below the Cowichan Lake weir and 2.8 m^3/sec in the river below the Catalyst Paper pumphouse (Photo 3). In the summer of 2003, due to drought conditions, the licences were revised to allow Catalyst Paper to temporarily maintain a minimum flow of 4.25 m^3/sec below the weir and 2.5 m^3/sec below the point of diversion.

Photo 3. Catalyst Paper Corporation Crofton Division pumphouse on Cowichan River.

Figure 20 displays Catalyst Paper's average annual water withdrawal from the Cowichan River. Actual average withdrawal in 2004 was approximately 51.6 million m^3/year, or 60% of the total permitted. Figure 21 displays average annual water use in m^3/air-dried tonne of production.

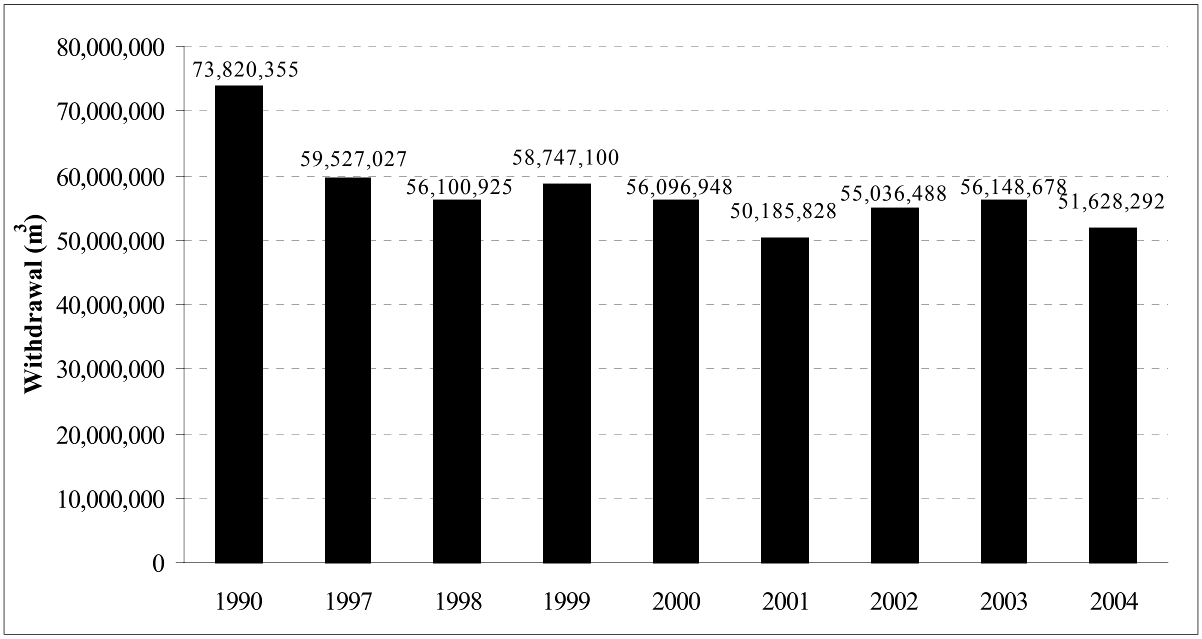


Figure 20. Catalyst Paper Corporation Crofton Division pulp and paper mill average annual water withdrawal from Cowichan River, 1990 to 2004.

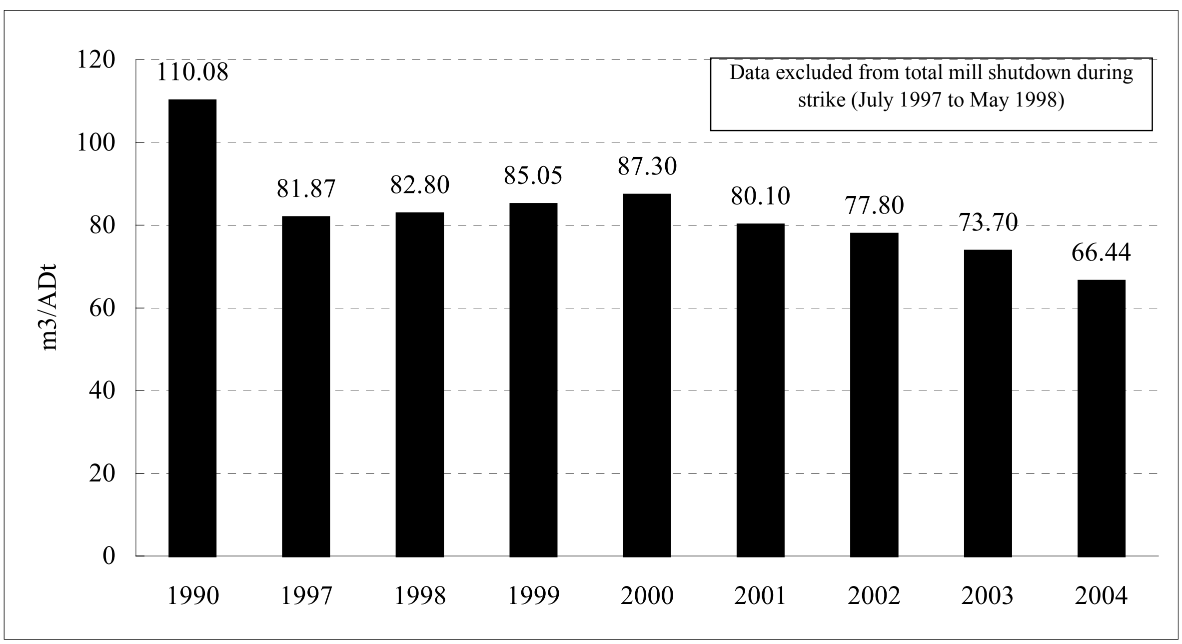


Figure 21. Catalyst Paper Corporation Crofton Division pulp and paper mill average annual water use in m^3/air-dried tonne of production.

Water monitoring and conservation

Catalyst Paper implemented numerous water conservation and monitoring programs in the past fifteen years, beginning in 1990 with kraft mill modernization and process optimization projects that resulted in a water reduction of approximately 15.9 million m^3/year (see Figure 20). In 2003, the mill began using seawater, instead of river water, for effluent cooling at the treatment plant and implemented additional process optimization projects for a savings of 5.0 million m^3/year (Vessey pers. comm.). There are documented operating practices and procedures, checklists and troubleshooting guides in place to support the water monitoring program, as well as extensive on-line water measurement instrumentation.

Water usage is monitored regularly by Catalyst Paper to meet the water usage targets set by senior management. On a daily basis, water consumption is reviewed by the shift supervisors and compared to a target set by senior management. Variances from this target are investigated and rectified by the shift supervisor, including the involvement of operations and maintenance employees. On a monthly basis, a water consumption report is generated comparing water usage to monthly water usage target and is distributed to all area managers and technical specialists. Variances from the target and water consumption trends are reviewed by area managers and the site Vice President. Area managers are held accountable for meeting the water consumption targets. The mill's target for 2005 is a 5% reduction in mill water, and the mill will continue to work towards reducing water consumption in the future (Vessey pers. comm.).

4.1.3 Other water users

Individual water licences

Detailed information on individual licensed quantities is included in Section 3 of *Water Facts*. No actual withdrawal data were available for individual licence holders, so the actual water use was assumed to be the same as the licensed quantity. Licensed withdrawal volume is, in most cases, not the same as the actual water withdrawal   Water that is not allocated by Land and Water BC to the major water systems discussed in Section 4.1.1 is licensed to individuals to be used for conservation purposes, land improvements, domestic use, irrigation, and enterprise purposes. The total licensed withdrawal amount is 5.2 million m^3/year. Total licensed storage is 517,478 m^3/year.

Private well owners

The potential rates of ground water use and extraction by private well owners cannot be determined because they are not required to report potential well yields or actual use. Well yields reported at the time of drilling were used to estimate potential ground water extraction rates by private well owners. These estimates usually refer to the maximum yield and are based on drillers' estimates and not on pumping test or flow test data. Well information such as the owners, locations, and purpose of wells, and reported yield is included in Section 4 of *Water Facts*.

The reported yield of private wells in the Cowichan Basin is 27.5 million m^3/year. Although it is impossible to prove due to a lack of data on well withdrawal in the Basin, this number is likely much higher than actual withdrawal from wells. Many of the wells are used for irrigation of agricultural land and withdrawal increases, or occurs, only during the summer months. Other wells serve single households that do not require even close to the maximum yield of their wells to supply enough water for their domestic needs. For the purposes of this report, it is estimated that actual withdrawal from private wells is half of the maximum reported yield, or 13.8 million m^3/year.

4.1.4 Summary of water withdrawal

Figure 22 displays the estimated annual water withdrawals by category of user. Of the estimated 79.2 million m^3/year withdrawn from surface and ground water in the Cowichan Basin:

- Catalyst Paper's surface withdrawals of 51.6 million m^3 account for 65% of Cowichan Basin water use,
- Private well owners use 17% (13.8 million m^3) from ground water,
- Individual surface water licensees use 7% (5.2 million m^3),
- Local utilities use 9% (7.4 million m^3) from ground water, and
- Local utilities use 2% (1.2 million m^3) from surface water sources.

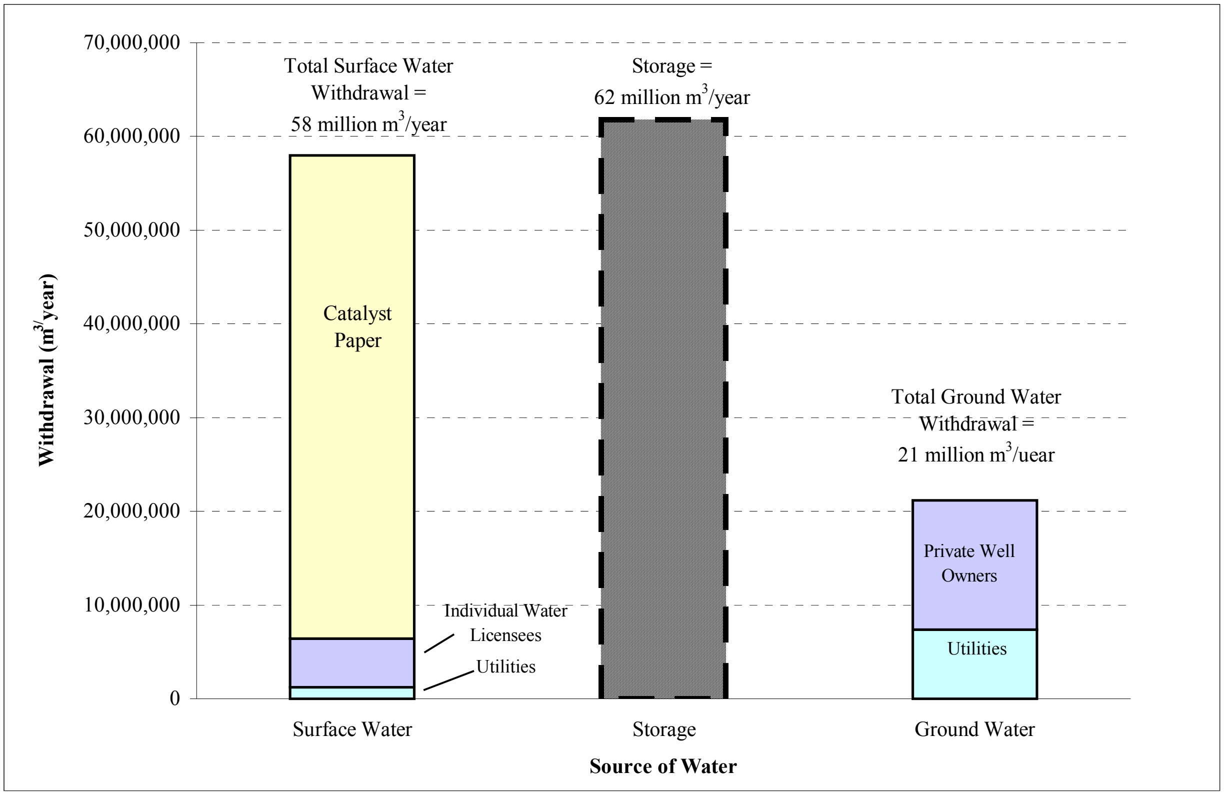


Figure 22. Total surface and ground water withdrawals by utilities, private users, Catalyst Paper Corporation Crofton Division and licensed storage for surface water sources.

It is important to note that some of the licensed water withdrawals, mainly Catalyst Paper, are supported by licensed storage. Where water is licensed for storage it is to be stored in the winter to allow for withdrawal during the summer low flow period.

4.2 Agricultural water use

Despite receiving ample rainfall in the winter, a major challenge to farmers in the Cowichan Basin is drought. Drought conditions prevail in this area during the main growing months of May, June, July and August. These drought conditions require farmers to irrigate their land to sustain soil quality and optimize crop yields. Water is used by plants to build plant tissue (photosynthesis) and to regulate temperature.

Good quality water is needed for irrigation to protect the health of crops, the soil, and underlying ground water. In Canada as a whole, agriculture withdraws a relatively small amount of water (approximately 9%) compared to other uses such as municipal water supply and industry. However, agriculture consumes a large portion of what it withdraws, with 70% consumed and retained by the crop or farm animal. Only 30% of water used is returned to its source (surface or ground water).

The Cowichan Basin is blessed with substantial areas of superior agricultural lands. A combination of excellent soils (typified by the Fairbridge silt loam) and mild climate have created some of the most diverse and productive agricultural land in the province. A mild climate with a long frost-free period and large number of sunshine days brings with it summer drought conditions. The Cowichan Basin is not as dry as the Okanagan, however. The Lower Cowichan Basin receives 50 percent more rainfall during the growing period of May to August than does Penticton.

Some Cowichan Basin farmers have noted that a major constraint to their agricultural expansion is the availability of water for irrigation at affordable price. It has been demonstrated elsewhere in British Columbia that producers can improve production by increasing the amount of water applied to their crops. In order to improve agricultural production and economics, it may be prudent to allocate additional water for agricultural irrigation purposes. However, it should also be recognized that improvements in irrigation and conveyance efficiencies may free-up water for other uses.

4.2.1 Survey of agricultural water use

A survey form was prepared to ask farmers in the Cowichan Basin about their water use. The form was reviewed by staff of the Ministry of Agriculture and Lands, and was distributed by the Island Farmers' Alliance. Of the 88 forms mailed out, 13 were returned. The results of the survey are presented in Section 5 of *Water Facts*.

Responses came from farmers involved in production of dairy products, hay, beef cattle, ornamental plants, sheep, nuts, vegetable production, and Christmas trees. Irrigation water is obtained from public (piped) supply, wells, surface water withdrawals, and sub-irrigation ("flooding"). Spray irrigation is the most common method of applying water. Among farmers who irrigate, water use varied from a high of nearly 36,000 m^3/ha/year to as little as 600 m^3/ha/year.

Respondents were asked how their farming and water use might change over the next 10 to 25 years. No consistent pattern emerged, with some farmers saying that they expect little change in farming or water needs, and others saying they expect to change crops, sell their property, or retire. Some farmers said they will require more water, others will require less.

Most respondents identified water issues that affect them. Several farmers wanted more water from an alternative source (wells or public water), and some were critical of the high price charged for public water used for irrigation. Farmers stated that having more water would increase their production. Too much water is a problem in some places; respondents from the

Quamichan or Somenos areas identified the problems they have with drainage, particularly the yield-reducing impact of shortened seasons and wet fields.

4.2.2 Present agricultural water use

In order to determine the amount of water used in the Cowichan Basin for agricultural purposes, it was first necessary to identify the area of land being used for agricultural purposes, then to estimate the proportion receiving irrigation. This information was generated by reviewing aerial photo mosaics covering the study area. The photographs were taken in 2002 and 2004, and are considered to represent current land use conditions in the region. Land areas of crop types were delineated on the aerial mosaics on land designated Agricultural Land Reserve (ALR), as well as land outside the ALR that is being used for agricultural purposes. These land areas were designated as one of the following five Crop types:

- pasture
- hay and corn silage
- berries and grapes
- tree fruits
- nursery crops.

The designation of these irrigated crop types were reviewed and verified with the Regional Agrologist (Haddow pers. comm.). No field verification of these crop types was undertaken.

Areas of each crop type that are likely being irrigated were determined by computer analysis and are provided in Table 6. The areas of each of the five crop types were then multiplied by the estimated annual water demand per unit area (m^3/ha and acre-inches). Estimated water demands by crop type were determined from responses to the Agricultural Water Use Survey that was mailed to 88 farmers in the Basin, supplemented by data from a study undertaken on the Saanich Peninsula (Water and Agriculture – Priorities for Sustainability, 1996). Table 7 presents the estimated water demand by crop type and Table 8 outlines the current estimated water demand by irrigation in the Basin. In total, irrigated agriculture covers approximately 2,486 ha of the Basin and requires an estimated 19 million m^3 of water per year.

Table 6
Area of crop type[2]

Crop type	Area in Cowichan Basin (ha)
Pasture	1,298
Hay and Corn Silage	1,140
Berries and Grapes	33
Tree Fruits	9
Nursery Crops	6
Total	2,486

Table 7
Estimated agricultural water demand by crop type

Crop type	Estimate of water demand[3]	
	(m^3/ha/yr)	(acre-inches/yr)
Pasture	7,800	28.4
Hay and Corn Silage	7,700	28.0
Berries and Grapes	5,000	18.2
Tree Fruits	7,800	28.4
Nursery Crops	4,000	14.6

Table 8
Water demand by crop type

Crop type	Area (ha)	Estimated water demand (m^3/ha/yr)	Total m^3/yr
Pasture	1,298	7,800	10,124,400
Hay and Corn Silage	1,140	7,700	8,778,000
Berries and Grapes	33	5,000	165,000
Tree Fruits	9	7,800	70,200
Nursery Crops	6	4,000	24,000
Total			**19,161,600**

4.2.3 Future agricultural water use

Predicting the future use of any resource, including water demand for agriculture, is challenging. While significant achievements have been made in increasing the efficiency of irrigation methods and the means of getting water to the farm, the use of water by agriculture in the Cowichan Basin is more likely to increase than decrease. The increase will result from increasing the amount of land used for agricultural production, intensifying the use on the existing agricultural land base, and the potential for climate change.

2 Estimated from analysis of available aerial mosaics.
3 Estimate based on actual use provided in responses to questionnaire as well as the B.C. Irrigation Manual.

One of the more significant issues that will affect the agricultural use of water is climate change. The Cowichan Basin is already drought-prone during the growing season. Droughts appear to be occurring more frequently and with greater severity in some parts of Canada, potentially related to climate change, resulting in an increase in demand for water. Increased demand will be a major issue for agriculture in areas like the Cowichan Basin that are already dry, where irrigation would be needed to ensure the maintenance of yields in response to potential drought stress. For example, a substantial amount of farm land in the Somenos sub-basin is sub-irrigated (i.e., crops obtain their water from a high water table and do not require surface irrigation). Were the water table to drop due to drought conditions, this land would require surface irrigation to sustain agricultural production.

An estimated 5,919 ha of land in the Cowichan Basin is in the Agricultural Land Reserve (ALR). In 20 to 25 years, much of this land could be in agricultural use. It is also conceivable, as is happening today with grape production, that land outside of the ALR will be used for agricultural purposes. Assuming that all ALR land is brought into production, three possible scenarios could be conceived, each with different effects on future water use:

Scenario One: All ALR land is in crop production, half of which is irrigated at a nominal rate of 7,000 m^3/ha/yr.

Scenario Two: All ALR land is in crop production, all of which is irrigated at a nominal rate of 7,000 m^3/ha/yr.

Scenario Three: All ALR land is in crop production and irrigation requirements are half of the present suggested levels due to water conservation practices such as drip irrigation.

Table 9 provides the results of applying these three scenarios to the Cowichan Basin. On this basis, one could conclude that in the next 20 to 25 years, water demand for agricultural purposes will be between 21 million and 41 million m^3/yr, compared to the present predicted use of 19 million m^3/yr. Hence, water demand could increase by 10% to 116% from present levels.

Table 9
Potential future agricultural water demand

Scenario	Water Demand m^3/ha/yr	Area of Land (ha)	Total Demand (million m^3)
1	7,000	2,960	21
2	7,000	5,191	41
3	3,500	5,919	21

The projected growth of water demand under the three scenarios is presented for each jurisdiction in the CVRD in Section 6 of *Water Facts.*

4.3 Estimates of present and forecast water use based on land use analysis

How water demand estimates were prepared

Estimates of present water use and future water demand in the Basin were developed for this report through a combination of factual data on past water use, population, and housing, and assumptions regarding future conditions in the region. Preparation of the water use estimates encountered the following challenges.

- Piped water used in the Basin comes from many water suppliers (utilities), some of which are small and have rudimentary monitoring data. Few utilities were able to provide forecasts of future demand.
- In addition to "public" water supplies from utilities, many people rely on private ground water wells or water licences that permit removal of water from lakes and streams. No information exists on actual use of water from these sources. Whereas some wells have information on maximum yield, no information exists on how much is actually used by the well owner. Similarly, water licences have maximum withdrawal limits, but no monitoring results are available to specify amounts withdrawn.
- Very little information is available on whether water is used for residential, commercial, or other purposes, particularly water from wells and utilities. Studies from other locations were used to obtain estimates of typical water use rates for detached homes, apartments, playfields, and businesses.
- Maps and policies in land use plans provided only general guidance to future development in the region. In the absence of regional-level planning, estimates of present use and forecasts of future consumption were based on planned areas for generalized classes of land use (residential, commercial, etc.).
- Few data were available on water consumption rates per person, per household, or per hectare in the Cowichan Basin.

The forecasts are based on as much local information as possible, but studies conducted elsewhere had to be used to help fill the many gaps in local data sets, particularly dealing with future water demand.

Water use factors

One of the fist steps in estimating present or future use is to determine how much water is consumed by a typical household, business, or other human activity. After considerable research, estimates of water consumption per hectare and per household were developed for the study (Table 10). Some of the assumptions associated with developing these use factors are contained in the table.

Table 10
Water use factors for Cowichan Basin

Land Use Type	Consumption (m^3/year)		Comment
	Per hectare	Per unit	
Detached housing[4]	7,000		All residential use rates are the same per hectare, but per-unit consumption varies according to density of development. Urban lots, 13 units/ha; suburban, 8 units/ha; rural 0.4 units/ha; attached, 30 units/ha.
Urban lots		538	
Suburban lots		875	
Rural lots[5]		1,400	
Attached housing[6]	6,000	200	
Commercial	7,000		Includes retail, services
Industrial	4,800		Light and medium industry; excludes Catalyst Paper
Institutional	6,000		Schools, hospitals, etc. Consumption same as attached housing.
Playfields	6,400		Includes irrigated parkland; nature parks excluded.
Agriculture	7,700		Average estimated Basin farmland consumption rates.

These water use values should be considered as broad estimates for all land use classes, and subject to very large variations. For example, residential water consumption figures from published literature range from as little as 226 m^3/unit/year (Polis 2005) to a high of 2,087 m^3/unit/year (Edaw 2002). The actual levels of use are affected by many variables, such as:

- climate and weather,
- lawns and garden watering,
- water distribution technology (including leakage from pipes and pumps),
- types of plumbing fixtures,
- conservation measures applied by water users,
- density of development (higher density developments use less water per unit), and
- water pricing levels and mechanisms.

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4 Based on information from Design Guidelines for Rural Residential Community Water Systems (Land and Water BC, 2004), City of Greeley (Colorado) Water Demand Study (EDAW 2002), Trepanier Landscape Unit Water Management Plan (Summit Environmental 2004), and calculated from Cowichan Basin water utility data.

5 Rural lots average 2.5 ha, but can range from 0.5 ha to 40 ha in size. Per-unit consumption factors reflect domestic use and lawn watering; farm use is captured under agriculture.

6 Includes townhouses and apartments

Using information from Cowichan Basin water utilities on the numbers of residential connections and total volume of water used, average water use "per connection" ranged from 347 m^3/unit/year to 1,338 m^3/unit/year—nearly a four-fold difference. Hence, actual use rates could vary substantially from the estimates shown in Table 10.

Land use change

Human water use is determined primarily by land uses and activities conducted by people at home, at work, and at play. In the Cowichan Basin, present land uses reflect zoning, and uses likely to occur in the near future are described in Official Community Plans (OCPs). The land use investigations for this Issues Report are based on a review of OCPs and consideration of likely future land use change.

To allow comparison among jurisdictions in the Cowichan Basin, a common set of land use types were developed:

- Residential -- Detached urban, Detached rural, Detached suburban, Attached
- Commercial
- Industrial
- Institutional
- First Nations (reserves)
- Agricultural
- Playfields (irrigated parks)
- Forestry
- Other.

Land use categories contained in the six OCPs covering the Cowichan Basin were interpreted to fit into the 12 Water Management Plan categories. This process involved interpreting future land use maps in the OCPs. Consultation with municipal and regional district staffs was undertaken to ensure that the plans were correctly interpreted.

The land use information was mapped, and tables prepared that summarized the estimates of the area of land in the 12 categories. This information formed the basis for non-residential water demand estimates and forecasts throughout the Basin. Residential demand outside of the District of North Cowichan was based on census information. In the District of North Cowichan, the OCP contains an estimate of present housing stock and forecasts of future housing growth. This OCP information was used instead of land use mapping to estimate residential water demand in North Cowichan.

Present and forecast population

BC STATS provides census information for all political jurisdictions in British Columbia. For this study, the proportion of each jurisdiction's population residing in the Cowichan Basin was estimated on the basis of available mapping (Table 11).

Table 11
Proportion of jurisdictions' populations estimated to live in the Cowichan Basin

Jurisdiction	Total 2001 population	% of population in Basin	Basin population
City of Duncan	4,699	100	4,699
Town of Lake Cowichan	2,827	100	2,827
District of North Cowichan	26,148	60	15,689
First Nation Reserves	1,730	100	1,730
Area B (Shawnigan Lake)	7,081	0	0
Area D (Cowichan Bay)	2,689	10	269
Area E (Cowichan Station)	3,805	50	1,903
Area F (Cowichan Lake)	1,763	85	1,499
Area I (Youbou)	1,149	90	1,034
Totals	51,891	57	34,528

Communities such as Duncan, Lake Cowichan, and the Cowichan Tribes' reserves are entirely within the Cowichan Basin. Other areas, however, straddle the watershed boundary. For example, a portion of Area B (Shawnigan Lake) is in the Cowichan Basin, but this is forested land with few or no permanent residents.

BC STATS also publishes the number of dwelling units in each jurisdiction. For all areas except North Cowichan, BC STATS data formed the basis for estimating the present mix of housing types. In North Cowichan, the OCP was used to guide housing type estimates. The proportion of each jurisdiction's housing stock in the Basin (Table 12) is assumed to be the same as the proportions of population living there (Table 11). A detailed table of housing type estimates is presented in Section 7 of *Water Facts*.

Table 12
Housing by type in Cowichan Basin, 2005

Housing type	Number of units	Proportion of total units
Urban	4,410	35
Suburban	5,087	40
Rural	1,213	10
Attached	1,991	15
Total	12,701	100

The rate of growth in the number of housing units was based on the rate of population growth. After each census, BC STATS runs a model to project the number of future residents in a regional district. The results of this P.E.O.P.L.E. model are presented only for regional districts as a whole, not for constituent municipalities and electoral areas.

Figure 23 shows the actual and projected population growth in the CVRD between 1941 and 2031. This pattern of a 6-fold expansion of the population in 90 years is dramatic and, if it continues, will prove unsustainable.

For the purposes of estimating future water demand, the forecast 29 percent increase in population between 2005 and 2031 will be used in several calculations.

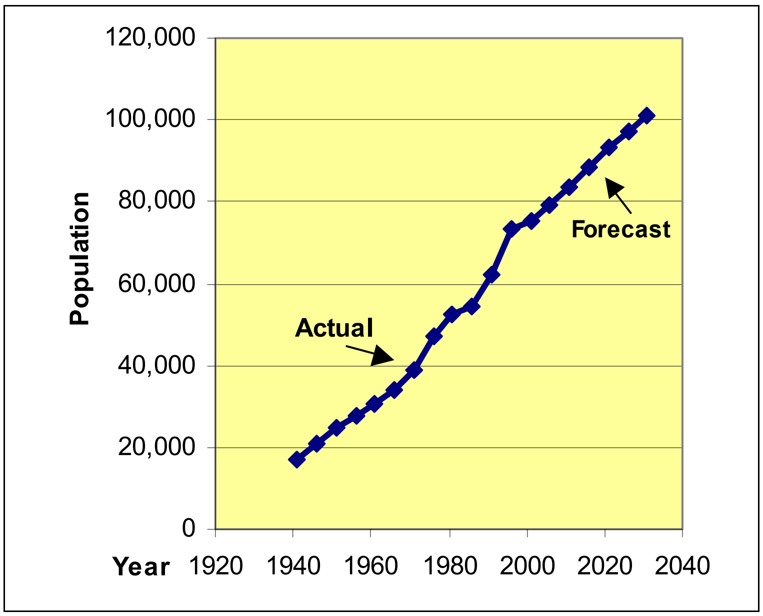

Figure 23. Actual population in the Cowichan Basin (1941-2004) and forecast growth (2005-2031).

To create a projection of water demand in the Cowichan Basin over the next 25 years, the 29 percent increase in population was applied to the number of existing housing units in each municipality and electoral area (Section 8 of *Water Facts*). In the absence of a regional growth management strategy, there is no basis for allocating the growth in parts of the region differently from the existing pattern. Therefore, the total forecast increase in population of 22,700 was assumed to settle in the region in the same way as the existing residents.

In forecasting housing growth, a *status quo* and a "densified" estimate were prepared. The *status quo* represents a continuation of the existing housing mix. The "densified" estimates represent a modest progression toward denser residential development, primarily in the municipalities. The densified forecasts assume that a greater proportion of future housing will be attached units and urban (i.e., small lot) detached units. A smaller proportion of housing stock is expected to be provided on suburban and rural lots. Table 13 summarizes housing forecasts for 2031 under the *status quo* and the densified assumptions.

Table 13
Mix of housing in Cowichan Basin, 2031

Jurisdiction, Housing type	***Status quo* housing mix**		**"Densified" housing mix**	
	% of dwellings by type	**Number of dwellings**	**% of dwellings by type**	**Number of dwellings**
Total Basin		16,384		16,384
Detached--Urban	35	5,709	41	6,709
Detached--Suburban	40	6,584	31	5,088
Detached--Rural	9	1,522	5	859
Attached	16	2,570	23	3,728

These housing forecasts formed the basis of residential water demand estimates for the Basin.

4.3 Present and future water consumption estimates

Present levels of water consumption in the Basin were calculated on the basis of:

- per unit water consumption for residential land uses, and
- per hectare water consumption estimates for commercial, industrial, institutional, commercial, and playfield uses.

Much uncertainty exists in the methods and assumptions used to estimate water use by either withdrawal (supply) or land use (demand) approaches. Section 9 of *Water Facts* contains a detailed description of the methods and assumptions used to prepare the forecasts.

Firstly, a detailed presentation of the present and forecast water consumption levels in the Cowichan Basin, by land use and jurisdiction, was prepared. A summary of these results is presented in Table 14. The "urban" water consumption is forecast to increase from the present level of 15.8 million m^3/year to nearly 20 million by 2031 (a 27% increase) if present consumption patterns are followed. With modest densification and conservation measures enacted, a smaller increase in urban water use would be expected, to 17.7 million m^3/year, an 11% increase.

Table 14
Water use in "urban" land use categories

Land use	Water use (m^3/year)		
	2005 estimate	**2031 *status quo***	**2031 with densification and conservation**
Detached urban	2,372,400	3,060,300	3,609,500
Detached suburban	4,450,700	5,741,400	4,452,000
Detached rural	1,900,000	2,451,100	1,525,800
Attached	398,300	513,800	745,500
Residential subtotal	9,121,400	11,766,500	10,332,800
Commercial	2,602,800	3,261,500	2,935,300
Industrial	2,255,900	2,707,100	2,436,400
Institutional	971,400	1,165,700	1,049,100
Parks	869,100	1,032,900	929,600
"Urban" Total	15,820,600	19,933,700	17,683,200

Using estimates of water use for agriculture, Catalyst Paper's Crofton mill, and the "urban" categories, Table 15 shows the total potential water use for the Cowichan Basin in 2031 if the *status quo* persists, and with modest densification and conservation.

Table 15
Cowichan Basin estimated water consumption by land use, 2005 and 2031

Land use	Water use (m^3/year)		
	2005 estimate	**2031 *status quo***	**2031 with densification and conservation**
Urban uses (residential, commercial, etc.)	15,820,600	19,933,700	17,683,300
Catalyst Paper	51,628,700	49,047,300	46,465,800
Agriculture	19,161,600	41,300,000	20,650,000
Total for Basin	86,610,900	110,281,000	85,799,100

For commercial, industrial, institutional, and playfield uses, the densification or conservation estimates assume a 10% reduction in water use over the 2031 *status quo* estimate. For Catalyst Paper Corporation, the *status quo* forecast assumes a 5% reduction by 2031, primarily due to expected equipment upgrades and continuing conservation efforts. The conservation estimate assumes that a 10% reduction in water use would be achieved by a more aggressive conservation program.

The resulting estimates of water use based on land use show that 86.6 million m^3 of water are used annually in 2005. This value compares favourably to the 79.0 million m^3/year that are estimated to have been withdrawn from surface and ground water sources in the Basin in 2004.

Given the uncertainty in the methods and assumptions used to estimate water use by either withdrawal (supply) or land use (demand) approaches, the estimates should be considered approximate only.

Table 15 also shows that with conservation and densification, water consumption in the Basin could actually be reduced over the next 25 years. With the modest reduction assumptions contained in the forecast model, a 2% decline in water demand could be achieved, even as population grows by 29%. Most of the reduction in demand results from introduction of improved irrigation techniques (described in Section 4.2), though the urban and Catalyst Paper reductions also contribute to the estimated benefit.

4.4 Water supply and demand forecasts

How much of the summer flow of the Cowichan River is consumed by human use? Given the uncertainty of water consumption data and the annual variation in river flow, this question cannot be answered with precision. Even without precise results, however, a review of existing flow data and estimates of consumption provide results that cause concern.

As described in Section 2.2 of this report, the amount of water flowing into Cowichan Lake is approximately 1.6 billion m^3/year. Human surface water use (water licences for withdrawals from Cowichan Lake, Cowichan River, their tributaries, and water from the Somenos and Quamichan systems) in 2004 was estimated to be 58 million m^3/year, or less than 4% of the total flow. The amount of ground water pumped from wells near the river remove additional—but unknown—quantities from the river's "base flow." Even with substantial effects of well withdrawals, it appears that from the perspective of *total annual water supply*, human demand can be adequately met from the Cowichan system.

Under *status quo* conditions, water demand could increase by 28% over the next 25 years, just to satisfy population growth. If economic development requires additional water, all of the licensed capacity in the Basin could be used, resulting in demand for 96 million m^3/year of surface water by 2031. Removal of ground water by wells may withdraw 7.1 million m^3/year from Cowichan River base flows in 2005, rising to 9.2 million m^3/year by 2031. Under this "high consumption" scenario, total withdrawals of surface water and ground water that could affect Cowichan River flow are estimated to reach 105 million m^3/year by 2031 (very similar to the 110 million m^3/year in Table 15). As a proportion of annual Cowichan River flow, this amount is 6.5% of the total annual flow, which seems to be a modest amount taken for human use.

This rosy picture is misleading. In an average year, 90% of the Cowichan River inflow (runoff from precipitation into the lake and river) occurs between October and April. In a dry year, 96% of the inflow may occur in the winter. Hence, only 4 to 10% of the annual inflow occurs between May and September, the period when demand is the highest. Similar inflow and use patterns also apply to the Somenos and Quamichan basins, though their water volumes are a fraction of those in Cowichan Lake.

Table 16 shows that in a normal year, such as 1966, more water flows into Cowichan Lake than flows out in the winter, but from May to September, outflows exceed inflows. In a dry year, such as 1995, the winter inflow "surplus" is lower, and is exceeded by outflows during the summer. In an extremely dry year, like 1998, outflows exceed inflows in all seasons.

Table 16
Cowichan Lake inflows and outflows in normal and dry years

	Net Inflows[2]		Lake Outflows (estimated)[3]		Water balance
Precipitation scenario[1]	**Inflow rate m^3/s**	**Total for period (million m^3)**	**Discharge m^3/s**	**Total for period (million m^3)**	**Inflow minus outflow (million m^3)**
Normal year (average summer flow) (1966)					
October-April	78.9	1,445.2	74.7	1,368.5	76.7
May-August	14.5	154.1	16.2	172.0	-17.9
September	3.9	10.1	7.0	18.1	-8.0
Total		1,609.4		1,558.6	50.8
Dry year (~ 1:20-year low flow) (1995)					
October-April	74.7	1,368.3	73.0	1,338.0	30.3
May-August	4.6	48.9	9.9	105.5	-56.6
September	1.1	2.9	5.9	15.4	-12.5
Total		1,420.0		1,458.8	-38.8
Extreme dry year (~ 1:50-year low flow) (1998)					
October-April	79.0	1,447.0	79.3	1,453.2	-6.2
May-August	5.7	60.6	9.9	105.4	-44.9
September	-0.9	-2.3	5.3	13.7	-16.1
Total		1,505.3		1,572.4	-67.1

Note: 1 - Return period and probability based on frequency analysis of average control period (April - Sept) discharges.
2 - Net flows into Cowichan Lake (Net Inflow = Actual Inflow - Losses (evaporation, etc.)).
3 - Estimated Cowichan Lake outflows based on results of Cowichan Lake routing model using current release schedule.

The importance of the summer season for water management can hardly be overestimated. In comparing these three years with normal, dry, and very dry summers, the normal annual inflow is 1,609 million m^3, only 13% more than inflow during a dry year of 1,420. In summer, however, the normal inflow of 164 million m^3 is three times (315%) greater than the 52 million m^3 inflow in a dry summer. Water balance deficits (in which more water flows out of the lake than lows in) occur in summer, even in normal years.

Forecast 2031 "high consumption" water withdrawals from the Basin could reach 105 million m^3/year, or 6.5% of a normal year's annual inflow (Table 17). From May to August, 27% of the inflow is removed for human use, and in September the amount removed leaps to 110% of inflows—30 times the proportion of inflow used in winter. The only way that more than 100% of inflow can be used in summer is if winter runoff is stored for later release. The Cowichan Lake weir presently has the capability to store 69 million m^3 of water in the lake.

Table 17
Cowichan River normal year water supply and forecast high consumption demand, 2031 conditions

Period	Normal Year Inflows (million m^3)	2031 Withdrawals from Cowichan Lake and River (million m^3)			Use as % of inflow
		Surface	Well water from river	Total	
Oct-April	1,445	49	4	53	3.6
May-Aug	154	37	4	41	27
Sept only	10	9.5	1	11	110
Total	1,609	96	9	105	6.5

Based on recent information, 54% of annual consumption by water utilities' customers occurs in the five months between May and September. Lawn watering, car washing, and similar domestic uses increase in summer. The only major water user in the Basin that does not materially increase withdrawals during the summer is Catalyst Paper, whose mill uses only 3% more water in summer than winter. Catalyst Paper's consumptive use is supported by equivalent storage of winter flows, detained behind the Cowichan Lake weir.

Records show that during drought years, water consumption for human use increases, particularly for lawn and garden use and for irrigation. To reflect this phenomenon, the surface and well withdrawals in a dry summer (Table 18) are assumed to be 10% higher than in a normal year for all users except Catalyst Paper, whose consumption is assumed to be 2% higher than in a normal year.

During drier than average summers, the volume of withdrawals greatly exceeds inflows. As shown by Table 18, dry year withdrawals in October-April and for the entire year differ little from withdrawals in a normal year (Table 17). During the May to August period, dry year inflows are only one-third of those in a normal year. Dry summer withdrawals in 2031 would consume 88% of inflows, compared to 27% in a normal summer. In September of a dry year, 2031 demand would remove four times as much water from the system as flows into it. If sufficient winter inflow cannot be stored, the river would be dry for much of the summer. If fall rains come late (perhaps in October or November instead of September), the effects of negligible river flows on human and ecological needs would be even more dire.

Table 18
Cowichan River dry summer water supply and forecast high consumption demand, 2031 conditions

Period	Normal Year Inflows (million m^3)	2031 Withdrawals from Cowichan Lake and River (million m^3)			Use as % of inflow
		Surface	Well water from river	Total	
Oct-April	1,368	49	4	53	3.8
May-Aug	52	42	5	46	88
Sept only	3	11	1	12	400
Total	1,420	102	10	111	7.8

As was experienced in 2003, when Cowichan River flows fell to low levels, drought causes stress to fish populations and riparian vegetation, dilution of sewage treatment plant discharges declines, and economic activities (such as river recreation and the Catalyst Paper mill) are threatened.

Even these examples miss some additional potential risks to the river system in low flow years. For instance, the weir may hold enough storage to allow 7 m^3/sec to be released from May to early September in a normal year, providing that the lake level is at the top of the weir on April 1 (UMA 2001). If full storage is not attained, or if rain does not come until October or later, then the stored volume would be insufficient to avoid serious ecological, health, and economic effects for one month or more. In 1998, a very dry year, Cowichan Lake had *negative* inflows for much of July, August, and September, and evaporation losses from the lake (which can exceed 7 m^3/sec) were greater than lake outflows (UMA 2001).

Well pumping effects in the Basin. Downstream of Duncan, other factors compound the issues associated with surface withdrawals from the lake and river. Irrigation, most of which is in the Somenos and Quamichan sub-basins and other District of North Cowichan areas, occurs exclusively in the summer, generally peaking in July and August. Much irrigation water is obtained from wells. Ground water also provides the domestic supply for Duncan and North Cowichan, whose utilities operate wells near the Cowichan River. Pumping from wells likely has a greater effect on the river during the summer than winter, because river flows are lower and rates of pumping are higher. Because the local water utilities' wells are downstream of the Catalyst Paper pump station, wells can place additional stress on lower reaches of the Cowichan River during low flow periods.

Most of the wells in the Cowichan Basin are located in the lower part of the Basin, and withdrawal records are poor (except for utilities). The effects of well pumping on the Cowichan River are virtually unstudied. A carefully designed and implemented program of well and river monitoring would be needed to determine the effects of wells on the river. Such a program might involve continuous pumping wells of interest while stream flow changes are measured. This analysis requires a detailed understanding of stream, aquifer, and substrate characteristics (Idaho Water Resource Research Institute, 1998).

Data related to the impacts of well pumping on summer flow in the Cowichan River are not available, but a comparable study has been conducted for the Chemainus River. Two wells located 50 to 85 m from the Chemainus River were studied. Based on a low flow of 43,200 m^3/day during summer months, pumping the two wells at a combined rate of 11,232 m^3/day could reportedly cause flux out of the river equal to the maximum pumping rates, or close to one-quarter of the total river discharge. Pumping of this magnitude could lower the river level several centimetres, which could be significant during low flows (SRK Consulting, 2003). Care must be taken in extrapolating such results to the Cowichan River, which has greater flow and greater well withdrawals than the Chemainus.

Summary implications. The implications of these findings for water management can be summarized as follows:

- On an annual basis, the Cowichan system appears to have sufficient water to sustain human use and ecological integrity. This perception is misleading, however, because annual averages disguise seasonal water supply-demand imbalances.
- Even in average years, water is in limited supply during summer, and careful water management is needed to ensure that human uses (domestic, irrigation, effluent dilution, and industrial, recreational) do not harm the Basin ecosystem.
- In low-flow summers, withdrawals from Cowichan Lake and Cowichan River greatly exceed inflows, increasing the risk that the existing low weir cannot store sufficient water to sustain fisheries, ecological, recreational, and effluent dilution functions of the river.
- Future growth in water demand will increase summer stress on the Cowichan system, particularly in low-flow summers. Action will be needed to balance demand for withdrawals with the need to maintain supply for in stream human and ecological purposes.
- Catalyst Paper presently withdraws only about 60% of its licensed volume from the Cowichan River, but there are no guarantees that the remaining volume would not be removed in the future. Withdrawing Catalyst's entire 87 million m^3 allocation from the river in a dry year would have a substantial effect on flows and downstream users.
- Well withdrawals reduce Cowichan River base flows in summer by an amount that is unknown but potentially substantial, rising ecological and health risks in the lower Basin.
- Summer drought and extreme low flows were common prior to construction of the weir, even though human use of water was much lower. Today's water demands and expectations of multiple uses of water in the Basin require a higher level of management than was considered when the weir was built.

4.5 Water metering and pricing

Traditionally, there have been two common approaches to water pricing, flat rate systems and volume-based rate systems. Flat rates are fixed payments in each billing period, unrelated to the volume of water used (Burke *et al.* 2001). The flat rate system is the most common pricing method used in the Cowichan Basin. The main advantage of flat rate pricing is ease of administration and billing. The principal disadvantage of flat rate pricing is that it generally results in higher water use than volume-based pricing, because customers can use as much water as they want once they have paid the monthly fee. Customers have no incentive to conserve water and municipalities have little control over water demands.

Volume-based rates relate the amount consumers pay to the amount of water they use (Tate *et al.* 1991). A water utility must have proper tracking capabilities, typically water meters, to implement volume-based rates. The increasing block rate (IBR) schedule, a volume-based rate system in which the unit price of water increases progressively through the blocks of the rate schedule, is used for some metered connections in the Cowichan Basin.

The Table 19 summarizes the patchwork of differing methods and formulas for water pricing in the Cowichan Basin. A complete listing of prices for the Town of Lake Cowichan and the City of Duncan is included in Section 10 of *Water Facts*.

Table 19
Summary of metering, pricing methods, and rate schedules for major water systems in the Cowichan Basin

Water System	Meters	Pricing Method	Rate Schedule
Town of Lake Cowichan	Some commercial	Flat rate (unmetered customers)	Standard (detached) residential - \$19.43/month. Flat rate for a commercial connection varies. Examples: Office or store - \$13.09/ month Licensed pub - \$52.53/month Laundromat - \$21.20/washer/month.
		Increasing block rate (metered customers)	Metered detached dwellings (including duplex and triplex) - \$16.13/ month for the first 30 m^3 and \$2.02 for each additional 3.8 m^3 All other metered buildings - \$10.08/month for the first 19 m^3 and \$2.02 for each additional 3.8 m^3
Honeymoon Bay Water System	No	Flat rate	\$160/year
Youbou Water Utility Corporation	No	Flat rate	\$180/year
Utility Waterworks Improvement District	No	Flat rate	\$190/year
Sutton Creek	No	Flat rate	\$240/year
City of Duncan	6,569 unmetered 239 metered commercial and industrial	Flat rate (unmetered customers)	Residential - \$122/year in the City and \$152/year outside of the City Multiple dwellings - \$122/year for the first unit and \$94 per year for each additional unit in the City, \$152 per year for the first unit and \$118 for each additional unit outside the City Commercial – varies, see Section 10 of *Water Facts*
		Combination of flat rate and IBR pricing methods (metered customers)	Flat rate of \$122 per year for the first 170 m^3 Rates increase by \$4.00, \$4.20, and \$4.40 per 17 m^3 used, up to 680 m^3, 850 m^3, and 1,700 m^3, respectively.

Water System	Meters	Pricing Method	Rate Schedule
South End Waterworks District	Yes, universally metered	Combination of flat rate and IBR pricing methods	First 26 m^3 per month is $10.12 for residential use and $13.52 for commercial use. Monthly meter rates are $6.60 per month for apartments or seniors housing and $13.52 for commercial. Monthly residential metered excess consumption rates are $1.29 for each additional 3.8 m^3 used between 26.5 m^3 to 121 m^3, and $1.90 for each additional 3.8 m^3 used above 121 m^3.
Dogwood Improvement District	No	Flat rate	$360/year
Mesachie Lake Water System	No	Flat rate	$108/year
Pioneer	No	Flat rate	$100/year
Lakeside Estates	Yes, universally metered	Flat rate pricing method and volume-based IBR methods	Flat rate of $72.00 every six months for the first 240 m^3 of water used, or 30¢ per m^3, and 60¢ per m^3 for any volume higher than 240 m^3.

4.5.1 Provincial water rental rates

Water rental rates were reviewed in 2003 and 2004, as part of a government-wide initiative to improve outdated structures. The review concluded that water rental rates are overly complex and out of date. Currently, the rental rates include 90 different water user categories each having its own unique water rental rate, and four different Imperial-based water volume measures (acre-feet per annum, cubic-feet per second, gallons per day, and gallons per year). Commencing January 1, 2006, new rental rates will come into effect for water licences. The rental rate changes will be phased in from 2006 to 2009.

According to Land and Water BC (now the Ministry of Environment), the new rates will bring water conservation, equitable water use pricing, and the provision of key water management services into balance. The new rates reduce the number of water user categories from 90 to 9 and replace several flat fee rentals with volume-based rates. Similar water users will have the same rental rate based on sectors. The new rent structure is summarized in Table 20.

Table 20
New provincial annual water licence rental rate structure, effective January 1, 2006

New Sector	New Annual Rental Rate Based on Volume (per 1,000 m^3)	Minimum Annual Rent for Sector
Agriculture	$0.60	$25.00
Aquaculture	$0.08	$100.00
Conservation and land Improvement	$0.01	$25.00
Domestic	$0.60	$25.00
Industrial and commercial	$0.85	$100.00
Mining and petroleum	$1.10	$100.00
Storage	$0.01	$25.00
Waterworks (water supply)	$1.10	$100.00
Waterpower residential (supplied by landowner)	$0.01	$100.00

There will be both increases and decreases to annual rent changes. For example, Catalyst Paper will pay twice as much for their water by 2009 ($72,000) as they did in 2005 ($38,000). Local authorities that have water licences for waterworks will receive a water rent decrease commencing in 2006, from approximately $1.54 per 1,000 m^3 to $1.10 per 1000 m^3. The new rent structure is intended to have a minimal impact on domestic users. Most water licence holders use water volumes that will qualify them for the minimum rent level.

5.0 Water Issues

5.1 Issues identified by the Water Management Forum

As part of the water management planning process, a multi-party *Cowichan Basin Water Management Forum* (Forum) has been created to represent community, business, environmental, government, and First Nations interests from throughout the Basin. The purposes of the Forum are to ensure that a wide range of viewpoints are represented and included in the development of the Water Management Plan, and to provide information, advice, and recommendations regarding the development of the Water Management Plan.

At its inaugural meeting on April 14, 2005, the Water Management Forum identified values, issues, and priorities associated with water in the Basin (Photo 4). The Forum identified the following main water management issues:

- Developing a plan that has broad public and government support,
- Managing water use and demand,
- Protecting fisheries and other values in the Cowichan River,
- Resolving issues related to regulation and jurisdiction,
- Maintaining sufficient water storage to supply river needs during summer,
- Controlling population growth and urban development in the Basin,
- Managing the Basin ecosystem as a whole, not focusing on charismatic species (like salmon),
- Improving public and decision maker awareness of water and its management,
- The need for a long-term plan to replace "crisis management,"
- Knowing the difference between water "needs" and "wants,"
- Planning in the midst of conflicting water interests in the Basin.

The values identified as part of the Forum's deliberations fell into the following categories:

- Property and development—semi-wild character of the area, attractiveness as a place to live,
- Culture—the river has historic, spiritual, and other values for the Cowichan Tribes, who have lived here for centuries,
- Utilities—provides water supply to many communities, and dilution of sewage effluent,
- Environment and ecology—highly productive system, supports rare and endangered species and many fish,
- Economy—ability of the system to support of small businesses, large industry, and agriculture,
- Recreation and aesthetics—fishing, hiking, swimming, tubing, nature appreciation,

- Personal use—availability of clean water for drinking and other personal uses

Section 11 of *Water Facts* contains a detailed summary of the values and issues identified by Forum members.

Photo 4. Members of the Water Management Forum identifying values and issues at the April 14, 2005 meeting.

5.2 Values and issues identified by the public

Members of the public had an opportunity to express their views on the importance of water, issues that the Water Management Plan should address, and what should be done to resolve these issues. More than 160 people attended open houses held in June, and 241 people submitted comment response forms.

When asked to identify valued aspects of water in the Cowichan Basin, clean drinking water and healthy ecosystems for plants, animals, and people were chosen by more than two-thirds of the respondents. Fish and fishing, aesthetics, quality of life in the Basin, and effluent treatment are also valued by many of the respondents. Some response form comments varied according to where respondents live. Clean drinking water was rated as important by most respondents, but was rated most highly by residents the District of North Cowichan and Duncan. High water levels are of particular concern for many lakeside residents. Low water levels were not rated as important by North Cowichan residents, who rated economic benefits more highly than other area residents.

According to the public respondents, the four most important issues the Water Management Plan should address are:

- sufficient water for household supply,
- sufficient water for fish and fishing,
- managing growth and development, and
- reducing the demand for water (by individuals, municipalities and industry).

The public also wants the Water Management Plan to include protecting water quality, ecosystems and species, and managing logging practices. Again, choices varied slightly according to where respondents live. When compared to the 'average' respondent, North Cowichan residents were most likely to be concerned with household water supply and growth and development. Cowichan Lake residents were the most anxious about waterfront landowner concerns, such as high water levels, which still ranked fifth among their important issues. Managing growth and development was a much higher priority in North Cowichan than elsewhere, and water for irrigation, business, Crofton's mill, and sediment movement ranked low in all locations.

Respondents had varied suggestions for resolving water issues in the Cowichan Basin, and included the following actions:

- Develop a Water Management Plan with public input, based on solid research and science.
- Manage growth and development in the Basin.
- Implement demand management (water conservation) through education, regulation, metering, pricing and incentives.
- Investigate alternatives to raising the weir. Some respondents felt that raising the weir is a solution, whereas others adamantly opposed this action. Some people suggested creating additional storage reservoirs elsewhere in the Cowichan Basin or even outside the Basin.
- Protect water quality and quantity through management of effluent discharge and reduction of non-point sources of pollution (e.g., leaking septic fields, agricultural runoff, siltation).
- Manage logging in the watershed to retain water and avoid erosion and sedimentation.

A detailed summary of the input received from 241 response forms is included in Section 12 of *Water Facts*.

5.3 Water supply and demand

Water is supplied to users throughout the Cowichan Basin by many different kinds of water systems. The systems range in size from individual licence holders and well owners to large utilities servicing thousands of connections. Individual licence holders and well owners are not required to report annual withdrawal quantities or to pay based on the volume they use. Water purveyors, especially the smaller systems that are privately owned and operated, may not have the funds or initiative to ensure water system infrastructure is efficient (i.e. free of leaks) or customers are conserving water. The large number of water purveyors, and the fact that few water users quantify their annual consumption, makes it difficult to accurately assess total water use in the Cowichan Basin.

On an annual basis, the Cowichan system appears to have sufficient water to sustain human use and ecological integrity. Examining annual averages can disguise short-term or seasonal water supply-demand imbalances. Even in average years, water is in limited supply during summer when demand is at its peak. The relationship between seasonal river flow and human demand for water from the Cowichan system is shown in Figure 24. The peak in demand is in June through September, precisely when river flows are at their lowest levels. Conversely, less water is withdrawn for human use in winter, when the system has plenty of water.

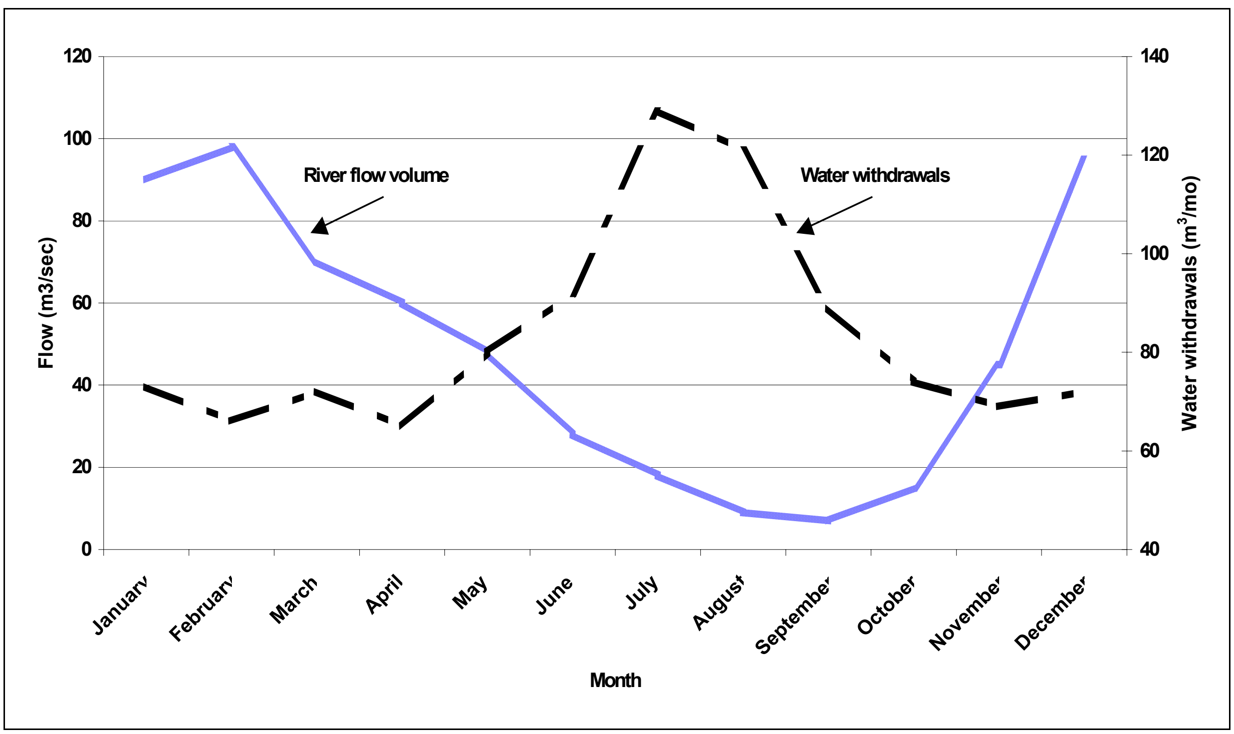

Figure 24. Relationship between seasonal river flow and human demand for water from the Cowichan System.

In low-flow summers, fisheries and ecological functioning of the river are stressed, partly as a result of withdrawals of water for human use. Water stress on the system is particularly acute in at the end of summer, when estimates show that water is removed from Cowichan Lake and River at twice the rate of inflows. Were it not for storage of spring runoff in Cowichan Lake, the river would have virtually no flow by September of a dry year. Summer drought and extreme low flows were common prior to construction of the weir, even though human use of water was much lower. Today's water demands and expectations of multiple uses of water in the Basin require a higher level of management than was considered when the weir was built. Future growth in water demand will increase summer stress on the Cowichan system, particularly in low-flow summers. Action will be needed to balance demand for withdrawals and for instream human and ecological purposes.

5.4 Water metering and pricing

Most water connections in the Cowichan Basin are not metered. Without meters it is difficult, if not impossible, to quantify how much water is being used by individuals and to promote personal responsibility for water conservation. Meters provide a method of collecting time-series data that can be used to identify trends in water consumption and, in turn, factors contributing to these trends. Demand management programs can then be implemented to address the factors.

Flat rate formulas are the most common water pricing method used in the Cowichan Basin. The principal disadvantage of flat rate pricing is that it results in higher water use than volume-based pricing, because customers can use as much water as they want once they have paid the monthly fee. Customers have no incentive to conserve water and municipalities have little control over water demands. Volume-based rates relate the amount consumers pay to the amount of water they use, thus encouraging water conservation. A water utility must have proper tracking capabilities, typically water meters, to implement volume-based rates.

5.5 Ecological issues

Maintaining ecological health in the Cowichan Basin is related to the quantity and quality of water throughout the year. The complex inter-relationships among fish, waterfowl, wildlife, vegetation and humans require assessing water management needs from a complete system perspective. Water management issues related to ecological functions are summarized below.

- Fish in the Cowichan Basin require a continuous flow of clean, cool water throughout the entire year. They are stressed when water temperatures increase or other habitat characteristics are altered by low river flows.

- Fish need sufficient water in the river during the late summer and fall to travel upstream to spawn.
- Fish need enough cool water to cover incubating eggs, provide rearing areas, allow movement between side channels and the river, and enable downstream migration during the spring.
- Sediment deposition from natural sources and human disturbance can degrade spawning gravels and incubation success.
- River flows during the driest periods of the year may not allow enough dilution and mixing of sewage waste, resulting in a variety of problems including reduced oxygen levels and lowered habitat quality.
- Climate change could affect the snow pack in the Cowichan Basin and, in turn, water temperatures.
- Riparian vegetation along lake edges, streams, and river corridors relies on water to fulfill its role as a filter for pollutants, as a wildlife passage, and as a source of food.
- Drainage and water storage management is important to maintain rearing and wintering habitat for fish and waterfowl in the Somenos and Quamichan sub-basins.
- Introduced species can affect water flows in the Cowichan Basin by potentially altering the native plant composition and function, impeding flood control, drainage and irrigation.
- Beavers impound water in the Quamichan sub-basin and Somenos outlet areas, slowing drainage, affecting water flows, and affecting farmer's fields.
- Urban and agricultural development has altered the natural characteristics of the Somenos sub-basin. Key wildlife management issues relate to declines in biodiversity as a result of simplification of habitats, the influence of non-native species through predation and competition, reductions in migratory songbird populations (although an international phenomenon), and displacement and other disturbance effects from human and pet activities. Another significant issue is the decline in carrying capacity for Great Blue Herons, wintering swans, geese and other waterfowl, which seem to find the best feeding in the flooded fields of the Somenos sub-basin (Williams and Radcliffe 2004).
- Quamichan Lake is naturally eutrophic, meaning that high levels of nutrients are found in the water. This condition results in reduced oxygen levels during the summer, which can lead to fish kills. In addition to natural sources, nutrients from agricultural fields, septic tanks, and urban run-off contribute to eutrophication.

5.6 Flooding in the lower Basin

In the Somenos and Quamichan sub-basins, water drainage and removal are commonly cited issues. Poor drainage affects spring and early summer access to fields and reduces crop yields. This flooding is related to constricted drainage, increased runoff from surrounding development, and, potentially, deflating organic soils resulting from tillage. High water levels on the Cowichan River cause backflows into Somenos Creek, flooding low-lying portions of the sub-basin.

Flood risks also exist on the main stem of the Cowichan River. Dyking of the Cowichan River has created a restricted area for the river to flow. Narrow bridge openings within the dykes reduce flow velocities, resulting in deposition of gravel in the channel. This aggrading (rising) channel increases the risk of flooding. The Cowichan Tribes' IR #1 is particularly subject to flooding risk.

5.7 Sedimentation and gravel deposition

Land development and resource extraction activities in the watershed have given rise to concerns about sedimentation and drainage problems (Williams pers. comm.). Sediment from the clay banks of the Stoltz Slide, 27 km upstream of Cowichan Bay, is a major cause for concern. During high water level periods, the river is cloudy as the water transports fine material from the exposed slide. Fine sediments from this, and other slides, plug gravels needed for fish spawning and reduce the quality of water for human use. Catalyst Paper currently removes sediment from the river water used in industrial processes due to high sediment loadings. A joint federal-provincial-Catalyst Paper initiative has been undertaken to stabilize the sediment from the slide area (BCCF 2005).

Large deposits of gravel accumulate where river flows are slowed by topography and built structures such as bridges and dykes. The Cowichan Tribes have conducted gravel removal programs to maintain channel capacity through their reserves. Flood risk is increased by gravel deposition on dyked rivers, such as the lower Cowichan River.

5.8 Lakeside properties

One area of concern voiced during the June open houses and on public response forms was the impact of increased and fluctuating Cowichan Lake water levels on the value of lakeside properties. The following issues were raised:

- Will higher lake levels negatively affect property values?
- Will higher lake levels reduce assessment values and hence property taxes?

- If more lake storage is sought, should property taxes be reduced?
- How will the seasonal effects of higher lake levels in the spring and early summer (when recreational uses of the properties are the greatest) affect property values?
- Will fluctuating lake levels affect the use and upkeep of docks?
- Is there any potential for compensating lakeside residents for use of property for water storage?
- What is the likelihood of unexpected water level changes and how would this affect property values?

Assessment and taxation issues

The BC Assessment Act requires that property tax assessments reflect market values:

> "Market value is the price an unencumbered property would sell for if a reasonable amount of time is allowed to find a purchaser …
>
> When establishing the market value for a particular property, BC Assessment considers each property's unique characteristics. These are the same characteristics that a home purchaser would consider, including size, layout, shape, age, finish, quality, number of carports, garages, sundecks, and condition of buildings. Services in the area, location, views and neighbourhood may also influence a property's value….
>
> In any area, properties of equal value contribute the same tax."
>
> (www. Bcassessment.ca).

To follow up on this issue, telephone discussions were held with a representative from BC Assessment Agency's (BCAA) Nanaimo office, the office responsible for property assessments in the study area. It was confirmed that property value for tax assessment purposes "comes from the market" i.e., that sales prices determine the assessed values. Thus, if sales prices change as a result of an increased period of flooding or of higher flood levels, these price changes would be reflected in the assessed values of the properties so affected. In the short term, assessors would attempt to find examples of similar impacts elsewhere and apply that experience or, barring that, would apply their own judgement until enough properties are sold to clarify pricing trends.

Property values

Current property values are presumed to reflect the current level and seasonality of flooding, which has been in place for some 50 years. The impact of increased flooding in time (i.e. spring, summer) or in location on the value of lakeside properties is difficult to forecast, because these properties sell at a premium reflecting their scarcity. If a property becomes unusable or significantly less usable because of a change in the water management regime, a significant change in value might occur. Because properties have different shapes, topography and market values, it is difficult to generalize the potential impacts of lake level increases. Based on earlier studies (KPA 1991) summer water levels with increased storage might be 45 cm higher than normally occurs now. The effect of this change on any specific property is largely determined by the width and shape of its beach.

For some low-gradient farmlands, such as those near Robertson Creek, any further increase in water storage will further reduce agricultural potential of the land. Predicting the extent of property effects would require detailed flood zone mapping.

Compensation for water storage

As to lakeside properties being infringed upon for water storage, and thus deserving of compensation, the BCAA could not offer an opinion. This is a legal issue that should be explored by a qualified lawyer. It was noted, however, that should an agreement be reached whereby property owners were compensated for providing water storage, such income might actually increase property values. Income from compensation might also have income tax implications, particularly if compensation increases property values. Legal advice should be sought if this issue is to be considered further. A variety of questions needs to be answered, such as:

- Who would be responsible for making payments?
- Does any obligation exist?
- Are there precedents in other jurisdictions?
- Did the owner purchase the property after the current lake management regime was in place (1957)?

5.9 Recreation and tourism

The Cowichan Basin provides diverse tourism and recreational opportunities for residents and visitors. Ample quantities of clean water are needed to support visitor activities such as swimming, fishing, and boating. The relationship between waters levels, effluent dilution, and recreation is a concern (Brookman pers. comm.). As water levels decrease through the summer, the ability to adequately dilute sewage effluent released from the Lake Cowichan and Joint Utilities Board waste treatment plants has been questioned by some members of the public. Waste discharge from boats and malfunctioning septic fields is a regular topic appearing in local newspapers.

Other aspects of tourism and recreation may also be affected by changes in river flows and lake levels. Low lying campgrounds, recreation sites, trails or other infrastructure would be affected by changes in water levels. Access to some fishing areas is limited during periods of low lake levels and river flows. High water temperatures affect target fish populations for anglers and drift fishermen need enough river flow to avoid rocks while fishing in the spring. Kayakers, canoeists and tubers need a reliable river flow during the dry summer period.

Much of the tourism and recreation attraction of the Cowichan Basin is related to the presence of visually appealing landscapes and natural features. Maintaining high levels of visual quality, including the river corridor and surrounding vegetation is important to providing viable tourism products.

The acoustic environment is also part of the visitor experience. During the winter and early spring, the sounds of high river flows over rapids and throughout the river corridor enhance visitor activities (Barrie pers. comm.). The river is quieter in summer, so visitors are more likely to hear the sound of birds, other recreationists, and traffic, when near roads.

5.10 Sewage treatment

The sewer system in the Town of Lake Cowichan includes a collection network, four lift stations, a lagoon system that provides secondary treatment (see Photo 5), chlorination and dechlorination, and an outfall to the Cowichan River. The system is designed to accommodate a population of 4000 persons, which exceeds the current population, but during wet periods, its capacity is reduced by inflow and infiltration. This reduced capacity has historically resulted in water quality issues downstream of the outfall (Town of Lake Cowichan 1999).

Photo 5. Town of Lake Cowichan sewage treatment lagoons.

The City of Duncan, the Municipality of North Cowichan (South End) and Electoral Area D (Cowichan Bay) are serviced by the Joint Utility Lagoon which provides secondary treatment (CVRD Engineering Services 2005). Through recent improvements, the facility is expected to provide an increased capacity over the next 15-20 years (District of North Cowichan 2002). Treated wastewater from the Joint Utility Lagoon is discharged into the Cowichan River near Marchmont Road (Lynn Jackson 2005), which is just upstream of a popular and historic bathing area for the Cowichan Tribes.

Liquid waste disposal in most rural areas in the Cowichan Basin is based on private onsite septic systems. Exceptions include small connection networks with in-ground disposal, such as the Mesachie Lake and Creekside facilities, which service 26 and 75 homes, respectively (Lynn Jackson 2005). Natural winter flooding levels in Cowichan Lake inundates some septic fields, resulting in a transport of sewage into the lake.

5.11 Climate change

Though climatologists are studying and forecasting potential changes in global climate, regional-level predictions cannot be made with accuracy. Even without relying on long-range predictions, however, the Cowichan Basin may already be experiencing climate change. The low level of snowpack and increasing length and frequency of summer droughts are consistent with the effects of climate change described by scientists.

It would be unwise to presume that future climatic conditions will resemble those of past decades. The risks of failure to plan for less winter snow and more summer drought could be severe for the people and ecosystems in the Basin. The Water Management Plan, therefore, should avoid excessive optimistic forecasts of future flow conditions, and pursue a conservative or precautionary approach.

5.12 Lack of basin thinking

Many resource management challenges arise from the human tendency to apply a frame of reference that is too narrow. We tend to think in the short term (months or years) when many environmental phenomena are measured in decades, centuries, or even millennia. In the 10,000 years between the retreat of glaciers and Euro-Canadian settlement of the Cowichan Basin, a complex lake, river, and estuary ecosystem developed. This ecosystem supported an array of fish, mammal, plant, and invertebrate species whose complex relationships were influenced by the Basin's seasonal variations in water flow and climate. The Aboriginal people of the Cowichan Basin understood and, generally, adapted their practices to accommodate the natural patterns. The subtlety and wonder of this productive Cowichan Basin ecosystem does not appear to have influenced the development plans and directions that prevailed in the Nineteenth and Twentieth Centuries, during which the demands of markets for resources were deemed paramount.

Thinking in terms of centuries is inconsistent with human life spans. Economics is notorious for focusing on short-term returns. Economist John Maynard Keynes is quoted as dismissing long-term perspectives, saying the "'long run' is a misleading guide to current affairs. In the long run we are all dead." Politicians take substantial risks in proposing short-term sacrifice in pursuit of long-term goals. So fickle is the electorate, that it is said, "in politics, a week can be a very long time." British Columbia's forest policy is based on the German concept of "sustained yield," in which complex ancient forests with thousand-year-old trees are replaced by 80-year rotation tree farms of a few commercial species. Official Community Plans are intended to offer a "long term" perspective on land use in communities, though they are intended to be revised every five years and rarely consider the sustainability of "full build out" of a plan. British Columbia's water management legislation, too, values economic development over conservation or protection of natural water systems. Under the *Water Act*, water licences cannot be granted unless the applicant builds "works" to remove the water from a stream or lake. Most of our laws and regulations clearly value economic use of water over the long-term health of water bodies and water-dependent ecosystems.

Basin thinking requires a perspective that considers the potential effects of our actions on the needs of other people and species, and on the complex functioning of watersheds. As individuals, we tend to focus on how a circumstance affects us personally, and discount effects on other people, other species, or the functioning of ecosystems. We worry more about our jobs, bank balances, property values, or personal convenience than about environment or future generations. We readily divert water to supply our showers, hot tubs, and industries, with little concern for how the act of turning the tap affects aquatic animals and plants, or even our neighbours. Water flowing to the sea transports minerals and sediments, and sustains fish, birds, mammals, plants, and insects, yet such water is seen by some as "wasted" if is not used by humans for some economic purpose.

By adopting basin thinking, we begin to understand that the water moving through the Cowichan Basin has ecological functions that have developed over eons. The study of ecology is only a few decades old, and watershed management is even younger. Neither field claims to understand all of the relationships between water, land, and organisms. Hence, our water management actions need to be developed with an open admission of our ignorance about the many roles of water in the Cowichan Basin.

Basin thinking has the following characteristics:

- Understanding that humans are a single--but disproportionately influential--part of the Cowichan Basin system
- Appreciating the complexity and beauty of the water, land, and biota of the Cowichan Basin, and recognizing that these things evolved without us, and have value beyond our economic use,
- Recognizing that our water works, wells, and diversions all disrupt the Basin's hydrological cycle in some way,
- Accepting that our lives, jobs, and economic decisions are fleeting, and that our time scale is inconsistent with the long-term cycles that created and maintain the Cowichan Basin ecosystem,
- Understanding that the cumulative effects of individual actions affect the ecological functioning of the lake, river, estuary, and biota of the Cowichan Basin,
- Understanding that the laws and "rights" associated with water have little to do with the healthy functioning of the Basin,
- Agreeing that each resident, institution, and business in the Basin, and users outside of the Basin, have a responsibility for protecting the flow and quality of water,
- Believing that prevention, not dilution, is the solution to pollution,
- Accepting that all water users should pay a fair tariff for water used, while appreciating that the price of water is not necessarily the same as its value,

- Recognizing the ground water and surface water are part of an integrated Cowichan Basin water system,
- Moving beyond upstream-downstream personal perspectives, and grasping that we are all downstream of the height of the Basin, and we are all upstream of the estuary and Cowichan Bay.

As residents of the Cowichan Basin learn more about the water system and become more involved in its management, they may elaborate on the concept of basin thinking, expanding it and adapting it to local circumstances. For water management to be a success, basin thinking needs to replace the outmoded concepts that influence our allocation and use of water today.

5.13 Regulatory gaps and overlaps

Other sections of this report have described the plethora of legislation, regulations, guidelines, plans, and pricing systems that influence the use of water in the Cowichan Basin. The failure of existing regulations to protect ecological values is commonplace; laws and regulations are often based on legal precedent, political priorities of the day, or ease of implementation. Even when resource management actions are ecologically disruptive, they usually comply with laws, regulations, and plans. As with many social contracts of the past century, in balancing economics and ecology, resource management laws and regulations and most land use plans clearly favour economics.

Many newly-adopted plans and stewardship guidelines contain excellent policies and directions for ecologically sound, holistic management of water. Implementing those plans and guidelines, however, may be hobbled by the need to comply with, or obtain permits or licences issued under, legislation and regulations that are not consistent with principles of sustainability.

Effective water management must involve the owners and regulators of the resource. It is challenging, however, to determine the ownership and management responsibilities for land and water in the Basin. Who owns the water? Who owns the fish that swim in it? Who owns the bed of the lake or the river, or the foreshore? What responsibilities are attached to those rights? Who monitors and enforces those uses, rights, and responsibilities? What are the limits to those rights?

Questions of ownership of water may be the wrong questions. "Water is not 'ours' or 'theirs,' but the planet's. We use water, and it passes on, and then it comes back to us. But it is not, surely, something we should either hoard or prevent others from using" (De Villiers 200 p. 301). To the extent that our laws imply or grant "ownership" of water, they may be inconsistent with water's ecology.

A water management plan needs to be aware of these regulatory limitations and the associated confusing and often conflicting mandates and responsibilities, but the plan must avoid becoming mired by them. The plan needs to articulate a positive, accepted direction for water management, and develop ways of achieving those goals.

Multiple agencies, fragmented responsibilities, and regulatory issues are parts of the water management reality. Indeed, the partners who support the Cowichan Basin Water Management Plan recognize the need for collaboration. As the Water Management Plan progresses, issues associated with implementing management alternatives will become more important. With public support and a logical plan, many of the hurdles and regulatory gaps and overlaps can be resolved through dedicated implementation.

5.14 Lack of a forum for discussing watershed issues

Prior to the start of the Water Management Plan, the Cowichan Basin lacked an organization for discussing water and water management issues. Utilities, local governments, First Nations, provincial and federal agencies could discuss issues of relevance to their specific mandates, but rarely could residents, regulators, and business come together to discuss water in the Basin. In the absence of such an organization, it is difficult to assemble people from the broad range of interests and geographic areas needed to examine Cowichan Basin water issues.

With the creation of the Water Management Forum under the auspices of the Water Management Plan partners, a broad cross-section of water interests has a legitimate mandate to discuss and resolve Basin-wide water management issues. It is likely that once a Water Management Plan is adopted, a similar organization will be needed to implement the plan and monitor its success.

5.15 Communicating with affected interests

With more than 30,000 people dwelling in the Cowichan Basin, communication of water management issues is a major challenge. Because so many people have an interest in water in the Basin, the Water Management Plan partners recognize the importance of communication. How best to reach the affected parties? Websites? Mail? Surveys? Meetings? Newspaper articles? Media notices? All of these methods are being used, recognizing that, nonetheless, some groups may not receive the materials or may not respond.

Responsibility for communication involves all parties. The Water Management Plan partners assume responsibility for developing and distributing information to the public and specific interests. The recipients of the materials, too, bear responsibility for informing themselves about the issues and communicating their concerns.

The importance of communication will increase when water management alternatives are developed. Some parties may be affected more than others by specific alternatives, and special care will be needed to ensure that they understand the proposals and are invited to respond. This dialogue with affected parties is doubly challenging because of the size and diversity of the Basin, and the cost and logistics of communication.

5.16 Suspicion

Although this Water Management Plan is the first broadly based effort to manage water throughout the Basin, other topic-specific initiatives have been proposed in the past. Some of these initiatives left a legacy of suspicion that must be overcome if water management is to be accepted. The highest profile of these initiatives focused on raising the weir at Lake Cowichan to increase water storage in the lake. These proposals were supported by some people, but aroused considerable public opposition from others, particularly among some lakeshore property owners. In the acrimony that accompanied the discussion of the proposals, suspicion thrived in the community. This suspicion and distrust persists, and is an issue that the Water Management Plan must address.

For water management planning to succeed, distrust needs to be replaced by open discussion of facts and issues. Involvement of all interests needs to be sought, common interests identified, and concerns aired. In the spirit of basin thinking, all parties need to have a voice in the discussion of legitimate issues and concerns, and fairness needs to prevail in implementing decisions. Adopting an ethic of stewardship and sustainability that extends to the entire Basin is a goal of basin thinking.

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