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AN INFORMATION BASE FOR WATER IMPACT ASSESSMENTS IN THE CAMPBELL RIVER BASIN

June 1979

Inland Waters Directorate
Pacific and Yukon Region
Vancouver, B.C.

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D. Sherwood

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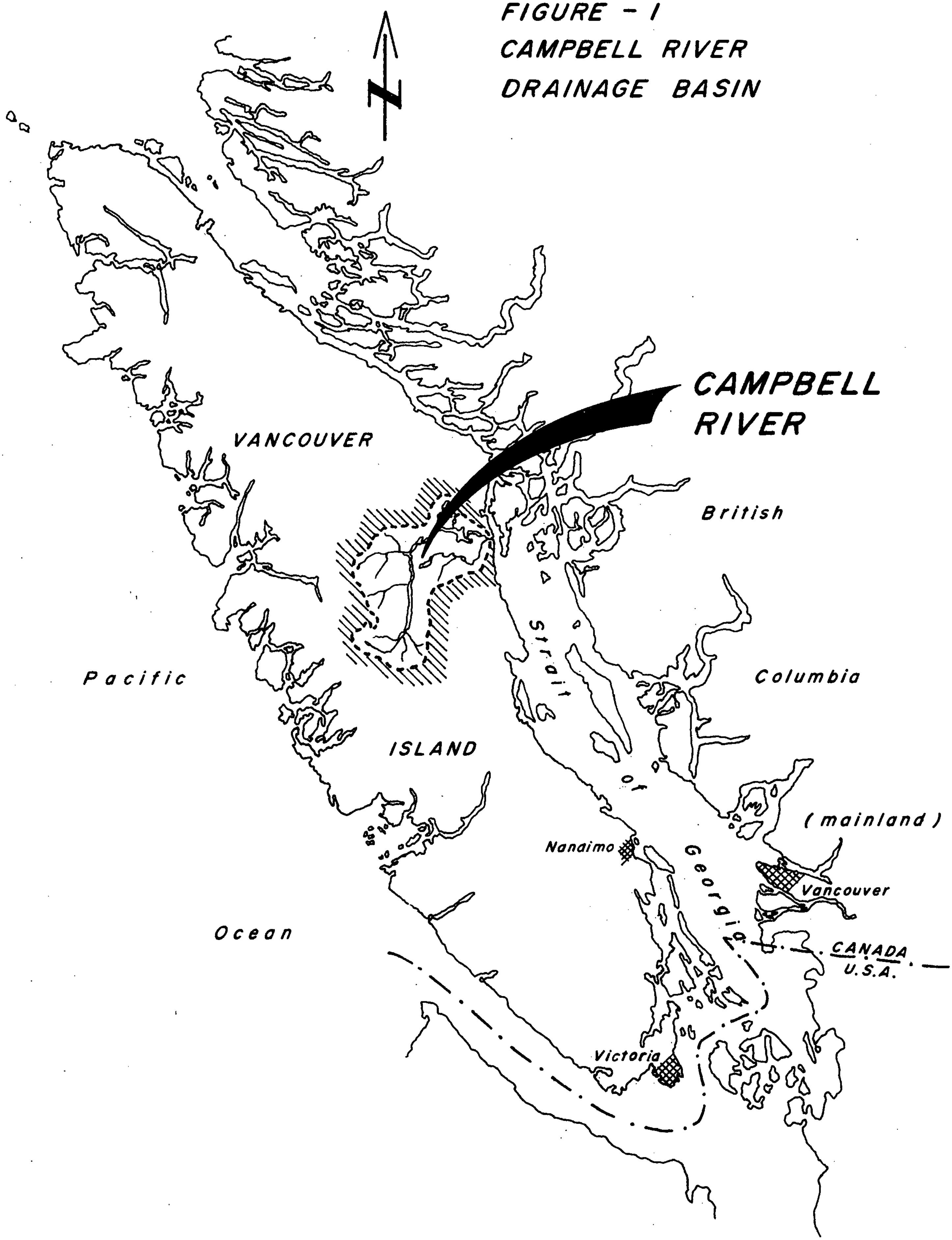


INTRODUCTION

The Campbell River Basin is located on the eastern side of Vancouver Island, midway between the northern and southern extremities of the Island. The Basin is rich in natural resources, including minerals, water, wildlife and fisheries.

Currently, a copper mine is operating on the south end of Buttle Lake and a coal mine is proposed near Quinsam River. The waters of the Campbell River System have been developed by the British Columbia Hydro and Power Authority. Three generating stations connected to the Island's distribution network, provide the largest source of power on Vancouver Island. Although no large scale forest harvesting occurs within the Campbell River Basin, forest processing industries are a major source of employment in the region. Sports and commercial fisheries are also significant contributors to the regional economy. A federal fish hatchery, located on the Quinsam River, has been established to enhance salmon and trout populations in nearby waters. Strathcona Park, the first provincial park and largest on the Island is a tribute to the Basin's unique natural environment. Three nature conservancy areas have been designated within the park to protect endangered flora and fauna, and preserve the mountain ecosystems.

Campbell River's strategic mid-Island location and abundant natural resources have produced a diversified economic base with opportunities for continued development.

This study describes the environmental knowledge for the Campbell River Basin to 1978, and highlights information relevant to the management of the water resource.

The report was prepared by Ms. D. Walters, Water Impact Assessment Division, under the direction of Dr. V.G. Bartnik, Division Head, Water Planning and Management Branch.

I. HISTORICAL PERSPECTIVE

The first inhabitants of the Campbell River Basin were the Southern Kwakiutl Indians. These early settlers lived in fishing villages at the mouth of the Campbell River. In the summer months, they moved to the Quinsam River flats where they harvested and preserved salmon and deer for winter use (53).

Their traditional lifestyle was interrupted in 1792 by Captain George Vancouver, and subsequently by other exploratory and survey ships, both British and Spanish. As exposure to the white man increased, smallpox and measles spread among the native population, a fur trade developed, white man's ways were gradually accepted, and slowly native tradition was abandoned (53).

It is assumed, and generally accepted, that Campbell River was named after Dr. Samuel Campbell, surgeon aboard the survey ship HMS Plumper which charted the coastal waters in the early 1800's (51). In 1860, John Buttle, a surveyor with the Vancouver Island Exploration Expedition, first sighted and mapped the largest of the lakes in the Campbell River system, the lake now bears his name. The first land survey of the Campbell River area was made in 1887 (4).

By 1900, several homesteaders had established in the area. The first to settle and farm in the valley was Frederick L. Nunns, an Irish immigrant. Other settlers followed along with trappers, surveyors, prospectors, loggers, and by 1907 Campbell River was firmly established as a settlement, complete with a hotel, store, post office, and wharf. At this time, the fishery resource of the area was recognized and in the summer months Campbell River became a sport fisherman's paradise. A commercial cannery was established at Quathiaski Cove, on Quadra Island.

The hydro potential of the Campbell River Basin was recognized as early as the 1880's, but it was not until 1903 that the first power licence was issued to the Island Power Company (51). The licence lapsed in 1909 and a second licence was granted to Mike King of the Campbell River Power Co. Although World War I disrupted plans for immediate power development, daily records of water flow were maintained by the Campbell River Power Co., and assessments of potential markets were prepared. These records and surveys aided greatly in the eventual evaluation of potential hydro developments on the Campbell River (53).

In 1924, the provincial Water Rights Branch, under the direction of F.W. Knewstubb, made a detailed survey of the river from Buttle Lake to Discovery Passage (53). In the following years, four companies vied for the rights to harness the river. However, in 1945 the British Columbia Power Commission was established and assumed control of the water rights. Shortly thereafter, work began on developing the Campbell River and in 1947 the John Hart Development was officially opened.

Forestry was and is the number one industry in the Basin. Most of the early lumbermen came from the United States, many on a speculative basis. In 1898, an eastern Canadian family, the McLarens, purchased extensive holdings in the Campbell River area to supply their mill on Burrard Inlet (53). In the early 1900's, the International Timber Company, now the Elk River Timber Co., and the Vancouver Timber and Trading Company bought lands in the vicinity of Campbell River. Camps were established on the slopes and benches of the river and timber was exported to a mill in Blaine, Washington (51). From the 1920's on, there were three main logging companies, all exporting timber to distant mills: Lamb's; Bloedel, Stewart and Welch; and the Campbell River Timber Co. (3). In 1939, H.R. MacMillan bought out the Campbell River Timber Co. and by doing so became one of the largest timber holders in British Columbia (53).

The first sawmill in Campbell River was built in 1922 and was expected to cut 10,000 board feet per day. In June of 1952, a 25 million dollar pulp and paper mill was erected at Duncan Bay by the Elk Falls Co. Ltd. (a joint venture by Pacific Mills and Crown Zellerbach Canada Ltd.). This operation has had a significant impact on the economic development of Campbell River (53).

II. PHYSICAL RESOURCES

1. Physiography

The Campbell River drains 1461 km^2 of Central Vancouver Island (4). Rising in the Vancouver Island Mountains at an elevation greater than 214 m (700'), the river flows northward for 64 kilometres from its source at Buttle Lake, then turns eastward for 26 kilometres, flowing through Upper and Lower Campbell and John Hart Lakes before discharging into Discovery Passage south of Seymour Narrows. Three kilometres upstream of the river mouth, the Campbell is joined by its largest tributary, the Quinsam River, which drains an additional area of 280 km^2. Other major tributaries include the Elk and Wolf Rivers and Myra, Thelwood, Price and Ralph Creeks, and Iron River, a tributary of the Quinsam River (See Figure 2).

The Basin lies within two major physiographic subdivisions of the Western System, the Outer Mountain Area and the Coastal Trough. The Outer Mountain Area comprises the St. Elias Mountains in the extreme northwest corner of the Province, and the Insular Mountains of the Queen Charlotte Islands and Vancouver Island (44). The Vancouver Island Mountains form a continuous chain trending northwest-southeast through the central interior of the Island, where they culminate in several peaks over 1525 m (5,000') elevation - Mt. Golden Hinde 2202 m (7,219'), Elkhorn Mountain 2196 m (7,200'), and Mount Colonel Foster 2135 m (7,000'), all within the study area (16).

The Coastal Trough is a partly submerged low-lying area situated between the Insular and Coast Mountains. The Trough extends from Puget Sound to Dixon Entrance, a distance of more than 805 km (500 miles). A westerly extension of the Coastal Trough, the

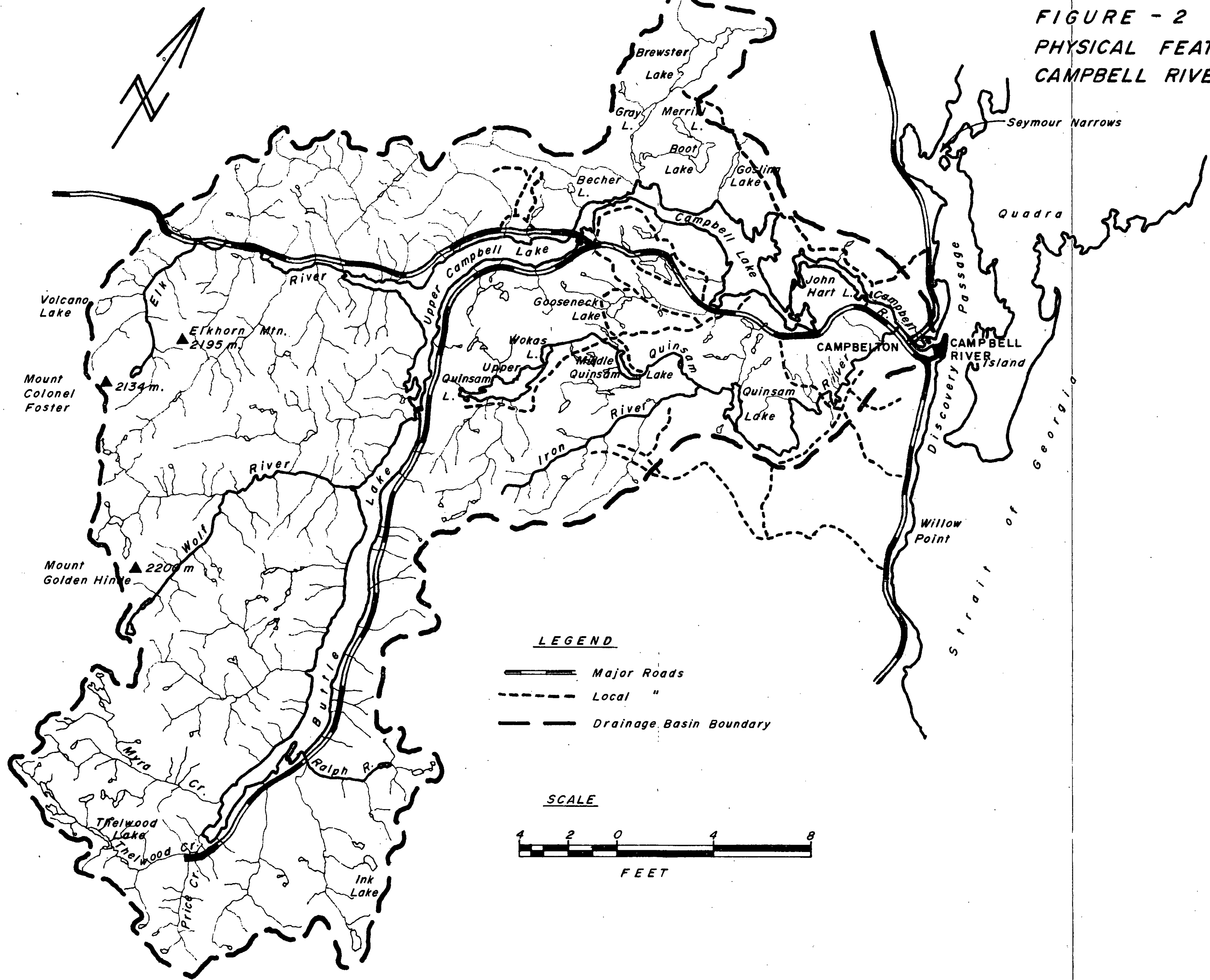


FIGURE - 2
PHYSICAL FEATURES
CAMPBELL RIVER BASIN

Nanaimo Lowland fringes Georgia Strait and lies below 610 m (2,000') (44). This is an area of significant development and population density.

Generally, the Vancouver Island Mountains are composed of folded and faulted volcanic and sedimentary rock intruded by masses of granitic rock, chiefly Mesozoic. Tertiary uplift and dissection of the surface produced an extremely rugged topography in the central part of the Basin which was later modified by glaciation during the Pleistocene (44). Evidence of glaciation may be seen in the angular sharpness of high ridges, the steep smooth U-shaped valleys, cirques, glacial striations on exposed rock surfaces and glacial till covering the lowland areas. The Lowlands are predominantly sedimentary rocks with scattered volcanics and Quaternary sediments (26). Marine and glaciomarine deposits formed during the melting of the glaciers on Vancouver Island are found throughout the Nanaimo Lowlands (4).

2. Climate

Vancouver Island, according to the Köppen system of climatic classification, has a marine west coast climate (4). This classification can be further divided into three sub-regions: a dry southeast coast; a wetter northeast coast; and a wet, but temperate west coast. The Campbell River Basin is essentially in a transition zone, being colder, wetter and cloudier than the dry southeast. For example, Campbell River annually receives 1750 hours of sunshine compared to Victoria's 2207 (16).

The Basin has a generally moderate climate with warm summers, mild winters and a long frost-free season of 180 days (April to October) (57). Campbell River has a mean daily temperature of

8.9 C ranging from a January mean daily temperature of 1.3 C to a July mean daily temperature of 17.4 C (2). The minimum recorded temperature at Campbell River is -17.8 C, and the maximum recorded temperature is 37.2 C (18).

Due to the orographic effect of the Vancouver Island mountains, the Basin lies in a comparative rainshadow and receives less precipitation than the west coast. Campbell River receives an average of 1540 mm of precipitation a year, peaking in November and December with 231 mm and 270 mm respectively, and gradually dropping to an average low of 39 mm in July (4). Summer precipitation is low, May to August inclusive receives less than 52 mm. Snowfall peaks in December and January (30 cm - 44 cm) with lesser amounts near the ocean. A comparison of annual rainfall and snowfall from 1973 to 1976 at three stations is shown in Table 1. These figures are published by the B.C. Department of Agriculture from Atmospheric Environment Service records.

There are seven active stations and one inactive station located within the Basin. The stations, their locations, elevations and years of record are noted in Table 2. Climatic data for 1976 for the seven active stations is assembled in Appendix 1. Historical temperature and precipitation data for Campbell River and Duncan Bay are given in Appendix 2. Detailed information for all stations is available from Monthly Records Meteorological Observations in Canada published by the Atmospheric Environment Service. The Water Planning and Management Branch Library has back issues to 1941. Appendix 3 lists the table headings for the data compiled in the monthly records.

There are no stations which record wind velocity or duration in the Basin but several reports are in agreement that the prevailing winds are from the southeast and northwest (16,48,53). The

TABLE 1

ANNUAL RAINFALL (mm) AND SNOWFALL (cm) FOR 1973-1976 FOR THREE STATIONS

	CAMPBELL RIVER A			CAMPBELL RIVER BCFS			DUNCAN BAY		
	Rain	Snow	Total	Rain	Snow	Total	Rain	Snow	Total
1973	1290	53.3	1343	1452	56.9	1509	1559	32.5	1591
1974	1298	192.8	1491	1543	159.5	1702	1852	25.1	1877
1975	1320	177.0	1497	1698	265.7	1964	1964	101.9	1949
1976	844	114.6	959	1264	157	1421	1251	66.04	1317

(4 and 17)

TABLE 2

CLIMATIC STATIONS

Station	Location	Elevation	Years of Record (Temp. & Prec.)
Campbell River	$50^{o}01'N$ $125^{o}18'W$	79m asl	Prec. 1936-1969 Temp. 1958-1969
Campbell River 'A'	$49^{o}57'N$ $125^{o}16'W$	98m	1965-
Campbell River BCFS	$50^{o}04'N$ $125^{o}19'W$	128m	1969-
Campbell River BCHPA Gen.Stn.	$50^{o}03'N$ $125^{o}19'W$	31m	1972-
Duncan Bay	$50^{o}04'N$ $125^{o}17'W$	7m	Prec. 1957-
Quinsam River Hatchery	$50^{o}01'N$ $125^{o}18'W$	46m	1975-
Strathcona Dam	$50^{o}00'N$ $125^{o}35'W$	201m	1967-
Strathcona Park Lodge	$49^{o}53'N$ $125^{o}39'W$	229m	Discont. 1975-

(4 and 60)

southeast winds are generally strongest, less frequent, and blow from October through March (48). Northwest winds occur throughout the rest of the year and generally range from 11-15 kilometres per hour (48).

Climatic data for the Basin is sparse and discontinuous. Prior to 1965 only one station recorded precipitation and temperature on a regular basis. Five of the active stations are located within a 10 kilometre radius of the Campbell River townsite, adequate for the estuary but of little value for the rest of the Basin. The addition of the two inland stations to the meteorological network still does not provide an adequate coverage of temperature and precipitation for the Vancouver Island Mountains.

3. Water Resources

The Campbell River, combined with its major tributary the Quinsam River, has the second largest drainage area (1741 km^2) and the third largest mean annual discharge (108 cms) of all recorded rivers on Vancouver Island (4). A comparison of the drainage areas and mean annual discharges of the major Vancouver Island rivers is given in Table 3.

The earliest streamflow monitoring station in the Basin was established in 1910 on the Campbell River at the outlet of Campbell Lake (Station No. 08HD001) (70). This station, and four more recent ones, are listed in Table 4 and shown on Figure 3. Only one of the stations maintained by Water Survey of Canada, Quinsam River near Campbell River, is still active. Appendix 4 contains detailed historical data for four of the stations in the Campbell River System. Station number 08HD010, Quinsam River below Quinsam, was maintained by the Department of the Environment, Fisheries and Marine Service (now Department of Fisheries and

FIGURE - 3 WATER INVESTIGATIONS AND CONTROL

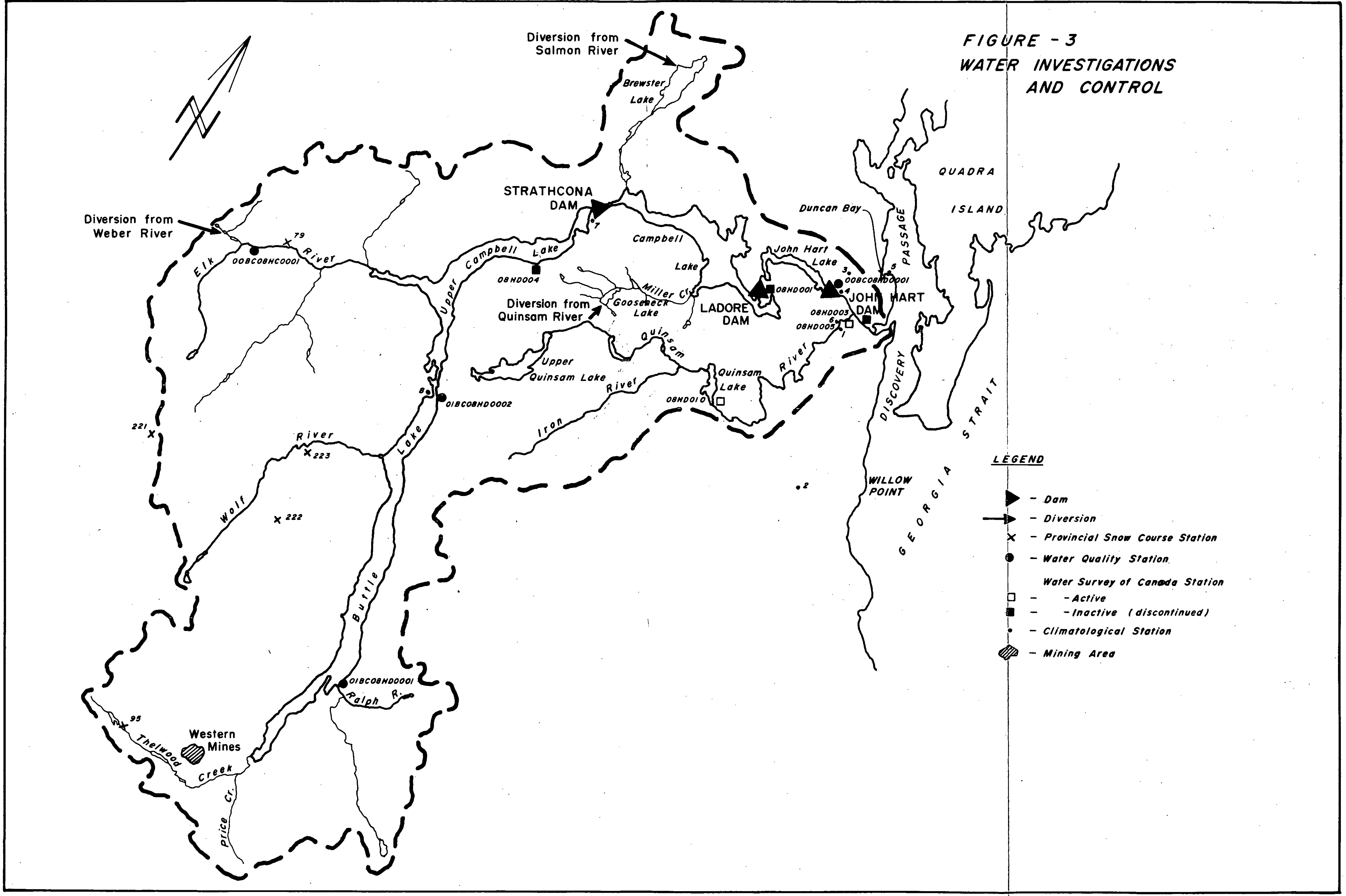


TABLE 3

COMPARISON OF DRAINAGE AREAS AND MEAN ANNUAL DISCHARGES OF THE MAJOR RIVERS ON VANCOUVER ISLAND

	MEAN ANNUAL DISCHARGE CMS (CFS)	DRAINAGE AREA SQ.KM (SQ.MI)	STATION NO.
Cowichan	53 (1890)	834 (322)	08HA011
Chemainus	19 (670)	378 (146)	08HA001
Nanaimo	41 (1460)	684 (264)	08HB034
Puntledge	43 (1510)	583 (225)	08HB006
Campbell	99 (3490)	1461 (564)	08HD003
Salmon	66 (2320)	1210 (467)	08HD006
Nimpkish	129 (4560)	1761 (680)	08HF002
Gold	88 (3110)	1036 (400)	08HC001
Somass	130 (4580)	1311 (506)	08HB017
Quinsam	9 (326)	280 (108)	08HD005

(4)

TABLE 4

HYDROMETRIC STATIONS

LOCATION	NUMBER	LAT/LONG	DRAINAGE AREA (sq.m)	DISCHARGE RECORDS	TYPE OF FLOW
ACTIVE					
Quinsam River near Campbell River	08HD005	50°01'45"N 125°17'55"W	108	1914-15 misc.meas. 49-55 misc.meas 56-77 man.gauge cont.operation	Regulated
DISCONTINUED					
Campbell River at Outlet of Campbell Lake	08HD001	50 00 08 125 23 20	542	10-37 man/cont. 38 man/seas. 39-49 man/cont.	Natural
Campbell River near Campbell River	08HD003	50 02 17 125 17 41	564	49-53 rec/cont. 54-55 rec/seas. 56-70 rec/cont.	Reg. since '47
Campbell River near Quinsam	08HD004	49 57 54 125 35 10	444	53-56 rec/cont	Natural
Campbell River below Quinsam Lake	08HD010	49 57 45 125 23 40	89	57-62 rec/cont. 68-70 rec/cont.	unpublished contr. by FMS (4)

(70)

Oceans); data is unpublished but available upon request (64). Daily discharges for 1977 for the Quinsam River near Campbell River Station are given in Appendix 5. Detailed information on daily water levels for most hydrometric stations in the Basin is available from Water Survey of Canada.

Annual flood magnitudes and corresponding flood frequency probability curves are shown in Appendix 6 for three stations. Annual seven day average low flows for the same stations are listed in Appendix 7. Figure 4 shows a sample discharge hydrograph for the Campbell River near Campbell River (08HD003). The hydrograph reflects typical seasonal variations with peak discharges from October through February as a result of winter storm activity, and low summer discharges, which when coupled with climatic factors, frequently produce soil moisture deficits (4). Secondary discharge peaks are often evident in late spring and early summer. For example, Appendix 6 (Flood Magnitudes and Probability) indicates spring floods in 1943, 1946, and 1948 for Campbell River at Outlet of Campbell Lake. These years could indicate the accumulation of a deep snow pack in the Basin's mountainous interior, followed abruptly by warm spring weather which resulted in rapid melting and downstream flooding.

Maximum daily discharge recorded on the Campbell River is 857 cms (30,300 cfs) observed on November 16, 1939 at Station 08HD001, Campbell River at Outlet of Campbell Lake. Minimum daily discharge of 7.9 cms (280 cfs) for the Campbell River was recorded at the same station on October 18, 1925 (Appendix 4).

A maximum daily discharge of 218 cms (7,700 cfs) was recorded for Quinsam River on June 19, 1968, and a minimum daily discharge of .9 cms (31.4 cfs) on September 21, 1956 (Appendix 4).

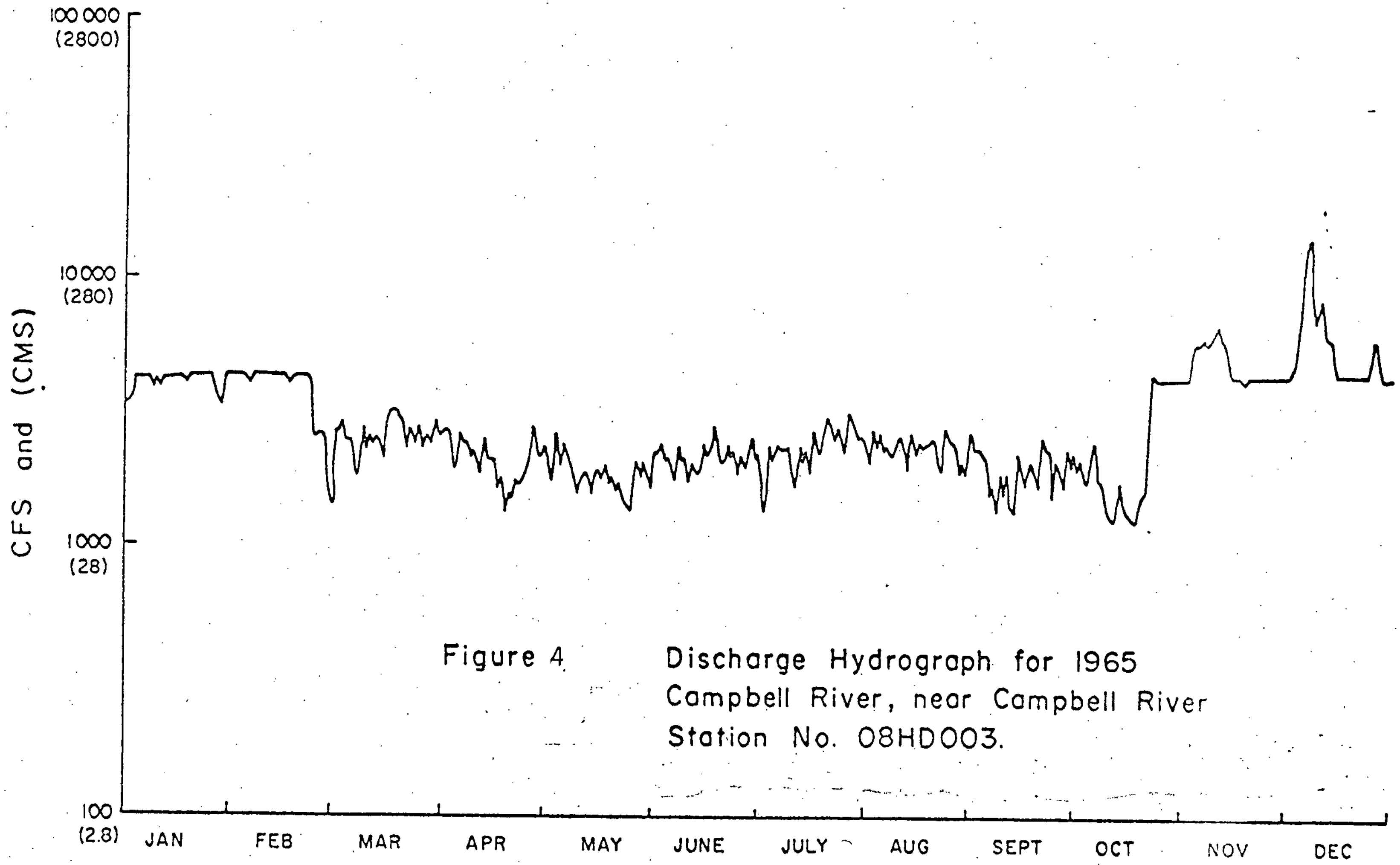


Figure 4 Discharge Hydrograph for 1965
Campbell River, near Campbell River
Station No. 08HD003.

(4)

Since 1947 flows in the Campbell River have been regulated by the British Columbia Hydro and Power Authority. An average annual flow of 99 cms (3,490 cfs) was measured at Station 08HD003 (Campbell River near Campbell River) from 1950 to 1970. British Columbia Hydro and Power Authority's Operation Order Number 412 requires an absolute minimum discharge of 13 cms (450 cfs), but, as recommended by the Fisheries and Marine Service for the protection of downstream fish habitat, the flow is not reduced below approximately 28 cms (1,000 cfs) (4). The maximum discharge from the power plant based on the hydraulic capacity of the turbines at the John Hart generating station is 124 cms (4,380 cfs) (4). Therefore, except during flooding, the discharge varies between 28 cms (1,000 cfs) and 124 cms (4,380 cfs).

Regulation of flow at the generating station greatly enhances downstream flood control. When combinations of extreme high tide at the mouth of the Campbell River and flooding conditions on the Quinsam River occur, the discharge from the power plant is reduced to minimize flooding. When potential flood conditions in the Campbell River occur, the flows are directed through the series of storage reservoirs, thereby minimizing potential flooding. Low-lying areas in the Campbell River floodplain are subject to inundation at high tides, even with low flows from the Quinsam and Campbell Rivers.

There are five provincial snowcourse stations with data applicable to the Basin: four stations within the Basin and one bordering the Basin. The stations are listed in Table 5 and their locations indicated on Figure 3 (27). Summary data to 1975 indicating monthly and annual mean snow depths (in cm) and water equivalents (in mm) are given in Appendix 8.

TABLE 5

SNOWCOURSE STATIONS

STATION	NUMBER	ELEVATION (metres)	1977 (mm)	1976 (mm)	WATER EQUIVALENT max. (mm)	min. (mm)	avg. (mm)	NO. YEARS RECORD
Elk River	79	270	0	213	546	0	203	17
Wolf River (lower)	223	640	48	488	660	48	418	7
Wolf River (middle)	222	1070	71	630	833	71	559	7
Wolf River (upper)	221	1490	305	1392	1605	305	1095	7
Upper Thelwood Lake	95	980	284	1796	2083	284	1188	17

Water quality parameters have been measured infrequently at four locations within the Basin by the Inland Waters Directorate's Water Quality Branch. The stations are listed in Table 6 and their locations indicated on Figure 3. Data from 1961-1971 for Station 00BC08HD0001 - Campbell River at John Hart Generating Station and Station 00BC08HC0001 - Elk River at Highway Bridge is assembled in Appendix 9. In addition, the following stations have water quality data (54 measured parameters), derived from miscellaneous sampling from 1967-76, stored on the Naquadat computer files:

Station number	01BC08HD0002	Buttle Lake near Outlet
	01BC08HD0001	Buttle Lake near Ralph River
	00BC08HD0001	Campbell River at John Hart Generating Station, 3 miles west of Campbell River.

This information is available for reference in computer printout form from the Water Quality Branch (33).

The British Columbia Pollution Control Branch also has computer files on a number of stations in the Campbell River Municipality. Appendix 11.2 of The Campbell River Estuary Status of Environmental Knowledge to 1977 lists the stations, their approximate locations, and parameters measured (4).

Several water quality surveys have been conducted in the Campbell River watershed. In 1973, the Inland Waters Directorate conducted a short-term water quality survey of the Cowichan, Nanaimo and Campbell Rivers (3).

Since significant spatial and temporal variance were found in the value of most parameters, the survey indicated that grab samples taken at a specific location could be representative of the water quality for a short reach of river only and not representative beyond a two to five day period (3).

A preliminary limnological investigation of Campbell Lake was carried out in 1937 by G.C. Carl. In June 1951, R.G. McMynn and P.A. Larkin, British Columbia Department of Recreation and Conservation, studied the effects of hydroelectric development on the lake morphometry, flora and fauna community characteristics, and water chemistry (50). Generally, they found the lakes of the Campbell River system to contain soft, well oxygenated and clear water. Lower Campbell Lake exhibited a thermocline at a depth of 7.6 to 12.2 metres with corresponding temperature changes of 18.2 to 4 C (50). A brief summation of their findings is found on page 150 of Appendix 10. After Upper Campbell and Buttle Lakes were flooded by the Strathcona Dam (1958), D.C. Sinclair, a University of British Columbia graduate student, prepared a thesis on the effects of water level changes on the limnology of two British Columbia lakes, with particular reference to bottom fauna. His thesis agreed with McMynn and Larkin's findings, except he observed a greater increase in water level fluctuations (4).

Many studies have been carried out to determine the effects of Western Mines Ltd. copper mining operations on the water quality of Buttle Lake and environs. Appendix 10, an overview report prepared by the Environmental Protection Service, provides a summation of the major Buttle Lake water quality studies, recaps their findings, conclusions and recommendations, and also offers original research and conclusions.

Briefly, the studies indicated that significant increases of total zinc, dissolved zinc, total solids, dissolved solids and turbidity occurred in deeper depths of the lake but not at the surface. The final conclusion was that deposition of tailings at the bottom of Buttle Lake had no detrimental effect on the quality of water for domestic purposes. But there was insufficient data to judge the effect on flora and fauna (40).

TABLE 6

WATER QUALITY STATIONS

LOCATION	STATION NUMBER	DATA AVAILABLE	LATITUDE - LONGITUDE
Buttle Lake near Outlet	01BC08HD0002	Detailed & Summary	49°51'25"N/117°52'43"W
Buttle Lake near Ralph River	01BC08HD0001	Detailed & Summary	49°38'40"N/125°31'35"W
Campbell River at John Hart Generating Station, 3 miles West of Campbell River	00BC08HD0001	Detailed & Summary	50°02'40"N/125°18'30"W
Elk River at Highway Bridge, near Elkhorn Mountain	00BC08HC0001	Detailed	

(65)

The Environmental Protection Service report concluded that British Columbia Pollution Control Branch objectives were being met, except for copper and cyanide (despite newly installed treatment facilities). The mine discharge did not meet the National Metal Mining Liquid Effluent Guidelines for total copper, total lead, total zinc and suspended solids.

The report agreed with the previous studies: no scientifically sound study had been conducted to date which delineated the environmental impact of the discharge. However, the Environmental Protection Service report suggested the data indicated that the mine effluent is acutely toxic and the copper is accumulating in resident fish tissue (40).

4. Vegetation

Dr. Vladimir Krajina, a University of British Columbia botanist, has developed a biogeoclimatic classification for British Columbia. His classifications, based on the unique interplay among biota, soils, topography and climate, give rise to twelve biogeoclimatic zones in the province, four of which occur in the Campbell River watershed: the Coastal Douglas Fir Zone, the Coastal Western Hemlock Zone, the Mountain Hemlock Zone and the Alpine Tundra Zone (see Figure 5).

The Coastal Douglas Fir Zone, generally corresponding with the Nanaimo Lowlands, occurs at elevations up to 450 metres. The zone is characterized by mild winters with temperatures greater than 10 C for five to six months of the year, rarely falling below 0 C. Frost free days number 244 to 354 annually. Precipitation, ranging from 657 mm to 1524 mm, falls mainly in the winter months with 2 to 9 percent as snowfall (49). The Campbell River Basin is in the wettest portion of this zone and is characterized by Douglas fir, grand fir, western red cedar, lodgepole pine, sitka spruce and western hemlock. Campbell River represents the northern limit of

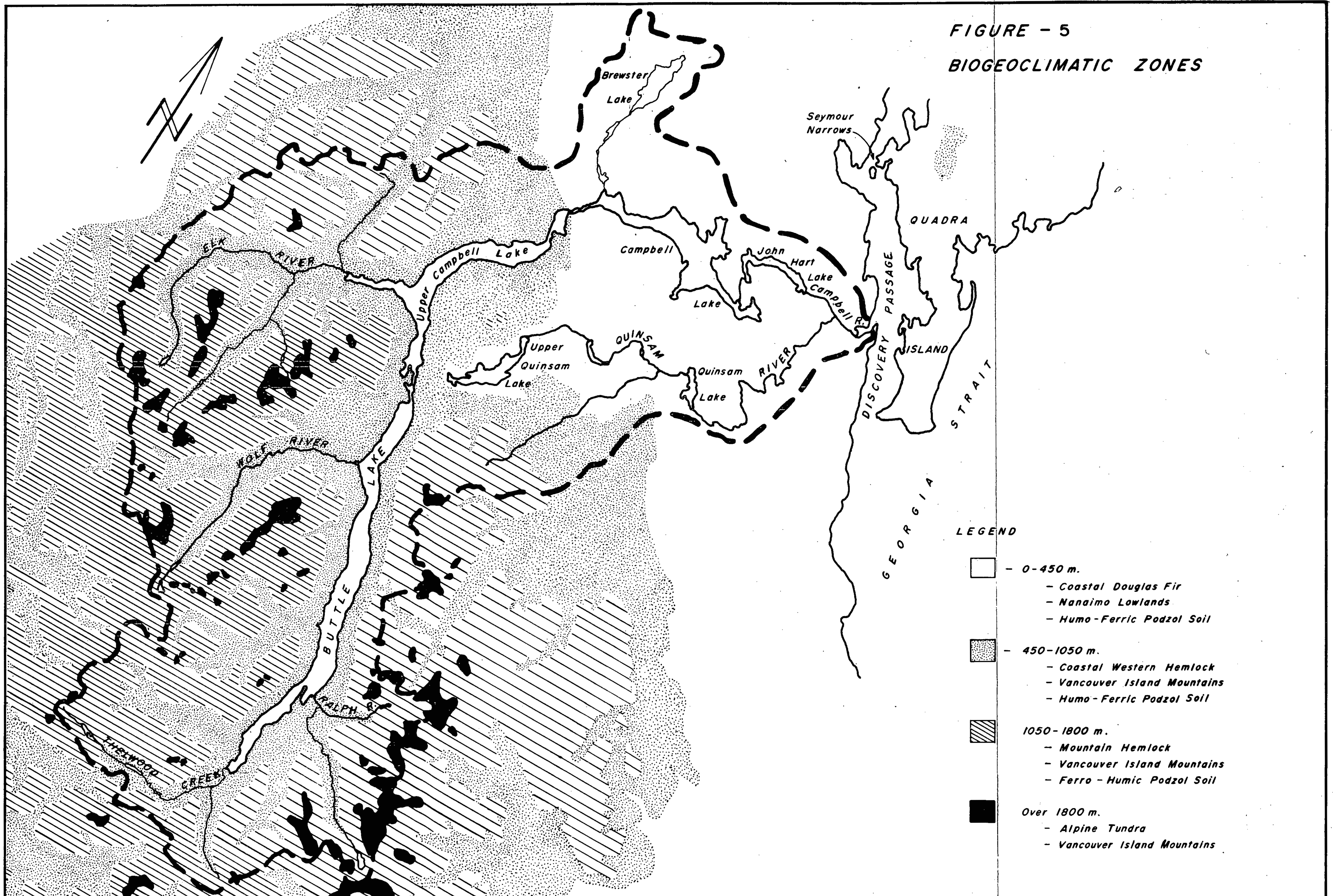


FIGURE - 5
BIOGEOCLIMATIC ZONES
Brewster Lake
Seymour Narrows
QUADRA
ISLAND
DISCOVERY PASSAGE
GEORGIA STRAIT
Campbell Lake
John Hart Lake
Campbell R.
Upper Campbell Lake
Upper Quinsam Lake
QUINSAM
Quinsam Lake
RIVER
ELK RIVER
WOLF RIVER
BUTTLE LAKE
RALPH R.
THELWOOD CREEK
LEGEND
- 0-450 m.
- Coastal Douglas Fir
- Nanaimo Lowlands
- Humo-Ferric Podzol Soil
- 450-1050 m.
- Coastal Western Hemlock
- Vancouver Island Mountains
- Humo-Ferric Podzol Soil
1050-1800 m.
- Mountain Hemlock
- Vancouver Island Mountains
- Ferro-Humic Podzol Soil
Over 1800 m.
- Alpine Tundra
- Vancouver Island Mountains

evergreen madrono (arbutus), the only broadleaf evergreen native to Canada. Deciduous vegetation includes willow, red alder, bitter cherry, western flowering dogwood, broadleaf maple, vine maple, balsam, poplar, and rarely, trembling aspen. Undergrowth is dominated by salmonberry, cow parsnip, devil's club, and salal (4). Appendix 11 lists common and scientific names for vegetation and wildlife in the Basin.

The Coastal Western Hemlock Zone occurs at elevations up to 1050 m in the Basin. It is the wettest zone, precipitation ranges from 1550 mm to 2800 mm in the dry subzone on the shores of Buttle Lake to greater than 2800 mm in the humid subzone among the high altitude headwater lakes and streams (4). Yearly temperatures exceed 10 C for five to six months, occasionally dropping below 0 C for one or two months with 180 to 344 frost free days.

This zone supports the highest production of several coniferous tree species. However, much of the forests have been destroyed by fires and logging, therefore present vegetation is predominantly second growth. The coastal variety of Douglas fir, which is highly shade intolerant, grows best in the dry subzone of the Coastal Western Hemlock zone as a pioneer tree. This is also true of grand fir, western white pine, and western red cedar. With few exceptions amabalis fir and yellow cedar are not present in the dry zone. Arbutus and lodgepole pine may occur in the driest areas of the dry subzone. The wet subzone is characterized by amabalis fir, yellow cedar, western hemlock and sitka spruce. Western red cedar is present in both subzones. Among deciduous angiosperms, red alder and black cottonwood are frequent, while bitter cherry, flowering dogwood, broadleaf maple, mountain maple, and vine maple are more frequent in the dry subzone.

The Mountain Hemlock zone occurs at elevations of 1050 m to 1800 m encompassing the higher elevations and mountainsides of the Vancouver Island ranges. Predominantly a cold snowy climate, where snow covers the ground for greater than one month and accounts for 20 to 70 percent of the total precipitation. Temperatures average 0 C for one to four months of the year, and greater than 10 C for one to four months; frost free days average between 110 to 210 days annually. This zone is characterized by mixed stands of mountain hemlock, amabalis fir and yellow cedar. Occasionally, western hemlock, western red cedar, sitka spruce and Douglas fir are present in the lower elevations. Above 1800 m is the Alpine Tundra Zone where trees become stunted or dwarfed and subalpine fir, whitebark pine and mountain hemlock dominate. The growing season is very short, therefore alpine wild flowers blossom profusely after snow melt, generally in late July. However, most alpine vegetation is limited to low shrubs, herbs, lichens, and bryophytes.

5. Soils

Two distinctive soil landscapes, the ferro-humic podzol and the humo-ferric podzol, are found on Vancouver Island, both landscapes occur within the Campbell River Basin (see Figure 5) (26).

The ferro-humic podzol soil landscape is typically found within the Coastal Western Hemlock biogeoclimatic zone on the windward side of mountains, however, within the study area, which is in the leeward side of the Vancouver Island mountains this landscape occurs at elevations ranging between 900 to 1400 m in the subalpine Mountain Hemlock biogeoclimatic zone. The soils rarely freeze due to the insulating qualities of snow. Because the terrain is rugged and steep the most common parent material in this landscape is colluvium, deposits of which are often shallow veneers overlying bedrock. The soils are deep (often between 1 and 2 metres in gently rolling areas), well to moderately well drained, loose to friable, and do not contain any sign of cemented horizons. The soils are dominated by a thick dark reddish B horizon, rich in iron, aluminum and organic matter; they have low pH values (less than 5.0), very low base saturation and strong indications of turbic activity. The soils are medium to coarse textured; and generally have horizons in which clay has accumulated. Leaching is intense.

The humo-ferric podzol soil landscape occurs predominantly within the Coastal Western Hemlock and Coastal Douglas Fir biogeoclimatic zones, on the eastern side of Vancouver Island. The vegetation consists of a moderately dense Douglas Fir and western hemlock forest with a moderately dense understory. Upper elevations range to 900 m, with rapid gradation to the ferro-humic podzol soil landscape as effective moisture increases.

The principal climatic features are relatively mild winters, cool to warm summers, and moderate to high precipitation. Summers are somewhat warmer and drier than in the ferro-humic podzol soil landscape and evapotranspiration rates are correspondingly higher. Abundant precipitation occurs in the winter mostly as rain. Morainal, colluvial, fluvial and marine materials comprise the main surficial deposits in this landscape. Morainal deposits are probably the most extensive parent material.

The above combination of factors has resulted in well to moderately well drained podzolic soils with dark reddish colours, low pH (4-5), moderate to high iron and aluminum content with low base saturation. Textures are coarse to medium. Where long-term seepage occurs, levels of organic matter are sufficiently high to classify the soil as ferro-humic podzol.

Varying environmental factors produce a broad transition zone with considerable interplay between the humo-ferric and ferro-humic podzol soil landscapes.

6. Wildlife

The biogeoclimatic diversity of the Campbell River watershed indirectly gives rise to a variety of wildlife species. The snow-capped Vancouver Island Mountains are the home of two rare species, the Island ptarmigan (white grouse) and the Vancouver Island marmot (56). Due to its limited distribution, the Vancouver Island marmot is considered one of the world's rarest animals (56). The Basin's forested mountain slopes support big game animals such as the Columbia blacktail deer (a subspecies of the coast deer), Roosevelt elk, black bear and cougar. A report written in 1892 mentioned sightings of wolverines, panthers and timber wolves, however, no current data is available on these species (53). Vancouver Island is the only habitat in British Columbia for the Roosevelt elk, with herds occurring in several remote valleys and mountains including the Campbell River Basin, Nimpkish Lake, Nanaimo Lake, Salmon River and White River (9). While most big game animals prefer a well forested habitat, blacktail deer thrive in patch-logged and secondary growth areas (8). The blacktail hunting season usually extends from early September to the end of November. The Roosevelt elk season is determined on an annual basis and is generally restricted to a maximum of two weeks per year. Black bear are common throughout the study area with hunting seasons in the fall and spring. Cougars frequent the habitat of the blacktail deer, its major prey. Smaller mammals such as martin, beaver, muskrat and mink inhabit marshy areas and valley bottoms.

Blue and ruffed (willow) grouse are abundant on the mountain slopes, while white grouse inhabit elevations greater than 1,500 metres. Other birds common to the basin include: ring-necked pheasants, California quail and band-tailed pigeons; there is also an abundance of ducks, geese and other sea birds. The Campbell River area boasts the largest concentration of bald-headed eagles in North America (45).

III. ECONOMIC DEVELOPMENT

1. Economic Geology

Since the 1880's the Campbell River Basin has been recongized as having a high potential for economic mineral deposits. Explorations at the mouth of the Iron River, a tributary of the Quinsam River, and at Iron Hill, east of Upper Quinsam Lake, are described in The Iron Ores of Canada (1926) by the Geological Survey of Canada and in the Provincial Ministry of Mines Annual Reports for 1902, 1952 and 1956 (72 and 21).

Geological Survey of Canada estimated the Iron Hill deposit to have an ore content of 1.5 million tonnes (1.7 million tons) of iron ore. Production at this site was brief, a one-year run in 1952 produced 59,000 tonnes (65,000 tons) of concentrate monthly for markets in the United States and Japan (4). The Iron River deposit was mined from 1951 - 1957 by the Argonaut Co. producing 3.7 million tonnes (4.0 million tons) of ore and 2.0 million tonnes (2.2 million tons) of iron concentrates (21).

The only present day mining operation in the basin is Western Mines Ltd. at the south end of Buttle Lake in Strathcona Park (see Figure 3). Mining operations on two massive ore bodies (containing zinc, copper, silver, gold and lead) began in January 1967 following completion of a 682 tonnes (750 tons)-per-day crusher and concentrater (increased to 818 tonnes (900 tons)-per-day in 1974 (4), and a 4,500 horsepower electrical generating plant. The ore is mined by underground and open pit methods at two sites near Myra Creek. The ore is processed on site, then trucked to the Western Mines docking facility on Tyee Spit (near Campbell River Municipality). Copper and zinc concentrates are shipped mainly to Japan but also to the United States and Australia, while lead concentrates are shipped to Vancouver, then by rail to the smelter at Trail, B.C. The mine employs 275 men and has an annual payroll greater than one million dollars (57).

During initial development phases of the mine, tailings were discharged into a tailings pond near the mine's generating plant. In 1967, the B.C. Pollution Control Branch granted permission to discharge tailings from the concentrator through a submerged outfall to the bottom of the south end of Buttle Lake (4). Water quality aspects of the mine discharges are discussed further in the Water Resources section and Appendix 10 of this report.

The British Columbia Water Rights Branch has issued the following water use licences to Western Mines Ltd.:

Licence for:	Location	Amount of Water
Power	Tennent Creek	17 cfs
Power	East Tennent Creek	17 cfs
Storage	Tennent Creek	3,000 acre feet per annum
Mining	Tennent Creek	4 cfs
Mining	Webster Creek	200,000 gallons/day
Mining	Watertank Creek	4 cfs

(34)

The Provincial Ministry of Mines Annual Report for 1977 reports that Western Mines Ltd. mined 247 646 tonnes of ore and milled 269 068 tonnes. The ore concentrates consisted of 8 670 tonnes of copper concentrates, 6 466 tonnes of lead concentrates, and 31 247 tonnes of zinc concentrate. Gross metal contents for 1977 were:

Gold	632 075 g
Silver ...	34 909 727 g
Copper ...	2 856 881 kg
Lead	3 356 196 kg
Zinc	18 607 822 kg
Cadmium ..	72 139 kg

(20)

In January 1978, Welwood of Canada Ltd. and Luscar Ltd. of Alberta announced plans to develop a fifty million dollar open-pit thermal coal mine near Middle Quinsam Lake. The area has proven surface mineable reserves of 13.9 million tonnes (15.2 m tons), future, underground and auger reserves of 16.4 million tonnes (18.0 m tons), and an additional 8.6 million tonnes (9.45 m tons) in the "Quinsam-East Block" development, totalling 38.8 million tonnes (42.65 m tons) of coal reserves. The project is estimated to have an average annual production of 910 000 tonnes and employ 235 persons. There will be an on-site preparation plant and the coal will be trucked to Campbell River docks. Following the Environment and Land Use Committee's "Guidelines for Coal Development", Stage II Feasibility Studies are underway. The resulting Environmental Impact Statement will be assessed by the provincial Coal Steering Committee and the federal Department of the Environment, Regional Screening and Coordinating Committee Task Force before mining operations proceed. (See Appendix 12 and Water Planning & Management file 554-38).

2. Forestry

Most accessible forested areas of the Campbell River Watershed were logged extensively in the early pioneering days. Throughout the years, forest fires have destroyed over 40 000 hectares of commercial prime stands (4). Today, the remaining forests are mostly immature. Leading tree types are Douglas fir, western hemlock, amabalis fir, and western red cedar. There is no large scale logging occurring in the Basin, however, several small companies are producing limited amounts of timber for local consumption and occasionally for markets along the B.C. coast. The Raven Lumber Company has a licence issued by the provincial Parks Branch to harvest in Strathcona Park, the logs are hauled by truck to the company mill on the Campbell River estuary. The Elk River Timber Company has many small private lots along the northwest bank of Upper Campbell Lake and around the Quinsam Lake system in the E & N Land Grant Belt. The company harvests approximately forty hectares a year, shipping the logs to Vancouver mills (46).

There are several other companies with ten to twenty hectare holdings closer to Campbell River Municipality, mainly supplying timber for domestic use. The B.C. Forest Service's only activities within the Basin are thinning and spacing of potential commercial stands, and management of two nurseries. One nursery, adjacent to the Quinsam hatchery, is predominantly a research station while the other nursery, near the John Hart generating station, provides seedlings for reforestation projects.

Although there is little or no harvesting within the Basin, large scale logging in nearby watersheds has created secondary and tertiary developments associated with the forest industry in Campbell River. Consequently, the forest industry is the primary employer in the Basin with over 3,200 persons and an annual payroll greater than $24 million (55).

Crown Zellerbach Company Limited operates the Elk Falls Mill, a major pulp and paper complex on Duncan Bay, just outside the Basin but utilizing water from the Campbell River (see Appendix 13). Most of the pulp and paper is exported to Holland and the U.S.A., but some is retained for domestic usage. The mill has a capacity of 150 mfbm per shift, a daily pulp capacity of 1,130 tons of kraft and 550 tons of ground wood, and a paper capacity of 690 tons of newsprint and 260 tons of coarse paper (19).

There are several other mills in the Campbell River vicinity, the largest owned by the Raven Lumber Company. These mills produce chips, shakes, shingles, and fence posts, etc. for local consumption.

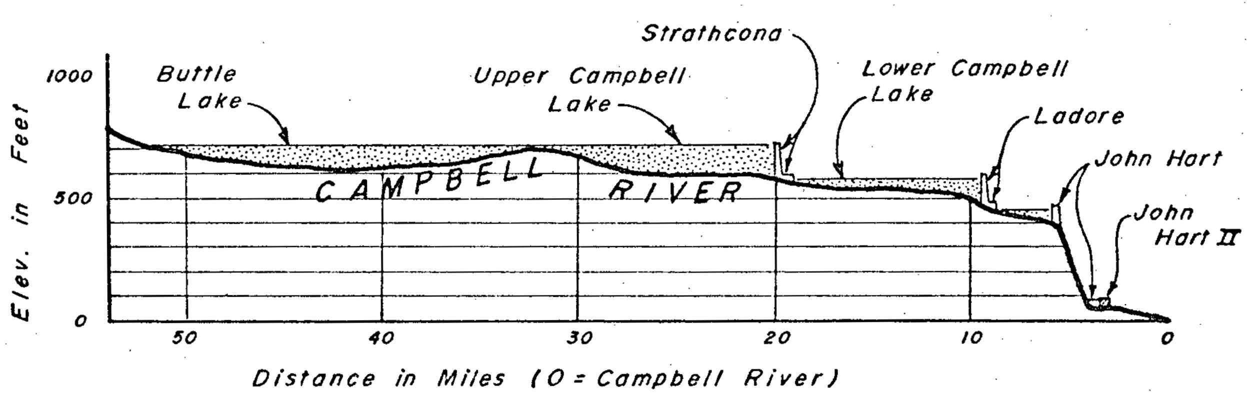
Both the Elk River Timber Company and the Raven Lumber Company boom their logs in the Campbell River estuary (46). At present, due to the limited extent of logging in the Basin, log booming is the major environmental concern associated with the water resource.

3. Hydroelectric Power

The Campbell River System was recognized as having a high hydro-electric potential as early as the 1880's, however, it was not until 1947, after the formation of the British Columbia Power Commission, that the river was finally harnessed (see Historical Perspectives section). Today, there are three generating stations on the Campbell System: John Hart, Ladore, and Strathcona. These stations, augmented by power transmitted through submarine cables from the mainland, supply most of Vancouver Island with electric power. Table 7 and Figure 6 summarize the generating capacities and key data for the three projects, their locations are indicated on Figure 3.

FIGURE 6

CAMPBELL RIVER PROFILE



The first stage of the John Hart Development, completed in 1947, includes a 30 m (100 ft) high concrete gravity dam, a gated overflow spillway with a discharge capacity of 1557 cms (55,000 cfs), earthfill wing dykes, a power intake located 0.4 kilometres (0.25 miles) southeast of the dam, three 1.6 kilometres (1 mile) long surface power conduits, and a six-unit surface powerhouse with

TABLE 7

INVENTORY OF EXISTING HYDRO AND THERMAL PLANTS IN THE BASIN

NAME	* Duncan Bay	* Elk Falls	**John Hart I	**Ladore Falls	**Strathcona
Type	T	T	H	H	H
Owner	Elk Falls Co.Ltd.	Elk Falls Co.Ltd.	BCHPA	BCHPA	BCHPA
Locality	Duncan Bay	Campbell R.	Campbell R.	Campbell R.	Campbell R.
Name-plate Capacity Mw	1.6	4.1	120.0	54.0	67.5
In-system Capacity Mw	1.6	4.0	126.0	46.5	49.1
In-system Energy Mwy/y	0.8	2.0	85.8	26.9	22.5
No. of Units		2	6	2	2
First Unit In Service		1964	1947	1957	1958
Latest Unit In Service		1965	1953	1957	1968
Head M (ft.)			123 (402)	38 (125)	43 (142)
Average River Flow cms (cfs)			111.8 (3 950)	111.8 (3 950)	84.9 (3 000)
Maximum Plant Discharge cms (cfs)			123.1 (4 350)	172.6 (6 100)	202.1 (7 140)
Usable Reservoir Storage cu. m. (ac.ft.)			Pondage Only	319.5×10^8 (259 000)	869.6×10^8 (705 000)

** Major Generation

* Minor Generation

(14 and 4)

T - Thermal

H - Hydroelectric

a name plate capacity of 120 MW. The six turbines discharge a total of 123.1 cms (4,350 cfs) (14). The dam raised the river above it to 140 m (458 ft) above sea level and created a reservoir with an area of 5.6 sq. km. (1.4 sq. mi.), providing pondage only (4).

The Ladore storage dam, completed in 1949, consists of a concrete gravity dam with a total installed capacity of 54 MW. The dam is situated at the outlet of Lower Campbell Lake above Ladore Falls and controls 321 x 10^6 cu. m (260,000 acre feet) of water to an elevation of 178 m (1,584 ft) (14). The reservoir covers an area of 2430 hectares almost ten times the area of John Hart Lake (4). The dam has a discharge capacity at normal full pool of 1568 cms (56,000 cfs) (25).

The Strathcona dam and generating station, completed in 1948, was the third and most recent power development in the Campbell River System. The project is located approximately 23 kilometres upstream from the Ladore Falls generating station. The reservoir created by the Strathcona dam brought Upper Campbell and Buttle Lakes to a common elevation of 221 m (725 ft). The reservoir has an area of 6683 hectares (165,000 acres) and provides storage of 762 x 10^6 cu. m. (618,000 ac.ft.). An additional flood storage capacity of 241 x 10^6 cu. m. (195,000 ac.ft.) is also available (14).

Three river diversions have been constructed to help meet the increasing load placed on the Campbell River power developments (Table 8 and Figure 3). The Salmon River diversion adds approximately 259 km^2 to the system and diverts an average flow of 11.3 cms (400 cfs) into Lower Campbell Lake. The Quinsam River diversion adds 78 km^2 and diverts a flow of 2.8 cms (100 cfs) into Lower Campbell Lake. The Heber Crest diversion also adds 78 km^2 to the system and diverts an average flow of 3.2 cms (113 cfs) into Upper Campbell Lake (4).

TABLE 8

RIVER DIVERSIONS ASSOCIATED WITH HYDROELECTRIC POWER DEVELOPMENT ON THE CAMPBELL RIVER

River Diversion	Salmon		Quinsam	Heber
Location of Discharge	Lower Campbell Lake		Lower Campbell Lake	Upper Campbell Lake
Average Flow Diversion	11.3 400	cms cfs	2.8 100	3.0 105
Maximum Works Capacity	42.5 1,500		8.5 300	22.6 800

Fisheries and Marine Service has studied the effects of hydro developments on the fishery resource and has recommended a maximum discharge of 122 cms (4,300 cfs) and a minumum discharge of 57 cms (2,000 cfs) from the power projects on the Campbell River System (42). As mentioned in the Water Resources section of this report, average recorded flows before hydro developments on the Campbell River were 95.12 cms (3,040 cfs), the river had an unregulated maximum recorded flow of 848.4 cms (30,300 cfs) in November 1939 and a minimum flow of 7.8 cms (280 cfs) in October 1925.

Plans to increase the total generating capacity of the Campbell River System have been prepared by B.C. Hydro but to date have not progressed beyond the feasibility study stage (14 & 54). Instead, additional submarine cables tapping mainland power sources have been, and are, currently being added to the Vancouver Island transmission network (15 and see "Cheekye to Dunsmuir 500 Kilowatt Transmission Line", Water Planning & Management, file 554-29).

4. Fisheries

The lakes and streams of the Upper Campbell River watershed are limited in their ability to support large populations of fish. Most feeder streams originate and flow through the granitic Vancouver Island mountains and consequently contain few of the nutrients required for biological growth. Very little published information is available on the freshwater fishery resource of the Basin, although the topic is mentioned in several comprehensive studies of the area (50 & 61). Six freshwater fish species have been identified in the upper reaches of the Campbell River watershed; coastal cutthroat trout, Dolly Varden char, Kokanee trout, prickly sculpin, rainbow trout, and threespine sticklebuck (4).

The lower portion of Campbell River has been studied intensively with an emphasis on the fishery resource since, and just prior to, the installation of B.C. Hydro's network of power projects on the Campbell River System. These studies are site specific, technical in nature and the majority are unpublished. Details such as substrate distribution, river morphology, current velocity and fish distribution are available, but are not discussed in this report. A bibliography is found in the Campbell River Estuary Study, p.298 (4).

The estuary has also been studied intensively in recent years. Interest in preserving the estuarine environment was stimulated in 1974 when a marina proposal submitted by the Campbell River Indian Band was rejected by the Fisheries and Marine Service (38). The provincial Fish and Wildlife Branch has surveyed the Quinsam River from Lower Campbell Lake to the Quinsam hatchery. The report details physical and biological characteristics of the river including substrate distribution, river bed morphology, aquatic and terrestrial vegetation and benthic invertebrates.

The Campbell System is one of three significant spawning rivers on the east coast of Vancouver Island. The lower reaches of the Campbell River, Quinsam River and the estuary are important spawning, rearing and holding habitat for the five species of Pacific salmon (chinook, coho, chum, pink and sockeye) and steelhead trout (53). Common and scientific names are listed in Appendix 11. Prior to construction of the John Hart dam (1947) the Campbell River was utilized by fisheries from the mouth to Elk Falls, 5.6 kilometers upstream. The dam eliminated 0.6 kilometers of this habitat. Because of natural obstructions, only a portion of the Quinsam River is available to anadromous fish. The uppermost obstruction is a waterfall just above the confluence of the Quinsam and Iron Rivers, 25.7 kilometres upstream from the confluence with the Campbell River. A second natural obstruction which can be crossed only by steelhead trout and coho occurs 21.7 kilometers from the Campbell River, between Middle and Quinsam Lakes (38).

The chinook salmon begin their upstream migration in mid-August, spawning begins about mid-October. The fry are free-swimming by early March, spend three months in the river, followed by three months in the estuary before heading to the sea in autumn. The chinook spawn mainly in the Campbell River. The pattern is similar for chum and coho, although chum start upstream in mid-October remaining in the main channel of the Campbell River, while coho start upstream in mid-September and spawn mainly in the Quinsam River. Pinks start upstream as early as July, spawning in August and September (4). The even year pink salmon run is evenly divided between the two rivers whereas for the odd-year pink run the Quinsam-Campbell spawning ratio is 6:1 (52). Appendix 14 gives salmon escapements for the years 1947 - 1975 for both the Campbell and Quinsam Rivers (52). Average escapements (in pieces) for 1970 - 74 are as follows: pink 5,930; chinook 5,076; coho 4,720; and chum 4,010 (38). The sockeye run is minimal, 141 was the average escapement for the same time span. Steelhead trout enter the Campbell River in mid-November and spawn from January to March, the young emerge in May and June, spend a year in the river then migrate directly to the sea. While Pacific salmon are a federal responsibility, steelhead trout, even though they migrate to sea for their adult lives, are a provincial jurisdiction (64).

In 1974, a salmon hatchery was established on the Quinsam River by the federal Fisheries and Marine Service. The largest of its kind to date in Canada, it cost approximately five million dollars and is expected to increase stocks for the commercial and sports fisheries of the Campbell System and Inner Passage (53).

The hatchery raises coho and steelhead from the Quinsam River and chinook from the Campbell River. In 1978, 1 million chinook, 1.5 million coho, and 20,000 steelhead fry were released to the Campbell River system (64). The potential production of the hatchery is expected to reach:

(1) 1.9 million coho smolts yielding 275,000 adults;
(2) 3 million chinook fingerlings yielding 30,000 adults; and
(3) 20,000 steelhead smolts yielding 2,000 adults.

As the 1978 figures indicate, coho and steelhead releases are nearing this production, but, chinook salmon will require a few more years (64). The hatchery facility consists of: a water supply diversion dam at Cold Creek, three concrete holding ponds, fifteen concrete rearing ponds, a fish diversion fence and fishway on the Quinsam River, and the hatchery building which contains egg incubators and laboratory facilities (52).

The hatchery has a water use licence on Cold Creek providing for an intake of .84 cms (30 cfs); also a licence on the Quinsam River for .28 cms (10 cfs) with a provision of up to .84 cms (30 cfs) if required (Appendix 13). Waste discharges from the hatchery are comprised of 30% suspended solids and 70% settleable solids. Wastes are channelled through two clarifiers with a one hour retention time before release to the Quinsam River. Fisheries & Marine Service is currently studying the downstream effects of hatchery discharges (64). Concern has also been raised as to the effect of the proposed upstream Quinsam coal mine on both the water quality and quantity required by the hatchery (Appendix 12).

Commercial and sport fishing are important to the economy of Campbell River, both have been instrumental in generating environmental concern for the estuary (38). It is difficult to identify the total impact of the fishing industry on a regional basis due to the high degree of movement between harvest areas and processing sites on the coast. The majority of fish processing is presently done outside the region with facilities becoming increasingly centralized in Vancouver and Prince Rupert. There is one herring processing plant in Campbell River which has been operating since 1972; a "custom cannery" which preserves catch for sports fishermen; and several cold storage facilities (5). Generally, 200 fishermen reside in the Campbell River district generating $3.5 million to the economy (45). Salmon (mainly pink, chum and sockey) is the most important catch, estimated at 91% of the value of the regional fishing industry. Fishing occurs principally in the summer months, from June to the end of September. Only chinook salmon are caught for commercial purposes during the winter months and even these on a limited basis.

The coastal waters have been divided geographically into areas and districts by the Fisheries and Marine Service for the purpose of research and recording. Campbell River lies in Federal Statistical Catch Area 13 which extends from Blenkinsop Bay near the mouth of the Salmon River to Shelter Point of Discovery Passage. Catch Area 13 yields the largest salmon catch of all Vancouver

Island Areas. Table 9 gives 1973 dollar returns for the salmon and herring fishery for Statistical Areas 13 and 14 (Courtenay) (5).

TABLE 9 - RETURNS FROM SALMON AND HERRING - 1973

Area	Vessels	Value of Landing by Home Port	Total Value of Landing	Landing
13 and 14 (Campbell River and Courtenay)	287	$5.8 million	$12.5	91.4% salmon 1.1% herring

It is important to note the dependence of the Cape Mudge and Campbell River Indian Bands on the fishery, particularly salmon and herring. The total Indian food fishing catch for Area 13 in 1974 amounted to 8,198 pieces (4).

One of the most intensive sport fisheries in the province occurs off the mouth of Campbell River. Sports fishing and associated services provide a major area of development potential.

The Campbell River sport fishery was worth an estimated $5.5 million in 1972 over a 100 day tourist season (71). In a random sample of fishing parties conducted in the same summer, 40% preferred fishing in tidal waters, 24% in Campbell River, and 25% in the upper watershed (56). In 1975, the Campbell River (Area 13) sport catch of salmon amounted to 69,977 pieces, or 16% of the provincial total (4). Sport catch is mostly chinook and coho. The number of tyee (chinook greater than 30 pounds) taken by all sport methods in Discovery Passage between Seymour Narrows and Cape Mudge annually ranges between two to three hundred (4).

5. Agriculture

Agriculture in the Campbell River Basin is concentrated in the Lower Quinsam River Valley, and is devoted almost entirely to pasture and forage due to soil moisture deficiencies. However, several small farms produce vegetables, eggs, and beef for local consumption (19). Most produce and dairy products are imported from Saanich Peninsula, Fraser Valley, California, and Mexico. There are no poultry or other self-sustaining full-time livestock farms in the region.

Approximately 10,000 to 15,000 acres (41 to 60 km^2) of land within the Basin are designated as Agricultural Land Reserve (ALR) (4). These regions are located mainly in the Lower Quinsam Valley, on the outskirts of Campbell River Municipality and along the Island Highway. The acreages are summarized in the following table:

TABLE 10

AGRICULTURAL LAND RESERVE ACREAGES

Electoral Location Area	Location	Acreage of Electoral Area	ALR Acreage	ALR % of Electoral Area
D	Oyster Bay/Buttle Lake (negligible acreage in Basin)	146,000	13,403 (mostly in Oyster River watershed)	9.2
E	Quinsam	1,984	780	39.3
F	North Campbell River	1,024	115	11.2
H	Sayward/Bloedel (negligible acreage in Basin)	515,264	19,570 (mostly north of Basin)	3.8
	Campbell River	33,049	9,357	28.3

Very little of the Agricultural Land Reserve is presently used for agriculture with poor irrigation (and prohibitive costs associated with irrigating) and pre-existing land uses (e.g., airports) being major limiting factors (16). Other handicaps include stoniness, a dense forest canopy, low natural fertility, and an undulating topography. Few areas north of the Oyster River have been successfully farmed (4).

IV. SOCIAL DEVELOPMENT

1. Population and Municipal Services

The District of Campbell River is the only organized municipality within the Basin. Two unincorporated districts, Quinsam and North Campbell River, are situated adjacent to the District of Campbell River (56). The population of the remainder of the Basin is confined almost entirely to the Western Mines operation at the south end of Buttle Lake. A small recreation area is centred around Strathcona Lodge on the east side of Upper Campbell Lake, however, only a few permanent residents reside here (56).

Population figures for 1971, 1976 and corresponding percent change for Campbell River and Electoral Areas E Quinsam and F North Campbell River are shown in Table 11 (57). Electoral Area D Oyster Bay-Buttle Lake is also noted on this table, but only a small portion lies within the Campbell River Basin.

There are two Indian Reserves within the Basin: Number Eleven - The Campbell River Reserve located on Tyee Spit and occupied by the Campbell River Band; and Number Twelve - The Quinsam Reserve located on the lower Quinsam River and occupied by members of the Cape Mudge Band (see Figure 7) (31).

Municipal services for the three districts include: electricity supplied by the British Columbia Hydro and Power Authority; B.C. Telephone; cablevision; a piped water supply; and a secondary sewage system (19).

Water supply is administered by two water districts, the Greater Campbell River Waterworks District and the North Campbell River Waterworks District. The Greater Campbell River Waterworks System completed in 1949, uses the headpond of the John Hart generating station as a supply source. An 8 inch (20 cm) line carries water from the penstocks to a 150,000 gallon (681 900 litre) tank which provides storage at the south end of Lower Campbell Lake. The water is chlorinated and fluoridated before distribution through a gravity system to the town.

TABLE 11

POPULATION

	1971	1976*	% Change
Campbell River	10,000	12,240	22.4
Electoral Area:			
D Oyster Bay-Buttle Lake**	1,464	2,170	48.2
E Quinsam	2,330	3,616	55.2
F North Campbell River	1,862	1,645	-11.7

* 1976 figures include Indian Reserve Populations
** partially on Basin
(57)

The North Campbell River Waterworks system, completed in 1957, also receives its supply from the penstocks of the John Hart plant (53). An agreement with B.C. Hydro allows a diversion, through a 10 inch (25.4 cm) line, of 400,000 gallons (1 818 400 litres) per day (4). Major users of the North Campbell River Waterworks are the Elk Falls Mill at Duncan Bay and Raven Lumber Company.

Prior to 1962, there was no piped water supply system to Quinsam and residents relied on groundwater supplies (4). Today, isolated areas of the Basin rely on wells for their water source (16). Groundwater in the Campbell River area is found in confined aquifers beneath till or older sediments, also limited supplies are found in till deposits. Wells dug in the lower Quinsam River valley show the water table ranging from 4 m (13 ft) to 8.5 m (28 ft) (41). The Quinsam Indian Reserve stores water in a 20,000 gallon storage tank which is pumped from a 4.8 m (16 ft) well dug in fluvial and channel deposits (see Figure 7) (41). Detailed well records from the provincial Water Investigations Branch for the Campbell and Quinsam

Rivers are held in the Water Impact Section of the Water Planning and Management Branch.

The Campbell River Water Pollution Control Center treats all sewage from Campbelton south to Willow Point (see Figure 2) (43). Constructed in 1974, the secondary treatment plant consists of headworks, an aerated grit tank, an aeration tank, a final clarifier, an aerobic digester and storm clarifiers (43). The treatment plant is located near the district boundary at 6th Street and Island Highway, the treated sewage is discharged into Discovery Passage via a 6 cm (24") diameter outfall extending 305 m (1,000') offshore (43).

The unincorporated districts of Quinsam and North Campbell River rely on septic tanks for sewage disposal. Only the District of Campbell River has a sewage system except for the Elk Falls Mill at Duncan Bay which has a small secondary sewage treatment plant for domestic use only.

2. Tourism & Recreation

Tourism and recreation have been a part of the Campbell River economy since the early 1900's. Today the Northern Island is opening up and Campbell River is becoming the hub of the Island, servicing points west and north, and also nearby islands to the east.

The attractions to the area are found in the physical environment, from Discovery Passage to the Vancouver Island Mountains. Saltwater sports fishing draws thousands of tourists annually. The season begins with a salmon festival on July 1st and continues until the end of September, although, many enthusiasts claim that fishing is excellent year round. The favoured catch is the "Tyee" salmon, a chinook weighing greater than 30 pounds. These Pacific salmon are generally found at great depths and heavy leads are needed, however, along the edges of the bars on Discovery Passage light tackle rod-and-line trolling is successful. The Tyee Club was formed in 1925, membership is comprised of sportspersons who must follow stringent restrictions and regulations to catch their Tyee. Record weight for the Tyee is 71 pounds, caught in 1968. Other Pacific salmon, such as spring coho and blueback, are also excellent catch. These salmon are fished upstream as far as the John Hart generating station. Marinas, boat rentals, and guide services are prolific in Campbell River.

Freshwater fishing is also popular, trout and steelhead being the major fish. The Basin's parks and scenic interior valleys provide an ideal setting for hiking, camping, hunting, boating, water-skiing and horseback riding. Forbidden Plateau, located just outside the Basin, is a 4 896 hectare public recreational park offering skiing and winter camping (see Figure 2). A new ski area is currently being developed in Strathcona Park.

Campbell River municipality has an outdoor swimming pool, ice arena, and a golf course (there are two other courses within thirty kilometres). A compressor and rental facilities for scuba diving are also available. Local sightseeing attractions include tours of the Elk Falls mill, Quinsam hatchery, John Hart generating station and the Campbell River museum (22).

The area boasts over forty motels or hotels and numerous tent and trailer parks and campsites. Strathcona Park Lodge, on Upper Campbell Lake, is maintained as a center for environmental education with one to three week courses running throughout the year (22).

In 1973, W.C. Yeomans, a consultant for the provincial government, provided an estimate of total tourist expenditures in the Campbell River area. Based on the number of motel/hotel units available and a 100 day season, total expenditures were estimated at $4,782,000. Including expenditures in nearby areas the total could rise to

$5.5 million (71 and 56). Thus, available data substantiates the assumption that tourism is playing a vital role in the Campbell River economy.

3. Parks

There are three Class A provincial parks within the Basin and one recreation area. The parks are shown on Figure 7, Table 12 presents their names, location, size, classification and facilities (24). Many other small camping and picnicking areas have been established for public use by private forestry companies and the B.C. Department of Highways (56). These sites have not been listed due to their temporary nature.

Strathcona Park, established in 1911, was British Columbia's first provincial park (23). The highest points on Vancouver Island, Mount Golden Hinde (2 202 m) and Elkhorn Mountain (2 196 m) stand almost in the middle of the park west of Buttle Lake. Della Falls, reputed to be the highest waterfall in Canada, is located in the southern section of the park and has an overall drop of 440 meters in three cascades (4). Strathcona Park has two camping areas, one with 85 camping sites at the north end of Buttle Lake on Highway 28 (Campbell River to Gold River), and the other with 76 sites at Ralph River (24 km south along the Buttle Lake road). There is also a wilderness camping area on Marble Mountain overlooking Buttle Lake (24). The park has three nature conservancies within its boundary, namely Big Den (12 053 ha), Central Strathcona (87 007 ha) and Comox Glacier (23 476 ha). These areas were established as wildlife sanctuaries to preserve Roosevelt elk, ptarmigan, and the Island marmot. Nature conservancies are defined as wilderness tracts reserved for the preservation of representative ecosystems and landforms in their natural state. No exploitation or development is permissible except as may be necessary to ensure preservation and wilderness use (24).

Elk Falls Park, located on the Gold River Highway approximately six kilometers from Campbell River Municipality, is a popular camping

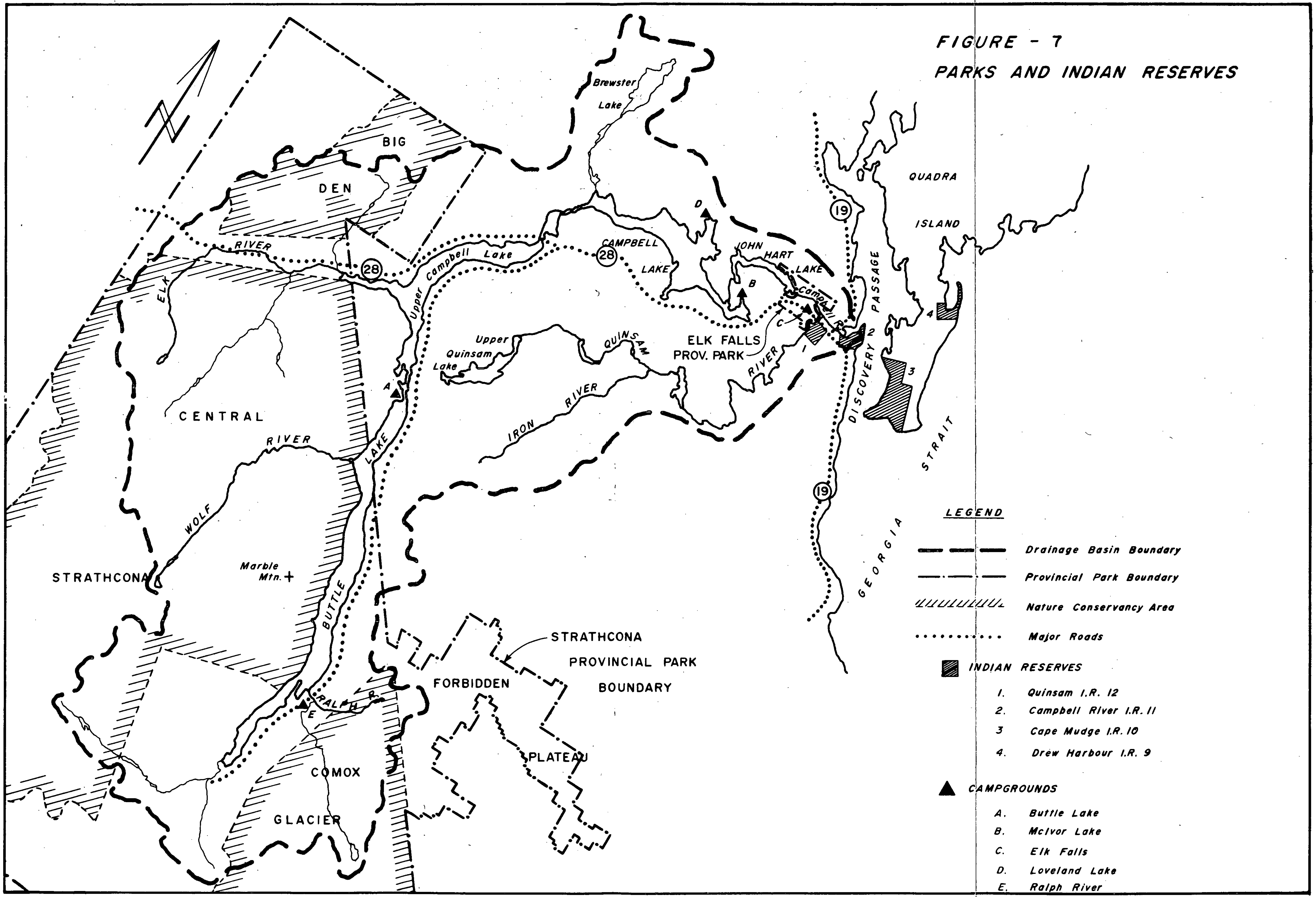


FIGURE - 7
PARKS AND INDIAN RESERVES
LEGEND
Drainage Basin Boundary
Provincial Park Boundary
Nature Conservancy Area
Major Roads
INDIAN RESERVES
1. Quinsam I.R. 12
2. Campbell River I.R. 11
3 Cape Mudge I.R. 10
4. Drew Harbour I.R. 9
CAMPGROUNDS
A. Buttle Lake
B. McIvor Lake
C. Elk Falls
D. Loveland Lake
E. Ralph River
QUADRA
ISLAND
DISCOVERY PASSAGE
GEORGIA STRAIT
Brewster Lake
BIG DEN
ELK RIVER
CAMPBELL LAKE
JOHN HART LAKE
Campbell R.
ELK FALLS PROV. PARK
Upper Campbell Lake
Upper Quinsam Lake
QUINSAM RIVER
IRON RIVER
CENTRAL
WOLF RIVER
Marble Mtn.
BUTTLE LAKE
STRATHCONA
STRATHCONA PROVINCIAL PARK BOUNDARY
FORBIDDEN PLATEAU
RALPH R.
COMOX GLACIER
19
28

TABLE 12-PARKS

PARK NAME	LOCATION	HECTARES	STATUS/CATEGORY	CAMP SITES	PICNIC SITES	TOILETS (Pit)	ADDITIONAL INFORMATION
Elk Falls	North West of Campbell River in Quinsam River	1087	Prov / A6*	121	10	26	- pressure wat system - sanitation - fireplace
Loveland Bay	North End of John Hart Lake	30	Prov / RA* (B.C.Forest Service)				
Morton Lake	North West of Campbell River	67	Prov / A3*	24	10	6	- boat ramp - beach area
Strathcona Park	Central Vancouver Island	227 211	Prov / A6	121		31	- water pump - 2 boat ramps - beach
McIvor Lake	Upper Campbell Lake	162	Municipal				

Note: *CLASS "A" PARKS are intended to preserve outstanding natural, scenic, and historic features for public recreational use. No commercial or industrial exploitation is permissible except as may be necessary to planned recreational use.

*RECREATION AREAS are intended primarily for public recreational use. Other resource may be permitted provided it does not materially detract from the areas recreational potential.

*CATEGORY numbers designate the main purpose and type of development permitted in the park. Category "3" specifies enjoyment, convenience, and comfort to the travelling public. Category "6" specifies development and improvement directed towards and limited in accordance with a zoning plan allocating its various lands to two or more purposes.

(24 and 56)

area. The park is situated on the Quinsam River in a stand of virgin Douglas fir, near attractions such as the John Hart generating station and scenic Elk Falls.

Several potential archaeological sites have been identified within the Basin by the Heritage Conservation Branch of the provincial government. At present five proposed sites are recorded at the mouth of the Campbell River, however, the lack of sites in the rest of the Basin reflects the limited amount of archaeological and not the absence of sites (11).

4. Transportation

The development of an integrated transportation network has been fundamental in establishing Campbell River as the key distribution center for the northern regions of Vancouver Island.

The Island Highway, or Highway 19, runs from Nanaimo through Campbell River to Port Hardy. Highway 28 branches westward from Highway 19 at Campbell River and runs 97 kilometers (60 miles) to Gold River (see Figure 2). Both highways are dual lane, high speed and hard surfaced.

Vancouver Island Coach Lines (an agent for Greyhound) services all island centers with four trips daily to Nanaimo and Victoria, and daily service to Gold River and Kelsey Bay (45). An inland route between Courtenay and Campbell River is being considered to reduce downtown congestion in the summer months (56).

Local taxi and an airport limousine service is available in Campbell River. There are four major inter-provincial trucking lines with terminals in Campbell River, three local hauling and/or moving firms (including one mobile home towing service) and three firms which offer warehouse storage.

The provincial Ministry of Highways provides daily passenger and vehicle service aboard the ferry "Quadra Queen" to Quadra Island from Campbell River. The B.C. Ferry Corporation provides twice weekly service from Vancouver to Prince Rupert stopping at Port Hardy. Campbell River harbour has two deep-water port facilities and offers various tug and barge services. The harbour is the Northern Island's busiest, with ore and lumber shipments, plus calls from numerous cruise ships (56).

The Campbell River District Municipality operates a licensed airport with a 1 520 meter (1,500 ft.) paved runway. Pacific Western Airlines has several flights daily to Vancouver, Port Hardy, Comox, and Prince Rupert. Island Airlines operates an irregular service to Victoria. In 1974, the Campbell River Airport had a total of 37,858 passenger movements, compared to Port Hardy 69,237, Comox 39,662, Sandspit 37,837, and Powell River 28,305 (5). Possible future developments for the airport include installation of an instrument landing system with a central tower at a cost of over $300,000 (1976 Cdn. dollars) (5).

In 1946, the first seaplane base was established by B.C. Airlines at the mouth of Campbell River. Today Campbell River is considered one of the busiest seaplane bases in the world, servicing remote fishing, logging, and mining camps (45). Several companies, offering both scheduled and charter flights, now operate from two licensed bases on Tyee Spit.

The major airline companies and their destinations are listed below:

COMPANY	PLANE TYPE	SERVICE/DESTINATION	
Pacific Western Airlines	Wheel	Scheduled Vancouver, Port Hardy, Comox, Prince Rupert	
Gulf Air Aviation Ltd.	Float/Wheel		
Okanagan Helicopters Ltd.	Helicopters: Float/Skid	Charter/Open	
Alert Bay Air Services	Float/Wheel	Scheduled/ Charter	Port Hardy, Ocean Falls Bella Bella, Rivers Inlet, Alert Bay
Island Airlines Ltd.		Scheduled	Powell River, Cortes, Redonda, Toba Inlet, Tahsis, Vanc. Harbour Over 60 points).

(57)

CONCLUDING REMARKS

The intent of this report was to present the status of environmental information to 1978 for the Campbell River Basin, with an emphasis on the water resource. During compilation, several areas of data deficiencies were encountered.

A detailed catalogue of physical resources for the Campbell River Basin was lacking. Physiographic data was available on a large scale for British Columbia and Vancouver Island, but not for the Basin per se. Meteorological data did not include a parameter for wind measurements. The existing network of climatological stations provided an inadequate coverage of the upper watershed, since only one station recorded temperature and precipitation in the upper watershed. This station is located on Upper Campbell Lake and cannot be considered representative of higher elevations which constitute a major portion of the Basin.

Very little information exists on the freshwater fishery resource of the upper watershed. There is also no comprehensive report on the flora and fauna of the Basin.

Since the British Columbia Hydro and Power Authority assumed responsibility for regulating the flows of the Campbell River System, federally maintained hydrometric stations have been reduced to only one Water Survey of Canada station. Water quality measurements have been sporadic and site specific, providing very little insight into the water quality of the Campbell River System. Groundwater data is meagre and out-of-date. Information on the occurrence and development of groundwater within the coastal lowland of northeastern Vancouver Island was published in 1966 by the Geological Survey of Canada, no up-dates are available. An inventory of wells dug from 1963 to 1969 was provided by the provincial Water Investigations Branch, however, the data was supplied on a voluntary basis and cannot be considered complete nor accurate.

Stresses on the water resource of the Campbell River Basin are evident even now. Future increases in industrial activity, i.e. the proposed Quinsam coal mine and expansion in the service and secondary manufacturing sectors, will emphasize these water use conflicts and make water impact assessments critical in the long term planning of the Campbell River Basin.

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APPENDIX 1

1976 CLIMATIC DATA FOR SEVEN STATIONS

in the

CAMPBELL RIVER BASIN

(17)

MONTHLY AND ANNUAL MEAN TEMPERATURE FOR THE YEAR 1976 AND STANDARD 1941-1970 AVERAGE

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
Campbell River A	37	37	38	45	50	M	59	60	57	47	41	40	M	Actual
	32	37	39	44	52	57	62	61	55	47	40	35	47	Average
Campbell River BCFS	37	37	38	47	52	55	59	60	58	49	42	40	48	Actual
Campbell River BCHPA Gen	37	38	38	47	50	55	63	60	59	49	42	40	48	Actual
Quinsam River Hatchery	37	37	38	46	50	55	60	60	58	49	41	39	48	Actual
Strathcona Dam	36	M	M	M	M	M	M	M	M	M	M	M	M	Actual
	32	37	40	46	54	59	64	63	58	49	42	36	48	Average
Strathcona Park Lodge	36	36	35	45	50	54	59	60	60	51	43	40	47	Actual

MONTHLY AND ANNUAL TOTAL PRECIPITATION FOR THE YEAR 1976, WINTER SNOWFALL 1975/1976 AND STANDARD 1941-1970 AVERAGE

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Winter Snow	Alt. (ft)	
Campbell River A	6.16	4.48	4.80	2.40	2.88	1.46	1.18	2.46	0.46	3.71	2.47	5.29	37.75	45.1	346	Actual
Campbell River BCFS	9.64	7.03	5.89	3.66	4.04	1.88	2.14	3.85	1.58	5.42	2.80	8.02	55.95	61.8	420	Actual
Campbell River BCHPA Gen	8.29	5.69	5.90	3.27	4.13	1.89	0.82	3.23	1.50	5.26	2.09	6.48	48.55	44.2	100	Actual
Duncan Bay	8.59	6.23	5.36	3.43	3.69	1.77	1.72	3.66	1.74	5.46	2.57	7.64	51.86	26.0	22	Actual
	8.89	6.33	5.31	3.29	1.92	2.06	1.57	2.31	2.95	7.93	8.31	11.86	62.73	29.8		Average
Quinsam River Hatchery	7.54	5.99	6.00	2.89	3.16	1.53	1.57	3.05	1.04	4.76	2.43	5.93	45.89	M	150	Actual
Strathcona Dam	M	M	M	M	M	M	M	M	M	M	M	M	M	M	660	Actual
Strathcona Park Lodge	9.94	7.99	6.30	1.51	2.97	1.77	1.20	2.32	1.12	5.84	3.56	8.57	53.09	M	750	Actual

EXTREMES OF TEMPERATURE FOR EACH MONTH OF THE YEAR 1976 WITH ABSOLUTE* TEMPERATURES

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Absolute	
Campbell River A	55	57	57	71	71	74	78	78	79	65	57	56	100	Max
	22	18	9	26	31	34	41	40	37	26	18	21	-11	Min
Campbell River BCFS	49	49	51	71	74	75	78	78	78	66	58	54	M	Max
	25	23	14	30	35	40	46	46	44	32	27	28	M	Min
Campbell River BCHPA Gen	49	50	51	73	71	77	85	80	80	67	59	54	M	Max
	24	23	16	29	35	37	45	45	42	30	24	27	M	Min
Quinsam River Hatchery	50	50	50	71	71	77	80	81	76	66	58	56	M	Max
	25	21	15	29	33	36	45	44	41	29	23	26	M	Min
Strathcona Dam	49	M	M	M	M	M	M	M	M	M	M	M	M	Max
	25	M	M	M	M	M	M	M	M	M	M	M	M	Min
Strathcona Park Lodge	48	49	47	72	72	75	80	78	79	67	57	56	M	Max
	27	21	17	28	36	37	45	40	46	37	28	31	M	Min

* Highest and lowest temperature ever recorded at station

APPENDIX 2

TEMPERATURE AND PRECIPITATION MEANS (1941-1970)

FOR TWO STATIONS:

CAMPBELL RIVER AND DUNCAN BAY

(2)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CAMPBELL RIVER (Latitude 50 01 N Longitude 125 18 W Elevation 260 ft ASL)													
Mean Daily Temperature (Deg. F)	34.4	38.4	40.2	45.4	52.6	58.5	63.3	62.4	56.6	48.1	40.8	36.7	48.1
Mean Daily Maximum Temperature	39.1	44.0	47.5	54.0	62.6	68.6	74.3	72.6	65.6	54.5	45.9	41.0	55.8
Mean Daily Minimum Temperature	29.7	32.8	32.8	36.7	42.6	48.4	52.3	52.1	47.5	41.6	35.6	32.3	40.4
Extreme Maximum Temperature	58	64	70	69	85	89	99	93	81	71	59	58	99
No. of Years of Record	11	11	11	11	11	10	11	11	11	11	11	11	
Extreme Minimum Temperature	1	19	16	27	29	37	40	40	36	29	17	0	0
No. of Years of Record	11	11	11	11	11	10	11	11	11	11	11	11	
No. of Days with Frost	19	14	16	7	1	0	0	0	0	1	11	16	85
Mean Rainfall (inches)	7.22	5.94	5.36	2.99	1.91	2.01	1.54	2.03	2.65	6.55	8.89	9.44	56.53
Mean Snowfall	17.2	5.8	2.8	0.2	0.0	0.0	0.0	0.0	0.3	0.0	2.7	12.0	41.0
Mean Total Precipitation	8.94	6.52	5.64	3.01	1.91	2.01	1.54	2.03	2.68	6.55	9.10	10.64	60.57
Greatest Rainfall in 24 hrs.	3.02	3.75	2.81	3.14	1.53	2.00	1.55	1.66	1.42	3.51	3.42	4.13	4.13
No. of Years of Record	29	30	33	30	32	32	31	33	29	31	28	29	
Greatest Snowfall in 24 hrs.	21.6	16.0	14.0	2.5	0.0	0.0	0.0	0.0	8.7	T	9.0	22.0	22.0
No. of years of Record	31	31	33	31	33	33	33	33	33	33	31	30	
Greatest Precipitation in 24 hrs.	3.02	3.75	2.81	3.14	1.53	2.00	1.55	1.66	1.42	3.51	3.62	4.13	4.13
No. of Years of Record	30	30	33	30	32	32	31	33	29	31	29	28	
No. of Days with Measurable Rain	13	11	12	10	9	8	6	7	9	14	15	14	128
No. of Days with Measurable Snow	4	2	1	*	0	0	0	0	0	0	1	2	10
No. of Days with M. Precipitation	16	12	13	11	9	8	6	7	9	14	16	16	137

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
DUNCAN BAY (Latitude 50 04 N Longitude 125 17 w Elevation 22 ft ASL)													
Mean Rainfall (inches)	7.71	5.93	5.11	3.27	1.92	2.06	1.57	2.31	2.95	7.93	8.16	10.83	59.75
Mean Snowfall	11.8	4.0	2.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.5	10.3	29.8
Mean Total Precipitation	8.89	6.33	5.31	3.29	1.92	2.06	1.57	2.31	2.95	7.93	8.31	11.86	62.73
Greatest Rainfall in 24 hrs.	3.48	2.42	1.96	1.35	1.24	1.37	1.08	1.60	1.35	2.62	2.08	3.20	3.48
No. of Years of Record	11	12	13	13	13	12	13	12	12	13	13	14	
Greatest Snowfall in 24 hrs.	17.6	5.2	3.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	6.6	12.5	17.6
No. of years of Record	12	13	13	13	13	13	13	13	13	14	13	14	
Greatest Precipitation in 24 hrs.	3.48	2.42	1.96	1.35	1.24	1.37	1.08	1.60	1.35	2.62	2.08	3.20	3.48
No. of Years of Record	12	12	13	13	13	12	13	12	12	13	14	14	
No. of Days with Measurable Rain	19	16	16	14	11	9	7	9	11	17	18	20	167
No. of Days with Measurable Snow	4	*	1	*	0	0	0	0	0	0	*	3	8
No. of Days with M. Precipitation	22	16	16	14	11	9	7	9	11	17	18	21	171

APPENDIX 3

TABLE HEADINGS FROM

MONTHLY RECORD - METEOROLOGICAL OBSERVATIONS

IN CANADA

TABLE HEADINGS

TABLE 1

General Synopsis of Temperature and Precipitation
District and province
Mean daily (Temperature)
Difference from normal
Mean daily maximum
Mean daily minimum
Mean daily range
Extreme highest
Extreme lowest
Precipitation
Fall in inches
Difference % from normal
Number of days
Greatest fall in 24 hours

TABLE 2

Temperature and Precipitation Summaries
Temperature
Mean maximum
Mean minimum
Mean daily
Difference from normal
Maximum, date
Minimum, date
Number of days with freezing temps.
Precipitation
Total amount
Difference from normal
Number of days with .01 or more
Heaviest fall in month
Snowfall (in inches)
Number of days with measurable snow
Snow on ground at end of month (in.)

TABLE 3

Daily Temperature
Day of month
Mean

TABLE 4

Daily Precipitation

TABLE 5

Summary of Observations of Pressure, Temperature, Vapour Pressure, Cloud, Visibility and Wind at Fixed Hours at Selected Stations during the month of -
Hour, time zone
Height of barometer, M.S.L. (feet)
Mean station pressure
Mean sea level pressure
Mean temperature
Mean dew point
Mean vapour pressure
Cloud amount
Number of observations
Mean percentage
Visibility
Wind, number of observations
Speed, directions

TABLE 6

Summary of Winds at Hourly Reporting Stations
Frequency in hours
Prevailing direction
Mean speed
Maximum reported hourly speed
Speed, direction, date

TABLE 7

Summary of Hourly Winds
Frequency in hours
Prevailing direction
Mean speed
Maximum recorded hourly speed

TABLE 8

Daily Bright Sunshine

TABLE 9

Summary of Sunshine Records
Duration in hours
% of possible duration
Difference from normal (hours)
Maximum sunshine in one day
Number of days with no sunshine

TABLE 10

Soil Temperature
Depth, mean

TABLE 11

Total Daily Solar Radiation Received on a Horizontal Surface

TABLE 12

Recording Rain Gauge Data
Maximum amounts for durations indicated with dates of occurrence
Hourly rainfall - number of occurrences in classes shown

TABLE 13

Class A Pan Evaporation Data
Total net water loss from pan (inches)
Average of daily values
Wind mileage
Water temperature
Air temperature
Total calculated lake evaporation (inches)

TABLE 14

Meteorological Stations in Canada
Latitude north
Longitude west
Height above sea level
Type of observation
Precipitation
Temperature Extremes
Synoptic
Wind
Sunshine
Soil temperature
Radiation
Rainfall intensity
Evaporation
Station listing number

APPENDIX 4

Monthly and Annual Mean Discharges

Stations:

08HD003
Campbell River near Campbell River

08HD004
Campbell River near Quinsam

08HD001
Campbell River at Outlet of Campbell Lake

08HD005
Quinsam River near Campbell River

(69)

CAMPBELL RIVER NEAR CAMPBELL RIVER - STATION NO. 08HD003

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC FEET PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1949	---	---	---	---	---	---	---	---	---	---	---	5540	---	1949
1950	2040	2630	2670	2720	3600	5790	4110	1370	2190	3730	4620	5400	3410	1950
1951	4040	2640	1200	3110	4100	2140	1650	1340	1370	3070	2980	2520	2520	1951
1952	1140	1640	1340	3210	3740	4990	4540	2050	1860	2160	2230	3230	2680	1952
1953	4830	3830	1720	1980	4950	4420	4240	2500	2480	3130	9780	5100	4080	1953
1954	2820	5260	2760	2400	3630	3790	4420	2880	2410	---	9450	5120	---	1954
1955	2900	2980	---	---	1680	2820	3510	2340	2330	2020	4320	2320	---	1955
1956	2590	2440	2340	2190	4630	4690	4260	2400	2230	2000	4350	4370	3210	1956
1957	2310	2490	2270	2010	965	729	833	1200	1030	1830	1820	1130	1540	1957
1958	3200	5190	3210	3030	6160	4570	2840	3820	3050	3230	3530	7300	4090	1958
1959	4120	3370	3130	3090	4250	6340	3020	2810	2830	2750	2950	3530	3510	1959
1960	2690	3140	2680	3930	4690	5120	3390	2280	2550	3250	4210	3820	3470	1960
1961	8510	6450	4010	3580	4250	5380	3490	2550	2540	2520	2840	2330	4020	1961
1962	5140	4360	3210	2830	2570	2620	2410	2540	1820	2650	7320	8350	3820	1962
1963	4090	4480	2710	3650	2850	3110	3390	2710	2640	4890	5930	6830	3940	1963
1964	5420	4180	3300	2530	2030	4230	5200	3160	2570	3510	3580	3800	3630	1964
1965	4160	3900	2620	2120	1890	2180	2370	2360	1950	2570	4940	6060	3090	1965
1966	4870	4400	4240	4030	4080	4320	2920	1920	3390	3540	4370	8650	4230	1966
1967	4680	4520	4260	4320	2480	4110	3450	2580	2400	4960	5000	5590	4030	1967
1968	9840	4800	4440	4350	4060	2970	1730	1570	2330	5040	6730	5080	4410	1968
1969	4340	2820	3110	3920	4420	6650	4210	3280	3540	3830	4180	4470	4070	1969
1970	4120	3810	3450	2710	1910	2440	2470	2130	2140	2320	1860	2240	2630	1970
MEAN	4180	3780	2930	3090	3470	3970	3260	2370	2360	3150	4620	4670	3490	MEAN

LOCATION - LAT 50 02 17 N, LONG 125 17 41 W — DRAINAGE AREA 564 SQ MILES, REGULATED SINCE 1947

CAMPBELL RIVER NEAR CAMPBELL RIVER - STATION NO. 08HD003

ANNUAL EXTREMES OF DISCHARGE IN CFS AND ANNUAL TOTAL DISCHARGE IN AC-FT FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE	MAXIMUM DAILY DISCHARGE	MINIMUM DAILY DISCHARGE	TOTAL DISCHARGE	YEAR
1949	---	17900 CFS ON DEC 3	---	---	1949
1950	8120 CFS AT 1215 PST ON JUN 23	7820 CFS ON JUN 24	610 CFS ON JAN 28	2470000 AC-FT	1950
1951	11000 CFS AT 0500 PST ON FEB 15	7350 CFS ON OCT 19	755 CFS ON DEC 25	1820000 AC-FT	1951
1952	10300 CFS AT 1730 PST ON DEC 30	8820 CFS ON MAY 22	750 CFS ON JAN 1	1940000 AC-FT	1952
1953	29500 CFS AT 1700 PST ON NOV 15 •	28200 CFS ON NOV 15 •	1210 CFS ON APR 6	2950000 AC-FT	1953
1954	21600 CFS AT 1445 PST ON NOV 20	20500 CFS ON NOV 20	1360 CFS ON APR 19	---	1954
1955	21300 CFS AT 1430 PST ON NOV 4	17800 CFS ON NOV 5	---	---	1955
1956	11900 CFS AT 1400 PST ON NOV 16	10100 CFS ON MAY 23	812 CFS ON SEP 30	2330000 AC-FT	1956
1957	---	2900 CFS ON JAN 14	562 CFS ON SEP 4 •	1120000 AC-FT	1957
1958	18200 CFS AT 1730 PST ON DEC 3	15900 CFS ON DEC 3	830 CFS ON JAN 1	2960000 AC-FT	1958
1959	14300 CFS AT 1700 PST ON JUN 13	13000 CFS ON JUN 14	1120 CFS ON MAR 30	2540000 AC-FT	1959
1960	17800 CFS AT 2000 PST ON DEC 13	16100 CFS ON DEC 13	1200 CFS ON DEC 25	2520000 AC-FT	1960
1961	22600 CFS AT 2000 PST ON JAN 17	20300 CFS ON JAN 17	1320 CFS ON DEC 26	2910000 AC-FT	1961
1962	18100 CFS AT 0730 PST ON NOV 20	16900 CFS ON NOV 20	1200 CFS ON JUL 2	2760000 AC-FT	1962
1963	16500 CFS AT 0900 PST ON DEC 27	14800 CFS ON DEC 25	1410 CFS ON SEP 2	2850000 AC-FT	1963
1964	12300 CFS AT 1600 PST ON JAN 4	10900 CFS ON JAN 4	1330 CFS ON APR 5	2630000 AC-FT	1964
1965	15000 CFS AT 0500 PST ON DEC 5	14500 CFS ON DEC 5	1260 CFS ON OCT 17	2240000 AC-FT	1965
1966	16100 CFS AT 1845 PST ON DEC 20	14900 CFS ON DEC 21	1350 CFS ON SEP 4	3060000 AC-FT	1966
1967	14900 CFS AT 0315 PST ON NOV 1	14300 CFS ON NOV 1	1370 CFS ON SEP 4	2920000 AC-FT	1967
1968	21800 CFS AT 0415 PST ON JAN 22	20500 CFS ON JAN 22	1220 CFS ON AUG 28	3200000 AC-FT	1968
1969	11300 CFS AT 0411 PST ON JUN 11	11100 CFS ON JUN 11	1660 CFS ON SEP 2	2950000 AC-FT	1969
1970	4540 CFS AT 2102 PST ON MAR 16	4500 CFS ON JAN 1	1310 CFS ON MAY 23	1900000 AC-FT	1970
				2530000 AC-FT	MEAN

• - EXTREME RECORDED FOR THE PERIOD OF RECORD

CAMPBELL RIVER NEAR QUINSAM - STATION NO. 08HD004

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC FEET PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1953	---	---	---	---	4630	4200	3860	2250	1240	4510	6370	3980	---	1953
1954	1790	3820	1730	1700	4030	4610	4550	2580	1930	4490	8930	4590	3720	1954
1955	1560	1170	1150	1460	2350	5890	3770	1860	1380	3070	4540	1710	2490	1955
1956	1500	1270	1690	2820	5900	5460	4270	1780	1930	---	---	---	---	1956
MEAN	1620	2090	1520	1990	4230	5040	4110	2120	1620	4020	6610	3430	3110	MEAN

LOCATION - LAT 49 57 54 N, LONG 125 35 10 W — DRAINAGE AREA 444 SQ MILES, NATURAL FLOW

CAMPBELL RIVER NEAR QUINSAM - STATION NO. 08HD004

ANNUAL EXTREMES OF DISCHARGE IN CFS AND ANNUAL TOTAL DISCHARGS IN AC-FT FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE	MAXIMUM DAILY DISCHARGE	MINIMUM DAILY DISCHARGE	TOTAL DISCHARGE	YEAR
1953	---	16600 CFS ON NOV 14	---	---	1953
1954	---	17800 CFS ON NOV 20 •	1010 CFS ON JAN 31	2690000 AC-FT	1954
1955	---	14600 CFS ON NOV 4	840 CFS ON APR 30 •	1810000 AC-FT	1955
1956	---	10500 CFS ON MAY 21	1140 CFS ON FEB 15	---	1956
				2250000 AC-FT	MEAN

• - EXTREME RECORDED FOR THE PERIOD OF RECORD

CAMPBELL RIVER AT OUTLET OF CAMPBELL LAKE - STATION NO. 08HD001

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC FEET PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1910	---	---	---	---	---	4670	4130	2000	867	3830	4940	3500	---	1910
[redacted]	1570	988	1200	1660	3410	5370	3970	1720	1420	2070	3980	3630	2590	1911
[redacted]	3460	4230	1000	1110	3120	3060	1730	1120	1010	1200	5340	2330	2390	1912
[redacted]	1410	1700	1290	2120	3120	5830	4460	2030	1660	2200	4010	3690	2790	1913
[redacted]	4540	1350	4060	5200	4830	4630	3980	1730	1420	6620	8720	2360	4130	1914
1915	1650	1640	3250	4290	3150	2560	1700	1040	653	4460	3940	3300	2640	1915
1916	925	2510	5330	3760	4710	7060	5210	2400	1210	574	1690	1180	3050	1916
[redacted]	1100	2040	1020	1910	4260	5630	3570	1630	1730	1910	5560	4300	2890	1917
[redacted]	9120	7390	3400	3780	4260	5270	2720	1890	848	2310	4180	3740	4060	1918
[redacted]	4210	2850	1370	3700	4710	5290	6600	3760	1470	747	5150	4910	3740	1919
[redacted]	3700	2640	1130	937	1760	3360	2970	1420	4450	4800	3830	5930	3080	1920
1921	3690	2820	2490	2180	4360	7540	4710	2910	3790	8020	4190	4160	4250	1921
1922	878	751	711	1280	3660	5240	2460	1200	2290	2450	2260	3900	2260	1922
[redacted]	3500	1640	1360	2480	3560	3490	2220	918	628	920	2740	8160	2650	1923
[redacted]	2300	7050	2030	1450	3730	3030	1920	1150	1140	5530	4590	5380	3260	1924
[redacted]	1910	2990	2050	2550	4940	3830	2560	1230	708	413	2370	8120	2810	1925
[redacted]	2130	4630	2320	2750	2660	1950	1210	970	486	3880	3050	4100	2500	1926
1927	5070	2040	2340	1890	4070	6860	4370	1980	2270	6180	4660	3110	3750	1927
1928	6090	2480	2470	2030	5150	3940	2280	1030	873	3070	4060	3020	3050	1928
1929	1480	565	1330	2040	4220	4150	2520	1270	649	1820	1060	2690	2000	1929
[redacted]	2610	5110	2010	3990	2360	3400	1690	895	825	1840	3230	2910	2550	1930
[redacted]	3960	3230	2840	2480	3900	4150	2060	854	1060	3590	4670	1820	2880	1931
[redacted]	2400	1970	3520	3050	4020	4140	2550	1370	784	2230	5910	3910	2990	1932
1933	2360	874	1790	2310	3960	4640	4880	2310	2880	4600	4650	3690	3260	1933
1934	4650	4940	3780	4880	4160	2610	1980	1870	870	2000	7740	2940	3520	1934
[redacted]	7410	9060	3070	1570	3330	4490	2910	1190	1630	2210	1220	3860	3460	1935
[redacted]	2780	872	1780	3060	4480	4730	2050	721	822	911	1770	4210	2350	1936
[redacted]	1120	862	2310	2730	5210	6590	3120	1350	832	3300	5890	4310	3140	1937
[redacted]	2610	1250	2750	2350	4000	4260	---	---	---	1760	2970	4230	---	1938
[redacted]	5950	1300	1590	3010	4120	3540	3040	1160	923	1850	11800	11200	4140	1939
1940	3940	3960	3240	2770	4160	2780	1510	1120	1060	5220	3040	6900	3310	1940
[redacted]	5000	6830	2120	2740	3590	3350	2440	917	1230	3210	4660	8090	3660	1941
[redacted]	1940	1900	1520	2190	3110	3370	2040	772	462	2890	3030	4030	2270	1942
[redacted]	1960	1540	1910	5180	2820	3810	2820	1270	997	2460	2230	2480	2460	1943
[redacted]	5850	1700	1780	1900	2610	3130	1470	743	962	1900	5320	3260	2550	1944
1945	3910	3200	1690	1820	5220	4460	2440	992	777	683	2040	3230	2540	1945
1946	3310	1640	2890	1990	7290	6000	4600	2450	1440	1600	1390	3680	3210	1946
[redacted]	3370	4390	2600	2730	4230	3530	2810	1130	778	3730	2760	4110	3010	1947
[redacted]	2870	1660	1550	2210	4880	7670	2720	1500	2620	3740	3760	2750	3160	1948
[redacted]	1000	983	2700	3190	5830	4360	2400	---	---	---	---	---	---	1949
[redacted]	3280	2810	2250	2650	4020	4440	2940	1470	1330	2890	4060	4180	3040	MEAN

LOCATION - LAT 50 00 08 N LONG 125 23 20 W   DRAINAGE AREA 542 SQ MILES NATURAL FLOW

CAMPBELL RIVER AT OUTLET OF CAMPBELL LAKE - STATION NO. 08HD001

ANNUAL EXTREMES OF DISCHARGE IN CFS AND ANNUAL TOTAL DISCHARGE IN AC-FT FOR THE PERIOD OF RECORD

[redacted]	MAXIMUM INSTANTANEOUS DISCHARGE	MAXIMUM DAILY DISCHARGE	MINIMUM DAILY DISCHARGE	TOTAL DISCHARGE	YEAR
[redacted]	---	10900 CFS ON OCT 10	---	---	1910
[redacted]	---	10700 CFS ON NOV 26	690 CFS ON MAR 3	1880000 AC-FT	1911
1912	---	12600 CFS ON NOV 23	650 CFS ON SEP 29	1730000 AC-FT	1912
1913	---	9300 CFS ON NOV 29	890 CFS ON JAN 22	2020000 AC-FT	1913
1914	---	18100 CFS ON OCT 18	910 CFS ON DEC 29	2990000 AC-FT	1914
[redacted]	---	19200 CFS ON OCT 29	450 CFS ON SEP 27	1910000 AC-FT	1915
[redacted]	---	14800 CFS ON MAR 13	450 CFS ON OCT 15	2210000 AC-FT	1916
[redacted]	---	14600 CFS ON DEC 31	780 CFS ON JAN 1	2090000 AC-FT	1917
[redacted]	---	28200 CFS ON JAN 3	590 CFS ON SEP 29	2940000 AC-FT	1918
1919	---	15600 CFS ON DEC 28	590 CFS ON OCT 26	2700000 AC-FT	1919
[redacted]	---	13500 CFS ON DEC 5	716 CFS ON APR 18	2240000 AC-FT	1920
[redacted]	---	17300 CFS ON OCT 30	1220 CFS ON SEP 19	3080000 AC-FT	1921
[redacted]	---	11200 CFS ON DEC 29	600 CFS ON FEB 4	1640000 AC-FT	1922
[redacted]	---	16800 CFS ON DEC 19	464 CFS ON OCT 3	1920000 AC-FT	1923
[redacted]	---	16600 CFS ON DEC 14	575 CFS ON SEP 16	2370000 AC-FT	1924
1925	---	13700 CFS ON DEC 13	280 CFS ON OCT 18 •	2030000 AC-FT	1925
[redacted]	---	13600 CFS ON DEC 31	280 CFS ON SEP 25	1810000 AC-FT	1926
[redacted]	---	17800 CFS ON JAN 2	962 CFS ON SEP 25	2710000 AC-FT	1927
[redacted]	---	16300 CFS ON JAN 10	484 CFS ON SEP 6	2210000 AC-FT	1928
[redacted]	---	12800 CFS ON DEC 30	430 CFS ON OCT 1	1440000 AC-FT	1929
1930	---	13700 CFS ON FEB 19	470 CFS ON SEP 26	1840000 AC-FT	1930
1931	---	10300 CFS ON JAN 31	625 CFS ON AUG 29	2090000 AC-FT	1931
1932	---	12900 CFS ON FEB 29	532 CFS ON OCT 10	2170000 AC-FT	1932
[redacted]	---	10500 CFS ON OCT 30	622 CFS ON FEB 17	2360000 AC-FT	1933
[redacted]	---	13500 CFS ON NOV 16	472 CFS ON OCT 7	2550000 AC-FT	1934
[redacted]	---	26900 CFS ON FEB 2	620 CFS ON OCT 10	2510000 AC-FT	1935
1936	---	9630 CFS ON DEC 23	505 CFS ON NOV 10	1710000 AC-FT	1936
1937	---	14900 CFS ON OCT 29	595 CFS ON SEP 29	2280000 AC-FT	1937
1938	---	9540 CFS ON DEC 10	490 CFS ON OCT 9	---	1938
[redacted]	---	30300 CFS ON NOV 16 •	535 CFS ON OCT 13	3000000 AC-FT	1939
[redacted]	---	17100 CFS ON OCT 21	640 CFS ON OCT 7	2410000 AC-FT	1940
[redacted]	---	22700 CFS ON DEC 3	685 CFS ON SEP 3	2650000 AC-FT	1941
[redacted]	---	8630 CFS ON OCT 12	325 CFS ON SEP 30	1640000 AC-FT	1942
1943	---	8310 CFS ON APR 22	795 CFS ON SEP 17	1780000 AC-FT	1943
1944	---	22200 CFS ON JAN 20	485 CFS ON SEP 12	1850000 AC-FT	1944
[redacted]	---	10100 CFS ON JAN 15	370 CFS ON OCT 10	1840000 AC-FT	1945
[redacted]	---	9040 CFS ON MAY 13	654 CFS ON OCT 18	2320000 AC-FT	1946
[redacted]	---	10200 CFS ON FEB 15	643 CFS ON SEP 26	2180000 AC-FT	1947
[redacted]	---	12500 CFS ON MAY 30	1060 CFS ON DEC 28	2290000 AC-FT	1948
1949	---	---	---	---	1949
		• - EXTREME RECORDED FOR THE PERIOD OF RECORD		2200000 AC-FT	MEAN

QUINSAM RIVER NEAR CAMPBELL RIVER - STATION NO. 08HD005

ANNUAL EXTREMES OF DISCHARGE IN CFS AND ANNUAL TOTAL DISCHARGE IN AC-FT FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE	MAXIMUM DAILY DISCHARGE	MINIMUM DAILY DISCHARGE	TOTAL DISCHARGE	YEAR
1956	---	---	31.4 CFS ON SEP 21 •	---	1956
1957	---	1070 CFS ON DEC 26	53.0 CFS ON OCT 19	173000 AC-FT	1957
1958	---	2280 CFS ON DEC 2	52.0 CFS ON AUG 17	240000 AC-FT	1958
1959	---	1540 CFS ON JAN 12	58.0 CFS ON AUG 14	213000 AC-FT	1959
1960	---	2020 CFS ON DEC 14	58.0 CFS ON SEP 16	201000 AC-FT	1960
1961	---	3900 CFS ON JAN 12	67.0 CFS ON AUG 10	295000 AC-FT	1961
1962	---	2380 CFS ON DEC 6	75.0 CFS ON AUG 1	265000 AC-FT	1962
1963	---	2540 CFS ON DEC 24	81.1 CFS ON JUN 29	265000 AC-FT	1963
1964	---	1080 CFS ON JAN 4	72.0 CFS ON AUG 24	137000 AC-FT	1964
1965	---	1920 CFS ON DEC 4	69.6 CFS ON AUG 2	206000 AC-FT	1965
1966	---	2640 CFS ON DEC 4	72.0 CFS ON AUG 25	272000 AC-FT	1966
1967	---	1350 CFS ON DEC 7	53.0 CFS ON JUL 16	233000 AC-FT	1967
1968	---	7700 CFS ON JAN 19 •	68.0 CFS ON AUG 4	345000 AC-FT	1968
1969	---	2180 CFS ON DEC 11	55.0 CFS ON AUG 1	234000 AC-FT	1969
1970	---	1560 CFS ON DEC 14	43.0 CFS ON FEB 28	155000 AC-FT	1970
1971	---	3400 CFS ON NOV 10	65.5 CFS ON AUG 11	250000 AC-FT	1971
1972	---	2620 CFS ON MAR 16	51.0 CFS ON AUG 1	264000 AC-FT	1972
1973	---	3240 CFS ON JAN 16	34.0 CFS ON AUG 10	215000 AC-FT	1973
1974	---	2310 CFS ON JAN 16	61.6 CFS ON AUG 19	247000 AC-FT	1974
1975	---	5100 CFS ON NOV 14	42.0 CFS ON AUG 1	274000 AC-FT	1975
1976	---	930 CFS ON JAN 31	61.0 CFS ON AUG 10	153000 AC-FT	1976
				234000 AC-FT	MEAN

• - EXTREME RECORDED FOR THE PERIOD OF RECORD

APPENDIX 5

Daily Discharge for Quinsam River near

Campbell River, 1976 and 1977

(Station Number 08HD005)

QUINSAM RIVER NEAR CAMPBELL RIVER - STATION NO. 08HD005

DAILY DISCHARGE IN CUBIC FEET PER SECOND FOR 1976

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	730	780	266	302	233	200	119	64.8	122	135	242	128	1
2	630	630	230	299	257	209	117	66.2	148	128	254	122	2
3	552	552	194	290	260	215	115	64.8	135	124	245	110	3
4	460	580	185	257	257	212	106	63.4	126	91.6	200	101	4
5	350	520	168	257	254	206	108	64.8	128	130	194	110	5
6	400	380	155	260	248	188	103	64.8	122	128	188	128	6
7	420	320	160	260	218	182	104	66.2	119	135	163	143	7
8	380	260	165	269	215	188	104	63.4	119	137	160	158	8
9	380	239	173	260	230	188	103	62.0	117	137	173	237	9
10	320	245	215	260	254	191	99.6	61.0	117	137	163	255	10
11	299	245	200	269	251	185	96.4	62.0	108	158	148	287	11
12	260	230	185	290	230	182	91.6	62.0	103	137	141	281	12
13	275	227	188	314	209	170	90.0	61.0	101	137	141	281	13
14	275	230	215	332	212	188	87.2	62.0	122	120	135	290	14
15	290	275	200	314	209	160	85.8	62.0	128	135	141	302	15
16	305	317	188	287	200	158	83.0	64.8	128	135	160	347	16
17	290	368	188	239	179	160	83.0	69.0	126	120	194	488	17
18	329	350	188	185	188	185	81.6	70.4	122	124	278	428	18
19	350	329	170	209	153	165	78.8	71.8	126	124	293	460	19
20	350	305	185	191	124	163	76.0	71.8	148	126	263	347	20
21	320	260	281	188	124	153	76.0	73.2	128	124	257	353	21
22	335	278	356	160	124	139	71.8	74.6	128	124	212	317	22
23	335	290	452	158	124	141	67.6	73.2	153	122	191	293	23
24	341	299	480	179	126	124	70.4	73.2	139	124	176	293	24
25	365	296	428	165	135	122	69.0	73.2	130	124	176	266	25
26	432	299	380	160	139	120	69.0	91.6	124	124	150	528	26
27	500	284	344	160	153	120	70.4	108	128	122	143	576	27
28	540	278	350	158	170	115	69.0	103	128	137	139	568	28
29	780	269	338	160	188	117	70.4	104	141	132	139	548	29
30	870		317	173	233	115	67.6	104	139	130	128	362	30
31	930		308		217 E		66.2	111		248		311	31
TOTAL	13393	9935	7852	7005	6114	4961	2699.4	2287.2	3803	4109.6	5587	9489	TOTAL
MEAN	432	343	253	234	197	165	87.1	73.8	127	133	186	306	MEAN
AC-FT	26600	19700	15600	13900	12100	9840	5350	4540	7540	8150	11100	18800	AC-FT
MAX	930	780	480	332	260	215	119	111	153	248	293	576	MAX
MIN	260	227	155	153	124	115	66.2	61.0	101	91.6	128	101	MIN

SUMMARY FOR THE YEAR 1976

MEAN DISCHARGE, 211 CFS
TOTAL DISCHARGE, 153000 AC-FT
MAXIMUM DAILY DISCHARGE, 930 CFS ON JAN 31
MINIMUM DAILY DISCHARGE, 61.0 CFS ON AUG 10

TYPE OF GAUGE - MANUAL
LOCATION - LAT 50 01 45 N
LONG 125 17 55 W
DRAINAGE AREA 108 SQ MILES

E-ESTIMATED
REGULATED

QUINSAM RIVER NEAR CAMPBELL RIVER - STATION NO. 08HD005

DAILY DISCHARGE IN CUBIC FEET PER SECOND FOR 1977

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	287	163	374	176	158	191	64.0	66.6	159	113	896	698	1
2	263	148	384	150	141	194	66.0	65.9	161	95.4	1740	2190	2
3	236	141	484	145	160	185	70.0	54.9	162	91.5	975	2230	3
4	203	137	424	143	165	191	72.0	54.3	115	84.3	680	1630	4
5	191	126	329	143	121	209	80.0	53.2	115	83.6	560	878	5
6	176	130	329	170	132	185	84.0	52.7	100	91.5	451	415	6
7	163	141	368	197	132	188	78.0	53.8	90.9	95.4	377	280	7
8	148	137	876	197	141	163	70.0	54.3	98.7	101	384	263	8
9	132	137	948	215	100	158	66.0	54.9	110	95.4	377	273	9
10	139	263	840	200	115	155	78.0	50.5	102	106	389	308	10
11	128	404	655	191	113	130	82.0	51.6	129	117	367	462	11
12	128	585	540	176	117	117	84.0	49.4	115	117	441	649	12
13	128	630	480	168	136	108	83.0	49.9	117	116	906	823	13
14	168	615	456	168	138	106	81.7	50.5	113	127	1380	884	14
15	197	368	371	188	134	108	86.9	53.5	141	115	1180	943	15
16	206	356	365	173	100	94.0	89.5	48.8	134	127	1000	900	16
17	317	384	311	160	119	88.0	76.4	47.7	127	111	728	746	17
18	341	353	260	148	136	74.0	76.4	43.3	139	129	562	411	18
19	377	293	230	141	141	72.0	77.7	43.3	146	101	422	424	19
20	356	755	206	132	141	68.0	73.8	42.8	141	119	346	368	20
21	326	876	200	125	138	70.0	73.8	42.4	136	110	287	350	21
22	317	846	191	125	136	80.0	62.7	41.5	144	132	249	321	22
23	281	786	206	136	134	76.0	62.0	48.3	142	257	242	291	23
24	236	524	206	143	132	72.0	62.0	47.2	135	426	208	226	24
25	206	548	245	173	130	70.0	62.0	43.3	142	564	260	179	25
26	191	448	236	206	138	66.0	54.9	42.8	144	813	388	150	26
27	176	424	230	194	160	66.0	54.9	44.6	168	568	432	147	27
28	168	404	200	173	347	68.0	54.9	104	135	555	485	145	28
29	150		200	148	248	66.0	63.3	115	126	713	479	150	29
30	139		197	143	194	55.2	64.6	162	117	884	474	148	30
31	148		197		191		67.3	162		621		142	31
TOTAL	6622	11122	11538	4947	4588	3493.2	2221.8	1895.0	3904.6	7779.1	17714	18024	TOTAL
MEAN	214	397	372	165	148	116	71.7	61.1	130	251	590	581	MEAN
AC-FT	13100	22100	22900	9810	9100	6930	4410	3760	7740	15400	35100	35800	AC-FT
MAX	377	876	948	215	347	209	89.5	162	168	884	1740	2230	MAX
MIN	128	126	191	125	100	55.2	54.9	41.5	90.9	83.6	208	142	MIN

SUMMARY FOR THE YEAR 1977

MEAN DISCHARGE, 257 CFS
TOTAL DISCHARGE, 186000 AC-FT
MAXIMUM DAILY DISCHARGE, 2230 CFS ON DEC 3
MINIMUM DAILY DISCHARGE, 41.5 CFS ON AUG 22

TYPE OF GAUGE - MANUAL
LOCATION - LAT 50 01 45 N
LONG 125 17 55 W
DRAINAGE AREA 108 SQ MILES

REGULATED

APPENDIX 6

Flood Magnitudes and Probability

Stations:

08HD001

Campbell River at Outlet of Campbell Lake

08HD003
Campbell River near Campbell River

08HD005

Quinsam River near Campbell River

MAXIMUM DAILY MEAN FLOWS

Station No. 08HD001
Campbell River at outlet of Campbell Lake

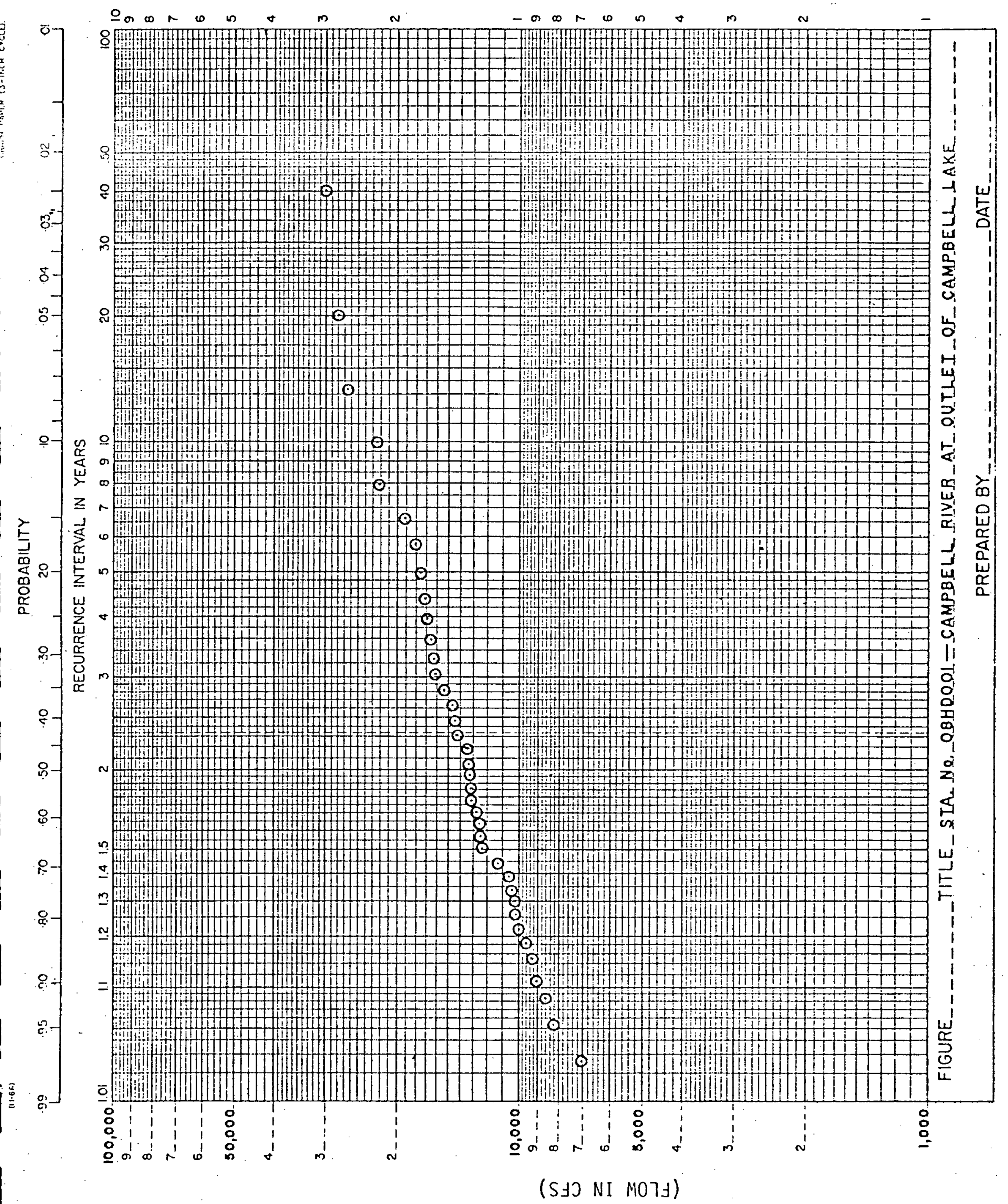
Date	Maximum daily flow in cfs
Nov 26, 1911	10700
Nov 23, 1912	12600
Nov 29, 1913	9300
Oct 18, 1914	18100
Oct 29, 1915	19200
Mar 13, 1916	14800
Dec 31, 1917	14600
Jan 3, 1918	28200
Dec 28, 1919	15600
Dec 5, 1920	13500
Oct 30, 1921	17300
Dec 29, 1922	11200
Dec 19, 1923	16800
Dec 14, 1924	16600
Dec 13, 1925	13700
Dec 31, 1926	13600
Jan 2, 1927	17800
Jan 10, 1928	16300
Dec 30, 1929	12800
Feb 19, 1930	13700
Jan 31, 1931	10300
Feb 29, 1932	12900
Oct 30, 1933	10500
Nov 16, 1934	13500
Feb 2, 1935	26900
Dec 23, 1936	9630
Oct 29, 1937	14900
May 28, 1938	7140
Nov 16, 1939	30300
Oct 21, 1940	17100
Dec 3, 1941	22700
Oct 12, 1942	8630
Apr 22, 1943	8310
Jan 20, 1944	22200
Jan 15, 1945	10100
May 13, 1946	9040
Feb 15, 1947	10200
May 30, 1948	12500

Rank	Recurrence interval in years	Maximum daily flow in cfs	Year
1	39.0	30300	1939
2	19.5	28200	1918
3	13.0	26900	1935
4	9.7	22700	1941
5	7.8	22200	1944
6	6.5	19200	1915
7	5.6	18100	1914
8	4.87	17800	1927
9	4.33	17300	1921
10	3.90	17100	1940
11	3.55	16800	1923
12	3.25	16600	1924
13	3.00	16300	1928
14	2.79	15600	1919
15	2.60	14900	1937
16	2.44	14800	1916
17	2.29	14600	1917
18	2.17	13700	1925
19	2.05	13700	1930
20	1.95	13600	1926
21	1.86	13500	1920
22	1.77	13500	1934
23	1.70	12900	1932
24	1.62	12800	1929
25	1.56	12600	1912
26	1.50	12500	1948
27	1.44	11200	1922
28	1.39	10700	1911
29	1.34	10500	1933
30	1.30	10300	1931
31	1.26	10200	1947
32	1.22	10100	1945
33	1.182	9630	1936
34	1.147	9300	1913
35	1.114	9040	1946
36	1.083	8630	1942
37	1.054	8310	1943
38	1.026	7140	1938

Mean annual flood: 14800 cfs

Drainage area: 542 sq mi

Standard deviation: 5480 cfs


PROBABILITY
RECURRENCE INTERVAL IN YEARS
(FLOW IN CFS)
FIGURE
TITLE STA. No. 08HD001 — CAMPBELL RIVER AT OUTLET OF CAMPBELL LAKE
PREPARED BY
DATE

MAXIMUM DAILY MEAN FLOWS

Station No. 08HD003
Campbell River near Campbell River

Date	Maximum daily flow in cfs
Jan 24, 1950	7820
Oct 19, 1951	7350
May 22, 1952	8820
Nov 15, 1953	28200
Nov 20, 1954	20500
Nov 5, 1955	17800
May 23, 1956	10100
Jan 14, 1957	2900
Dec 3, 1958	15900
Jun 14, 1959	13000
Dec 13, 1960	16100
Jan 17, 1961	20300
Nov 20, 1962	16900
Dec 25, 1963	14800
Jan 4, 1964	10900
Dec 5, 1965	14500
Dec 21, 1966	14900
Nov 1, 1967	14300
Jan 22, 1968	20500
Jun 11, 1969	11100
Jan 1, 1970	4500

Rank	Recurrence interval in years	Maximum daily flow in cfs	Year
1	22.0	28200	1953
2	11.0	20500	1954
3	7.3	20500	1968
4	5.5	20300	1961
5	4.40	17800	1955
6	3.67	16900	1962
7	3.14	16100	1960
8	2.75	15900	1958
9	2.44	14900	1966
10	2.20	14800	1963
11	2.00	14500	1965
12	1.83	14300	1967
13	1.69	13000	1959
14	1.57	11100	1969
15	1.47	10900	1964
16	1.37	10100	1956
17	1.29	8820	1952
18	1.22	7820	1950
19	1.158	7350	1951
20	1.100	4500	1970
21	1.048	2900	1957

Mean annual flood: 13900 cfs

Drainage area: --- sq mi

Standard deviation: 5980 cfs

Remarks: Storage since 1947
Flow diverted into basin since 1957

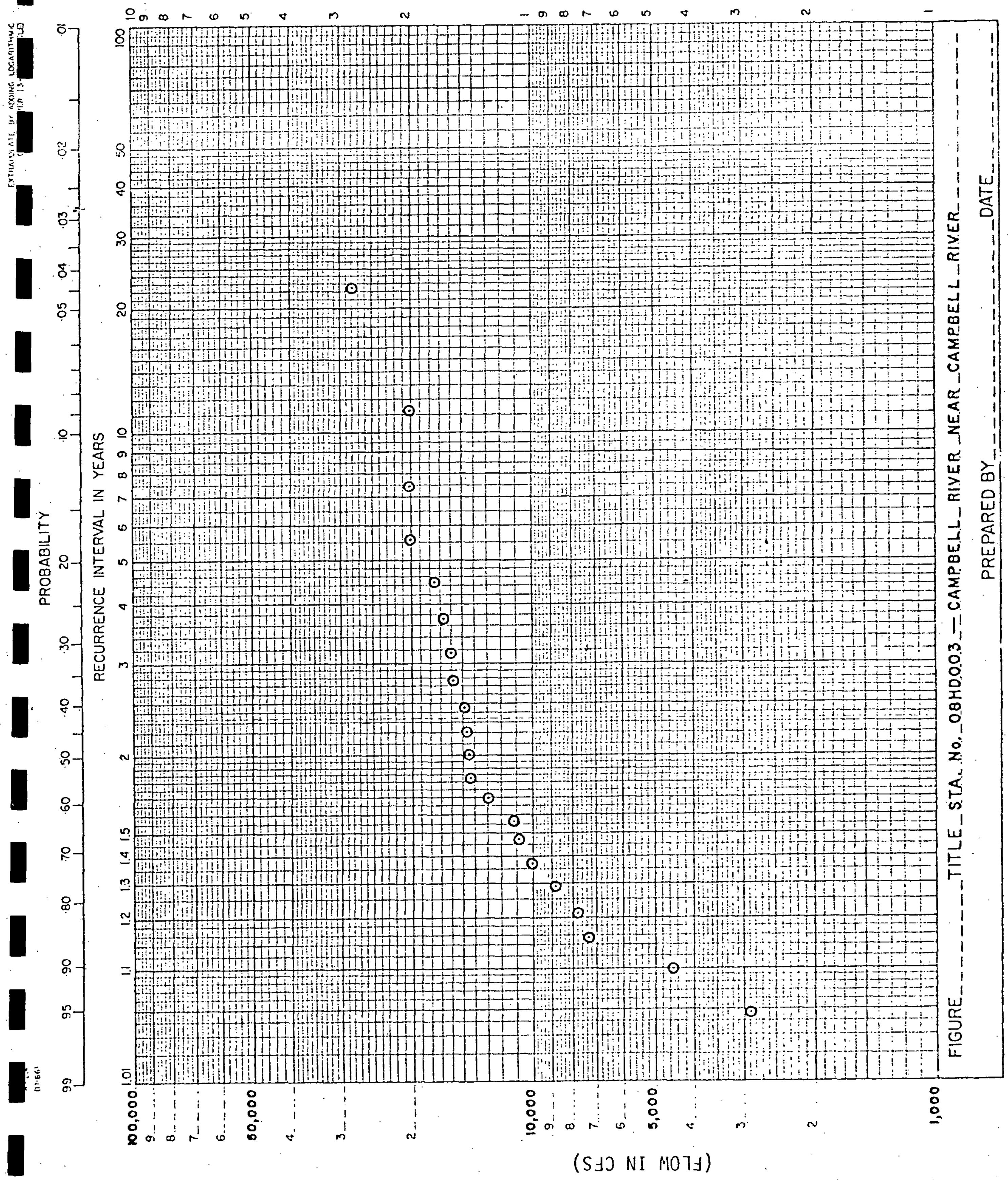


FIGURE
TITLE STA. No. 08HD003 — CAMPBELL RIVER NEAR CAMPBELL RIVER
PREPARED BY
DATE
PROBABILITY
RECURRENCE INTERVAL IN YEARS
(FLOW IN CFS)

MAXIMUM DAILY MEAN FLOWS

Station No. 08HD005
Quinsam River near Campbell River

Date	Maximum daily flow in cfs
Dec 26, 1957	1070
Dec 2, 1958	2280
Jan 12, 1959	1540
Dec 14, 1960	2020
Jan 12, 1961	3900
Dec 6, 1962	2380
Dec 24, 1963	2540
Jan 4, 1964	1080
Dec 4, 1965	1920
Dec 4, 1966	2640
Dec 7, 1967	1350
Jan 19, 1968	7700
Dec 11, 1969	2180
Dec 14, 1970	1560
Nov 10, 1971	3400

Rank	Recurrence interval in years	Maximum daily flow in cfs	Year
1	16.0	7700	1968
2	8.0	3900	1961
3	5.3	3400	1971
4	4.00	2640	1966
5	3.20	2540	1963
6	2.67	2380	1962
7	2.29	2280	1958
8	2.00	2180	1969
9	1.78	2020	1960
10	1.60	1920	1965
11	1.45	1560	1970
12	1.33	1540	1959
13	1.23	1350	1967
14	1.143	1080	1964
15	1.067	1070	1957

Mean annual flood: 2500 cfs

Drainage area: 107 sq mi

Standard deviation: 1640 cfs

Remarks: Flow diverted since 1957

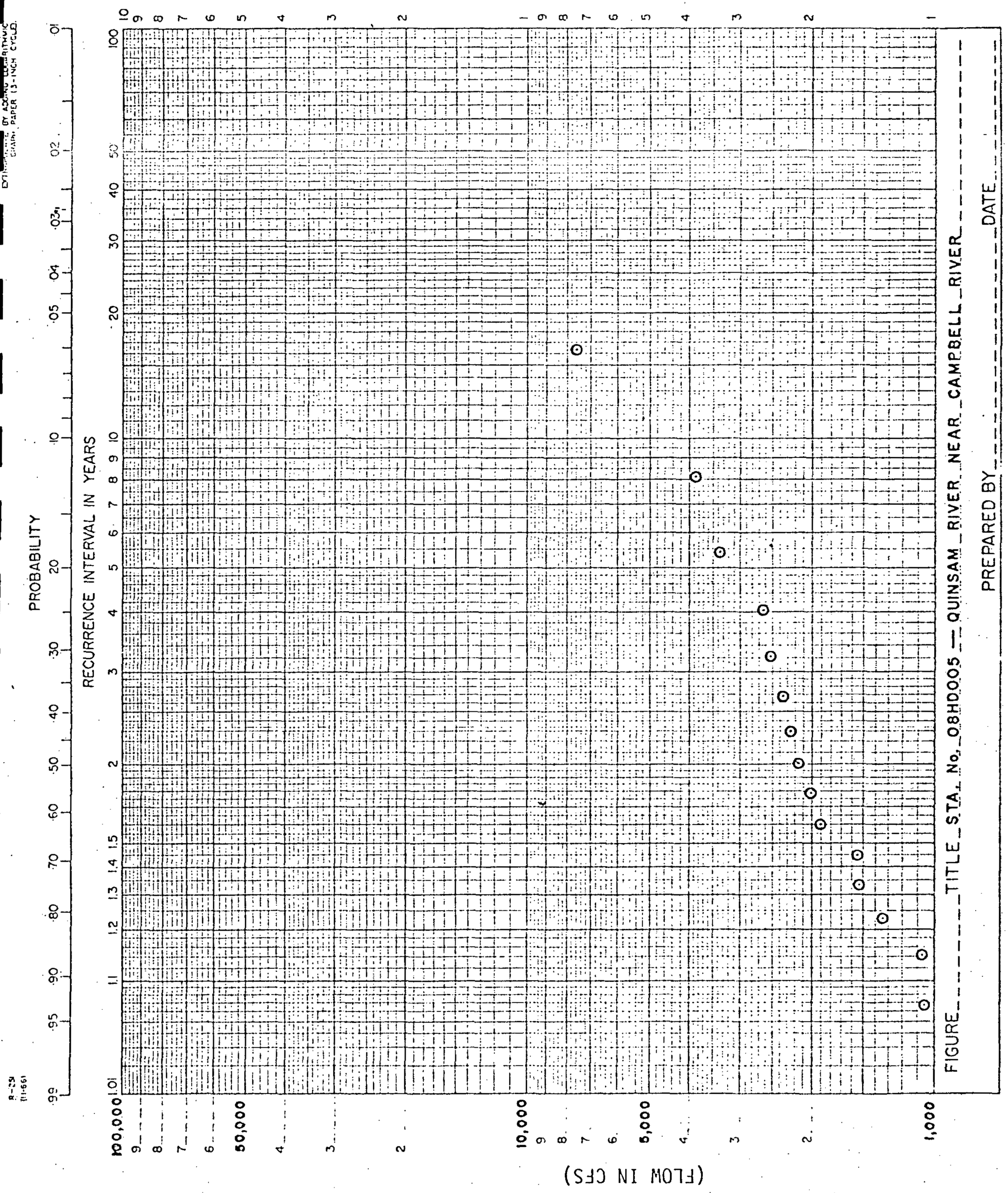


FIGURE
TITLE STA. No. 08HD005 — QUINSAM RIVER NEAR CAMPBELL RIVER
PREPARED BY
DATE
PROBABILITY
RECURRENCE INTERVAL IN YEARS
(FLOW IN CFS)
100,000
50,000
10,000
5,000
1,000

APPENDIX 7

Annual 7-day Average Low Flows

Stations:

08HD001
Campbell River at Outlet of Campbell Lake

08HD003
Campbell River near Campbell River

08HD005
Quinsam River near Campbell River

Station No. 08HD001
Campbell River at outlet of Campbell Lake

Date	7-day avg. low flow in cfs
Mar 4, 1911	701
Mar 24, 1912	839
Oct 28, 1912	684
Feb 18, 1914	1080
Jan 29, 1915	927
Oct 28, 1915	459
Oct 16, 1916	459
Oct 23, 1917	916
Oct 1, 1918	612
Oct 29, 1919	590
Aug 23, 1920	1100
Feb 4, 1922	614
Feb 12, 1923	764
Oct 3, 1923	475
Sep 18, 1924	580
Oct 21, 1925	280
Sep 27, 1926	285
Mar 7, 1928	1020
Feb 28, 1929	506
Sep 30, 1929	453
Sep 23, 1930	504
Feb 19, 1932	632
Oct 8, 1932	578
Sep 16, 1933	1250
Oct 4, 1934	528
Feb 26, 1936	606
Nov 8, 1936	531
Sep 27, 1937	616
Oct 7, 1938	559
Oct 15, 1939	537
Oct 5, 1940	689
Aug 31, 1941	726
Sep 27, 1942	364
Sep 17, 1943	834
Sep 12, 1944	491
Oct 13, 1945	370
Oct 17, 1946	705
Sep 28, 1947	648
Feb 12, 1949	683

Rank	Recurrence interval in years	7-day avg. low flow in cfs	Year
1	40.0	280	1925
2	20.0	285	1926
3	13.3	364	1942
4	10.0	370	1945
5	8.0	453	1929
6	6.7	459	1915
7	5.7	459	1916
8	5.0	475	1923
9	4.44	491	1944
10	4.00	504	1930
11	3.64	506	1929
12	3.33	528	1934
13	3.08	531	1936
14	2.86	537	1939
15	2.67	559	1938
16	2.50	578	1932
17	2.35	580	1924
18	2.22	590	1919
19	2.11	606	1936
20	2.00	612	1918
21	1.90	614	1922
22	1.82	616	1937
23	1.74	632	1932
24	1.67	648	1947
25	1.60	683	1949
26	1.54	684	1912
27	1.48	689	1940
28	1.43	701	1911
29	1.38	705	1946
30	1.33	726	1941
31	1.29	764	1923
32	1.25	834	1943
33	1.21	839	1912
34	1.176	916	1917
35	1.143	927	1915
36	1.111	1020	1928
37	1.081	1080	1914
38	1.053	1100	1920
39	1.026	1250	1933

Mean flow: 646 cfs Drainage area: 592 sq mi

Standard deviation: 220 cfs

Station No. 08HD003
Campbell River near Campbell River

Date	7-day avg. low flow in cfs
Jan 31, 1950	665
Dec 27, 1951	866
Jan 28, 1952	955
Mar 7, 1953	1560
Apr 19, 1954	1970
Jun 9, 1955	1440
Oct 7, 1956	1410
Jun 6, 1957	645
Jan 11, 1958	1260
Jul 28, 1959	1880
Dec 25, 1960	1730
Dec 28, 1961	1460
Jul 4, 1962	1420
May 22, 1963	2090
May 25, 1964	1710
Oct 14, 1965	1400
Aug 15, 1966	1610
Sep 5, 1967	1790
Aug 26, 1968	1340
Sep 4, 1969	2530
May 23, 1970	1420

Rank	Recurrence interval in years	7-day avg. low flow in cfs	Year
1	22.0	645	1957
2	11.0	665	1950
3	7.3	866	1951
4	5.5	955	1952
5	4.40	1260	1958
6	3.67	1340	1968
7	3.14	1400	1965
8	2.75	1410	1956
9	2.44	1420	1962
10	2.20	1420	1970
11	2.00	1440	1955
12	1.83	1460	1961
13	1.69	1560	1953
14	1.57	1610	1966
15	1.47	1710	1964
16	1.37	1730	1960
17	1.29	1790	1967
18	1.22	1880	1959
19	1.158	1970	1954
20	1.100	2090	1963
21	1.048	2530	1969

Mean flow: 1480 cfs

Drainage area: 564 sq mi

Standard deviation: 459 cfs

Remarks: Because of substantial regulation, the calendar year has been used in selecting the flows.
Storage since 1947 (Elk Falls Dam).
Flow diverted into basin since 1957.

Station No. 08HD005
Quinsam River near Campbell River

Date	7-day avg. low flow in cfs
Oct 19, 1957	56.7
Aug 19, 1958	53.7
Aug 14, 1959	58.4
Sep 15, 1960	58.7
Aug 11, 1961	67.3
Jul 30, 1962	76.9
Jun 26, 1963	83.7
Sep 2, 1964	79.8
Aug 2, 1965	70.3
Aug 24, 1966	74.8
Jul 15, 1967	58.4
Aug 7, 1968	68.0
Jul 31, 1969	57.6
Jul 16, 1970	53.8
Aug 12, 1971	68.3

Rank	Recurrence interval in years	7-day avg. low flow in cfs	Year
1	16.0	53.7	1958
2	8.0	53.8	1970
3	5.3	56.7	1957
4	4.00	57.6	1969
5	3.20	58.4	1959
6	2.67	58.4	1967
7	2.29	58.7	1960
8	2.00	67.3	1961
9	1.78	68.0	1968
10	1.60	68.3	1971
11	1.45	70.3	1965
12	1.33	74.8	1966
13	1.23	76.9	1962
14	1.143	79.8	1964
15	1.067	83.7	1963

Mean flow: 65.8 cfs

Drainage area: 108 sq mi

Standard deviation: 9.8 cfs

Remarks: Flow diverted since 1957.

APPENDIX 8

Basin Snowcourse Data Summary

(27)

BRITISH COLUMBIA SNOW COURSE DATA SUMMARY

No. 95 UPPER THELWOOD LAKE REGION: COASTAL

ELEV. 980 METRES LAT. 49-32 LONG. 125-42 DRAINAGE: VANCOUVER ISLAND

YEAR	JANUARY 1 DATE	JANUARY 1 SNOW DEPTH CM	JANUARY 1 WATER EQUIVALENT MM	FEBRUARY 1 DATE	FEBRUARY 1 SNOW DEPTH CM	FEBRUARY 1 WATER EQUIVALENT MM	MARCH 1 DATE	MARCH 1 SNOW DEPTH CM	MARCH 1 WATER EQUIVALENT MM	APRIL 1 DATE	APRIL 1 SNOW DEPTH CM	APRIL 1 WATER EQUIVALENT MM	MAY 1 DATE	MAY 1 SNOW DEPTH CM	MAY 1 WATER EQUIVALENT MM	MAY 15 DATE	MAY 15 SNOW DEPTH CM	MAY 15 WATER EQUIVALENT MM	JUNE 1 DATE	JUNE 1 SNOW DEPTH CM	JUNE 1 WATER EQUIVALENT MM	JUNE 15 DATE	JUNE 15 SNOW DEPTH CM	JUNE 15 WATER EQUIVALENT MM
1958				2-01	244	864A	2-26	183	777A	3-27	330	1504	4-28	254	1250A									
1959										4-06	483	1931												
1960				1-30	152	546	2-26	168	559	4-05	213	971A	4-28	422	1756									
1961							2-27	213	747	3-28	409	1730												
1962				2-04	173	686D	3-07	257	552	3-30	287	1072	5-07	279	1214				6-01	173	803	6-14	102	551
1963	1-03	159	563				3-03	135	671				5-03	190	851				5-28	99	485			
1964	1-02	157	734	1-31	434	1534	3-02	447	1819	4-01	452	2088	5-01	478	2027				5-29	366	1834			
1965				1-29	213	762	2-28	343	1135	3-31	295	1245	5-02	272	1278				6-01	175	876			
1966							2-25	376	1504	3-29	455	2078	4-28	394	1902	5-13	338	1742	5-31	305	1638	6-15	231	1280
1967	12-29	165	546	1-30	310	1036	3-04	396	1527	3-31	516	2007	4-27	467	2159				5-31	338	1702	6-15	234	1224
1968				1-29	183	772	2-27	251	1138	3-30	373	1542	5-03	330	1621				5-31	213	1113			
1969				2-05	439	1199	2-25	432	1829	3-28	455	2057	5-01	526	2659				5-30	381	2205			
1970				1-29	231	889	2-26	269	1189	3-26	300	1400	5-01	330	1646	5-18	284	1364	5-29	234	1252			
1971										3-30	523	2154	4-27	503	2377				5-28	378	2042			
1972				1-26	366	1532				3-27	538	2405A	4-25	523	2390									
1973				1-25	254	747	2-23	284	1158	3-28	376	1626	4-27	317	1562									
1974				1-30	335	1118	2-26	569	2083	4-01	574	2774	4-30	505	2766	5-13	495	2697	5-30	460	2601	6-15	404	2413
1975				1-29	279	1107	3-03	401	1034	3-26	490	1900	4-30	419	2042	5-15	356	1939	5-30	317	1636			
MEANS		159	616		280	964		315	1208		416	1781		388	1645		368	1911		287	1516		243	1367

BRITISH COLUMBIA SNOW COURSE DATA SUMMARY

No. 79 ELK RIVER REGION: COASTAL

ELEV. 270 METRES LAT. 49-51 LONG. 125-49 DRAINAGE: VANCOUVER ISLAND

YEAR	JANUARY 1			FEBRUARY 1			MARCH 1			APRIL 1		
	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM
1955										3-23	76	2648
1956	1-03	114	264	1-25	163	544	2-28	163	546	3-28	147	607
1957	1-04	152	[illegible]	1-24	25	58	2-26	51	147	3-28	0	0
1958	1-07	48	166	1-29	41	155	2-26	0	0	3-25	0	0
1959				1-30	33	107	2-27	0	0	3-30	0	0
1960	12-29	0	0	1-28	25	54	2-30	0	0	3-31	0	0
1961	1-03	58	152	2-01	0	0	2-27	0	0	4-01	0	0
1962				2-01	48	150						
1963												
1964				1-31	53	178	3-02	46	201			
1965				1-29	74	239	3-02	79	315	3-31	0	0
1966	1-05	33	211	2-01	89	284						
1967												
1968												
1969							2-25	145	541	3-31	91	381
1970				1-30	0	0	2-26	0	0	3-26	0	0
1971				1-27	94	282	2-26	81	231	3-26	81	317
1972				1-25	112	307	2-25	112	411	3-24	97	4328
1973				1-29	58	219	2-26	51	183	3-29	0	0
1974				1-29	53	193	2-25	86	320	4-02	94	381
1975				1-30	79	244	2-28	107	343	3-27	95	427
MEANS		63	227		59	193		61	216		39	163

YEAR	MAY 1			MAY 15			JUNE 1			JUNE 15		
	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM
1958	4-30	0	0									
1969	5-01	0	0									
1970	5-01	0	0									
1971	4-27	0	0									
1972	4-24	0	0									
1973	4-27	0	0									
1974	4-30	0	0									
1975	5-01	0	0									
MEANS		0	0									

BRITISH COLUMBIA SNOW COURSE DATA SUMMARY

No. 223 WOLF RIVER (LOWER)

REGION: COASTAL

DRAINAGE: VANCOUVER ISLAND

ELEV. 640 METRES LAT. 49-44 LONG. 125-42

YEAR	JANUARY 1			FEBRUARY 1			MARCH 1			APRIL 1			MAY 1			MAY 15			JUNE 1			JUNE 15		
	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM
1970							2-26	69	274	3-26	51	178	5-01	0	0				5-29	0	0			
1971				1-29	145	528	2-25	122	518	3-30	224	913	4-27	175	798				5-28	0	0			
1972				1-28	152	513							4-25	137	620	5-12	81	406	5-29	0	0			
1973				1-26	94	229	2-23	104	396	3-28	104	437	4-27	36	170	5-15	0	0	5-31	0	0			
1974				1-30	124	417	2-26	244	660	4-01	221	945	4-30	160	711	5-13	114	549	5-30	48	193			
1975				1-29	107	328	2-26	170	544	3-26	180	650	4-30	112	447	5-15	46	213	5-30	0	0			
MEANS					124	402		142	478		156	609		103	458		61	292		8	32			

BRITISH COLUMBIA SNOW COURSE DATA SUMMARY

No. 222 — WOLF RIVER (MIDDLE) — REGION: COASTAL

ELEV. 1070 METRES — LAT. 49-42 LONG. 125-41 — DRAINAGE: VANCOUVER ISLAND

YEAR	JANUARY 1 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	FEBRUARY 1 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	MARCH 1 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	APRIL 1 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	MAY 1 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	MAY 15 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	JUNE 1 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	JUNE 15 DATE	SNOW DEPTH CM	WATER EQUIVALENT MM
1970							2-26	137	528	3-26	135	523	5-01	135	559				5-29	0	0			
1971				1-28	175	579	2-25	163	589	3-30	290	960	4-27	245	1036				5-28	142	620			
1972				1-28	221	742							4-25	245	1087	5-12	218	980	5-25	155	691			
1973				1-26	168	422	2-23	142	498	3-28	201	701	4-27	169	635	5-15	109	447	5-31	56	249			
1974				1-30	180	538	2-26	292	833	4-01	305	1290	4-30	274	1229	5-13	241	1148	5-30	221	1016			
1975				1-29	155	488	2-26	239	767	3-26	282	914	4-30	226	792	5-15	180	742	5-30	122	498			
MEANS					180	554		155	643		243	876		216	890		187	829		116	514			

BRITISH COLUMBIA SNOW COURSE DATA SUMMARY

No. 221 WOLF RIVER (UPPER) REGION: COASTAL

ELEV. 1490 METRES LAT. 49-42 LONG. 125-40 DRAINAGE: VANCOUVER ISLAND

YEAR	JANUARY 1			FEBRUARY 1			MARCH 1			APRIL 1			MAY 1			MAY 15			JUNE 1			JUNE 15		
	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM	DATE	SNOW DEPTH CM	WATER EQUIVALENT MM
1970							2-26	259	1072	3-26	287	1219	5-01	307	1433				5-29	218	1082			
1971				1-28	297	1077	2-25	272	1016	3-30	401	1605	4-27	383	1773				5-28	287	1478			
1972				1-29	320	1265				3-27	394	1880	4-25	397	1905	5-12	353	1869	5-25	305	1676			
1973				1-26	265	909	2-23	241	996	3-28	323	1311	4-27	277	1341	5-15	241	1250	5-31	190	1026			
1974				1-30	335	711	2-26	409	1605	4-01	485	2123	4-30	447	22480	5-13	437	2174	5-31	386	2093			
1975				1-29	251	975	3-03	335	1280	3-26	394	1585	4-30	323	1646	5-15	284	1504	5-30	244	1321			
MEANS					294	987		303	1194		379	1621		357	1724		329	1699		272	1446			

APPENDIX 9

Water Quality Data 1961-71

Stations:

00BC08HD0001

Campbell River at John Hart Generating Station, 3 miles west of Campbell River.

00BC08HC0001

Elk River at Highway Bridge Near Elkhorn Mountain, B. C.

WATER QUALITY DATA 1961-1971

STATION 00BC08HD0001 LATITUDE 50 D 2 M 40 S LONGITUDE 125 D 18 M 30 S
CAMPBELL RIVER AT JOHN HART GENERATING STATION, 3 MILES WEST OF CAMPBELL RIVER, BRITISH C

	02061F TEMP. DEG C	10301L PH PH UNITS	02011L COLOUR APPARENT REL. UNITS	02073L TURBIDITY JTU	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	10451L RESIDUE FILTERABLE MG/L	10551L RESIDUE FIXED FILTERABLE MG/L	00210L SATURATION INDEX (CALCD.) PH UNITS	00211L STABILITY INDEX (CALCD.) PH UNITS
SAMPLES	54	59	57	57			4	4	50	50
LOW	2.8	6.9	L5	L.1			23	7	-2.5	10.6
HIGH	20.0	7.7	10	12.0			30	17	-1.4	12.1
PERCENTILES										
10TH	4.4	7.0	L5	0.3					-2.4	11.0
25TH	5.6	7.2	L5	0.4			23	11	-2.2	11.1
MEDIAN 50TH	11.7	7.4	5	0.7			24	15	-1.9	11.3
75TH	14.4	7.5	5	0.9			28	17	-1.8	11.6
90TH	16.1	7.6	8	1.4					-1.7	11.7
BACKUP CODES	61S			71L						

	02041L SPECIFIC CONDUCT. UHMO/CM	00201L TOTAL DISSOLVED SOLIDS (CALCD.) MG/L	10603L HARDNESS TOTAL CACO3 MG/L	20101L CALCIUM DISSOLVED CA MG/L	12101L MAGNESIUM DISSOLVED (CALCD.) MG MG/L	19103L POTASSIUM DISSOLVED K MG/L	11103L SODIUM DISSOLVED NA MG/L	11201L SODIUM ABSORPTION RATIO REL. UNITS	06401L FREE CO2 (CALCD.) MG/L	06001L CARBON TOTAL ORGANIC C MG/L
SAMPLES	59	51	59	55	53	54	55	55	58	3
LOW	36	21	16.4	5.5	0.3	L.1	0.3	0.03	0.2	L.5
HIGH	56	30	23.0	7.4	1.7	0.4	2.5	0.25	4.1	4.0
PERCENTILES										
10TH	38	22	17.4	5.9	0.5	L.1	0.5	0.05	0.8	
25TH	38	22	18.2	6.1	0.5	L.1	0.6	0.06	0.9	
MEDIAN 50TH	40	23	18.6	6.3	0.7	0.1	0.6	0.06	1.3	2.0
75TH	42	24	19.6	6.7	0.8	0.1	0.7	0.07	2.0	
90TH	45	25	20.9	6.9	1.0	0.2	0.8	0.08	3.2	
BACKUP CODES										

	10101L ALKALINITY TOTAL CACO3 MG/L	06201L BICARBONT. (CALCD.) HCO3 MG/L	06301L CARBONATE (CALCD.) CO3 MG/L	17203L CHLORIDE DISSOLVED CL MG/L	09104L FLUORIDE DISSOLVED F MG/L	07105L NITROGEN DISSOLVED NO3 & NO2 N MG/L	15413L PHOSPHORUS TOTAL PHOSPHATE P MG/L	15314L PHOSPHORUS TOTAL INORG. PO4 P MG/L	14102L SILICA REACTIVE SIO2 MG/L	16303L SULPHATE DISSOLVED SO4 MG/L
SAMPLES	58	58	58	54	27	59	11	6	55	53
LOW	4	5	0	L.1	L.01	L.005	L.005	L.005	2.8	L1.
HIGH	20	24	0	0.9	0.2	0.180	0.069	0.019	4.2	5.9
PERCENTILES										
10TH	16	19	0	0.4	L.01	L.005	L.005		3.1	L1.
25TH	16	20	0	0.5	0.03	L.005	L.005	L.005	3.2	L1.
MEDIAN 50TH	17	21	0	0.5	L.1	0.020	0.007	L.005	3.5	1.1
75TH	18	22	0	0.7	L.1	0.029	0.023	0.007	3.7	1.8
90TH	19	23	0	0.7	0.11	0.034	0.044		3.8	2.2
BACKUP CODES					05L			13L		

WATER QUALITY DATA 1961-1971

STATION **00BC08HD0001** LATITUDE **50** D **2** M **40** S LONGITUDE **25** D **18** M **30**

CAMPBELL RIVER AT JOHN HART GENERATING STATION, 3 MILES WEST OF CAMPBELL RIVER, BRITISH C

	29105L COPPER DISSOLVED CU MG/L	29306L COPPER EXTRBLE. CU MG/L	26302L IRON SUSPENDED FE MG/L	82103L LEAD DISSOLVED PB MG/L	82301L LEAD EXTRBLE. PB MG/L	25304L MANGANESE EXTRBLE. MN MG/L	80301P MERCURY EXTRBLE. HG MG/L	30104L ZINC DISSOLVED ZN MG/L	30304L ZINC EXTRBL ZN MG/L	103 TOX. TO (CU (CA REL.
SAMPLES	13	5	2	11	4	4		13	5	5
LOW	L.001	L.01	0.040	L.001	L.01	L.01		L.00	L.01	0.0
HIGH	L.01	L.01	0.15	L.05	L.01	L.01		0.05	L.01	0.0
PERCENTILES										
10TH	L.001			L.001				0.00		
25TH	0.003	L.01		L.001	L.01	L.01		0.01	L.01	0.0
MEDIAN 50TH	L.01	L.01	0.10	L.05	L.01	L.01		L.01	L.01	0.0
75TH	L.01	L.01		L.05	L.01	L.01		L.01	L.01	0.0
90TH	L.01			L.05				0.02		
BACKUP CODES	06L	06P	04P	01L				05L	04P	

WATER QUALITY DATA 1961-1971

STATION 00BC08HC0001

ELK RIVER AT HIGHWAY BRIDGE, NEAR ELKHORN MOUNTAIN, BRITISH COLUMBIA

SAMPLE DATE D M Y	TIME PST H M	97163F DISCHARGE DAILY MEAN CFS	97183F DISCHARGE MONTHLY MEAN CFS	02061F TEMP. DEG C	10301L PH PH UNITS	02011L COLOUR APPARENT REL UNITS	02073L TURBIDITY JTU
14 9 68				11.1 61S	7.3	5	0.3

SAMPLE DATE D M Y	TIME PST H M	97163F DISCHARGE DAILY MEAN CFS	02041L SPECIFIC CONDUCT. UHMO/CM	00201L TOTAL DISSOLVED SOLIDS (CALCD.) MG/L	10603L HARDNESS TOTAL CACO3 MG/L	20101L CALCIUM DISSOLVED CA MG/L	12101L MAGNESIUM DISSOLVED (CALCD.) MG MG/L	19103L POTASSIUM DISSOLVED K MG/L	11103L SODIUM DISSOLVED NA MG/L
14 9 68			23	15	9.9	3.3	0.4	L.1	0.2

SAMPLE DATE D M Y	TIME PST H M	97163F DISCHARGE DAILY MEAN CFS	10101L ALKALINITY TOTAL CACO3 MG/L	06201L BICARBONT. (CALCD.) HCO3 MG/L	06301L CARBONATE (CALCD.) CO3 MG/L	17203L CHLORIDE DISSOLVED CL MG/L	09104L FLUORIDE DISSOLVED F MG/L	14102L SILICA REACTIVE SIO2 MG/L	16303L SULPHATE DISSOLVED SO4 MG/L
14 9 68			9	11	0	0.5	L.01	3.2	2.1

SAMPLE DATE D M Y	TIME PST H M	97163F DISCHARGE DAILY MEAN CFS	06001L CARBON TOTAL ORGANIC C MG/L	07105L NITROGEN DISSOLVED NO3 & NO2 N MG/L	15413L PHOSPHORUS TOTAL PHOSPHATE P MG/L	15314L PHOSPHORUS TOTAL INORG. PO4 P MG/L	08301L OXYGEN TOTAL COD O2 MG/L	08102F OXYGEN DISSOLVED O2 MG/L
14 9 68				0.068	L.005			

SAMPLE DATE D M Y	TIME PST H M	26302L IRON SUSPENDED FE MG/L	82103L LEAD DISSOLVED PB MG/L	82302L LEAD EXTRBLE. PB MG/L	25302L MANGANESE EXTRBLE. MN MG/L	80301P MERCURY EXTRBLE. HG MG/L
14 9 68				L.01 01L	L.01 04L	

STATION: 00BC08HC0001

[illegible] RIVER AT HIGHWAY BRIDGE, NEAR ELKHORN MOUNTAIN, BRITISH COLUMBIA

SAMPLE DATE			TIME PST		29105L COPPER DISSOLVED CU MG/L	29305L COPPER EXTRBLE. CU MG/L	29301L COPPER EXTRBL. CU MG/L	30105L ZINC DISSOLVED ZN MG/L	30304L ZINC EXTRBL. ZN MG/L	10991L TOX. UNITS TOTAL (CU + ZN) (CALCD.) REL. UNITS
D	M	Y	H	M						
14	9	68				L.01 06L			L.01	0.000

SAMPLE DATE			TIME PST		06401L FREE CO2 (CALCD.) MG/L	00210L SATURATION INDEX (CALCD.) PH UNITS	00211L STABILITY INDEX (CALCD.) PH UNITS	11201L SODIUM ABSORPTION RATIO REL UNITS	10401L RESIDUE NONFILTR. MG/L	10501L RESIDUE FIXED NONFILTR. MG/L	10451L RESIDUE FILTERABLE MG/L	10551L RESIDUE FIXED FILTERABLE MG/L
D	M	Y	H	M								
14	9	68			0.8	-2.6	12.6	0.03				

APPENDIX 10

Unedited First Draft. Unpublished Environmental Overview -

Chapter 22 - Western Mines Ltd.

Environmental Protection Service, 1978

(40)

22 WESTERN MINES LTD.

Western Mines Limited (W.P.L.) has operated a 1000 TPD copper-lead-zinc concentrator within the boundaries of Strathcona Provincial Park at Myra Creek near the south end of Buttle Lake, since December 1966. Ore for the concentrator is obtained from the three mine site as follows (Figure 9) :

(a) Lynx Mine - underground and openpit located adjacent to to concentrator.

(b) Myra Mine - located across the Myra Creek Valley from the Lynx Mine.

(c) Price Mine- located a Thelwood Creek.

The mill produces separate lead, zinc and copper concentrates. Values of gold, silver and cadmium report to all three base-metal sulphides. A simplified flowsheet showing the milling and tailings disposal circuits is given in Figure 10 (Eccles, 1977). The zinc circuit tailings, which represents 70% of the total mill effluent and contains all the solid wastes, is gravity fed to a tailings raft located three miles distant on Buttle Lake. Thickener effluents which contain dissolved copper and cyanide report to the alkaline chlorination plant. The alkaline chlorination plant effluent is combined with the zinc circuit tails and discharged together with a flocculant solution, 80 feet below the lake surface.

Lynx Mine water seepage and yard drainage enters Myra Creek from a series of three settling ponds. Seepage from Myra Mines and Price Mine is directed to a single settling pond at each location and exfiltrated to Myra and Thelwood creeks respectively.

22.1 Effluent Quality

22.1.1 Western Mines Limited (W.P.L.) Mill Effluent. For the first six years of operation, direct discharge of mill effluent to Buttle Lake was authorized under Pollution Control Permit PE-185 issued in May of 1967.

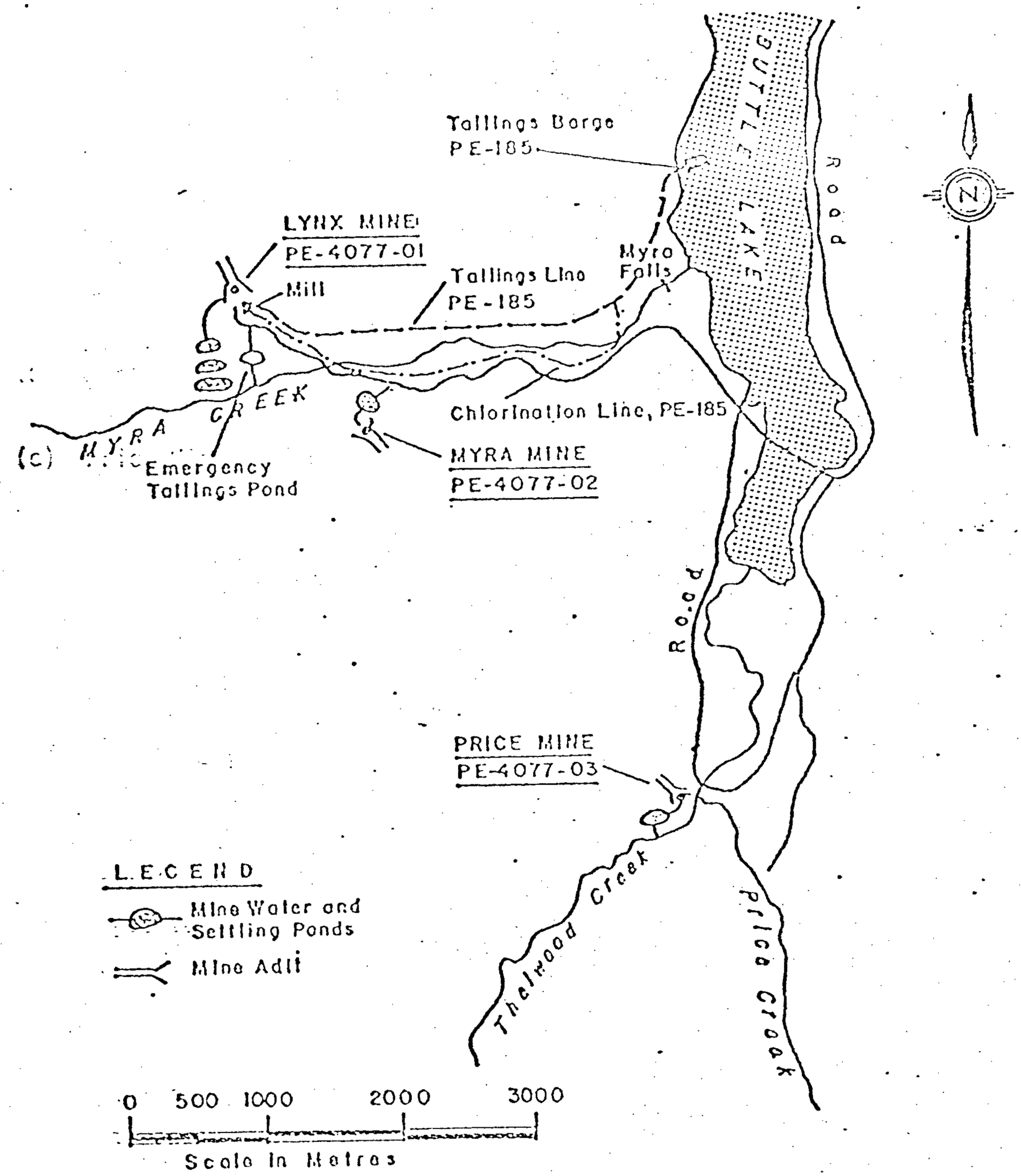


FIGURE 9 LOCATION MAP OF WESTERN MINES LTD.
PRICE, MYRA AND LYNX MINE SITES

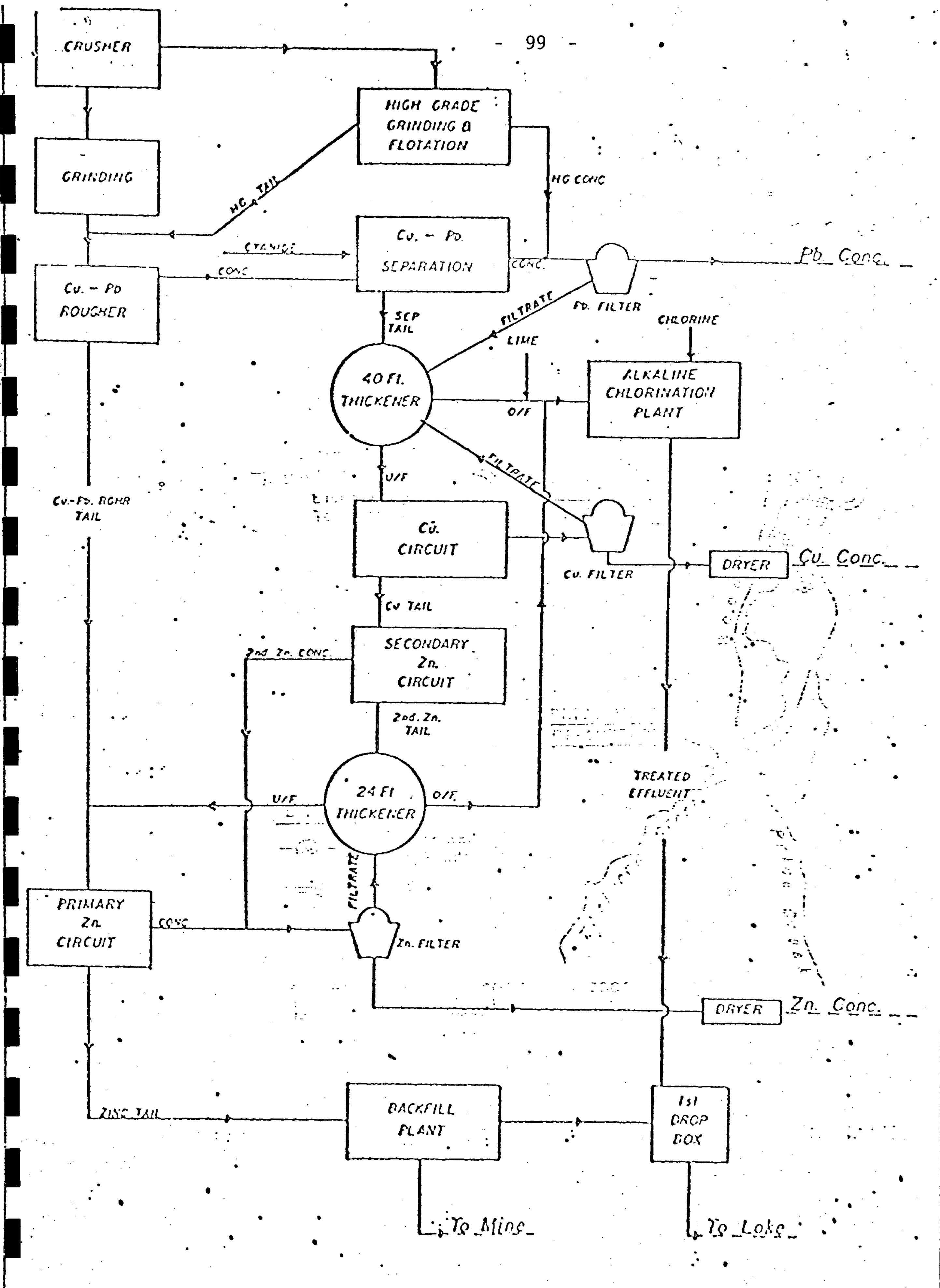


FIGURE 10 — Mill and tailing disposal flowsheet at Western Mines Limited.

X

Although the then Department of Fisheries did not comment on the above pit application because no anadromous species of fish were evident in the upper Campbell River watershed, the fact that there occurred substantial discussion of joint lake monitoring implies that historically the Department of Fisheries accepted in principle the proposed (and currently existing) effluent disposal scheme (Villamere to Claggett, Environmental Protection Service internal memo, 1977).

Permit PE-185 stated that an average of 720 000 gpd of effluent could be discharged to the bottom of Buttle Lake approximately one-half mile north of the mouth of Myra Creek. The effluent should be at a pH of 6.5 - 8.5 and contain less than : 10 mg/l dissolved copper; 10 mg/l dissolved hexavalent chromium; 5 mg/l dissolved zinc; 5 mg/l dissolved cyanide. The total solids content should not exceed 135 800 mg/l. The permit required that the effluent be sampled and analyzed once each month to ascertain the levels of pertinent dissolved substances present. In addition, the permit required that a survey of the method of disposal of the tailings be undertaken by an independent party.

Heavy metals at that time (1967) were not considered a problem, due to the pH of the circuit. Lead production commenced in June of 1970 but was limited for the following 2-1/2 years at which time the Myra Mine high lead grade ore was brought on line. Consequently, the plant circuit was modified and cyanide was increased substantially to provide copper-lead separation. The essential use of cyanide greatly increased the levels of cyanide and dissolved copper in the effluent.

B.C. Research (1974) in summary analyses of all data obtained by five different agencies between April, 1966 and September, 1973 concerning Buttle Lake and the effluent discharge concluded the following :

1. The mean values for dissolved copper, chromium and zinc in the tailings were within the permit limits, but the individual samples assayed by Western Mines exceeded permissible zinc limits, 14% of the time. The dissolved copper

content of the tailings pond (used only for a short period of time) effluent was above the limit specified in Permit No. 185, 70% of the time, and the dissolved chromium levels 5% of the time; as reported by Western Mines.

2. Western Mines reported that the cyanide content of the tailings exceeded the permit limit up to 5% of the time, The values in the tailings pond effluent exceeded the Permit No. 185 limit in above 61% of the samples taken after 1970.

3. The Pollution Control Branch reported that the mean pH of both the tailings and the tailings pond effluent were above the permit limit. The individual samples were outside the limit 60% and 70% of the time respectively. Western Mines reported that mean values within limits, but the individual samples were outside the limit up to 74% of the time for the tailings, and up to 63% of the time for the tailings pond overflow. Western Mines reported that values that were much more acidic than those reported by the Pollution Control Branch, which in part may account for the higher mean values reported for heavy metals.

4. The Pollution Control Branch data indicated a mean total solids value for the tailings which was outside permit limits. The individual values exceeded 135 800 mg/l total solids 69% of the time. The Western Mines values were within the limits due to the procedures used to collect their composite tailings sample.

5. The mean dissolved copper content of the tailings themselves was 1.3 times the suggested level, whereas, the dissolved lead values were within the suggested level. Bioassay data using rainbow trout indicated the tailings were not toxic over 96 hours when flocculents were added.

However, in contradiction to the last statement, the Environmental Protection Service mine effluent chemistry and acute toxicity survey of 1973 (Hoos and Holman) observed that "Western Mines effluent, in particular, contained exceedingly high levels of total copper (230 mg/l), zinc (1300 mg/l), and lead (88 mg/l) and, although no dissolved measurements were conducted on this sample, it would appear that these metals, in conjunction with other effluent components, acted synergistically to produce the acutely toxic response reported in the bioassay results (LT_{50}– 1.6 hour)."

As a result of the B.C. Research (1974) review the Pollution Control Branch on April 8, 1974 under Section 10(f) of the Pollution Control Act, ordered Western Mines to increase the degree of treatment of the effluent covered by PE-185 with the following monitoring provisions was issued June 6, 1975 :

1. A monthly analyses of a 4 hour composite tailings sample for total and dissolved Cu, Pb, Zn; dissolved SO_4, pH, suspended solids, total cyanide, and free and total residual chlorine,
2. Twice annual "assessing toxicity type bioassay" on the composite tailings sample supernatant,
3. The copper, lead, zinc, and mercury content of the flesh and liver of a minimum of five fish, three times per year,

and that the effluent characteristics not to exceed the following :

pH	- 6-10
SO_4	- 1000 mg/l
Dissolved Cu	- 0.30 mg/l
Dissolved Zn	- 5.0 mg/l
Dissolved Pb	- 0.1 mg/l
Total CN	- 0.50 mg/l
Suspended Solids	- 135 000 mg/l
Total discharge	- 720 000 IGPD

Subsequent to the Pollution Control Branch directive, investigations indicated that the most efficient and economical method of removing cyanide and copper contaminants from the effluent would be alkaline chlorination. Construction of a plant for this purpose commenced in August, 1973, and full operation was achieved in mid 1975 (Eccles, 1977b).

Table 42 summarizes all effluent data submitted pursuant to the above permit requirements. Except for copper and cyanide the effluent appears to be meeting those requirements. Ninety six-hour LC_{50} static bioassays, performed on the tailings effluent twice per year, were initiated in August of 1975. They show the effluent to be marginally toxic to toxic (Eccles, 1976, 1977a).

22.1.2 Western Mines Limited (N.P.L.) Mine Drainage. Mine water discharged from the Lynx, Myra, and Price main mine adits are authorized under Polluction Control Permit PE-4077 in average daily amounts of 720 000, 619 200 and 763 000 IGPD respectively. Except for the Lynx Mine and concentrator yard drainage which is treated in a series of three settling ponds all visible seepate exfiltrating from the mine water settling ponds must be equivalent to or better than : total suspended solids - 75 mg/l, total solids - 1200 mg/l, pH - 6.5 to 8.5, dissolved arsenic - 0.05 mg/l, dissolved cadmium - 0.005 mg/l, dissolved copper - 0.30 mg/l, dissolved lead - 0.05 mg/l, dissolved zinc - 2.0 mg/l, total mercury - 0.001 mg/l, total cyanide - 0.10 mg/l, and dissolved SO_4 - 200 mg/l.

A monthly receiving water monitoring program which includes the above parameters is also prescribed for upstream and downstream stations on Myra and Thelwood Creeks.

Table 43 provides a summary of the limited available data on the three settling pond exfiltrates. Yearly averages all fall below maximum permissable limits.

TABLE 42 WESTERN MINES MILL EFFLUENT DATA SUMMARY*

Component	Date*	Maximum	Minimum	P.C.B. Requirement	Average
Dissolved Cu (mg/l)	1974	2.66	.004	10.0	0.58
	1975	.83	.002	0.30	0.90
	1976	3.52	.033	0.30	0.92
	1977				0.26
Total Cu (mg/l)	1974	88.0	0.26		29.97
	1975	53.8	0.04		16.77
	1976	95.2	0.40		62.61
	1977				84.4
Dissolved Pb (mg/l)	1974	0.80	0.001	-	0.089
	1975	1.00	0.003	0.1	0.204
	1976	0.10	0.003	0.1	0.032
	1977				0.041
Total Pb (mg/l)	1974	52.0	0.08		17.39
	1975	85.0	0.02		20.17
	1976	112.0	0.02		54.44
	1977				65.6
Dissolved Zn (mg/l)	1974	0.96	0.005	5.0	0.125
	1975	0.70	0.002	5.0	0.205
	1976	0.28	0.044	5.0	0.126
	1977				0.18
Total Zn (mg/l)	1974	340	0.08		113.43
	1975	340	0.20		72.44
	1976	803	0.07		404.48
	1977				503
Cyanide (mg/l)	1974	2.9	0.004	-	0.55
	1975	3.8	0.004	0.50	0.78
	1976	6.0	0.010	0.50	1.58
	1977				0.68
Sulfate (mg/l)	1974	389	251	-	232.1
	1975	432	308	1000	376.9
	1976	480	368	1000	444.1
	1977				436
Suspended Solids (mg/l)	1974	42.6	10.6	135 800	27.9
	1975	61 800	5	135 800	17 988.0
	1976	100 000	59 600	135 800	82 040.0
	1977				88 030.0
pH	1974	11.1	8.2	6.5-8.5	10.1
	1975	11.4	7.7	6-10	10.5
	1976	10.9	7.6	6-10	9.7
	1977				9.5

*Reported values for 1977 are calculated from average of June 1, 1976 to May 31, 1977 data provided in Eccles, (1977a).

TABLE 43 WESTERN MINES YEARLY AVERAGE MINE WATER EFFLUENT QUALITY

Parameter	Date	Lynx	Myra	Price
Dissolved Arsenic (mg/l)	1975	0.005	0.005	0.010
	1976	0.005	0.005	0.005
Dissolved Cadmium (mg/l)	1975	0.0078	0.0020	0.0005
	1976	0.0025	0.0043	0.0006
Dissolved Copper (mg/l)	1975	0.012	0.040	0.002
	1976	0.021	0.190	0.003
Dissolved Lead (mg/l)	1975	0.003	0.006	0.028
	1976	0.003	0.042	0.029
Total Mercury (μg/l)	1976	0.050	0.200	0.050
Dissolved Zinc (mg/l)	1975	1.66	0.52	0.06
	1976	.78	0.95	0.07
Cyanide (mg/l)	1975	0.01	0.01	0.01
	1976	0.01	-	-
SO_4 (mg/l)	1975	125.0	47.9	24.9
	1976	98.3	27.9	36.0
Suspended Solids (mg/l)	1975	61.0	2.0	1.0
	1976	14.5	3.0	23.0
pH	1975	7.8	7.2	8.0
	1976	7.6	6.8	8.0

22.2 Receiving Environment and Impact

22.2.1 Buttle Lake and the Campbell River System. The Campbell River chain of lakes and tributaries is situated in the central portion of Vancouver Island and drains an area of 542 square miles, Buttle Lake lies in a north-south valley at the head of the system. It drains northward into Lower Campbell Lake. The main tributary to Buttle Lake is Elk River. The Campbell River drops rapidly from Lower Campbell Lake through several canyons and over Elk Falls and enters the sea at the town of Campbell River on the west side of Discovery Passage (Figure 11).

Upper Campbell Lake is contained behind Strathcona Dam on the Campbell River. This reservoir is the uppermost in a series of reservoirs beginning with the John Hart Dam and reservoir (Head Pond) situated downstream of Ladore Dam and reservoir (Lower Campbell). Upper Campbell Lake at full pool is joined with Buttle Lake, a former natural lake located 11 km (7 mi) upstream of Strathcona Dam. The generation facility at Strathcona Dam is capable of producing 6.75×10^4 kilowatts of power. Mean discharge from the reservoir is 81 m^3/s (2850 cfs) and elevation at full pool is 225 m (737 ft). The reservoir first reached full pool in 1958 and can have a maximum level fluctuation of 25 m (82 ft).

22.2.2 Receiving Environment Biology. Except for a report on Lower Campbell Lake, prepared by Dr. G.C. Carl (1937), little was known of the biology of the Campbell River system until it was examined in detail by the British Columbia Game Department in 1951 (McMynn and Larkin, 1953). Their report, which was performed in response to three proposed British Columbia Power Commission hydro electric projects on the system, provides an excellent summary of morphometry, physical limnology and biology of Buttle, Upper Campbell, Lower Campbell lakes, as well as Head Pond and Campbell River. In overall terms their findings with respect to the fishery potential were as follows :

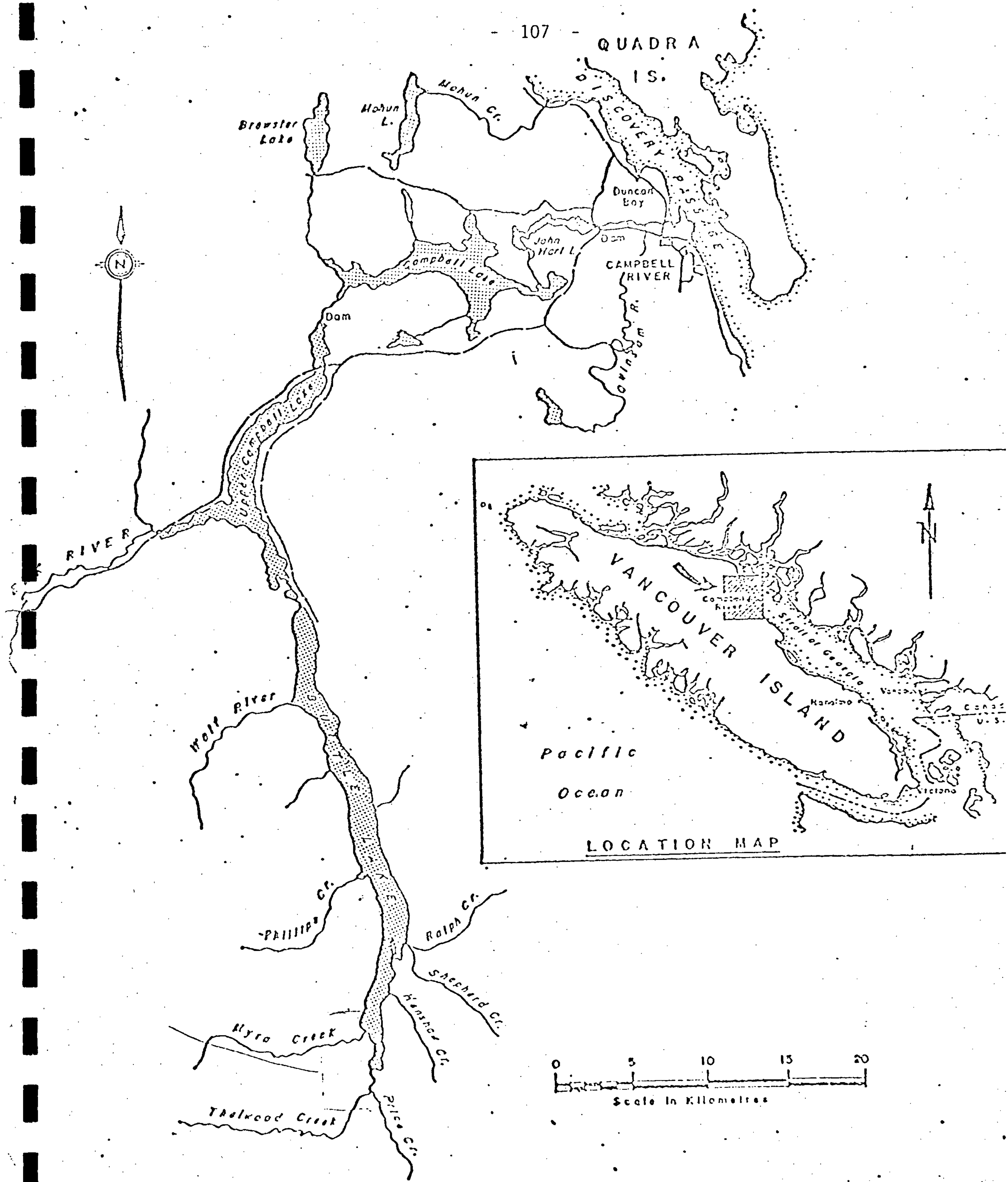


FIGURE 11 LOCATION MAP OF THE CAMPBELL RIVER DRAINAGE SYSTEM

(a) Buttle Lake: oligotrophic, poorly defined thermocline, soft (40 mg/l) and highly transparent (secchi disc 40-45 feet at both ends of the lake).

Relatively high settled volumes of plankton and substantial productivity in profoundal fauna.

Four species (Salmo gairdneri, Salmo clarki clarki, Cottus and Salvedinus alpinus malma) of fish were observed. Resource not heavily fished. Nine streams including Price, Myra, and Thelwood were identified as providing exeptional trout spawning facilities. Apparent great recreational value.

(b) Upper Campbell Lake: Rapid flushing in part responsible for poor bottom fauna and poor plankton production. Available trout spawning potential approximately three fold greater than Buttle Lake.

(c) Lower Campbell Lake: Created by the Ladore Dam. Well defined thermocline. Secchi disc of 25 feet in dull weather indicated moderately high transparency and total dissolved solids content moderate (40 ppm).

Plankton hauls from 1937 and 1951 were similar. Phytoplankton contained both eutrophic and oligotrophic types and the zooplankton were the abundant forms. Bottom fauna in both 1937 and 1951 were poorly developed.

Fish populations in 1937 were principally Salmo-gairdneri with some Salmo clarki clarki, Salvelinus alpinus malma and Cottus. Only rainbow and cutthroat trout were caught in 1951.

From brief reconnaissance of tributary streams spawning potential were viewed as adequate to excellent.

(d) Head Pond: Created as a result of a power development completed in 1947. Efficiently mixed and rapid flush-out. Total dissolved solids slightly higher than other lakes in system (68 ppm).

High volume of plankton may be result of drift down and lack of bottom fauna due to absence of a suitable substrate.

Fish species included Salmo gairdneri, Salmo clarki clarki, Salvelinus alpinus malma, Gasterosteous aculeatus and Cottus. Limited spawning potential except in tributary streams entering north side of lake.

(d) Campbell River below the Head Pond: "The Campbell River, below the Canyon, supports the following runs of migratory fish:

1. Spring salmon - August to November.
2. Humpback salmon - July to October.
3. Coho salmon - September to December.
4. Small numbers of dog salmon.
5. Occasional sockeye salmon.
6. Winter steelhead - November to April.
7. Summer steelhead - small fish spring run - May to June.
8. Summer steelhead - small fish fall run - August to September.
9. Cutthroat trout - spawning run - (winter months, peak probably February) and various feeding movements.
10. Rare Dolly Varden of small size.
11. Small number of lampreys.
12. Cottids and sticklebacks are present above tidal limits, as well as in the estuary.

13. Large runs of winter steelheads, coho, and humpback salmon pass through the river to reach the Quinsam River. They are followed by cutthroat.

The Quinsam River Hatchery, which was opened in 1975, has been desgined to enhance the Quathiaski Subdistrict escapements and commercial catches. The first benefits of the program were expected in 1977 with the return of adult coho. Adult chinook are expected in 1978. The facility also has the capacity of hatching and raising steelhead, but this program has not yet been implemented. Tables 44 and 45 provide a summary of escapement data for both the Campbell and Quinsam rivers (Fisheries and Marine Service, 1977).

22.2.3 Impact Assessment. Two reports prepared by Wright Engineers Limited (1966, 1966) on the feasibility of underwater of Western Mines' tailings, following discussions with the Department of Fisheries and the Department of Recreation and Conservation, reported on a number of preproduction effluent assessments and literature search. The findings of the two reports are as follows :

(a) Bioassay examinations of three effluent types on a 3:1 dilution showed "the effluents to be remarkably lower in toxicity than one might have expected. Bioassays indicated a 10% mortality rate after four days exposure."
(b) With or without flocculation mill effluent will settle to give a clean overflow and that there was no tendency for settled pulp to disperse under the influence of strong convection currents.
(c) "It is felt that the above data and information (conclusion to the literature search) is sufficient evidence that the proposal of Western Mines Limited (N.P.L.) to discharge the mill tailings into the very large basin which constitutes Buttle Lake under controlled conditions will, in no way, have a deleterious effect."

TABLE 44 CAMPBELL RIVER MAINSTEM ESCAPEMENTS

Year	Sockeye	Coho	Pink	Chum	Chinook
1975	25	400	1500	3000	2500
1974	75	1500	4000	3500	2500
1973	150	1000	1000	4000	4300
1972	75	1500	3500	3500	7500
1971	75	1500	750	1500	7500
AVERAGE	80	1180	2150	3100	4860
AVERAGE 1966-70	80	1660	2400	1850	4000

TABLE 45 QUINSAM RIVER ESCAPEMENTS

Year	Sockeye	Coho	Pink	Chum	Chinook
1975	25	3500	30 000	400	200
1974	N.O.	3500	7500	400	75
1973	N.O.	4600	4000	1000	5
1972	N.O.	1500	3500	1500	75
1971	N.O.	1500	400	400	25
AVERAGE	5	2900	9100	750	75
AVERAGE 1966-70	0	2550	1350	500	N.O.

N.O. - Not Observed

The original Pollution Control Permit PE-185 required that a survey of the method of disposal of the tailings be undertaken by an independent party.

Dr. G.B. Langford (1968, 1969) carried out such a survey and issued an interim report in February, 1968, followed by a final report in January, 1969. He concluded that the present methods of tailings disposal being practiced by Western Mines Limited conformed to acceptable health and engineering standards.

Langford considered that the water in Buttle Lake continued to be of high quality. The aquatic life had not suffered and no irreparable damage had been done to aesthetic values. He also concluded that there were no alternative methods of tailings disposal that would offer any improvement over the methods being employed.

He recommended that the surveillance of Buttle Lake and its' environs be maintained by the Pollution Control Branch and the Fish and Wildlife Branch of the Provincial Government to ensure that the discharge of tailings continue to be done in a satisfactory manner. He further recommended that the sampling procedures adopted in October, 1968, be continued.

The B.C. Research report (1974) prepared for the Pollution Control Branch, in a summary of available lake water chemistry and biology data from April, 1966 to September, 1973 concluded that :

(1) Significant increases occurred in values for total copper, zinc, and solids and turbidity at lower depths. Highest values were recorded at 250 feet of depth, two miles downstream.

(2) No significant difference occurred in surface waters at any sample site in Buttle Lake.

(3) No significant difference occurred between feeder stream water quality and water leaving Buttle Lake (excluding Myra Creek).

(4) Zinc concentrations of fish liver had not changed significantly since 1966. Copper content had not changed since 1969; however, significantly high than in 1966. Fish liver lead had increased significantly between 1969-1971 and 1971-1972.

(5) Disposal of tailings had no detrimental effect on water quality for domestic purposes; however, there was not enough available data to assess the impact on resident flora and fauna.

An interim report, (Department of Recreation and Conservation, 1971) reinforced the above findings, but noted differences between the north and south end of the lake with respect to fish tissue and bottom sediment metals. Also of significance at that time was the recording of a yearly decrease in Secchi disc readings from 1966 to 1969.

A more recent report, prepared for the Coast Region of the Pollution Control Branch (Baillie and Harrison, 1977), was initiated to provide regional normals of heavy metal content of Vancouver Island lake fish on which to compare data collected from Buttle Lake fish. Their data is summarized in Tables 46 and 47. The report concludes that although fish muscle mercury, copper, and zinc do not differ significantly from other Vancouver Island lakes, the litter of the same fish contains roughly six times the copper content. "In liver tissue, background fish copper ranged from 1.98 µg/g to 1303 µg/g with an average of 103 µg/g. Copper content in liver tissue of Buttle Lake fish ranged from 20.9 µg/g to 1980 µg/g with an average of 621 µg/g." Similar results have been found by Western Mines in their fish tissue analyses pursuant to their pollution control permit requirements (Eccles, 1976, 1977a).

During 1976, B.C. Hydro commissioned B.C. Research to characterize the limnological features of four large reservoirs under the management of B.C. Hydro; one of which was Upper Campbell Lake. The study was envisaged as providing an information base for lake/reservoir comparisons and prediction

TABLE 46 HEAVY METAL CONTENT OF DRY FISH MUSCLE TISSUE FORM SEVEN VANCOUVER ISLAND LAKES

(Baillie and Morrison, 1977)

Location	$\%H_2O$	Zn µg/g	Cu µg/g	Hg µg/g
Alice Lake Apr. 16/75	80.8	26.8	2.5	-
Alice Lake July 1/75	77.2	16.2	1.6	0.20
Benson Lake Nov/73	79.1	16.1	-	-
Benson Lake July/74	77.5	20.3	2.8	0.19
Comox Lake Nov. 28/74	76.4	17.5	1.5	0.13
Great Central Lake Apr. 9/75	76.7	16.7	2.1	0.11
Kennedy Lake March 27/74	79.9	102.0	2.0	0.84
Maynard Lake Nov. 8/73	77.9	20.7	-	-
AVERAGE	78.2	29.5	2.1	0.29
Buttle Lake Data July and October, 1973	73.9	18.3	2.84	0.36
(Sample size 26 fish)	77.7	28.3	2.2	0.33

TABLE 47 HEAVY METAL CONTENT OF DRY FISH LIVER TISSUE FROM SEVEN VANCOUVER ISLAND LAKES

(Baillie and Morrison, 1977)

Location	%H_2O	Zn µg/g	Cu µg/g	Hg µg/g
Alice Lake July 1/75	82.84	77.72	102.46	-
Benson Lake Nov/73	77.9	151.05	66.0	-
Benson Lake July/74	76.9	149.9	128.4	-
Comox Lake Nov. 28/74	76.6	154.5	138.0	-
Great Centreal Lake Apr. 9/75	81.5	88.1	197.6	0.10
Kennedy Lake March 27/74	78.9	109.4	30.0	-
Maynard Lake Nov. 8/73	76.0	125.3	59.7	-
AVERAGE	78.66	122.3	103.2	0.10
Buttle Lake data July and October, 1973	76.4	136.6	621	0.24
(Sample size 26 fish)	78.4	124.1		0.17

base for future hydro-electric developments (B.C. Research, 1977).

Multi-depth sampling was conducted at one site on Lower Campbell Lake, two sites on Upper Campbell Lake and one site on Buttle Lake during late summer (maximum thermal stratification) and late fall turnover. The trophic status each body was estimated from physical, chemical, and biological measurements.

Data from the study suggest that the Campbell River system thermally gradiates with no definite thermocline. Considerable mixing and short water retention periods were felt responsible for this observation. Primary productivity was low despite relatively high light transmittance and abundance of nutrients exept nitrogen. The report concluded that :

> "Concern that primary productivity in Upper Campbell Lake was directly affected by tailings entering Buttle Lake from Western Mines Ltd., Copper-lead-zinc mine located near the south end of the lake is without basis. An assessment of heavy metals levels in Buttle Lake indicated little or no transport of tailings out of Buttle Lake (B.C. Research, 1974). Metals monitored in the Campbell River system for this study (Cu, Zn, Pb, Fe) were all below detection limits with the single exception of Zn in Buttle Lake which did not appear in Upper Campbell Lake."

An attempt to classify the trophic status of the system was somewhat confused because of its relatively high phosphorous levels (meso-eutrophic) and its relatively low primary productivity and nitrogen levels (ultra-oligotrophic). However, most characteristics placed the system in oligotrophic status (B.C. Research, 1977).

22.3 Assessment of Pollution Control

At present the lake discharge is required to meet a combination of levels "B" and "C" of the Pollution Control Branch Objectives for Mining, Mine-Milling, and Smelting Industries. These levels are being met, except for copper and cyanide despite the fact that the company has recently installed specialized facilities to reduce these levels.

The discharge also falls far short of meeting the National Metal Mining Liquid Effluent Guidelines for total copper, total lead, total zinc, and suspended solids.

Despite the political significance of Western Mines in the past and the number of government agencies which have examined the discharge and its effects on the receiving environment, no scientifically sound study has been conducted to date which deliniates the environmental impact of the discharge. Basically, the main shortcoming is a lack of adequate preproduction data from which to draw any valid comparisons, or insufficient volumes of reliable data which makes evaluation difficult.

Indications are, however, that the copper content of the effluent, which is acutely toxic in itself, is accumulating in resident fish tissue. Turbidity in the lake is on the increase particularly at lower depths of the south end and heavy metals in the sediments were also much greater in the south end.

A full definitive study of Buttle Lakes and the Campbell River system morphometry, physical limnology, chemistry, and biology should be conducted in the immediate future to provide a conclusive impact assessment. A need to negotiate compliance to the Metal Mining Liquid Effluent Regulations with Western Mines can then be assessed on the basis of the study findings.

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APPENDIX 11

COMMON AND SCIENTIFIC NAMES

APPENDIX 11

COMMON AND SCIENTIFIC NAMES

Vegetation

Douglas fir	-	*Pseudotsuga menziessi*
Grand fir	-	*Abies grandis*
Western red cedar	-	*Thuja plicata*
Lodgepole pine	-	*Pinus contorta*
Sitka spruce	-	*Picea sitchensis*
Western hemlock	-	*Tsuga heterophylla*
Arbutus	-	*Arbutus menziesii*
Willow	-	*Salix*
Red alder	-	*Alnus rubra*
Bitter cherry	-	*Prunus emarginata*
Western flowering dogwood	-	*Cornus nuttallii*
Broadleaf maple	-	*Acer macrophyllum*
Vine maple	-	*Acer circinatum*
Balsam (Balsam fir)	-	*Abies amabilis*
Poplar (Balsam poplar)	-	*Populus balsamifera*
Trembling aspen	-	*Populus tremuloides*
Salmonberry	-	*Rubus spectabilis*
Cow parsnip	-	*Heracleum lanatum*
Devil's club	-	*Oplopanax horridum*
Salal	-	*Gaultheria shallon*
Mountain hemlock	-	*Tsuga mertensiana*
Whitebark pine	-	*Pinus monticola*
Subalpine fir	-	*Abies lasiocarpa*

Mountain maple	-	*Acer mertensiana*
Black cottonwood	-	*Populus balsamifera trichocarpa*
Yellow cedar	-	*Chamaecyparis nootkatensis*
Western white pine	-	*Pinus monticola*
Amabalis fir	-	*Abies amabalis*

Birds

Blue grouse	-	*Dendragapus obscurus*
Ruffed (willow grouse)	-	*Bonasa umbellus*
Ring-necked pheasant	-	*Phasianus colchicus*
Band-tailed pigeon	-	*Columba fasciata*
California quail	-	*Lophortyx californicus*
Island ptarmigan (white grouse)	-	*Lagopeus leucurus saxatilis*
Bald eagle	-	*Haliacetus leucoce phalus*

Fauna

Columbia blacktail deer	-	*Odocoileus hemionus*
Roosevelt elk	-	*Cervus canadensis*
Black bear	-	*Ursus americanus*
Vancouver Island marmot	-	*Marmata vancouverensis*
Cougar	-	*Felis concolor*
Wolverine	-	*Gulo luscus*
Timber wolf	-	*Canis lupus erassodon*
Marten	-	*Martes americana*
Beaver	-	*Castor canadensis*
Muskrat	-	*Ondatra zibethicus*
Mink	-	*Mustela vison*

Fish

Chinook, king, tyee, spring salmon	-	*Oncorhynchus tshawytscha*
Coho, silver	-	*O. kisutch*
Chum, dog	-	*O. keta*
Pink, humpback	-	*O. gorbuscha*
Sockeye, red	-	*O. nerka*
Steelhead trout (rainbow trout)	-	*Salmo gairdneri*
Dolly Varden char	-	*Salvelinus malmo*
Coastal cutthroat trout	-	*Salmo clarki clarki*
Kokanee trout	-	*Salmo*
Prickly sculpin	-	*Olig acottus rimensis*
Threespine stickleback	-	*Gasterosteus aculeatus*

APPENDIX 12

NEWSPAPER ARTICLES RE PROPOSED QUINSAM COAL PROJECT

Vancouver Sun 18 October 1978

Campbell River Courier 3 November 1978

Cam[redacted] Ri[redacted] Cou[redacted]

-3.NOV.1978

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Chamber probes deep-water port

BY QUENTIN DODD

A suitable deep sea dock facility for coal ships from the proposed Middle Quinsam Lake mine development could be combined with use of cruise ships if government funding were available.

That is the idea revealed this week by Norm McLaren, president of the Campbell River Chamber of Commerce, who told The Courier that the suggestion stems from area MP Hugh Anderson's statement some years ago that if more than one use could be found for such a facility the federal government might be prepared to help financially in the development.

McLaren said that the comment was made when the cruise ship Fairsea was about to be taken off the Campbell River route because of docking problems.

He said that the ship, which had visited the area on its way to Alaska, had been so thrown about by currents at the Spit – even with the assistance of tugs – that it pushed the dock pilings out of line, and it was eventually decided to leave Campbell River off the list of ports to visit.

He added, however, that the venture had been such a success that an approach had for government financing for a proper deep sea dock.

The answer at that time, McLaren said this week, was that cash for such a project would not be forthcoming without another use being found for the dock, apart from cruise ships.

With that in mind, the president said, when the Weldwood-Luscar coal mine proposal was made for the Campbell River area, he had got in touch with Anderson on behalf of the chamber to see whether such backing was still on the books. No firm reply had been received by earlier this week, by which time Anderson's position as parliamentary secretary to Federal Fisheries Minister Romeo LeBlanc had been taken over by Coast-Chilcotin MP Jack Pearsall.

In an interview earlier this week, McLaren said that he still wanted a reply from the federal government on the suggestion. On Thursday Pearsall said that he could not see the federal government at present putting cash into such a suggestion, because of the current spending restraints.

He also said that he felt that if Campbell River were to be given such "very costly" assistance, other ports such as Powell River, Prince want the same treatment.

Pearsall added that he thought it was a little premature to comment on the mine proposal's plan to use the Spit since provincial environment minister had not yet released a report looking into the socio-economic feasibility of moving companies out of the Campbell River estuary.

However, he said, he thought as parliamentary secretary to both LeBlanc and Environment Minister Len Marchand, that both LeBlanc and Marchand would be concerned if it was felt that either the local salmon hatchery or the estuary was going to be damaged by the mine project.

LeBlanc and Marchand would be concerned if it was felt that either the local salmon hatchery or the estuary was going to be damaged by the mine project.

In the meantime, McLaren said, investigations have shown that about eight ships are interested in coming to Campbell River during their coastal cruises, if a proper deep sea dock can be obtained.

"The Spit is definitely out as far as the chamber is concerned (both for coal ship-

(Continued from page 1)

ment and storage and for cruise ships), because of the potential problems relating to fisheries, tourism and the environment. Utopia is to have a site that's economically sound as well as environmentally desirable and while the Spit may cover the economically-sound area, it certainly doesn't comply with the environmental desirability. Directly opposite that site are trailer park sites and that would just kill them and put them out of business due to the dust.

"At this stage we favor Middle Bay, providing it's a functional situation and you can gain access and egress to it. If it's a physical impossibility – which I'm not convinced it is – we would have to look at other sites."

McLaren said there has been "a definite interest shown by certain shipping authorities (in visiting this area on their way to and from Alaska). In fact they have indicated orally to us: 'Give us the facility and we feel sure we can bring you in cruise ships'. Upwards towards eight have shown an interest in the Campbell River area."

He added that during the Fairsea's visits to the area, beginning in 1973, bus trips had been organized, golf excursions arranged and people had had the opportunity of going fishing in the area.

According to a report on the possibility of a deep sea port here, produced by the chamber's harbor development committee in 1975, the Fairsea carried 800 passengers per trip and was due to make six one-day visits to the area that year.

"The cruise ship passengers are considered as the most desirable form of visitors as they do not require housing accommodations during the peak vacation period, nor do they do any harm to the environment by comparison to campers, and they do not become a factor on the already-overcrowded Island Highway," says committee chairman L. Foort in the report.

Pilotage problems in the area have been on the minds not only of Weldwood-Luscar and the local chamber but also the municipality.

A spokesman for municipal hall said that investigations are now going on into possible shipping difficulties in the area but added that it has nothing to do with the coal proposal at present.

"What we're doing is independent of anything they have done or were doing, although it would be a tie-in later on," the spokesman said.

The probe involves people involved with pilotage and stretches as far as Vancouver and the spokesman said he hoped to have "some report of some kind" in the next few weeks.

Mayor Tom Barnett has gone on record as saying that the municipal council would prefer docking facilities to be north of the Elk Falls Mill, rather than at the Spit, as proposed by the coal companies at present.

VAN. SUN - 126 Oct. 18/78 A.22

Campbell River residents split on coal-mining project

By MOIRA FARROW

A proposed massive coal-strip mining project near Campbell River, in which the coal would be hauled through town and stockpiled near the estuary, is dividing the residents of that community in a bitter controversy.

The companies behind the project are now close to a decision on whether to seek provincial government approval to go ahead with the mine.

And a conservation group has called a public meeting for later this month to put into high gear its campaign against the project.

"This will be a bitter fight and a very divisive one locally," said Dick Murphy, chairman of the Campbell River Estuary Association. "But we're convinced this mine will have a devastating effect on the quality of life of this whole community."

To complicate the situation further, the provincial government still has not released a federal-provincial study of the estuary which was submitted to Environment Minister Jim Nielsen in May.

The coal project, a joint venture of B.C.-based Weldwood of Canada Ltd. and Alberta-based Luscar Ltd., was first announced last year.

The two firms submitted a prospectus to the provincial government outlining a $50 million thermal coal strip mine which would employ about 235 people and have an annual production of approximately one million short tons, and be in operation by 1981.

The open-pit mine would be about 27 kilometres southwest of Campbell River in the Quinsam Lake area. A multimillion-dollar federal fish hatchery built in 1972 is on the Quinsam River downstream of the mine.

Murphy said that according to the company prospectus, the coal will be hauled through Campbell River on 100-ton trucks to a waterfront area known as the Spit where Western Mines Ltd. has a dock.

He said Luscar has an agreement to use this facility but it will have to be expanded and the coal stockpiled on 10 to 15 acres of Indian reserve land near the river estuary.

"The company says 55,000-ton ships will come in here and the existing wharf will be extended to deeper water," Murphy said. "This is right on the edge of the world famous Tyee fishing pool."

According to the company prospectus, there are proven reserves of 33 million tons of coal at the mine site. The construction phase of the project will last 18 months and employ 500 men.

Construction will include a 500-man camp, a plant, offices and dock facilities. It will also be necessary, according to the prospectus, to establish road, water and sewer systems, provide power, and assemble mining equipment. It will take one year to erect the drag line.

Murphy said that the prospectus puts the life of the project at 11 years but it could be reduced to six. The coal will be washed at the mine site because it has a fairly high sulphur content, but whether it will also be dried at the site it not yet known.

Weldwood vice-president Pit Desjardins told The Vancouver Sun Tuesday that the company is now completing a final feasibility study of the economics of the project and a decision is likely this year.

He said the company is also completing a first-stage report of the project for the provincial government.

"If the economics are okay we're still looking at 1981 as a starting date, but we have yet to determine whether we have a market for the coal," Desjardins said. He added that there is stiff competition for coal markets from several other countries.

He said that once the mine is in operation the company will extend its drilling program to see if there are further coal reserves in the area.

He agreed that the "preferred location" for shipping the coal is Western Mines dock at the Campbell River spit which he described as close to the estuary but not in it.

Desjardins said the coal won't be trucked through a residential area, but he said it would go close to the community.

Assistant deputy environment minister Walter Redel said the study report on the estuary was received by the government in early summer at almost the same time as another report compiled by industries which use the estuary.

"There was some conflicting evidence from the professionals who worked on these reports, so we asked for a internal government examination of both of them," Redel said. "This third report has been completed and the minister has all three of them. Now we are waiting for some direction from the minister, and a decision on these reports is high on his agenda."

Meanwhile, Murphy said his association is sponsoring a public meeting to discuss the coal project on Oct. 28 at 8 p.m. in Campbell River.

"We as an association are completely opposed to any new industry in the estuary," he said. "Biologists have told us that 80 per cent of the estuary land is already being used. This coal dock would be going on some of the remaining 20 per cent of the estuary. I don't know how the coal dust can be controlled even if it is sprayed with something."

APPENDIX 13

WATER USE LICENCES IN THE CAMPBELL RIVER BASIN

(30)

NANAIMO WATER DISTRICT | COURTENAY PRECINCT | CAMPBELL RIVER & TRIBUTARIES

QUANTITIES IN BRACKETS ARE INCLUDED IN THE LARGER AMOUNTS

DATE	LICENCE Condi-tional	LICENCE Final	SOURCE	LICENSEE	LAND (Sayward Dist.Unless otherwise noted)	QUANTITY	Pur-Pose	Point of Diversion	Completion to 31 Dec.	Completion to Extends to 31 Dec.	File No. District Engineer	File No. Comptroller	REMARKS
6 Mar.1956	23169		Quinsam R.	B.C.Hydro & Pwr.Author.	D.L.1124 & L.1,R.P 10831 of pt.D.L.'s 87 & 88 on which are situate pwr.sites hse.	120,000 ac.ft.	Pwr.	92 F/NW (F-4) B,4825 92 K/3d	1960			0210707	Min. Flow Clause
26 Mar.1956	23170		Quinsam R.	B.C. Power Commission	Stor.for C.L.23169	10,000 ac.ft.	Stor.	92 K/3d 92 F/NW (F-4) B,4825	1960			0210707	Min. Flow Clause Stor.in Wokas Lake
3 May 1956	23682		Campbell R.	B.C. Power Commission	A pwr.hse.site on L.1,R.P.10831 of pt. D.L.'s 87 & 88	2850 c.f.s.	Pwr.	92 K/3d	1958			0206232	
22 Jan.1958	Amend. 24242		Quinsam R.	Eng.Div. Minings/ Forests	50 acs.of L's 1&2 of L. 1476,Pl.9399	75 ac.ft.	Irr.	P,4824		1973		0218980	
24 July 1958	24490		Campbell R.	N.Campbell R. Wwks. Dist.	Lands within the bdys.of the N.Campbell R. Wwks.Dist.	200,000 g.a.d.	Wwks.	B,4825	1963			0203476	R/W
4 Aug. 1958	45103		Fing Fisher Br.	Peace & Son Holding	6 acs.that pt.of L.66 lying S. of Pls.1403R & 7724	6 ac.ft. 1100 g.a.d	Irr. Dom.	Y,4824	1979			0221435	Sub. C.L.24621
Sept.1961	27111		Campbell R.	Crown Zellerback Canada	Lot 109,	65 c.f.s.	Ind.	F,4825	1965			0238250	
Apr. 1964	29102		Tennent Cr.	Western Mines Ltd.	A pwr.hse.site on UVCL & pwr. transmitted to L.1659 "Mink" MC & L.1660 "Lynx" MC all within Clayoquot Dist.	17 c.f.s.	Pwr.	92 F/NW (A-4)				0255644	
Apr. 1964	29103		Tennent Cr.	Western Mines Ltd.	Stor. for CL29102	3,000 ac.ft.	Stor.	92 F/NW (A-4)				0255644	Stor.in Tennent
1 July 1965	30908		Campbell R.	Crown Zellerback Canada	Lot 109	35 c.f.s.	Ind. Pulp & Paper Mill	C & F 4825	1968			0263415	

(Continued next page)

NANAIMO WATER DISTRICT — COURTENAY PRECINCT — CAMPBELL RIVER & TRIBUTARIES

QUANTITIES IN BRACKETS ARE INCLUDED IN THE LARGER AMOUNTS

DATE	LICENCE		SOURCE	LICENSEE	LAND (Sayward Dist. Unless otherwise noted)	QUANTITY	Pur-pose	Point of Diversion	Completion to		File No.		REMARKS
	Condi-tional	Final							31 Dec.	Extends to 31 Dec.	District Engineer	Comptroller	
21 Nov.1907		Amend 3913	Campbell R.	Elk R.Timber Co.	Undertaking of Co. adjacent to Campbell R. extending for about 1 mile near mouth.	Clearing Streams		92 K/SW (B-8) 4825	Nov.21 1976			0265053	
7 Sept 1939	14336	Amend 13573	Quinsam R.	Indian Affairs	12.7 acs.of 13.19 ac.pol.of I.R. No.12 Quinsam	12.7 ac.ft.	Irr.	P,4824	1964			0136633	
5 Nov.1940	O/C	1440	Campbell R. & Tribs.	RESERVED				92 K/SW 92 F/NW 4825				0139719	
23 Mar.1946	17294		Campbell R.	B.C.Power Commission	D.L. 1124	2716 c.f.s.	Pwr.	B,4825	1953			0156743	R/W
23 Mar.1946	17295		Lr.Campbell Lake	B.C. Power Commission	Stor. for C.L. 17294	251,000 ac. ft.	Stor.	92 K/3d	1953			0156743	W.R.Plans 3544-600' contour Stor.in Lower Campbell Lake.
22 Mar.1948	Amend 18794		Campbell R.	Gr.Campbell Corp.of Village River Water Dist.	Land within bdys.of Gr.Campbell River District	100,000 g.a.d.	Wwks.	B,4825		1970		0172749	R/W Pub.Utilities Comm. Amend.
20 Oct.1950	20012	15564	Campbell R.	Crown Zellerback Canada	D.L. 109	25 c.f.s.	Ind. Pulp Mill	C,4825				0186351	
22 June 1951	20713		Campbell R.	B.C. Power Commission	A power house site on D.L. 1124	1358 c.f.s.	Pwr.	B,4825	1955			0189364	
22 June 1951	20714		Buttle L.	B.C. Power Commission	Stor. for C.L.'s 20713 & 17294	360,000 ac.ft.	Stor.	92 F/NW (E-4) (B,4825)	1955			0189364	Stor.in Duttle Lake
13 Apr.1954	Amend 22156		Campbell R.	N. Campbell R. Wwks.Dist.	Land within bdys. of N.Campbell River Wwks. District	200,000 g.a.d.	Wwks.	B,4825	1963			0203476	
5 Jan.1955	22513		Campbell R.	B.C. Power Commission	A pwr.house site on pt. of D.L. 88 Sayward	2850 c.f.s.	Pwr.	92 K/SW (A-5) 92 K/3d	1958			0206232	R/W
14 Mar.1955	22581		Buttle L., Upr.Campbell L.& Campbell R.between Upr.Campbell & Campbell R.	B.C. Power Commission	Stor. for C.L.'s 20713, 17294, 22513, 33093	800,000 ac.ft.	Stor.	92 F/NW (F-4) 1959 B,4825 92 K/3d				0207076	R/W
28 Dec.1955	23074		Campbell R.	B.C. Power Commission	A pwr.house site located on parts of Blocks 45 & 129 Comox Dist.	3100 c.f.s.	Pwr.	92 F/NW (F-4)	1960			0210420	
23 Jan.1956	Amend 23083		Campbell R.	Gr.Campbell R.Water Dist.	Lands within bdys. of Gr.Campbell R. Water Dist.	1,000,000 g.a.d.	Wwks.	B,4825		1970		0172749	

(Continued next page)

DATE	LICENCE Condi-tional	LICENCE Final	SOURCE	LICENSEE	LAND (Sayward Dist. Unless otherwise noted)	QUANTITY	Purpose	Point of Diversion	Completion 31 Dec.	File No.	REMARKS
4 May 1966	31534		East Tennent Cr.	Western Mines Ltd.	A pwr.hse.on Crown land held under PUP 473 & pwr.transmitted to L.1659 Mink M.C. & L.1660 Lynx M.C. Clayoquot Dist.	17c.f.s.	Pwr.	92 F/NW (A-B-3)	1968	0267180	Supp. to C.L 29102 C/W pend.
4 May 1966	32063		Tennent Cr.	Western Mines Ltd.	Those lands within Clayoquot Dist.held under P U P #477	4 c.f.s.	Mng.	92 F/NW (A-B-3-4)	1968	0269082	
2 Sept 1966	42140		Langstroth Spring	B. Peterson	L.C. of L.1476 Pl.19754	500 g.a.d.	Dom.	S,4824	1975	0317559	Sub. C.L. 32065 (in pt.)
7 Nov.1966	35143		Upr.Campbell Lake	J.P. & M.H. Boulding	Ls.12 - 15 incl. of Blk.846 Comox Dist. Pl.13787	3 ac.ft. 10,000 g.a.d.	Irr.	92 F/NW (E F-3)	1971	0270750	
7 Mar.1967	32610		John Hart Lake	B.C.Forest Service Reforestration Div.	75 acs.of L.176, exc. Pl.17331 & Pt.of Blk. A L.51 held under Reserve 0278189	75 ac.ft	Irr.	92 K/3c (A-5)		0273125	
25 Aug.1967	33162		John Hart Lake	B.C.Forest Service Reforestration Div.	15 acs.of Blk.A of L.51 held under Reserve 0258758	15 ac.f.t	Irr.	92 K/3c (A-5,6)	1970	0273947	
4 Oct.1967			Quinsam R.	Gr.Campbell R.Water Dist.	Lands within the boundaries		Wwks.	92 F/NW (F-6)		0277166	R/W
19 Dec.1967	33093		Campbell R.	B.C. Hydro & Pwr. Auth.	A pwr.hse.site on pts. of Blks. 45 & 129 Comox Dist.	3100 c.f.s.	Pwr.	92 F/NW (F-4)		0277417	
15 Feb.1968	35953		Flintoff Creek	C. Kolonsky	7 acs.of Blks.A & B of L. 276	7 ac.ft.	Irr.	92 K/3c (B-1)	1974	0277611	
15 Feb.1968	35954		Flintoff Creek	C. Kolonsky	Stor.for C.L.35953	3 ac.ft.	Stor.	92 K/3c (B-1)	1974	0277611	R/W
17 May 1968	34798		John Hart Lake	Attorney General (Correct.Br.)	Pt.Blk.A of L.51 held under Reserve 0239955	10,000 g.a.d.	Wwks.	92 K/3c (B-1)	1975	0281083	
27 Sept.1968	34885		Cold Creek	I.M. F.M. Knowles	Ls. 1609 & 1610	1000 g.a.d.	Dom.	T,4824	1972	028177	
5 June 1969	35660		Cold Creek	I.M. & F.M. Knowles	Pwr.hse.site on L. 1610	2 c.f.s.	Pwr.	T,4824	1973	0285740	
8 May 1970	39942		Cold Creek	Dept. of Fisheries	L. 80	30 c.f.s.	Con.	V,4924	1976	0296403	R/W
22 July 1970	38422		Baikie Cr.	V.J. Albright	L.22 of Blk.846 Pl. 15452	500 g.a.d.	Dom.	92 F/NW (E-3)	1973	0296948	
22 July 1970	43113		Webster Cr.	Western Mines Ltd.	Land within Clayoquot Dist.held under Park Use Permit #477	200,000 g.a.d.	Mng. Dom.	92 F/NW (A-4)		0296950	
22 July 1970	43379		Water tank Creek	Western Mines Ltd.	Those lands within Calyoquot Dist.held under P U P 477	4 c.f.s.	Mng.	92 F/NW (A-R-3-4)	1976	0296951	

(Continued next page)

NANAIMO WATER DISTRICT COURTENAY PRECINCT CAMPBELL RIVER CREEK & TRIBUTARIES

DATE	LICENCE		SOURCE	LICENSEE	LAND (Sayward Dist. Unless otherwise noted)	QUANTITY	Purpose	Point of Diversion	Completion	File No.	REMARKS
	Conditional	Final							31 Dec.		
18 Nov.1970	37165		John Hart L.	Reforestration Div.(Forest Service)	L.176 exc.Pl.17331; & that pt.of Blk.A of 1.51 held under Res. 0276764	3000 g.a.d.	Dom.	92 K/3c (C-1)	1972	0300478	
APPROVAL 468			Baikie Sl Slough	Raven Lumber Ltd.	Appr.to constr.causeway & Bulkhead in vicintiy Blk.B of Ls. 67, 321, & 1217			H & J 4825		0304468	
22 Feb.1972	39943		Quinsam R.	Dept.of Fisheries	L. 80	10 c.f.s.	Con.	W,4824	1976	0309655	
9 Feb.1973	41862		Campbell R.	N.Campbell R. Waterworks District	All land within the bdys.of N. Campbell R.Waterworks Dist.	1,300,000 g.a.d.	Wwks.	B,4825		0316387	
18 July 1973	42345		Langstroth Spg.	W. Tuttle	L.B. of L. 1476 Pl. 19754	500 g.a.d.	Dom.	S,4824		0317279	
10 Dec.1974	44959		Irwin Cr.	William Williamson	L.1 of L.1476 Pl. 23286	1500 g.a.d.	L.Imp.	K,4825	1979	0328179	
APPROVAL	1110		Quinsam R.	Gr.Campbell R. Water Dist.	App.to lay pipe across Quinsam R.in vicinity of L.90 & L.14-76, Plan 9399			M,4825		0338110	
APPROVAL	1086		Arapha Br.	Ram Bldg. Supplies Ltd.	Channel Relocation within Lot 5 of Lot 66, Plan 2596			L,4825		0338086	
7 July 1976	47881		Baikie Cr.	G.J. Lee	L.23 of Bl. 846, Pl. 15452	500 g.a.d.	Dom.	92 F/NW	1978	0330950	
4 Aug.1976	47882		Baikie Cr.	H.B. Baikie	L.31 of Bl.846, Comox Dist. Pl.15452	500 g.a.d.	Dom.	92 F/NW	1978	0340066	
APPROVAL	1151		Bayle Cr.	Peace & Son Holding Ltd.	Channel relocation within L. 1392			Z,4824		0338151	
APPROVAL	1370		Collett Cr.	H. Portman	Appr.to make changes in a stream within Lot 1298			AA 4824		0338310	
APPROVAL	1389		Baikie Slough	Raven Lumber Ltd.	Appr.to dredge in a stream within Lots 217, 321, & 67.			N & P 4825		0338389	

(Continued next page)

APPENDIX 14

ESCAPEMENT RECORDS FOR CAMPBELL RIVER AND QUINSAM RIVER

(52)

ESCAPEMENT RECORD FOR CAMPBELL RIVER

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947		3500	3500	7500	7500	1500
48		3500	1500	15000	7500	1500
49		1500	400	3500	200.	1500
50		1500	750	3500	7500	1500
51		1500	750	7500	400	750
52		3500	3500	3500	7500	750
53		3500	750	1500	75	1500
54		1500	750	3500	1500	750
55		3500	750	750	200	750
56		750	750	1500	1500	750
57		1500	25	400	75	75
58		3500	400	1500	750	400
59		1500	750	750	75	UNK
60		3500	75	400	400	UNK
61		1500	400	1500	75	UNK
62		4000	750	750	400	UNK
63		4000	400	3500	200	UNK
64		6000	750	750	3500	UNK
65		8000	1500	400	400	UNK
66		3500	3500	750	3500	UNK
67		3500	400	750	750	UNK
68	200	3500	3500	750	3500	UNK
69	200	7500	400	3500	750	UNK
70	N/O	3500	3500	3500	3500	UNK
71	75	7500	1500	1500	750	UNK
72	75	7500	1500	3500	3500	UNK
73	150	4300	1000	4000	1000	N/O
74	75	2500	1500	3500	4000	UNK
75	25	2250	400	3000	1500	UNK
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
Time						
Arr.	AUG	AUG	SEPT	L SEPT	AUG	
Start	SEPT	SEPT	SEPT	OCT	SEPT	
Peak	L SEPT	L SEPT	L OCT	NOV	SEPT	
End	OCT	NOV	E DEC	NOV	OCT	

REMARKS

- Escapements prior to 1957 include Quinsam River counts.

ESCAPEMENT RECORD FOR QUINSAM RIVER

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947						
48						
49						
50						
51						
52						
53						
54						
55		*NO	RECORDS PRIOR TO 1957 (Except for 1935)			
56						
57		25	7500	1500	3500	750
58		75	1500	3500	7500	1500
59		25	7500	200	3500	UNK
60		25	1500	200	750	UNK
61			7500	750	3500	UNK
62			7500	750	750	UNK
63			3500	750	3500	UNK
64			3500	200	1500	UNK
65			12000	400	3000	UNK
66			3500	400	1500	UNK
67			1500	750	1500	UNK
68	75		3500	200	1500	UNK
69	N/O		750	400	750	UNK
70	N/O	N/O	3500	750	1500	UNK
71	25	25	1500	400	400	UNK
72	200	75	1500	1500	3500	UNK
73	38	5	4650	1000	4000	N/O
74	25	75	3500	400	7500	UNK
75	25	200	3500	400	30000	UNK
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
Time						
Arr.	AUG		SEPT	OCT	E SEPT	
Start	SEPT	SEPT	L SEPT	OCT	SEPT	
Peak	L SEPT	L SEPT	E NOV	OCT	SEPT	
End	OCT	OCT	DEC	L NOV	OCT	

REMARKS

* Prior to 1957, Quinsam River escapements were included in Campbell River counts.

APPENDIX 15

AGENCIES VISITED OR CONTACTED

AGENCIES VISITED OR CONTACTED

FEDERAL AGENCIES

Energy Mines and Resources

Geologic Survey of Canada - 100 West Pender Street, Vancouver, B.C.
(666-3812 Library)
Surveys and Mapping Division - 100 West Pender Street, Vancouver, B.C.

Environmental Management Service

Atmospheric Environment Service - 739 West Hastings, Vancouver, B.C.
(666-1179)
Canada Wildlife Service - 5421 Robertson, Delta, B.C.
(946-8546)
Inland Waters Directorate - 1001 West Pender Street, Vancouver, B.C.
Water Planning and Management Branch
Water Quality Branch
Water Survey of Canada

Canadian Forestry Service
Pacific Forest Research Center - 506 West Burnside Road, Victoria, B.C.
(388-3811)

Environmental Protection Service - Kapilano 100, West Vancouver, B.C.
(666-6711)

Fisheries and Oceans

Habitat Protection Unit - 1090 West Pender Street, Vancouver, B.C.
Campbell River Regional Office - Island Highway, Campbell River, B.C.
Library - 1090 West Pender Street, Vancouver, B.C.
(666-3851)
Quinsam Hatchery - Campbell River
(287-9564)

Indian and Northern Affairs

Head Office - 700 West Georgia Street, Vancouver, B.C.
(666-1681)

Campbell River District Office
(287-8834)

Manpower and Immigration

Economic Analyses and Forecast Branch - 1055 West Georgia Street, Vancouver, B.C.
(666-6328)

Statistics Canada - 1145 Robson Street, Vancouver, B.C.
(666-3695)

PROVINCIAL MINISTRIES/DEPARTMENTS

Agriculture - 808 Douglas, Victoria, B.C.
(387-5121)

Economic Development - 1405 Douglas, Victoria, B.C.

Education

Public Services Branch - 878 Viewfield, Victoria, B.C.

Environment - 780 Blanshard, Victoria, B.C.
(387-3347)

Environmental Land Use Committee - 614 Humboldt, Victoria, B.C.
(387-1665)

Land Commission (387-3171 - Ecological Reserves)
(294-5211 Vancouver Office)

Pollution Control Branch
(387-5321)

Resource Analyses Branch - 839 Academy Close, Victoria, B.C.
(387-5995)

Water Rights Branch
(387-3413)

Water Investigations Branch
Environmental Studies Division
(387-5321)

Forest Service

Campbell River District Office - 470 Island Highway, Campbell River, B.C.
(287-9135)

Forest Inventory - 1450 Government, Victoria, B.C.

Mines and Petroleum Resources

Economic & Planning Division - 1005 Broad Street, Victoria, B.C.
(387-3787)

Provincial Secretary and Travel Industry

(387-1727)

Travel - 1117 Wharf, Victoria, B.C.
(387-1642)

Recreation & Conservation

Fish & Wildlife - 1019 Wharf Street, Victoria, B.C.
(387-3473)

Campbell River - (287-2241)

Nanaimo - 324 Terminal, (754-1371)

Heritage Conservation Branch - 835 Humboldt, Victoria, B.C.

Archaeological Sites - (387-5038)

Historical Sites - (387-5165)

Parks - 1019 Wharf Street, Victoria, B.C.
(387-1696)

Recreation - 1019 Wharf Street, Victoria, B.C.
(387-3791)

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