Province of British Columbia
Ministry of Environment, Lands and Parks

Vancouver Island Region

French Creek

Water Allocation Plan

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FRENCH CREEK WATER ALLOCATION PLAN

1.0 INTRODUCTION

The Water Management Program's goals are to sustain a healthy water resource through anticipating and planning for water uses. Water Allocation Plans are a means of identifying water demands and ensuring that water use is compatible with the goals of a sustainable environment. Water should not be allocated beyond the ability of the resource to replenish itself. The natural amenities must be maintained for present and future generations. Allocations must be based on reasonable expectations that water will be available for the period required without significantly impacting existing licenced allocations or instream flow requirements. Advantages of preparing an allocation plan include:

1. Providing the public with our position on water allocation in advance of water applications (pro-active management, information available to applicants and the public);

2. Reducing response time by having plans in place prior to receiving applications;

3. Eliminating individual studies and reports on each application;

4. Improving the consistency of our approach and decisions;

5. Replacing or reducing most Water Licence Application Reports by pre-defining specific allocation directions and decisions;

6. Being more comprehensive in the plan than in present reports;

7. Eliminating the need for many referrals.

The Vancouver Island Region developed the following policy to provide water allocation direction:

Regional Policy:

The region shall be subdivided into watershed areas and a water allocation plan shall be prepared for each watershed area. Water licence decisions will be made in accordance with approved plans.

Assessments undertaken as part of the water allocation planning process include identifying the surface water resources available, the instream requirements for fish, the existing and potential licensable water demands and providing direction regarding

further water licence allocations.

Input may be sought from other agencies. Referrals go to Federal & Provincial Fisheries agencies and to Water Management in Victoria.

2.0 GENERAL WATERSHED INFORMATION

The French Creek Water Allocation Plan area is located on the East coast of Vancouver Island and encompasses all the streams between the Englishman River to the south and the Qualicum River to the north that drain from the Beauford Mountains into the Strait of Georgia. The plan area is approximately 121 km^2. The plan area encompasses most of the City of Parksville, the Town of Qualicum Beach and the communities of Coombs and Errington. The plan area is illustrated in Figure 1 and cadastral features is illustrated in Figure 2.

The largest stream at the centre of the plan area is French Creek. The headwaters of French Creek drain from a maximum elevation of 1080 meters in the Beauford Mountains to sea level in the Strait of Georgia. Approximately 80% of the plan area is below the 200 meter elevation. The largest body of water in the plan area is Hamilton Marsh which drains into French Creek downstream of the Alberni Highway (Highway 4).

For the purposes of assessing water supplies for allocation demands, the watershed and drainage areas in the following table were identified and illustrated in Figure 1.

French Creek Drainage Areas		
Drainage	Area (km^2)	Median Elevation (m)
Romney Creek	6.52	90
Carey Creek	3.47	50
Morningstar Creek	7.90	60
French Creek	79.09	140
Beach Creek	6.25	80
Grandon Creek	9.15	80

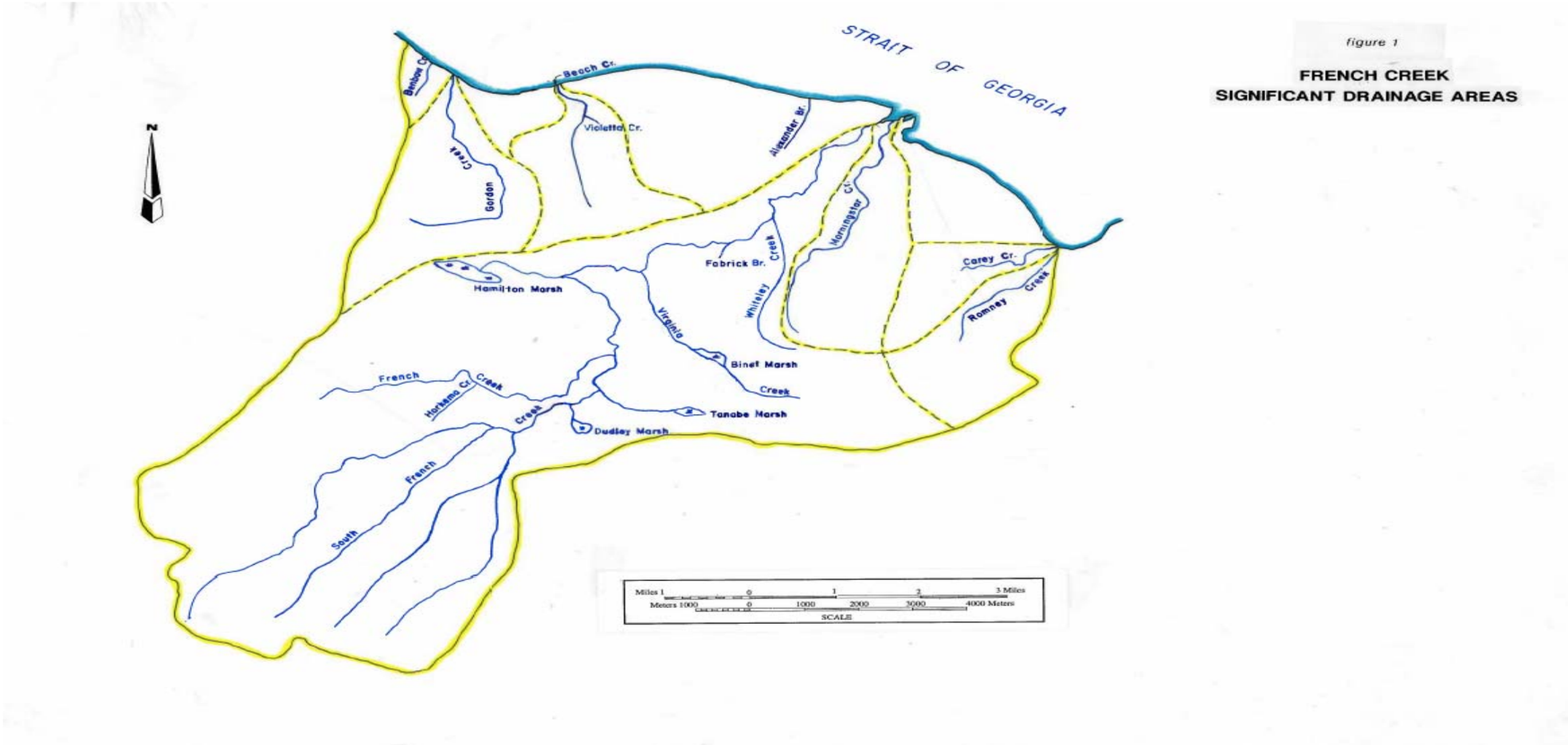


figure 1

FRENCH CREEK
SIGNIFICANT DRAINAGE AREAS

FRENCH CREEK **WATER ALLOCATION PLAN**

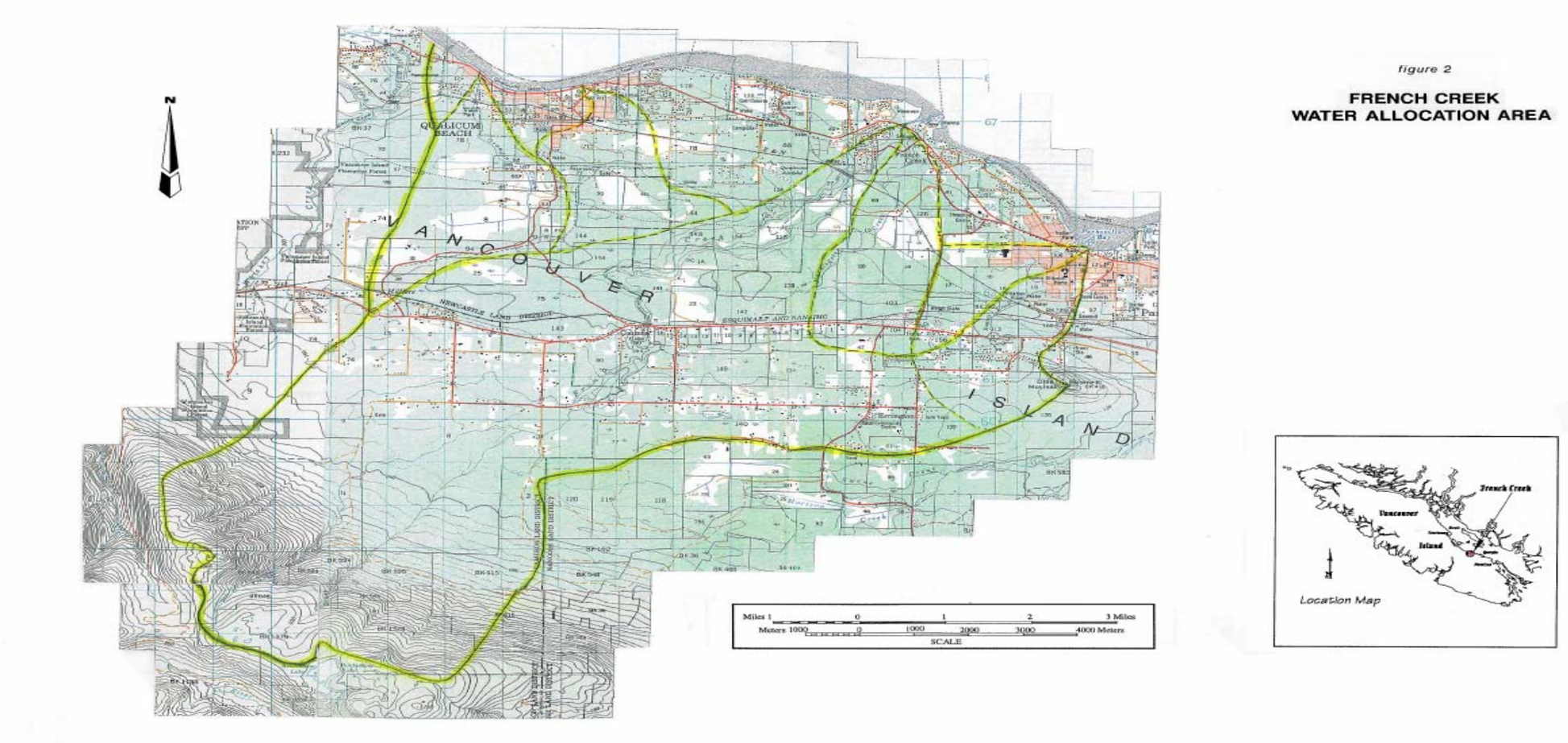


figure 2

FRENCH CREEK
WATER ALLOCATION AREA

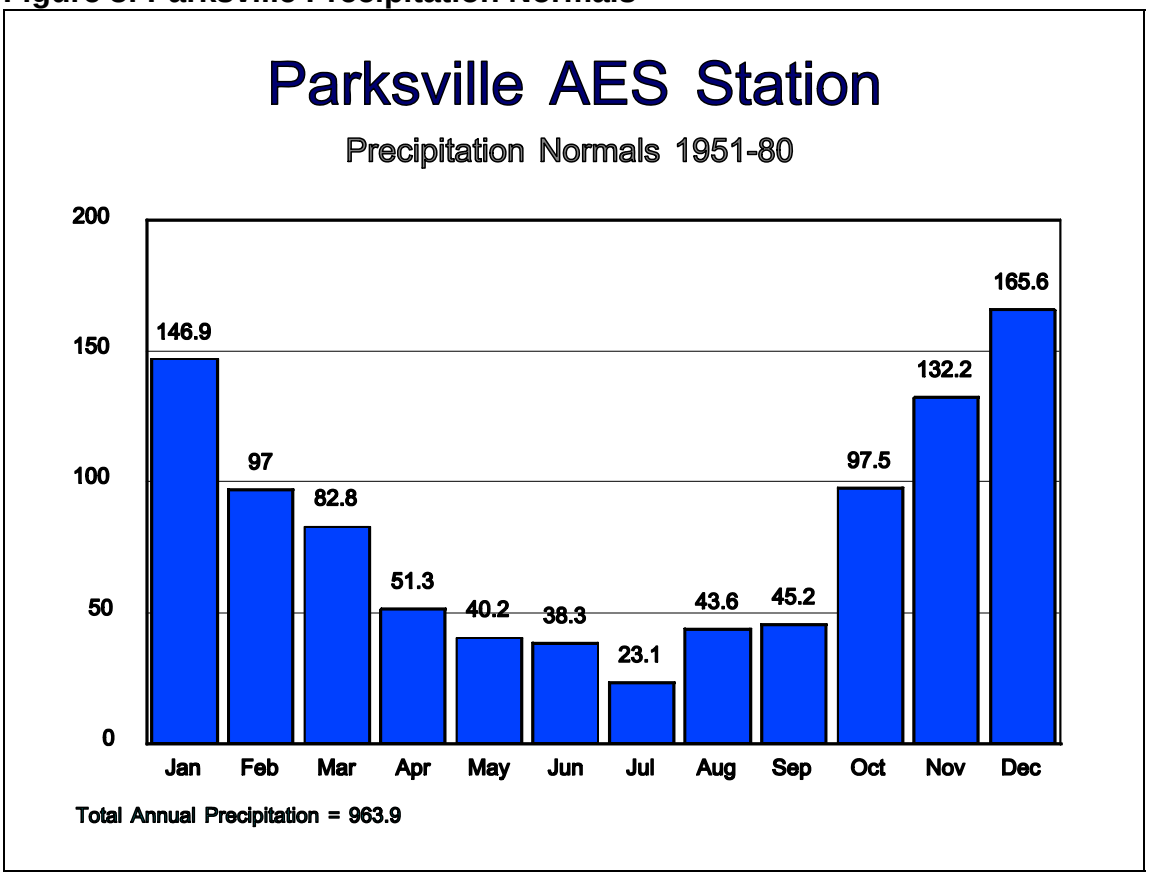
3.0 HYDROLOGY

3.1 Precipitation

There is one AES precipitation station in Parksville just to the west of the French Creek Allocation Plan area. A bar graph showing the monthly precipitation normals for the 1951 to 1980 period for these stations is shown in Figure 3. The Canadian Climatic Normals 1951-1980 data is provided in Appendix A.

The mean total annual precipitation is 963.9 mm (37.9 inches). The minimum mean monthly precipitation is 23.1 mm (0.9 inch) in July and the maximum mean monthly precipitation is 165.8 mm (6.5 inches) in December. The mean number of days with measurable precipitation is 180 days; with 173 days with rain and 11 days with snow.

Figure 3: Parksville Precipitation Normals



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3.2 Hydrometric Information

There are two Water Survey Canada (WSC) hydrometric stations within the French Creek Water Allocation Plan area. Both of these hydrometric stations are on French Creek and both stream flow records are for the April through September period.

The WSC hydrometric station French Creek at Coombs (08HB038) has daily flow records for the period April through September for the years 1969 to 1971 and 1983 to 1989. The mean monthly flow summary for this station is in the following table:

French Creek at Coombs (08HB038) Mean Monthly Discharge litres/sec 1971 to 1978											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			1610	973	271	77	8	48			

The WSC hydrometric station French Creek above the Pumphouse (08HB078) has daily flow records for the period April through September for the years 1990 to 1993 (present). The mean monthly flow summary for this station is in the following table:

French Creek above the Pumphouse (08HB078) Mean Monthly Discharge litres/sec 1990 to 1993											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			1062	437	205	45	77	106			

Neither of the above noted flow records are sufficient to estimate the mean annual discharge (MAD) and the annual distribution of flow for streams within the plan area. Therefore three additional WSC station with small drainage areas and complete annual records were used. The WSC stations used to estimate the MAD and annual distribution of flow are noted in the following table:

Selected WSC Stations			
WSC Station Name	Station Number	Years of Record	Drainage Area (km^2)
French Creek above Pumphouse	08HB078	1990-93	79.1
French Creek at Coombs	08HB038	1969-71 1983-89	58.3
Millstone River near Wellington	08HB027	1961-64 1969-74	46.1
Millstone River at Nanaimo	08HB032	1961-65 1986-90	86.2
Enos Creek at the Outlet of Enos Lake	08HB030	1962-78	1.68

A summary of WSC flow records may be found in Appendix B.

The unit area (1 Kilometre) discharge was estimated from the mean annual and mean monthly records for each station for the period of record. An average annual unit and average monthly unit discharges were used to estimate the mean monthly discharge and mean annual discharge (MAD) in all significant drainages within the French Creek Water Allocation Plan area. These estimated flows per unit area are in the following table:

Unit Area Discharge for Selected WSC Drainage Areas litres/second/Km^2													
Station Number	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAD
08HB078				13	6	3	1	1	1				
08HB038				28	17	5	1	0	1				
08HB027	64	57	62	39	22	6	2	1	0	9	49	95	34
08HB032	62	51	43	26	13	5	1	0	0	8	45	68	27
08HB030	70	45	42	15	4	4	1	0	0	1	20	56	21
Average	65	51	49	24	12	4	1	0	1	6	38	73	27

The above average flows were multiplied by the watershed area to obtain an estimated MAD and mean monthly flows for each identified significant watershed in the following sections of the report. The mean annual discharge (MAD) for the identified drainages and for a unit area (1 km^2) is in the following table:

Mean Annual Discharges		
Drainage	Drainage Area (km2)	MAD (m3/sec)
Romney Cr	6.52	0.179
Carey Cr	3.47	0.095
Morningstar Cr	7.90	0.216
French Cr	79.09	2.167
Beach Cr	6.25	0.171
Grandon Cr	9.15	0.251
Unit Area (1 km^2)	1.00	0.027

The period of low flow, for this report, is the period when the mean monthly flow is below 20% MAD. The percent MAD for the selected WSC stream flow stations with complete annual flow records is noted in the following table:

Percent MAD for Selected WSC Stations												
Station Number	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
08HB027	188%	169%	183%	116%	64%	18%	7%	3%	1%	25%	144%	281%
08HB032	231%	188%	159%	96%	50%	19%	5%	1%	1%	30%	166%	253%
08HB030	328%	211%	194%	72%	17%	19%	3%	0%	0%	6%	92%	261%
Average	249%	190%	179%	95%	43%	19%	5%	1%	1%	20%	134%	265%

The mean monthly flow is below 20% of MAD for the period of June through

September (4 months); the low flow period. The high flow period will be the remaining months of October through May (8 months) when the mean monthly flow is above 20% of MAD.

3.2.1 Romney Creek

Parksville Springs 1, 2 and 3 were originally part of the Romney Creek drainage area. However site inspection indicates that Romney Creek has been diverted into Carey Creek just downstream of the Parksville Springs. For purposes of this report the two creeks will be estimated as separate drainages as they were before the diversion.

Romney Creek has a total drainage area of 6.52 km^2 (2.52 mi^2) from a maximum elevation of 250 metres of Little Mountain to the south of the City of Parksville.

The estimated mean monthly discharge and mean annual discharge (MAD) flow estimates is in the following table:

Romney Creek Mean Monthly and Mean Annual Discharge
litres/sec

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
424	333	319	156	78	26	7	0	7	39	248	476	179

3.2.2 Carey Creek

Most of the drainage of Romney Creek may have been diverted into Carey Creek by drainage development for subdivision within the City of Parksville. For purposes of this report the two creeks will be estimated as separate drainages as they were before the diversion.

Carey Creek has a total drainage area of 3.47 km^2 (1.34 mi^2).

The estimated mean monthly discharge and mean annual discharge (MAD) flow estimates is in the following table:

Carey Creek Mean Monthly and Mean Annual Discharge
litres/sec

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
226	177	170	83	42	14	3	0	3	21	132	253	95

On August 27, 1986, the streamflow of Carey Creek was 1.7 litres/sec (0.059 cfs); measured using a bucket and stopwatch.

3.2.3 Morningstar Creek

Morningstar Creek is tributary to the French Creek tidal area. The drainage area of Morningstar Creek is estimated to be 7.90 km^2 (3.05 mi^2).

The estimated mean monthly discharge and mean annual discharge (MAD) flow estimates is in the following table:

Morningstar Creek Mean Monthly and Mean Annual Discharge litres/sec												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
514	403	387	190	95	32	8	0	8	47	300	577	216

There was no significant flow on August 27, 1986 in the culvert under Lee Road.

Norecol Environmental Consultants Ltd. reportedly measured the flow in Morningstar Creek as 180 litres/sec on November 30, 1988.

3.2.4 French Creek

As noted above, the largest stream at the centre of the plan area is French Creek. The headwaters of French Creek drain from a maximum elevation of 1080 meters in the Beauford Mountains to sea level in the Strait of Georgia. The drainage area of French Creek is estimated to be 79.09 km^2 (30.54 mi^2).

The estimated mean monthly discharge and mean annual discharge (MAD) flow estimates is in the following table:

French Creek Mean Monthly and Mean Annual Discharge litres/sec												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD

5,141	4,034	3,875	1,898	949	316	79	0	79	475	3,005	5,774	2,135

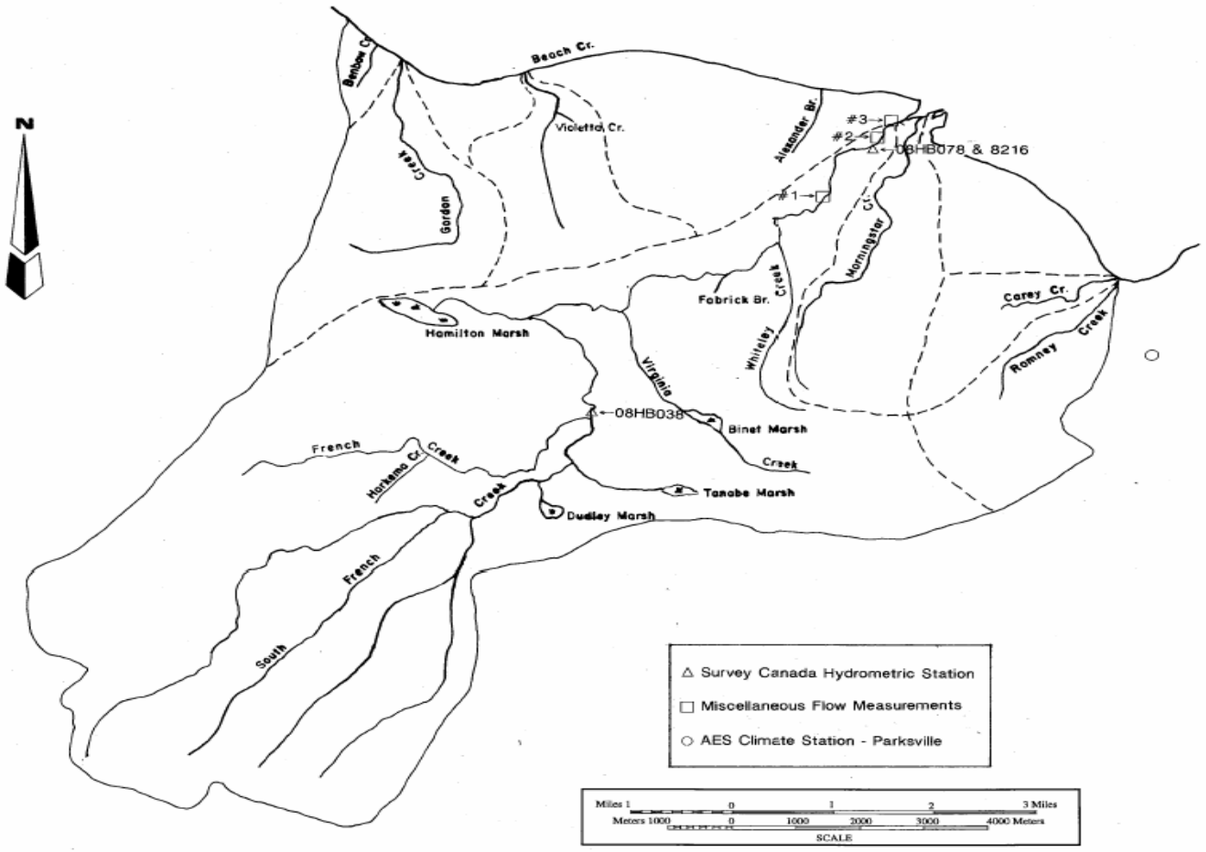

figure 4

FRENCH CREEK
FLOW MEASUREMENT LOCATIONS

As well as the two Water Survey Canada (WSC) hydrometric stations on French Creek used to derive the above estimate, there are also miscellaneous flow measurements on French Creek. From June to October in 1982 and from May to October in 1983, 23 flow measurements were made with a Price Flow Meter on French Creek upstream of the Pumphouse (Station Number 8216). Also in September, October and November of 1987, 15 flow measurements were made with Parshall Flumes at three locations, namely; French Creek at Railroad Trestle (#1); French Creek 1,000 ft below Barclay Road (#2); and French Creek above Island Highway (#3). These miscellaneous flow records where compared with the estimated monthly flows for French Creek and the mean monthly flows of the two Water Survey Canada (WSC) hydrometric stations on French Creek. These miscellaneous flows indicate that there may be a small flow maintained throughout the month of August and, during some low flow years, the flow in the months of September, October and early November may be substantially less than the estimated mean monthly flows in the above table. Flow measurement locations are illustrated in Figure 4. The miscellaneous flow records and the comparison may be found in Appendix C.

Tributaries of French Creek include Fabrick Brook, Whiteley Creek, Virginia Creek, Binet Marsh, Hamilton Marsh, Little Hamilton Marsh, Tanabe Marsh, Dudley Marsh and South French Creek. Most small creeks tributary to French Creek, without significant storage in a marsh, have little or no flow during the low flow period.

3.2.5 Beach Creek

The Beach Creek drainage area is estimated to be 6.25 km^2 (2.41 mi^2).

The estimated mean monthly discharge and mean annual discharge (MAD) flow estimates is in the following table:

Beach Creek Mean Monthly and Mean Annual Discharge litres/sec												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
406	319	306	150	75	25	6	0	6	38	238	456	171

Sigma Engineering Ltd. measured the outflow from the Qualicum Highland Golf & Country Club as 99 litres/second on February 26, 1990 (File 1001275).

Violetta Creek is tributary to Beach Creek.

3.2.6 Grandom Creek

The Grandom Creek drainage area is estimated to be 9.15 km^2 (3.52 mi^2).

The estimated mean monthly discharge and mean annual discharge (MAD) flow estimates is in the following table:

Grandom Creek Mean Monthly and Mean Annual Discharge litres/sec												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAD
595	467	448	220	110	37	9	0	9	55	348	668	251

3.2.7 Other Small Drainages

There are numerous springs and small brooks that flow into the Strait of Georgia in the areas between the above identified drainages. Alexander Brook, northwest of French Creek, and Benbow Creek, northwest of Grandom Creek, are two examples. The drainage areas of these smaller drainages can not be determined on the existing map scale. Information from investigations and reports associated with water licence applications indicate that there is no significant flow from most springs or streams in these smaller drainages from mid-July to the end of September.

3.3 Marshes

The largest body of water in the plan area is Hamilton Marsh which drains into French Creek downstream of the Alberni Highway (Highway 4). The storage provided in this marsh may contribute to the maintenance of some flow in French Creek below the confluence during the low flow period. Other small marshes, such as Price Marsh, Oldaker Marsh, Dudley Marsh, Binet Marsh, Whiteley Marsh and Clatworthy Marsh, provide small local water supplies.

3.4 Water Supply

The following table summarizes the estimated water supplies for each significant drainage and for a unit drainage:

Water Supply Summary			
Drainage	**MAD (m^3/sec)**	**June-Sept Min. Flow (l/sec)**	**Oct-May Volume (dam^3)**
Romney Creek	0.179	0.0	5,432
Carey Creek	0.095	0.0	2,891
Morningstar Creek	0.216	0.0	6,582
French Creek	2.167	0.0	65,894
Beach Creek	0.171	0.0	5,432
Grandon Creek	0.251	0.0	7,623
Unit Area	0.027	0.0	833

4.0 INSTREAM FLOW REQUIREMENTS

Maintaining the natural stream environment and instream uses is of paramount importance for present and future generations. Maintaining water for the fisheries resource is a key factor in also providing instream flow requirements for water quality, recreational, aesthetic and cultural values. The Provincial Ministry of Environment policy is:

In situations where a water allocation decision will significantly impact instream uses of water, the comptroller or regional water manager may refuse the application or include water licence conditions to protect the instream use.

Instream fisheries flow requirements are based on a provincially modified version of the Tennant (Montana) Method.

Modified Tennant (Montana) Method Instream Flow Requirements	
Flows	**Description**
30-60% MAD	Excellent spawning/rearing
20-30% MAD	Good spawning/rearing
10-20% MAD	Fair spawning/rearing
5-10% MAD	Poor spawning/rearing
>5% MAD	Severely degraded spawning/rearing

In drainages where fish are present, the minimum flow required to sustain the fisheries resource for fair spawning and rearing habitat is 10% of the Mean Annual Discharge (MAD). Therefore, the Regional policies to implement the Provincial policy are:

The minimum flow required to sustain the fisheries resources for spawning and rearing is 10% of the Mean Annual Discharge (MAD); unless a more rigorous analysis indicates a different minimum flow requirement.

For streams where the natural mean monthly flow falls below 10% of the MAD, extractive licensed demands should only be allowed for the period of months when the mean monthly flow is above 60% of the MAD

For streams where the mean 7-day average low flow falls below 10% of the MAD, extractive demands should only be allowed for the period of months when the mean monthly flow is above 60% of the MAD (Figure 1.3). Where the mean 7-day average low flow remains above 10%, then the 7-day low flow amount above 10% MAD is available)

Withdrawals from natural water bodies (lakes, ponds, swamps and marshes) supporting natural fisheries resources shall not reduce the shoal area more than 10%.

The shoal area is the area from the lake shore at average summer lake level to a 6 metre depth.

The flows in all the streams in the French Creek Water Allocation Plan area are naturally limiting to fish production and maintenance of fish habitat. Figure 5 indicates the identified fish habitat.

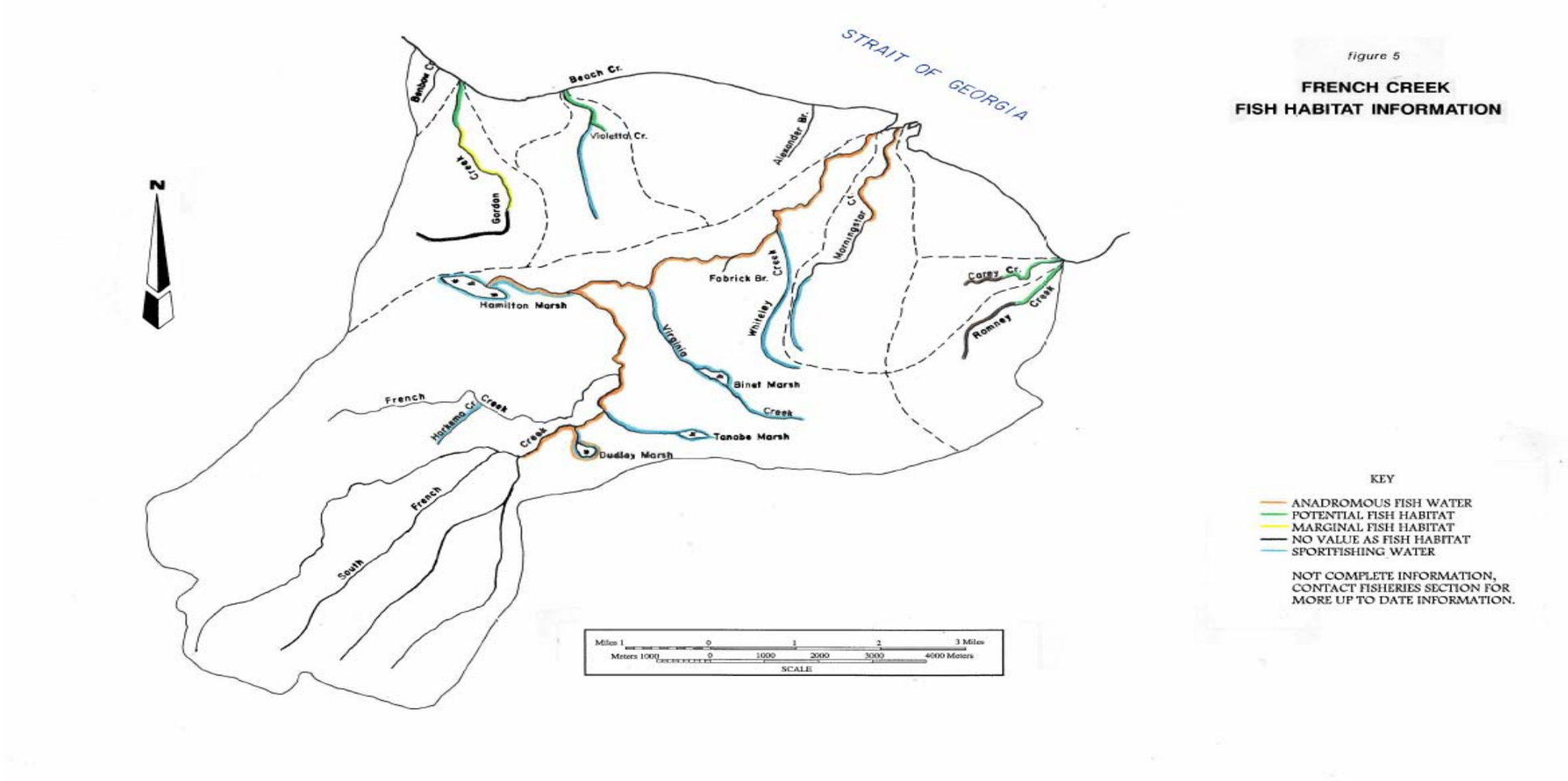

figure 5

FRENCH CREEK
FISH HABITAT INFORMATION

KEY

- ANADROMOUS FISH WATER
- POTENTIAL FISH HABITAT
- MARGINAL FISH HABITAT
- NO VALUE AS FISH HABITAT
- SPORTFISHING WATER

NOT COMPLETE INFORMATION, CONTACT FISHERIES SECTION FOR MORE UP TO DATE INFORMATION.

4.1 Romney Creek and Carey Creek

There was potential fish habitat identified in the lower reach of both Romney Creek and Carey Creek. However both creeks have been extensively channelized and culverted for subdivision development in the City of Parksville. Also Romney Creek has been diverted into Carey Creek just downstream of the Parksville Springs in order to accommodate further subdivision development. At the mouth of Carey a waterfall barrier to fish passage further limits its use by fish.

4.2 Morningstar Creek

Cutthroat trout and coho salmon utilize Morningstar Creek from just above Lee Road to the confluence with French Creek. However summer low flows naturally limit fish production and maintenance of fish habitat.

The estimated mean monthly flow in Morningstar Creek is below 10% of the Mean Annual Discharge (MAD) for the months of July, August and September. Therefore water is only available for extractive use during the months of November to April when the mean monthly flow is above 60% MAD. No water is available from Morningstar Creek when the flow is below 130 litres/second (60% MAD). Therefore the estimated volume of water available during the November to April period is 4,171 dam^3.

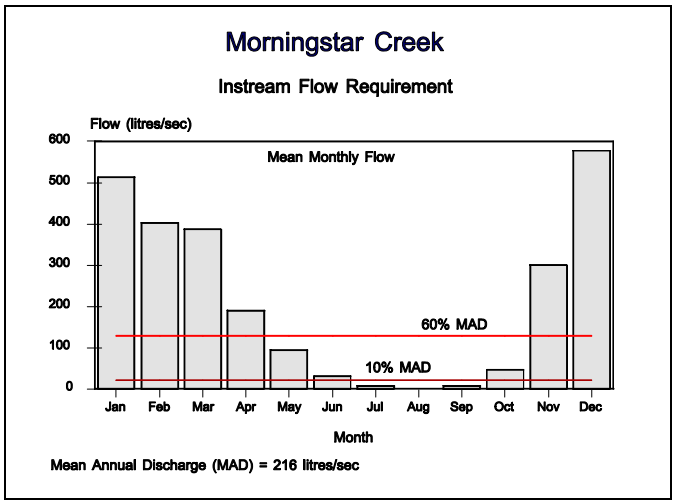

Figure 6

4.3 French Creek

French Creek is the most utilized stream for fish within the plan area. Pink, Chinook, Coho and Chum Salmon and Steelhead and Cutthroat Trout utilize French Creek. Coho Salmon have been stocked in French Creek. These fish not only utilize the main channel of French Creek but also Dudley Marsh and the channel that drains from Hamilton Marsh. However, even in French Creek, the summer low flows are naturally limiting to fish production and fish habitat maintenance

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Schaedler's Falls provides a barrier to spawning fish approximately 3.5 km upstream of Coombs on French Creek. Dudley Marsh is managed by Ducks Unlimited as an overwintering site for coho fry.

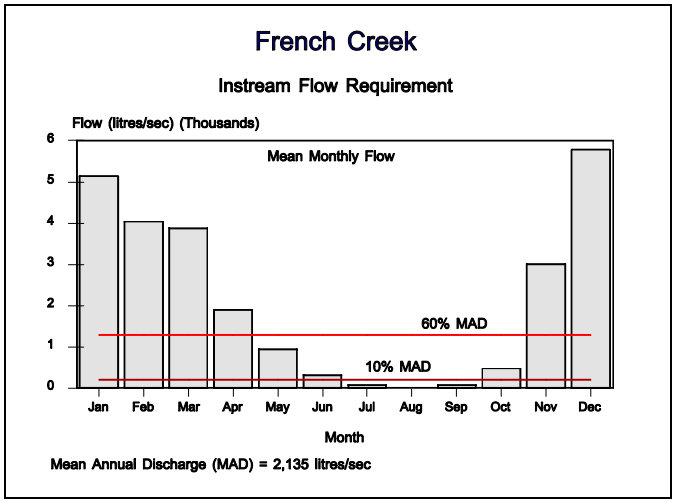


Figure 7

The estimated mean monthly flow in French Creek is below 10% of the Mean Annual Discharge (MAD) for the months of July, August and September. Therefore water is only available for extractive use during the months of November to April when the mean monthly flow is above 60% MAD. No water is available from French Creek when the flow is below 1,281 litres/second (60% MAD). Therefore the estimated volume of water available during the November to April period is 42,048 dam^3.

4.4 Beach Creek

Potential fish habitat identified in the lower reach of Beach Creek has been exploited by the fisheries agencies and the local fish and game club. A small salmon enhancement project has been implemented on the creek. Coho from the Big Qualicum Hatchery have been stocked in Beach Creek. Also a resident trout population has developed above the golf course's main pumping pond.

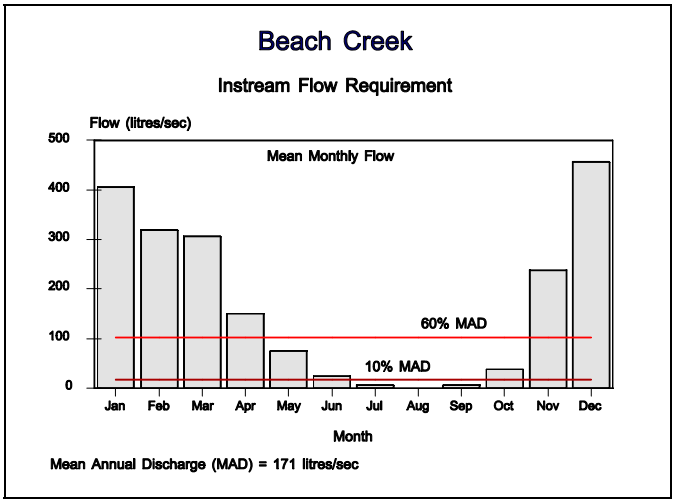


Figure 8

The estimated mean monthly flow in Beach Creek is below 10% of the Mean Annual Discharge (MAD) for the months of July, August and September. Therefore water is only available for extractive use during the

months of November to April when the mean monthly flow is above 60% MAD. No water is available from Beach Creek when the flow is below 103 litres/second (60% MAD). Therefore the estimated volume of water available during the November to April period is 3,295 dam^3.

4.5 Grandom Creek

Potential fish habitat and marginal fish habitat has been identified in Grandon Creek. However there is no evidence of fish utilizing this habitat.

4.6 Other Small Streams

There is no identified significant fish habitat in the other small streams within the plan area.

5.0 LICENSED WATER DEMAND

There are 69 water licenses currently (December 1993) within the French Creek Water Allocation Plan area. More than half of these water licences (36) are for domestic purposes for rural residential demands. Figure 9 illustrated the number of water licences issued for each purpose for streams within the plan area. There are 18 water licences for irrigation purposes, 6 water licences for industrial purposes, 3 water licences for conservation, 2 water licences for municipal waterworks purposes, 2 water licences for land improvement purposes and 2 water licences for storage purposes.

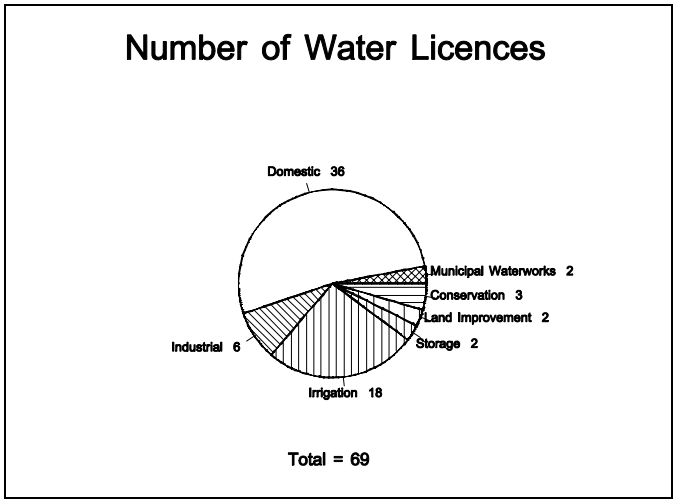


Figure 9

Of greater significance for water management is the estimated average annual licenced water demands and low flow water demands. The total estimated average annual licenced water demand for the plan area is 1,318.7 dam^3. Figure 10 illustrates the estimated average annual licenced water demands for each purpose under which water licences have issued within the plan area. The largest annual water demand is for conservation purpose. The second largest annual water demand is for municipal waterworks purpose; followed by irrigation purpose, industrial purpose, storage purpose, land improvement purpose and finally domestic purpose. The following table summarizes these annual water demands.

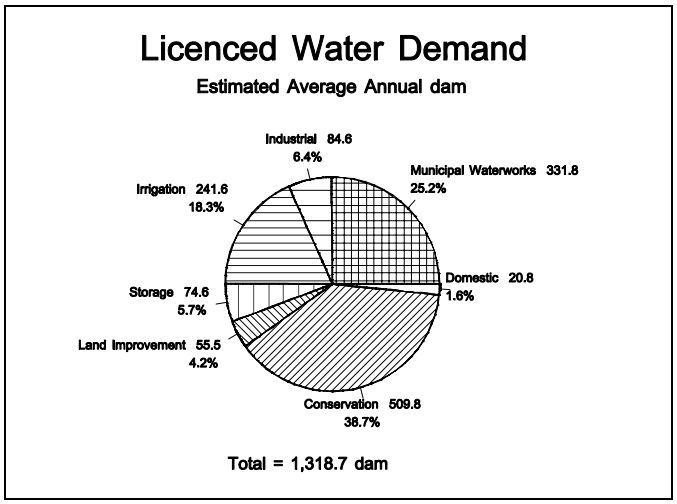


Figure 10

Estimated Average Annual Licenced Demand

Purpose	No. of Lic	Quantity Licenced	Average Annual Licenced Demand*	
			l/sec	dam^3
Municipal Waterworks	2	400,000 gpd	10.5	331.8
Domestic	36	25,100 gpd	0.7	20.8
Industrial				
(Fish Culture)	1	30,000 gpd	1.6	49.8
(Golf Course)	2	26.6 acft	1.0	32.8
(Greenhouses)	1	1.0 acft	0.0	1.2
(Stock Watering)	2	1,000 gpd	0.1	0.8
Sub total	6		2.7	84.6
Irrigation	18	195.85 acft	7.7	241.6
Storage	2	60.5 acft	2.4	74.6
Land Improvement	2	45 acft	1.8	55.5
Conservation				
(Storage)	1	51.3 acft	2.0	63.3
(Fish Hatchery)	1	0.5 cfs	14.2	446.5
(Fish Fence)	1	0.0	0.0	0.0
Sub total	3		14.9	509.8
Total	69		40.7	1,318.7

* Based on assumption that: Municipal waterworks demand and domestic demand is the authorizes maximum daily licenced divided by 2 to estimate the average daily demand. Industrial, irrigation, storage, land improvement and conservation licenced flow is a uniform demand over the year and licenced volume is the total annual demand; except Conservation (fish fence) which has no demand.

The low flow period licenced water demand may be critical between competing water uses and instream flow requirements to maintain the fish resource. The estimated low flow licensed demand for each identified drainage area and for other drainages in the French Creek Water Allocation Plan area is summarized in the following table.

Low Flow Licensed Demand by Drainage

Drainage	Low Flow Water Demand*	
	(l/sec)	Dam^3
Romney Creek	17.1	132.6
Carey Creek	0.0	0.0
Morningstar Creek	0.2	1.2
French Creek	25.2	195.0
Beach Creek	4.4	34.9
Grandom Creek	1.7	12.7
Other	1.4	10.4
Total	50.0	386.8

* Based on an estimated 90 day period demand assuming that; irrigation and industrial demands are totally withdrawn over the 90 day period; domestic and municipal waterworks demand is the authorizes licenced maximum daily for 90 days; authorized storage balances demand and therefore is a negative demand over 90 days; land improvement and conservation are non-consumptive and therefor have no demand.

The locations of licensed demand within the plan area is shown in Figure 11.

5.1 Municipal Waterworks Water Demand

Municipal waterworks purposes water licences are the second largest annual licenced water demand in the plan area. The City of Parksville has the largest of the two municipal waterworks water licenced demands, for 7.2 litres/second (275,000 gpd), from Parksville Springs; a tributary to Romney Creek. At present there are 2 artesian springs and 8 groundwater wells adjoining Romney Creek that the City of Parksville uses as part of their municipal water supply. During the winter most of the water supply for the city is from the artesian springs and associated wells as this source does not require water quality treatment; as does their alternative supply from the Englishman River. However the City of Parksville withdraws most its water supply during the summer from a licenced diversion on the Englishman River and no significant supply is available from the two Parksville Springs adjoining Romney Creek. The city has discontinued use of a third spring in the same area due to lack of quality and quantity.

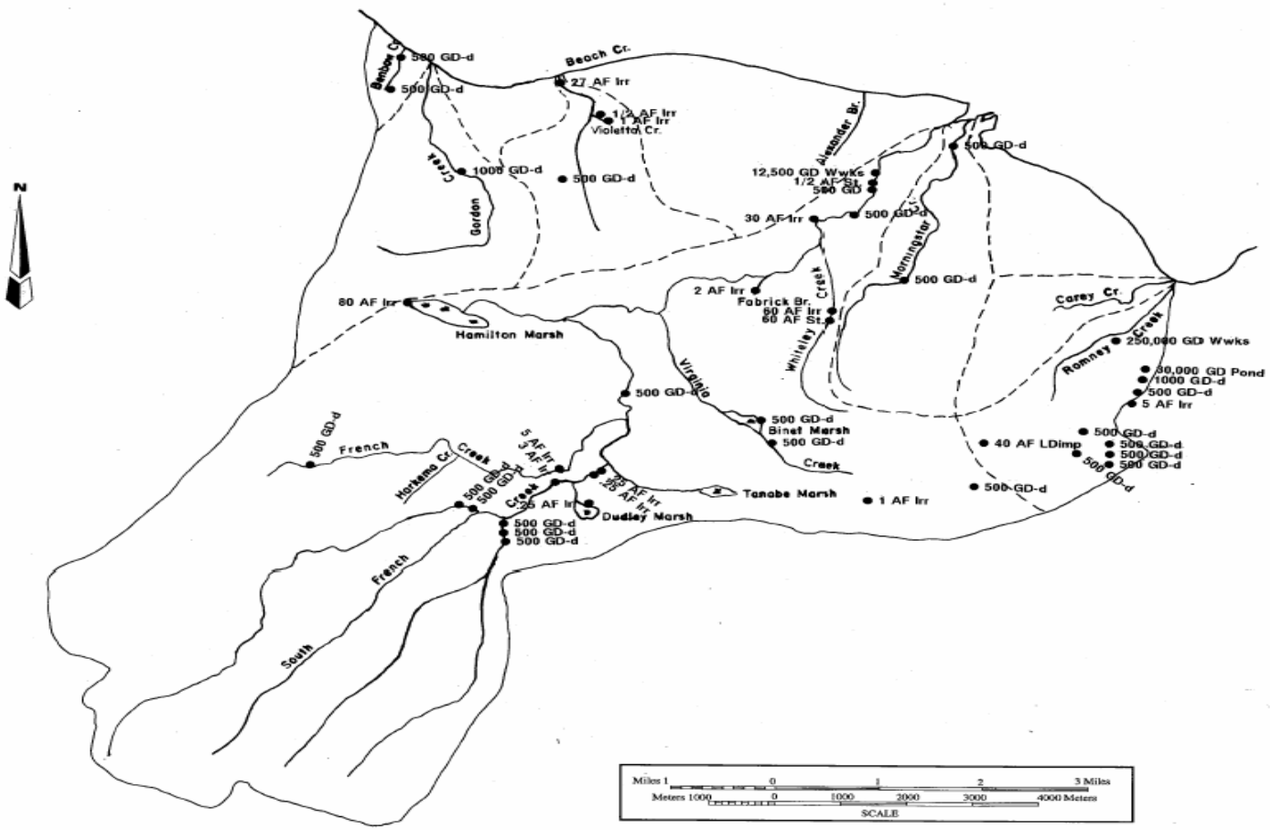


figure 11

FRENCH CREEK

LICENCED WATER

DEMAND LOCATIONS

Key

AF	acre feet
GD	gallons per day
Wwks	water works purpose
d	domestic purpose
Irr	irrigation purpose
LDimp	land improvement purpose
Ind	industrial purpose

The other municipal waterworks water licence for 3.3 litres/second (125,000 gpd) is held by the utility Breakwater Enterprises Ltd. This utility uses water from French Creek to supplement ground water well supplies during the summer months. Therefore this demand directly impacts on instream flow requirements for fish.

5.2 Domestic Water Demand

Despite the larger number of domestic water licences, the licenced domestic water demand represents only 1.6% of the total average annual demand. Except for local competition for water on small streams and springs, domestic demand is not significant.

5.3 Industrial Water Demand

The water demand under this category would be better described as commercial or agricultural demands; but under the Water Act Regulations are categorized as sub-categories under the industrial water demand category for purposes of water licensing.

An industrial (fish culture) water licence for 30,000 gpd on Smith and Peters Springs is within the Romney Creek watershed. This is an old licence and it is unlikely that these springs are able to supply the optimistic demand suggested by the licence unless an artesian spring or groundwater is used.

The two industrial (golf course) water licences for 32.8 dam^3 (26.6 acft) are held by the Village of Qualicum Beach to irrigate the village's golf course. The golf course uses water from a small dugout in Beach Creek to irrigate the golf course mainly during the summer months. Therefore this demand directly impacts on instream flow requirements for fish but the dugout also supplies a refuge for fish where otherwise fish may naturally not be able to exist on this stream.

The three water licences for industrial (greenhouses) and industrial (stock watering) are not significant demands in themselves. However they add to the local competition for water on small streams and springs and add to the overall demand within their respective watersheds.

5.4 Irrigation Water Demand

Irrigation water demand will have the most significant impact on low flows. Irrigation water demand occurs only during the low flow period and when the instream water requirement to support fish is the highest.

The three largest irrigation water licences are within the French Creek watershed. The three largest irrigation water demands are 74 dam^3 (60 acft) on Little Hamilton Swamp, 74 dam^3 (60 acft) on Whitely Creek and 37 dam^3 (30 acft) on French Creek. The latter two water licences are held by one farm owned by Fritzsche and the Whiteley Creek water licence requires that storage be developed to support the irrigation demand. The total irrigation demand in the French Creek watershed is 211.2 dam^3 (171.25 acft).

There are also irrigation demands of 6.2 dam^3 (5.0 acft) in the Romney Creek drainage, 1.9 dam^3 (1.5 acft) in the Beach Creek drainage, 12.3 dam^3 (10 acft) in the Grandom Creek drainage and 10 dam^3 (8.1 acft) in other drainages. These irrigation demands primarily impact on competing local demands for water.

5.5 Storage Water Demand

There are only two water licences for storage purpose within the plan area. The only significant storage for 74 dam^3 (60 acft) on Whitely Creek is to support the irrigation demand noted above. However the storage and irrigation use have reportedly not been developed and are subject to cancellation.

5.6 Land Improvement Water Demand

There are two land improvement demands to develop decorative ponds from small marshes. These improvements have no significant impact on low flows, instream fish flow requirements and licenced demands.

5.7 Conservation Water Demand

The largest licenced annual water demands are for conservation purposes. One licence, held by the Parksville/Qualicum Fish and Game Association, authorizes the diversion and use of 14.2 l/sec (0.5 cfs) from French Creek in a federal government sponsored (Salmon Enhancement Project) fish hatchery. This fish hatchery accounts for 35% of the total water demand in the plan area. The maximum water demand in the fish hatchery occurs during the period between October 1 and June 30.

Other conservation water licences include the storage of 63.3 dam^3 of water in Dudley Marsh (tributary to French Creek) for wild foul habitat development and maintenance of fish flows. The third conservation water licence authorizes the

construction of a fish counting fence in French Creek.

These water licences for conservation purposes are not a significant consumptive demand and do not significantly impact other water uses or the instream low flow requirements for fish. However the public associated with the fish hatchery have developed the false expectation that the licenced demand to the hatchery can be naturally maintained to support fish released from the hatchery during the low flow period. As noted in the above sections, the low flow in French Creek is naturally limiting to fish production. The low flow will not support enhanced fish releases into the main channel of French Creek. Fish from the hatchery need to be released into marsh areas (ie Hamilton Marsh or Dudley Marsh) unless storage is developed to increase flow in the main channel.

5.8 Projected Demand

There are only five water license applications pending as of February 1993. These pending water licence application demands are for 11.6 dam^3 (14,000 gpd) waterworks purpose, 492.2 dam^3 (399 acft) industrial (golf course watering) purpose, 146.8 dam^3 (119 acft) irrigation purpose and 231.9 dam^3 (188.4 acft) storage purpose. The storage purpose is intended to support the irrigation and industrial (golf course watering) demands.

Future water demands are anticipated to be similar to existing licenced water demands. Future water demands in the plan area will primarily relate to domestic, industrial golf course watering, irrigation, conservation, municipal waterworks and land improvement ponds and drainage works. These water demands will require that winter high flows be stored for summer low flow demands (supporting storage).

The population is increasing rapidly within the plan area. Groundwater developments and wells have supplied most of the subdivision municipal waterworks demands and local domestic demands. There have been recent indications that these groundwater supplies may have reached their capacity and other sources may be required. If municipal waterworks demands can not be supplied from further development of groundwater, then supporting storage sites will have to be found within the plan area or in adjoining watersheds.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Within the plan area there is a four month low flow period, from June through September, when the flow is below 20% of the mean annual discharge (MAD). During this summer low flow period there are zero flow or flows below 10% of the mean annual discharge (MAD) in all streams within the Plan area. The minimum mean monthly flow occurs in August and is 0.0 litres/second; except perhaps in the lower reach of French Creek where a minor flow may be maintained by flow from natural depression storage in Hamilton Marsh.

Mean monthly flows higher than 20% MAD occur from October through May (8 months). The mean monthly flow is above 60% MAD for the period of November through April (6 months). Therefore there is considerable flow available for at least half of the year.

The flows in all the streams in the French Creek Water Allocation Plan area are naturally limiting to fish production and maintenance of fish habitat. There is fish and fish habitat identified in three of the drainages within the Plan area; namely Morningstar Creek, French Creek and Beach Creek. French Creek is the most utilized stream by fish within the plan area. Although fish migration, rearing and habitat maintenance are limited by existing low flows, the fish agencies and local sports groups are very active in fish stocking and enhancement work in these creeks. Water is available in these streams only from November through April when the flow is above 60% MAD. In order to protect and maintain the fish resources, storage development should be required to support any further extractive water demand in the period from May through October.

There may be some potential fish habitat and marginal fish habitat in other drainages within the plan area, however there is no evidence of significant fish utilization. Subdivision development around Romney Creek, Carey Creek and possibly Alexander Brook has destroyed or limited any potential fish habitat in these creeks.

Although the largest number of water licences have issued for domestic purposes, the licenced demand for domestic purpose does not significant impact other water interests; except where there is a local competing water demand conflict. The largest existing annual licenced water demands are for conservation purposes, municipal waterworks purpose, irrigation purpose and industrial (golf course watering) purpose. These larger demands do conflict with each other and local fish enhancement and maintenance efforts. Irrigation water demands have the largest impacts on the low

flows as demand is coincident with the low flow period and the critical fish instream flow requirements.

There is not sufficient storage developed or proposed to maintain and support the existing and projected water demands through the low flow period. Further extractive demands, such as municipal waterworks, irrigation and industrial (golf course watering), will require supporting storage. Also any further salmon enhancement proposals that would increase fish stocks in the stream channels will require the development of supporting storage to maintain required low flows. Storage shall be required for all existing and proposed licenced water demand when applications for increased licenced water demands are received from an existing licensee.

Fish and debris screens shall be required on all intake or diversion works within the identified fish habitat areas of Morningstar Creek, French Creek and Beach Creek. Fish and debris screens are part of good intake design and should be encouraged on all intakes or diversion works. Fish passage provisions for both juvenile and adult fish shall be required on all storage dams or diversion works constructed on sources frequented by fish.

In stream works are to be constructed only during the period from June to October.

Springs developed for municipal waterworks and other purposes within the plan area have less water available than licenced. In order to ensure that a water licence on any new spring development reflects the quantities available, the applicant shall be required to determine the spring quantity yield (pump test) during the low flow period (June through September).

6.1 Waterworks

Waterworks purpose in the Water Act is the carriage or supply of water by a municipality, improvement district, regional district or private utility for the purpose of providing water to a residential area.

None of the drainages within this plan area have an adequate supply of water during the low flow period for waterworks demands. No further water licences shall issue within the French Creek Allocation Plan area for waterworks purpose unless storage is provided. No significant storage sites have been identified that may be adequate to supply the supporting storage required. Any large waterworks demands

may have to be supplied from further development of groundwater sources or supporting storage development in adjoining watersheds.

If a storage site can be identified then the applicants for a waterworks demand shall be require to assess the supply for a ten year projected demand and provide evidence that the projected demand is not excessive in comparison with adjoining community demands, water conservation is being promoted (ie. residential meters, pricing practices, education) and adequate system balancing storage (ie. volume difference between maximum hour and maximum day demands) will be constructed or is available for peek hour demands. Water Utilities will also have to provide evidence that the appropriate requirements for a Certificate of Public Convenience and Necessity (CPCN) have been met and a CPCN will be obtained. Licenced allocations will be limited to a 10 year projected demand except where the applicant can provide satisfactory evidence that a longer projection period is required (ie. because the cost of construction of works must be amortised over a longer period).

The licensee shall be required to meter or measure and record the water diverted from the source stream.

The licensee shall be required to treat the water supply in accordance with Ministry of Health requirements.

Adequate system balancing storage shall be required to ensure that the rate of withdrawal from the source during short term or maximum hour demand does not exceed the maximum daily demand. Good conservation techniques must be practised at all times and no increase in the amount of water in existing community waterworks licences shall be allowed unless meters and other conservation measures have been used.

6.2 Domestic

A domestic water licence shall be 2273 litres per day (500 gallons per day) for each rural dwelling as indicated on the plan attached to the water license application. This amount will allow for the maintaining of 0.10 hectares (0.25 acres) of garden associated with the dwelling. Domestic water licences shall not be issued solely to maintain green lawns and gardens where groundwater and other sources of water supply provide the primary domestic household needs.

Domestic water licence shall not be issued to provide evidence to subdivision approval authorities of an "adequate potable water supply" for subdivision development.

Large subdivision of land shall be encouraged to form a community water system.

To ensure an adequate domestic water supply for household uses, from a surface water source, applicants shall be required to develop storage or use marsh storage. For domestic water demands within the drainage areas of Morningstar Creek, French Creek and Beach Creek, the storage required is the average daily demand of 1135 litres per day (250 gpd) for the four month low flow period (June through September - 122 days); which is 138 m^3 (4,500 ft^3 or 0.11 acre feet). This requires a reservoir or dugout approximately 8 metres long by 6 metres wide with an average depth of 3.3 metres (20 feet wide by 25 feet long by 11 feet deep); allowing 0.3 metre (1 foot) for evaporation loss.

For domestic water demands within the plan area, but where there are no instream fish flow requirements, the storage required is the average daily demand of 1135 litres per day (250 gpd) for a one month period of no flow (August - 31 days); which is 35 m^3 (1,250 ft^3 or 0.03 acre feet). This requires a reservoir or dugout approximately 5 metres long by 3 metres wide with an average depth of 3 metres (15 feet long by 10 feet wide by 10 feet deep); allowing 0.3 metre (1 foot) for evaporation loss.

A water licence for domestic use shall not be issued to a residence within a community water supply area unless written leave to do so is obtained from the community water supply agency.

6.3 Industrial and Commercial

The industrial water licenses and water licence applications within the plan area are demands associated with golf course watering, greenhouses, stock watering and fish farming. All four demands are related to agricultural development.

Golf course watering and greenhouses are essentially an irrigation water demand except that the watering is not restricted to the irrigation period of April to September. The quantity of water required should be determined as follows in the irrigation section below. Except for the period of water withdrawal; which shall be whole year; the same requirements and conditions as irrigation demands shall apply. Storage is required to support these demands.

Cattle or livestock watering requiring more than 450 l/day (100 Igpd) are to be considered an Industrial (Agricultural) demand. Cattle or livestock requiring 450 l/day

(100 Igpd) or less will be considered a Domestic (livestock) demand. Estimated livestock demands are:

Recommended Livestock Water Requirements

Livestock	Water Requirements	
	l/day	Igpd
cattle (beef) per animal	45	10
cattle (dairy) per animal	132	29
chickens per 100 animals	27	6
turkeys per 100 animals	55	12

Commercial fish hatcheries and fish rearing facilities shall require an industrial water licence. Use of water by government and non-profit organizations in fish hatcheries and fish rearing facilities shall will be licensed as conservation purpose. Information on fish species and size, water temperature requirements and operating methods will be required in support of an application for a water licence. Fish Farm and Waste Management Permits will also be required.

6.4 Irrigation

The crop rooting depth, soil type and climatic characteristics determine requirements for irrigation.

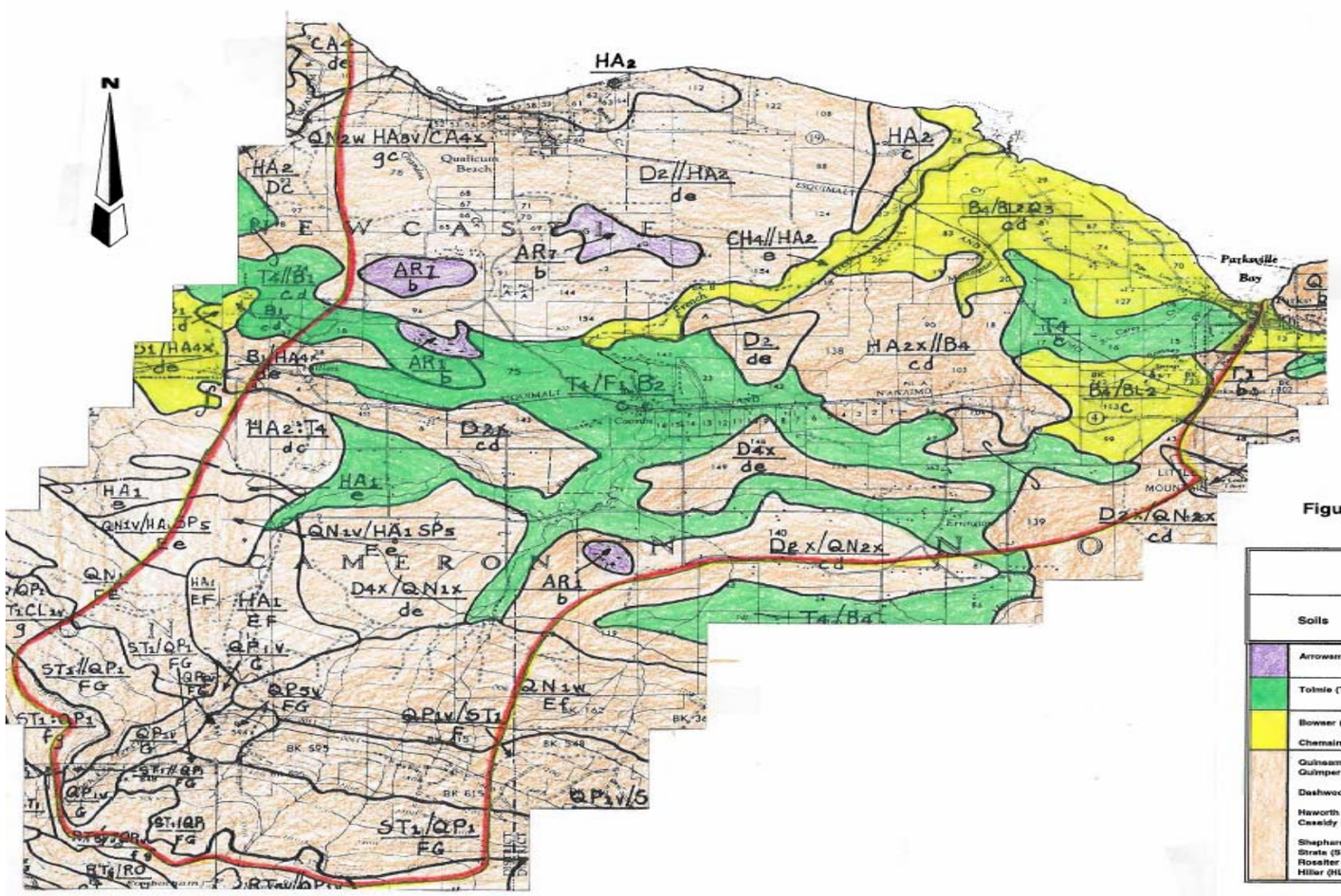
Different crops and their rooting depth and water availability coefficient were classified into shallow (0.5 metre) and deep (1.0 metre) effective rooting depths. The available water storage capacity (AWSC) was estimated for shallow and deep root zone depth for classes of similar soil associations identified for the French Creek Water Allocation Plan area on the maps for the publication Soils of Southern Vancouver Island (J.R. Jungen, P.Ag., Ministry of Environment, August 1985). Where composites of two or three soil associations are intermixed or occupy such small areas that they cannot be separated at the scale of the mapping, only the predominant soil association was considered. The following table was made using the climatic information for Parksville and the AWSC of irrigation requirements for different crop effective rooting depth classes and soil classes. A colour mapped of irrigation requirements is provided in

Figure 12.

Annual Irrigation Water Requirements millimetres (inches)		
Crops	Peas, Potatoes, Tomatoes, Lettuce, Pasture Species, Cranberries	Brussels Sprouts, Corn, Clover Grapes, Fruit trees, Alfalfa, Raspberries
Effective Rooting Depth	Shallow 0.5 m (1.6 ft)	Deep 1.0 m (3.3 ft)
Arrowsmith (AR) -organic	380 (15)	305 (12)
Tolmie (T) - sandy clay loam	460 (18)	305 (12)
Bowser (B) - loamy sand to gravelly sandy loam Chemainus (CH) - loam	530 (21)	460 (18)
Quinsam (QN) Quimper (QP) - gravelly sandy loam Dashwood (D) - very gravelly loamy sand to gravelly loamy sand Haworth (HA) Cassidy (CA) - very gravelly loamy sand Shephard (SP) Strata (ST) Rossiter (RT) Hiller (HL) - gravelly loamy sand	610 (24)	610 (24)

If the applicant for a water licence can provide more specific soil assessment information for a given area, that soil assessment may be used to assess irrigation demands.

It should be noted that these annual irrigation water requirements are for sprinkler irrigation systems only.



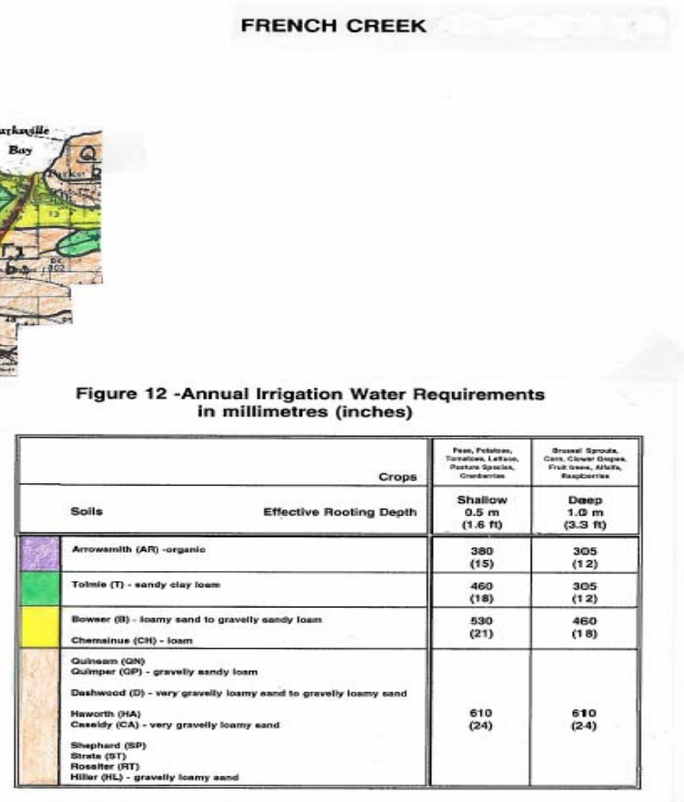


Figure 12 -Annual Irrigation Water Requirements in millimetres (inches)

Crops	Peas, Potatoes, Tomatoes, Lettuce, Pasture Grasses, Cranberries	Brussel Sprouts, Corn, Clover Grapes, Fruit trees, Alfalfa, Raspberries
Soils / Effective Rooting Depth	Shallow 0.5 m (1.6 ft)	Deep 1.0 m (3.3 ft)
Arrowsmith (AR) -organic	380 (15)	305 (12)
Tolmie (T) - sandy clay loam	460 (18)	305 (12)
Bowser (B) - loamy sand to gravelly sandy loam Chemainus (CH) - loam	530 (21)	460 (18)
Quinsam (QN) Quimper (QP) - gravelly sandy loam Dashwood (D) - very gravelly loamy sand to gravelly loamy sand Haworth (HA) Cassidy (CA) - very gravelly loamy sand Shephard (SP) Strata (ST) Rosalter (RT) Hiller (HL) - gravelly loamy sand	610 (24)	610 (24)

Irrigation gun or flood irrigation systems require greater irrigation quantities and should be discouraged. If irrigation gun and flood irrigation practices are to be used then suitable meters shall be installed and water withdrawals limited to the equivalent annual irrigation requirements for sprinkler systems. As the equivalent annual irrigation water requirements for sprinkler systems may not be adequate to sustain crops using these less efficient methods of irrigation, the applicant may be required to reduce crops, limit the acreage irrigated or convert to a more efficient sprinkler irrigation system.

Trickle irrigation can reduce water requirements by 35% and should be encouraged where practical.

All irrigation water demands must be supported by storage development. Storage required to support irrigation demands is the total required amount as per crop and soils, plus an additional allowance for evaporation and other losses from the storage reservoir.

The maximum irrigation system flow rate shall not exceed 19.1 l/sec (4.2 imperial gals. per minute) per 0.4 hectare (1 acre), and users must be encouraged to employ good agricultural practices (field size, system selection and farm management) to conserve water.

The authorized period of use for irrigation shall be from April 1 to September 30.

As noted above all intake works in fish bearing waters shall be screened to prevent fish and debris from entering the intake.

6.5 Land Improvement

Water required for land improvement aesthetic ponds shall be the volume of the pond to be created. All the requirements noted for storage development shall be required for land improvement development where applicable.

6.6 Conservation

Conservation purpose is the use and storage of water or the construction of work in and about a stream for the enhancement of fish or wildlife for non-profit purposes.

Salmon enhancement proposals that would increase fish stocks in the stream

channels will require the development of supporting storage to maintain required low flows. All the requirements noted for storage development shall be required for conservation development where applicable.

6.7 Storage

Storage purpose is the impoundment of water, either on-stream or off-stream in a dugout or behind a dam. In the unlikely event that a large storage development (ie. BC Hydro power, pulp & paper, large waterworks) is proposed a more specific supply versus demand and environmental impact assessment will be required.

The storage quantity required to support the smaller water demands anticipated to support domestic, industrial, commercial and irrigation uses shall be the volume of the water demand plus an additional allowance of 0.3 metres (1.0 foot) depth over the surface area of the storage reservoir for evaporation and other losses.

It is recommended that the applicant be required to submit a completed report form entitled "Dam and Reservoir Information Required in Support of a Water Licence Application for Storage Purpose (Schedule 2)" before the application be considered.

Total storage (dead and live) will be licensed. Dead storage should be licensed as it will in most cases have some intrinsic value such as providing conservation of water for wildlife or aesthetic value.

Diversion of water into off-stream storage will be during the period November to April. All in-stream storage will be required to pass any stream flows during the period May to October.

It is recommended that the applicant must obtain written agreement, right-of-way or easement for works or flooding affecting other lands.

Fish passage is required for both juvenile and adult fish, at all dams in fish bearing streams. Design of storage dams must consider fish ladders and provide adequate flow release and maintain fish passage where required.

Design plans must be submitted and accepted in writing before construction commences on any proposed dam over 3 m (10 ft) in height or on storage of 12 dam^3 (10acft) or more.

6.8 Allocation Plan Revision

The French Creek Water Allocation Plan should be reviewed and updated on or before January 1999.

Appendix A

Parksville
Canadian Climatic Normals
1951 - 1980

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNEE	CODE CODE	
CHEMALICUM R FISH RESEARCH															
49° 24'N 124° 37'W 8 m															
Daily Maximum Temperature	4.9	7.2	8.9	12.5	16.4	19.1	22.0	21.4	18.1	13.0	8.2	6.2	13.2	8	Température Maximale Quotidienne
Daily Minimum Temperature	-0.4	0.9	1.1	3.4	5.8	9.9	11.4	11.3	8.8	5.5	2.6	1.1	5.2	8	Température Minimale Quotidienne
Daily Temperature	**2.3**	**4.1**	**5.0**	**8.0**	**11.6**	**14.5**	**16.7**	**16.4**	**13.4**	**9.3**	**5.4**	**3.7**	**9.2**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.6	1.2	0.8	0.8	0.7	1.2	0.9	1.0	1.1	0.7	1.0	1.7	0.4	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	14.4	16.1	18.9	23.3	26.1	30.0	31.1	31.1	27.2	22.0	17.8	16.0	31.1		Température Maximale Extrême
Years of Record	18	18	18	17	17	18	18	19	19	19	19	19			Années de Relèves
Extreme Minimum Temperature	-15.6	-7.8	-6.5	-2.8	0.0	2.8	5.0	4.4	0.0	-2.8	-7.0	-14.4	-15.6		Température Minimale Extrême
Years of Record	18	18	18	17	17	18	18	19	19	19	19	19			Années de Relèves
Rainfall	189.4	140.5	113.2	61.4	44.5	39.3	26.3	41.8	58.5	137.9	203.4	219.0	1275.3	8	Chutes de Pluie
Snowfall	24.4	6.3	2.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	12.1	47.4	8	Chutes de Neige
Total Precipitation	**204.5**	**151.8**	**116.9**	**61.7**	**44.5**	**39.3**	**26.3**	**41.5**	**58.5**	**137.9**	**204.4**	**229.8**	**1317.2**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	110.2	56.0	49.1	34.8	16.5	18.4	22.9	28.8	40.3	91.3	97.9	76.3	219.9	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	117.3	61.7	69.1	29.5	27.7	34.2	25.4	38.1	31.8	72.6	85.1	85.4	117.3		Chute de Pluie Record en 24 heures
Years of Record	18	18	18	17	16	18	18	18	19	19	19	19			Années de Relèves
Greatest Snowfall in 24 hours	49.0	45.7	12.7	4.6	0.0	0.0	0.0	0.0	0.0	0.0	11.7	45.7	49.0		Chute de Neige Record en 24 heures
Years of Record	18	18	18	17	16	16	18	19	19	19	19	19			Années de Relèves
Greatest Precipitation in 24 hours	117.3	61.7	69.1	29.5	27.7	34.2	25.4	38.1	31.8	72.6	85.1	85.4	117.3		Précipitation Record en 24 heures
Years of Record	18	18	18	17	16	18	18	18	19	19	19	19			Années de Relèves
Days with Rain	16	15	16	12	10	9	6	8	10	15	17	19	153	8	Jours de Pluie
Days with Snow	4	1	1	0	0	0	0	0	0	0	1	2	9	8	Jours de Neige
Days with Precipitation	19	16	16	12	10	9	6	8	10	15	18	20	159	8	Jours de Précipitation
PARKSVILLE															
49° 18'N 124° 18'W 82 m															
Daily Maximum Temperature	4.7	7.7	9.7	13.2	17.4	20.3	23.5	23.0	19.5	13.6	8.2	5.8	13.9	8	Température Maximale Quotidienne
Daily Minimum Temperature	-1.6	-0.6	-0.1	2.1	5.0	8.1	9.8	9.5	7.4	4.2	1.0	-0.3	3.7	8	Température Minimale Quotidienne
Daily Temperature	**1.6**	**3.6**	**4.8**	**7.7**	**11.2**	**14.3**	**16.7**	**16.4**	**13.5**	**8.9**	**4.6**	**2.8**	**8.8**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	1.9	1.7	1.0	1.1	1.9	2.0	2.1	1.3	0.9	0.6	1.8	1.3	1.0	6	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	12.2	13.9	16.7	25.0	26.9	31.7	33.9	30.6	29.4	23.3	15.0	12.8	33.9		Température Maximale Extrême
Years of Record	6	6	7	7	7	6	6	6	6	6	6	6			Années de Relèves
Extreme Minimum Temperature	-15.0	-12.2	-8.9	-3.9	-2.8	1.1	4.4	3.9	-0.6	-3.3	-13.9	-10.0	-15.0		Température Minimale Extrême
Years of Record	6	6	7	7	7	6	6	6	6	6	6	6			Années de Relèves
Rainfall	119.0	83.9	73.9	51.3	40.2	38.3	23.1	43.6	45.2	97.5	128.1	144.6	888.7	8	Chutes de Pluie
Snowfall	26.4	10.7	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	18.8	66.1	8	Chutes de Neige
Total Precipitation	**146.9**	**97.0**	**82.8**	**51.3**	**40.2**	**38.3**	**23.1**	**43.6**	**45.2**	**97.5**	**132.2**	**165.8**	**963.9**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	59.4	41.9	27.0	25.3	10.1	20.0	20.6	36.0	21.2	54.4	63.7	46.8	122.1	8	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	66.5	54.9	51.6	47.2	48.3	36.1	42.2	37.6	44.2	54.9	69.3	66.6	69.3		Chute de Pluie Record en 24 heures
Years of Record	43	43	41	43	44	43	44	42	42	43	44	45			Années de Relèves
Greatest Snowfall in 24 hours	35.6	61.0	43.2	10.2	0.8	0.0	0.0	0.0	0.0	5.1	22.9	27.9	61.0		Chute de Neige Record en 24 heures
Years of Record	44	45	45	45	45	44	44	44	45	45	45	45			Années de Relèves
Greatest Precipitation in 24 hours	66.5	61.0	51.6	47.2	48.3	36.1	42.2	37.6	44.2	54.9	69.3	66.6	69.3		Précipitation Record en 24 heures
Years of Record	42	43	41	43	44	43	44	42	42	43	44	45			Années de Relèves
Days with Rain	17	16	17	14	15	11	7	10	11	16	19	20	173	8	Jours de Pluie
Days with Snow	4	2	1	0	0	0	0	0	0	0	1	3	11	8	Jours de Neige
Days with Precipitation	20	17	17	14	15	11	7	10	11	16	20	22	180	8	Jours de Précipitation

Appendix B

Water Survey Canada
Monthly and Annual Mean Discharges
French Creek
Millstone River
Enos Creek

FRENCH CREEK ABOVE PUMPHOUSE - STATION NO. 08HB078

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

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1990	---	---	---	0.975	0.430	0.391	0.064	0.016	0.021	---	---	---	---	1990
MEAN	---	---	---	0.975	0.430	0.391	0.064	0.016	0.021	---	---	---	---	MEAN

LOCATION - LAT 49 20 24 N LONG 124 22 29 W DRAINAGE AREA, 86.6 km² NATURAL FLOW

FRENCH CREEK ABOVE PUMPHOUSE - STATION NO. 08HB078

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1990	---	---	0.007 ON AUG 21 *	---	1990
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		---	MEAN

FRENCH CREEK AT COOMBS - STATION NO. 08HB038

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

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1969	---	---	---	2.48	1.96	0.432	0.103	0.012	0.361	---	---	---	---	1969
1970	---	---	---	1.58	0.487	0.074	0.012	0.008	0.006	---	---	---	---	1970
1971	---	---	---	1.85	1.68	0.565	0.069	0.006	0.017	---	---	---	---	1971
1983	---	---	---	0.983	0.413	0.131	0.249	0.019	0.025	---	---	---	---	1983
1984	---	---	---	1.11	1.53	0.432	0.072	0.014	0.035	---	---	---	---	1984
1985	---	---	---	2.15	1.05	0.196	0.014	0.001	0.017	---	---	---	---	1985
1986	---	---	---	0.657	0.996	0.246	0.088	0.005	0	---	---	---	---	1986
1987	---	---	---	1.26	0.370	0.215	0.063	0.002	0	---	---	---	---	1987
1988	---	---	---	1.90	0.750	0.288	0.055	0.006	0.014	---	---	---	---	1988
1989	---	---	---	2.09	0.489	0.074	0.027	0.008	0.002	---	---	---	---	1989
MEAN	---	---	---	1.61	0.973	0.271	0.077	0.008	0.048	---	---	---	---	MEAN

LOCATION - LAT 49 18 17 N DRAINAGE AREA, 58.3 km²
LONG 124 25 30 W NATURAL FLOW

FRENCH CREEK AT COOMBS - STATION NO. 08HB038

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1969	---	---	0 ON AUG 10 *	---	1969
1970	---	---	0 ON JUL 20	---	1970
1971	---	---	0.001 ON SEP 22	---	1971
1983	---	---	0.005 ON AUG 24	---	1983
1984	---	---	0.001 ON AUG 28	---	1984
1985	---	---	0 ON JUL 23	---	1985
1986	---	---	0 ON AUG 16	---	1986
1987	---	---	0 ON AUG 06	---	1987
1988	---	---	0 ON SEP 03	---	1988
1989	---	---	0 ON SEP 15	---	1989
		* - EXTREME RECORDED FOR THE PERIOD OF RECORD		---	MEAN

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MILLSTONE RIVER NEAR WELLINGTON - STATION NO. 08HB027

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

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1961	---	---	---	1.38	1.35	0.212	0.068	0.030	0.028	0.717	1.73	3.54	---	1961
1962	2.67	1.35	1.42	1.19	1.46	0.605	0.081	0.033	0.056	1.43	1.68	4.21	1.51	1962
1963	1.83	0.886	1.95	1.17	1.17	0.516	0.176	0.062	0.047	0.946	3.44	4.66	1.61	1963
1964	4.48	3.28	2.12	1.32	0.450	0.352	0.122	0.067	0.025	---	---	---	---	1964
1969	1.22	2.55	3.43	3.53	0.950	0.192	---	---	---	0.247	1.37	5.36	---	1969
1970	2.48	1.79	1.91	0.863	0.414	0.127	0.036	0.004	0.004	0.019	1.31	4.09	1.08	1970
1971	3.04	1.76	1.90	0.643	1.24	0.165	0.139	0.063	0.018	0.039	1.56	1.79	1.68	1971
1972	1.80	1.61	1.78	0.665	1.24	0.036	0.167	0.003	0.003	0.003	0.231	4.93	1.73	1972
1973	4.92	1.34	1.78	0.524	0.108	0.267	0.044	0.003	0.001	0.070	4.98	7.85	1.67	1973
1974	4.01	3.16	3.57	2.06	0.858	0.378	0.041	0.104	0.009	0.001	2.19	3.58	1.66	1974
MEAN	2.94	2.64	2.86	1.81	0.992	0.273	0.104	0.044	0.021	0.397	2.25	4.38	1.56	MEAN

LOCATION - LAT 49 12 22 N DRAINAGE AREA, 46.1 km²
LONG 124 03 08 W NATURAL FLOW

MILLSTONE RIVER NEAR WELLINGTON - STATION NO. 08HB027

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m³/s)	MAXIMUM DAILY DISCHARGE (m³/s)	MINIMUM DAILY DISCHARGE (m³/s)	TOTAL DISCHARGE (dam³)	YEAR
1961	---	---	0.023 ON AUG 30	---	1961
1962	---	10.9E ON JAN 03	0.045 ON SEP 08	47 600	1962
1963	---	15.8 ON DEC 24	0.040 ON SEP 11	50 800	1963
1964	---	---	0.020 ON SEP 25	---	1964
1969	---	18.7 ON DEC 14	0.004 ON JUL 14	---	1969
1970	---	15.0 ON DEC 17	0.002 ON SEP 27	34 200	1970
1971	---	13.1 ON MAR 12	0 ON JUN 13 *	53 000	1971
1972	---	19.0 ON DEC 19	0.001 ON AUG 13	54 400	1972
1973	---	22.4 ON DEC 18 *	0 ON AUG 17	52 700	1973
1974	---	15.2 ON JAN 16	0 E ON SEP 15	52 300	1974
				49 300	MEAN

E - ESTIMATED * - EXTREME RECORDED FOR THE PERIOD OF RECORD

MILLSTONE RIVER AT NANAIMO - STATION NO. 08HB032

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

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1961	---	---	---	---	---	0.377	0.088	0.017	0.047	0.959	2.58	5.91	---	1961
1962	4.86	2.60	3.07	1.92	2.41	0.904	0.085	0.087	0.084	2.67	5.45	6.24	2.54	1962
1963	2.89	5.43	3.89	4.05	2.84	0.183	0.138	0.019	0.007	1.47	5.84	9.05	2.97	1963
1964	7.57	5.27	4.30	1.78	0.736	0.469	0.170	---	---	---	---	---	---	1964
1965	---	6.69	2.28	2.22	---	---	---	---	---	---	---	---	---	1965
1986	---	---	---	---	---	---	---	---	0.036	0.016	2.36	5.63	---	1986
1987	9.24	5.53	4.73	1.20	0.411	0.110	0.045	0.008	0.006	0.006	0.083	5.69	2.73	1987
1988	4.77	3.64	2.93	2.47	0.361	0.580	0.148	0.044	0.034	0.182	5.54	4.13	1.87	1988
1989	4.11	2.73	5.03	2.68	0.525	0.081	0.055	0.028	0.029	0.042	0.329	2.67	1.53	1989
1990	4.72	5.10	3.34	1.53	0.659	0.794	0.152	0.003	0.004	0.267	8.69	7.71	2.73	1990
MEAN	5.37	4.37	3.70	2.23	1.18	0.439	0.110	0.029	0.031	0.702	3.86	5.88	2.32	MEAN

LOCATION - LAT 49 10 38 N LONG 123 58 04 W   DRAINAGE AREA, 65.2 km²   NATURAL FLOW

MILLSTONE RIVER AT NANAIMO - STATION NO. 08HB032

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1961	---	---	0.006 ON AUG 07	---	1961
1962	---	14.6 ON NOV 26	0.011 ON JUL 28	80 000	1962
1963	---	18.7E ON DEC 24	0.006 ON AUG 09	93 700	1963
1964	---	12.2 ON JAN 29	---	---	1964
1965	---	---	---	---	1965
1986	---	---	0.004 ON SEP 21	---	1986
1987	25.7 AT 04:25 PST ON DEC 10	23.8 ON DEC 10	0.005 ON SEP 27	70 900	1987
1988	23.6 AT 21:56 PST ON JAN 14	20.5 ON JAN 15	0.014 ON SEP 18	59 100	1988
1989	10.7 AT 19:01 PST ON MAR 12	10.4 ON MAR 12	0.006 ON AUG 08	48 100	1989
1990	44.2 AT 11:50 PST ON DEC 04 *	40.8 ON DEC 04 *	0.002 ON AUG 07 *	86 000	1990
				73 000	MEAN

E - ESTIMATED   * - EXTREME RECORDED FOR THE PERIOD OF RECORD

ENOS CREEK AT OUTLET OF ENOS LAKE - STATION NO. 08HB030

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

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1962	---	---	---	0.004	0.006	0.091	0.001	0	0	0.005	0.045	0.190	---	1962
1963	0.085	0.096	0.006	0.008	0.002	0	0	0.001	0.004	0.003	0.118	0.092	0.034	1963
1964	0.242	0.145	0.017	0.006	0	0	0	0	0	0	0	0.001	0.034	1964
1965	0.078	0.095	0.028	0.007	0.007	0	0	0	0	0.002	0.028	0.096	0.028	1965
1966	0.188	0.052	0.124	0.066	0.025	0.013	0.007	0.001	0	0.015	0.003	0.008	0.049	1966
1967	0.127	0.068	0.101	0.025	0.009	0.004	0	0	0	0.003	0.002	0.103	0.037	1967
1968	0.153	0.093	0.091	0.043	0.028	0.007	0.002	0	0	0.002	0.071	0.163	0.054	1968
1969	0.045	0.088	0.029	0.033	0.003	0.001	0	0	0	0.001	0.004	0.133	0.028	1969
1970	0.107	0.073	0.065	0.034	0.003	0.001	0	0	0	0	0.001	0.152	0.036	1970
1971	0.134	0.071	0.118	0.030	0.001	0	0	0	0	0	0.001	0.068	0.030	1971
1972	0.087	0.078	0.114	0.073	0.005	0.005	0	0	0	0	0	0.061	0.035	1972
1973	0.147	0.035	0.025	0.009	0.001	0.001	0	0	0	0	0.047	0.187	0.039	1973
1974	0.146	0.092	0.154	0.034	0.012	0.002	0	0	0	0	0.005	0.079	0.044	1974
1975	0.103	0.086	0.055	0.016	0.002	0	0	0	0	0.011	0.231	---	---	1975
1976	---	0.073	0.073	0.022	0.001	0	0	0	0	0	0	0	---	1976
1977	0.005	0.079	0.081	0.019	0.001	0	0	0	0	0	0	0.055	0.015	1977
1978	---	0.050	0.031	0.017	0.003	0	0	0	0	0	0	0	---	1978
MEAN	0.118	0.076	0.070	0.026	0.006	0.007	0.001	0	0	0.002	0.033	0.094	0.036	MEAN

LOCATION - LAT 49 17 13 N DRAINAGE AREA, 1.68 km²
LONG 124 09 32 W REGULATED

ENOS CREEK AT OUTLET OF ENOS LAKE - STATION NO. 08HB030

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m^3/s)	MAXIMUM DAILY DISCHARGE (m^3/s)	MINIMUM DAILY DISCHARGE (m^3/s)	TOTAL DISCHARGE (dam^3)	YEAR
1962	---	0.377 ON NOV 30	0 ON JUN 29 *	---	1962
1963	---	0.303 ON DEC 31	0 ON MAR 01	1 070	1963
1964	---	0.283E ON JAN 01	0 ON APR 18	1 080	1964
1965	---	0.411 ON FEB 05	0 ON JAN 06	884	1965
1966	---	0.991 ON JAN 07 *	0E ON JUN 09	1 560	1966
1967	---	0.595 ON JAN 20	0 ON JUL 01	1 160	1967
1968	---	0.977 ON JAN 18	0 ON JUL 05	1 170	1968
1969	---	0.464 ON DEC 13	0 ON MAY 13	879	1969
1970	---	0.745 ON DEC 11	0 ON MAY 31	1 140	1970
1971	---	0.456 ON DEC 17	0 ON MAY 28	1 200	1971
1972	---	0.629 ON FEB 29	0 ON JUL 04	1 120	1972
1973	---	0.711 ON DEC 16	0 ON APR 20	1 190	1973
1974	---	0.657E ON MAR 11	0 ON JUN 22	1 370	1974
1975	---	0.748 ON NOV 15	0 ON JUN 14	---	1975
1976	---	0.464A ON FEB 26	0 ON MAY 10	---	1976
1977	0.227 AT 13:50 PST ON DEC 16	0.224 ON DEC 16	0 ON JAN 01	489	1977
1978	0.297 AT 19:31 PST ON JAN 10 *	0.280 ON JAN 10	0 ON MAY 21	---	1978
				1 140	MEAN

A - MANUAL GAUGE E - ESTIMATED * - EXTREME RECORDED FOR THE PERIOD OF RECORD
(SEE REFERENCE INDEX)

Appendix C

Miscellaneous Flow Measurements and Estimates

French Creek Flow Measuements vs Estimate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Estimate	5,141	4,034	3,875	1,898	949	316	79	0	79	475	3,005	5,774
08HB078				1,062	437	205	45	77	106			
08HB038				1,610	973	271	77	8	48			
8216(1982)						256	66	46	33	37		
								19	34	103		
8216(1983)					187	167	123	90	59	37		
						179	433	29	29			
						275	103	14	54			
									18			
Sta#1(1987)									4	13		
									7			
									11			
									17			
Sta#2(1987)									3			
									2			
									3			
									6			
									13			
Sta#3(1987)									9	28	21	
										14		
										15		

French Creek at Pumphouse (10 ft below) **Station Number 8216** **Flow for 1982-83**

1982	cfs	l/sec
18-Jun	9.03	256
23-Jul	2.32	66
13-Aug	1.63	46
24-Aug	0.66	19
7-Sep	1.16	33
20-Sep	1.19	34
4-Oct	1.31	37
18-Oct	3.65	103

1983	cfs	l/sec
30-May	6.60	187
10-Jun	5.91	167
21-Jun	6.33	179
30-Jun	9.70	275
7-Jul	4.33	123
15-Jul	15.30	433
29-Jul	3.65	103
4-Aug	3.17	90

1983	cfs	l/sec
12-Aug	1.02	29
26-Aug	0.51	14
2-Sep	2.08	59
9-Sep	1.03	29
23-Sep	1.92	54
30-Sep	0.65	18
8-Oct	1.30	37

French Creek at Railroad Trestle **Station #1** **Flow for 1987**

1987	cfs	l/sec
9-Sep	0.152	4
10-Sep	0.24	7

1987	cfs	l/sec
11-Sep	0.396	11
29-Sep	0.602	17

1987	cfs	l/sec
2-Oct	0.474	13

French Creek 1,000 ft below Barclay Road **Station #2** **Flow for 1987**

1987	cfs	l/sec
9-Sep	0.09	3
10-Sep	0.057	2

1987	cfs	l/sec
11-Sep	0.104	3
16-Sep	0.208	6

1987	cfs	l/sec
29-Sep	0.454	13

French Creek above Island Highway **Station #3** **Flow for 1987**

1987	cfs	l/sec
29-Sep	0.306	9
2-Oct	0.288	8

1987	cfs	l/sec
16-Oct	0.496	14
20-Oct	0.516	15

1987	cfs	l/sec
5-Nov	0.74	21

French Creek Water Allocatio Plan Hydrology Assessment

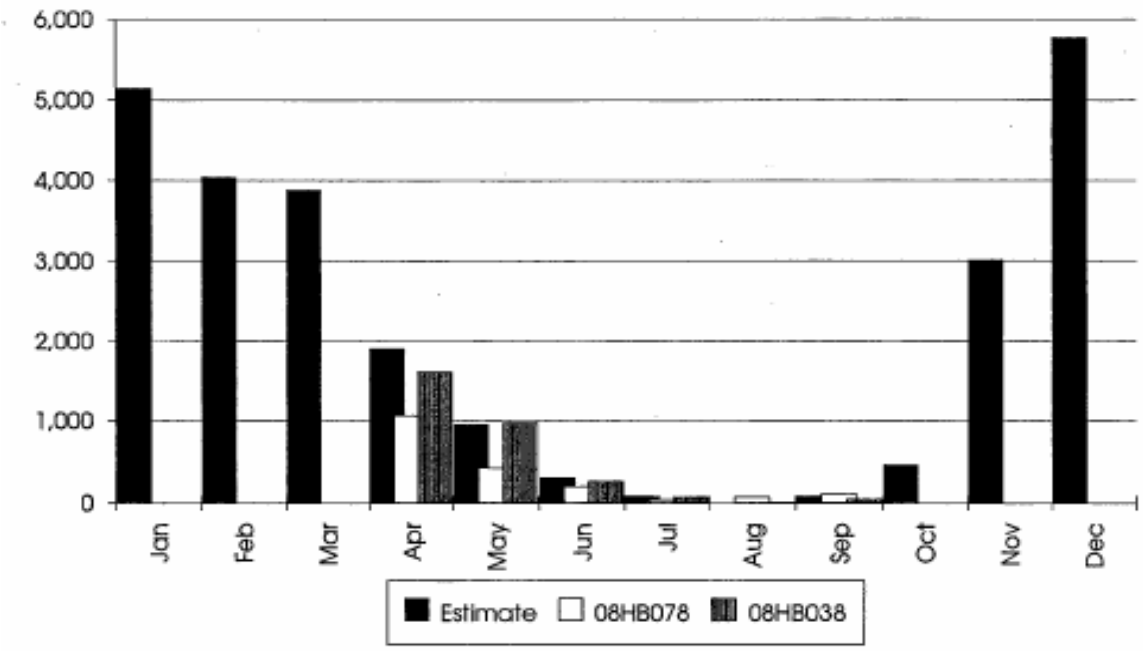
Comparison of % MAD

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MN ANN
Millstone near Wellington	188%	169%	183%	116%	64%	18%	7%	3%	1%	25%	144%	281%	100%
Millstone River at Nanaimo	231%	188%	159%	96%	60%	19%	6%	1%	1%	30%	166%	253%	100%
Enos Creek at Outlet of Enos Lak	328%	211%	194%	72%	17%	19%	3%	0%	0%	6%	92%	261%	100%
Average	249%	190%	179%	95%	43%	19%	5%	1%	1%	20%	134%	265%	100%

Comparison of Unit Area Discharge

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	MN ANN	Drainage Area (km2
French Creek above Pumphouse				0.013	0.006	0.003	0.001	0.001	0.001					74.2
French Creek at Combs				0.028	0.017	0.005	0.001	0.000	0.001					58.3
Millstone River near Wellington	0.064	0.057	0.062	0.039	0.022	0.006	0.002	0.001	0.000	0.009	0.049	0.095	0.034	46.1
Millstone River at Nanaimo	0.062	0.051	0.043	0.026	0.013	0.005	0.001	0.000	0.000	0.008	0.045	0.068	0.027	86.2
Enos Creek at Outlet of Enos Lak	0.070	0.045	0.042	0.015	0.004	0.004	0.001	0.000	0.000	0.001	0.020	0.056	0.021	1.68
Average	0.065	0.051	0.049	0.024	0.012	0.004	0.001	0.000	0.001	0.006	0.038	0.073	0.027	

French Creek
Monthly Flow Estimates



Appendix D

Licensed Water Demand by Purpose

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE	QUANTITY/ UNITS	LITRES/ SEC
Waterworks Purpose					
C035623	0281684	1968/09/06	French Creek	125000 GD	6.6250
C018817	0155723	1946/02/16	Parksville Springs	275000 GD	14.5750
			SUB-TOTAL	400000 GD	21.2000
Domestic Purpose					
F017900	0158523	1945/11/22	Bagshaw Spring	500 GD	0.0265
F045497	0243985	1962/05/24	Benbow Spring	1000 GD	0.0530
C045203	0323169	1974/05/31	Benbow Spring	100 GD	0.0053
C048186	0330297	1976/03/22	Binet Marsh	500 GD	0.0265
C036766	0296779	1970/07/13	Clatworthy Spring	500 GD	0.0265
F050180	0300335	1970/10/15	Fowler Spring	1000 GD	0.0530
C024357	0220404	1958/05/21	French Creek	500 GD	0.0265
F052376	0263424	1965/07/16	French Creek	500 GD	0.0265
C033493	0277522	1968/01/26	French Creek	1000 GD	0.0530
F040694	0290724	1970/01/06	French Creek	500 GD	0.0265
C046473	0329108	1975/07/04	French Creek	500 GD	0.0265
C047534	0330258	1976/03/09	French Creek	1000 GD	0.0530
C052866	0342458	1978/01/13	French Creek	500 GD	0.0265
C072605	0355984	1980/02/01	French Creek	500 GD	0.0265
C055168	0366526	1980/05/09	French Creek	500 GD	0.0265
C054995	0366816	1980/06/26	French Creek	1000 GD	0.0530
C058040	0369640	1981/11/23	French Creek	500 GD	0.0265
C024096	0218673	1957/12/17	Grandon Creek	1000 GD	0.0530
C057666	0367357	1980/10/08	Hait Spring	1000 GD	0.0530

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE	QUANTITY/ UNITS	LITRES/ SEC
C044820	0214025	1956/11/05	Judiesch Spring	1000 GD	0.0530
C065818	1000763	1987/08/25	Leone Spring	500 GD	0.0265
F018199	0205425	1954/09/20	Morningstar Creek	1500 GD	0.0795
F051251	0277527	1968/01/29	Morningstar Spring	1000 GD	0.0530
C056344	0368271	1954/12/30	Raper Spring	500 GD	0.0265
C068977	0323141	1974/05/28	Robinson Spring	500 GD	0.0265
C059717	0369644	1981/12/01	Robinson Spring	500 GD	0.0265
C027114	0239536	1961/11/13	Smiths/Peters Springs	1000 GD	0.0530
C024355	0220402	1958/05/22	South French Creek	2000 GD	0.1060
C048689	0220885	1958/06/20	South French Creek	500 GD	0.0265
C041858	0316817	1973/04/30	South French Creek	500 GD	0.0265
C048835	0340685	1976/12/24	South French Creek	500 GD	0.0265
C051409	0342060	1977/09/16	South French Creek	500 GD	0.0265
C052799	0342483	1978/01/10	South French Creek	500 GD	0.0265
C054428	0365694	1979/05/30	South French Creek	500 GD	0.0265
F016069	0151449	1943/12/07	Taylor Spring	500 GD	0.0265
F019901	0218294	1957/11/06	Young Spring	500 GD	0.0265
SUB-TOTAL				25100 GD	1.3303
Industrial Ponds Purpose					
C027114	0239536	1961/11/13	Smiths/Peters Sprs	30000 GD	1.5900
SUB-TOTAL				30000 GD	1.5900
Industrial Watering Purpose					
F052277	0173746	1948/05/27	Beach Creek	15 AF	2.3820
F056342	0365950	1979/07/17	Beach Creek	11.6 AF	1.8421
F057301	0208076	1955/05/31	Fabrick Brook	1 AF	0.1588

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE	QUANTITY/ UNITS	LITRES/ SEC
SUB-TOTAL				27.6 AF	4.3829
Industrial Stock Watering Purpose					
C065840	1001034	1989/02/21	French Creek	500 GD	0.0265
C072612	0300334	1970/10/15	Howard Spring	500 GD	0.0265
SUB-TOTAL				1000 GD	0.0530
Irrigation Purpose					
C019234	0178540	1949/05/22	Beach Creek	0.5 AF	0.0794
F045497	0243985	1962/05/24	Benbow Spring	3.1 AF	0.4923
C045203	0323169	1974/05/31	Benbow Spring	5 AF	0.7940
C048186	0330297	1976/03/22	Binet Marsh	10 AF	1.5880
C036766	0296779	1970/07/13	Clatworthy Marsh	1 AF	0.1588
F057301	0208076	1955/05/31	Fabrick Brook	1 AF	0.1588
C020120	0188579	1951/05/05	French Creek	30 AF	4.7640
F048233	0193517	1952/02/18	French Creek	5 AF	0.7940
C024096	0218673	1957/12/17	Grandon Creek	10 AF	1.5880
F018105	0214001	1956/10/29	Little Hamilton Sw	60 AF	9.5280
C030761	0264805	1965/10/06	Smiths/Peters Sprs	5 AF	0.7940
C048689	0220885	1958/06/20	South French Cr	0.38 AF	0.0603
C028224	0249580	1963/05/07	South French Cr	3 AF	0.4764
C034953	0285615	1969/05/27	South French Cr	0.25 AF	0.0397
C048690	0342518	1958/06/20	South French Cr	0.25 AF	0.0397
C048691	0342519	1958/06/20	South French Cr	0.37 AF	0.0588
C023922	0216633	1957/06/17	Violetta Creek	1 AF	0.1588
C064062	1000619	1986/06/13	Whiteley Creek	60 AF	9.5280
SUB-TOTAL				195.85 AF	31.1010

LICENCE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE	QUANTITY/ UNITS	LITRES/ SEC
Storage					
C065840	1001034	1989/02/21	French Creek	0.5 AF	-0.0794
C064063	1000619	1986/06/13	Whiteley Creek	60 AF	-9.5280
SUB-TOTAL				60.5 AF	-9.6074
Land Improvement Purpose					
C072283	1001020	1989/01/17	Oldaker Marsh	5 AF	0.7940
C036767	0296947	1970/07/22	Price Marsh	40 AF	6.3520
SUB-TOTAL				45 AF	7.1460
Conservation Storage Purpose					
C059538	1000073	1982/09/23	Dudley Creek	51.3 AF	8.1464
SUB-TOTAL				51.3 AF	8.1464
Conservation Use Purpose					
C063988	1000529	1985/09/13	French Creek	0.5 CS	0.0142
SUB-TOTAL				0.5 CS	0.0142
Conservation Works Purpose					
C061452	1000524	1985/09/12	French Creek	0 TF	0.0000
SUB-TOTAL				0 TF	0.0000

Appendix E

Licensed Water Demand by Drainage Area

Licensed Water Demand by Drainage Area

DRAINAGE/PURPOSE	LICENCED QUANTITY/UNITS	ESTIMATED litres/sec	ESTIMATED dam^3
Romney Creek			
Waterworks	275,000 gpd (max day)	14.5	112.5
Domestic	4,000 gpd	0.2	1.6
Irrigation	5.0 acft	0.8	6.2
Industrial	10.01 acft	1.6	12.3
Total Consumption		17.1	132.6
Land Improvement	6.352 acft	Non-consumptive	
Carey Creek			
none	none		
Morningstar Creek			
Domestic	3,000 gpd	0.2	1.2
Total Consumption		0.2	1.2
Land Improvement	5 acft	Non-consumptive	
French Creek			
Waterworks	125,000 gpd (max day)	6.6	51.1
Domestic	14,500 gpd	0.8	5.9
Irrigation	171.25 acft	27.2	211.2
Industrial	1.17 acft	0.2	1.4
Storage	60.5 acft	-9.6	-74.6
	Total Consumption	25.2	195.0
Land Improvement	40 acft	Non-consumptive	

DRAINAGE/PURPOSE	LICENCED QUANTITY/UNITS	ESTIMATED litres/sec	ESTIMATED dam^3
Conservation	51.3 acft (Dudley Marsh)	Non-consumptive	
	0.5 cfs (fish hatchery)		
	TF (fish counting fence)		
Beach Creek			
Domestic	500 gpd	0	0.2
Irrigation	1.5 acft	0.2	1.9
Industrial	26.6 acft (golf course)	4.2	32.8
Total Consumption		4.4	34.9
Grandom Creek			
Domestic	1,000 gpd	0.1	0.4
Irrigation	10.0 acft	1.6	12.3
Total Consumptive		1.7	12.7
Other			
Domestic	1,100 gpd	0.1	0.4
Irrigation	8.1 acft	1.3	10.0
Total Consumption		1.4	10.4

Appendix F

Pending (1993) Water Licence Applications

FRENCH CREEK ALLOCATION PLAN PENDING APPLICATIONS

LICENSE NUMBER	FILE NUMBER	PRIORITY DATE	SOURCE NAME	QUANTITY	LITRES/SEC
Waterworks Purpose					
Z100861	1000750	19870720	Unnamed Spring	14000 GD	7.4200
SUB-TOTAL				14000 GD	7.4200
Industrial Watering Purpose					
Z100840	1000976	19881130	Morningstar Creek	200 AF	31.7600
Z100891	1001258	19900329	Morningstar Creek	119 AF	18.8972
Z100896	1001275	19900502	Unnamed Creek	80 AF	12.7040
SUB-TOTAL				399 AF	63.3612
Irrigation Purpose					
Z100843	1000977	19881130	Morningstar Creek	119 AF	18.8972
SUB-TOTAL				119 AF	18.8972
Storage Purpose					
Z100843	1000977	19881130	Morningstar Creek	37.2 AF	-5.9074
Z100891	1001258	19900329	Morningstar Creek	65 AF	-10.3220
Z100896	1001275	19900502	Unnamed Creek	86.2 AF	-13.6886
SUB-TOTAL				188.4 AF	-29.9179
TOTAL DEMAND					59.7605

Appendix G

Fish Screening Requirements

FISH SCREENING DIRECTIVE

Government of Canada
Department of Fisheries and Oceans

WATER INTAKE FISH PROTECTION FACILITIES

The Department of Fisheries and Oceans has prepared this document as a guide to assist in the design and installation of water intakes and fish screening in British Columbia and the Yukon Territory to avoid conflicts with anadromous fish. Additional precautions must be taken at marine intake locations where entrainment of fish larvae, such as eulachon and herring larvae, is a possibility. The screening criteria constitutes the Department's policy regarding the design and construction requirements pursuant to Section 28 of the Fisheries Act.

PROVISIONS OF THE FISHERIES ACT - SECTION 28

Every water intake, ditch, channel or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters for irrigating, manufacturing, power generation, domestic or other purposes, shall, if the Minister deems it neccessary in the public interest, be provided at its entrance or intake with a fish guard or a screen, covering or netting, so fixed as to prevent the passage of fish from any Canadian fisheries waters into such water intake, ditch, channel or canal.

The fish guard, screen, covering or netting shall have meshes or holes of such dimensions as the Minister may prescribe, and shall be built and maintained by the owner or occupier of the water intake, ditch, channel or canal subject to the approval of the Minister or such officer as the Minister may appoint to examine it.

The owner or occupier of the water intake, ditch, channel or canal shall maintain the fish guard, screen, covering or netting in a good and efficient state of repair and shall not permit its removal except for renewal or repair, and during the time such renewal or repair is being effected, the sluice or gate at the intake or entrance of the water intake, ditch, channel or canal shall be closed in order to prevent the passage of fish into the water intake, ditch, channel or canal.

PROCEDURES FOR INSPECTION AND APPROVAL OF INTAKE STRUCTURES

Diversions less than 0.0283 cms (one cubic foot per second): The intake structure shall be constructed in accordance with specifications indicated herein. Upon completion of construction and prior to operation the owner shall contact a local representative of the Department of Fisheries and Oceans to arrange for on-site inspection and approval of the installation. Permanently submerged screens must be inspected prior to installation.

Diversons greater than 0.0283 cms (one cubic foot per second): The owner shall submit to the Department of Fisheries and Oceans 2 sets of detailed plans of the proposed installation for review and approval prior to fabrication. Design drawings are required whenever the diversion quantity exceeds 0.0283 cms (1.0 cfs) or 817,200 L/day (180,000 Igpd) for industrial diversions (calculated on the basis of 8 hours/day) or 123,350 cmy (100 ac.- ft./year) for irrigation diversions (calculated on the basis of 100 days/year and 12 hours/day). The plans shall contain the following information:

1. Intake structure location and dimensions.
2. Maximum discharge capacity of diversion.
3. Screen dimensions.
4. Mesh size.
5. Screen material.
6. Fabrication details.
7. Minimum and maximum water levels at the intake site.
8. Provision for bypassing fish.

The intake structure shall then be constructed in accordance with the approved plans. Upon completion of construction and prior to operation, the owner shall contact the local representative of the Department of Fisheries and Oceans to arrange for on-site inspection and approval of the installation. Permanently submerged screens must be inspected prior to installation.

SPECIFICATIONS FOR INTAKE STRUCTURES WITHOUT PROVISION FOR AUTOMATIC CLEANING

1. Screen Material: The screen material shall be either stainless steel, galvanized steel, aluminum, brass, bronze, or monel metal. Stainless steel is preferred since corrosion is greatly reduced.

2. Screen Mesh Size: Clear openings of the screen (the space between strands) shall not exceed 2.54 mm (0.10 inch). The open screen area shall not be less than 50% of the total screen area. The following square-mesh wire cloth screens are recommended:

   - 7 mesh, 1.025 mm (0.041 inch) wire, 51% open, 2.54 mm (0.10 inch) openings; or
   - 8 mesh, 0.875 mm (0.035 inch) wire, 52% open, 2.25 mm (0.09 inch) openings; or
   - 8 mesh, 0.700 mm (0.028 inch) wire, 60% open, 2.54 mm (0.10 inch) openings.

3. Screen Area: A minimum unobstructed screen area (gross area) of 0.93 square metre (10 square feet) shall be provided for each 0.0283 cms (1cfs) of water entering the intake. The required screen area shall be installed below minimum water level. Screen area lost by framing shall not be included as part of the unobstructed screen area.

4. Screen Support: The screen shall be adequately supported with stiffeners or back-up material to prevent excessive sagging.

5. Screen Protection: The intake structure shall, where necessary, be equipped with a trash rack or similar device to prevent damage to the screen from floating debris, ice, etc.

6. Screen Accessibility: The screen shall be readily accessible for cleaning and inspection. Screen panels or screen assemblies must be removable for cleaning, inspection and repairs.

7. Allowable Openings: The portion of the intake structure which is submerged at maximum water level shall be designed and assembled such that no openings exceed 2.54 mm (0.10 inch) in width.

8. Design and Location: The design and location of the intake structure shall be such that a uniform flow distribution is maintained through the total screen area.

9. Fish Bypass: The intake shall be designed to provide a transverse velocity (the component of the velocity parallel and adjacent to the screen face) to lead fish to a bypass or past the screens before they become fatiqued. In no case should the transverse velocity be less than double the velocity through the screen.

SPECIFICATIONS FOR INTAKE STRUCTURES WITH PROVISIONS FOR AUTOMATIC CLEANING

The specifications are identical to those for intake structures without provisions for automatic cleaning except that the minimum unobstructed screen area (gross area) of 0.23 square metre (2.5 square feet) need only be provided for each 0.0283 cms (1 cfs) of water entering the intake. However, a regular cleaning and maintenance schedule is required to ensure seals and screen panels remain in good repair preventing impingement and entrainment of fish and debris.

For these self-cleaning intake structures, the location, design and juvenile fish avoidance system all affect operating characteristics. The final design, therefore, may incorporate modifications reflecting the best current technology available for minimizing adverse impact upon the fisheries resource.

ALTERNATE FISH PROTECTION FACILITIES

Enquiries concerning the Department's requirements for indirect intakes, such as infiltration galleries and wells, for salt water ocean intakes, and for new methods or devices for screening intake structures should be directed to the Department of Fisheries and Oceans, Senior Habitat Management Biologist.

Conversion Factors:

1 cubic foot per second (cfs) = 449 U.S. gallons per minute (U.S. gpm).
= 374 Imperial gallons per minute (Igpm).
= 1.98 acre feet per day (Ac.-Ft./day).
= 28.3 litres per second (L/sec.).
= 0.0283 cubic metres per second (cms)

0.10 inch = 3/32" (approx.) = 2.54 millimetres

Addresses for Correspondence and Approvals

1. Senior Habitat Management Biologist
   Fraser River, Northern B.C. and Yukon Division
   Department of Fisheries and Oceans
   Room 330, 80 - 6th Street
   New Westminster, B.C. V3L 5B3 Phone: 666-6479

2. Senior Habitat Management Biologist
   South Coast Division
   Department of Fisheries and Oceans
   3225 Stephenson Point Road
   Nanaimo, B.C. V9T 1K3 Phone: 756-7270

3. Senior Habitat Management Biologist
   North Coast Division
   Department of Fisheries and Oceans
   Room 109, 417 - 2nd Avenue West
   Prince Rupert, B.C. V6J 1G8 Phone: 624-9385

Other Federal and Provincial agencies having jurisdiction in water withdrawals and construction pertaining to watercourses in British Columbia include:

1. Transport Canada
   Canadian Coast Guard.

2. B.C. Ministry of Environment
   Fish and Wildlife Management.

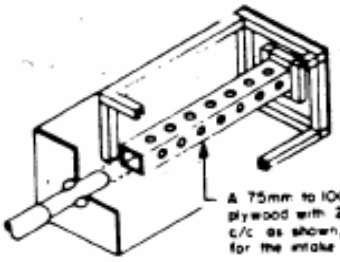
3. B.C. Ministry of Environment
   Water Management.

4. B.C. Ministry of Agriculture and Food.

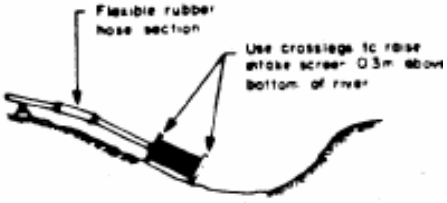
5. B.C. Ministry of Lands, Parks and Housing.

It may be necessary that several or all these agencies also be solicited for approvals prior to the installation of a water intake.

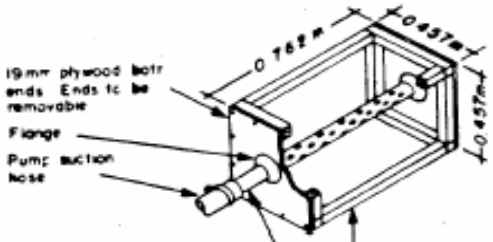
Revised January, 1986



A 75mm to 100mm square box of 19mm plywood with 25mm dia holes at 75mm c/c as shown, may be substituted for the intake pipe below

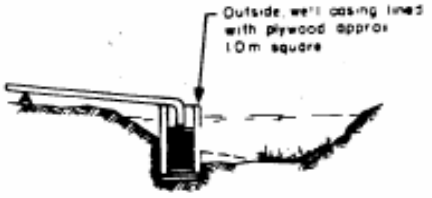


STANDARD INSTALLATION

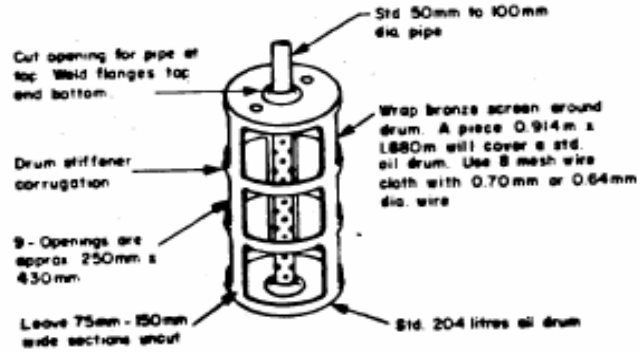


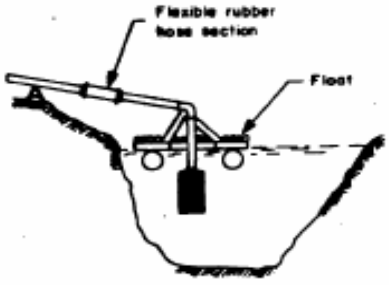
50mm - 100mm std pipe with the section inside the screen box perforated with 16mm dia holes at 50mm to 100mm c/c staggered

50mm x 50mm painted framing covered on 4 sides with bronze screen (wire cloth) stretched tight and fastened to the framing only. Plywood ends to be removable. Use 8 mesh wire cloth with 0.70mm or 0.64mm dia wire



INSTALLATION IN SHALLOW WATER MUDDY OVERGROWN BOTTOM





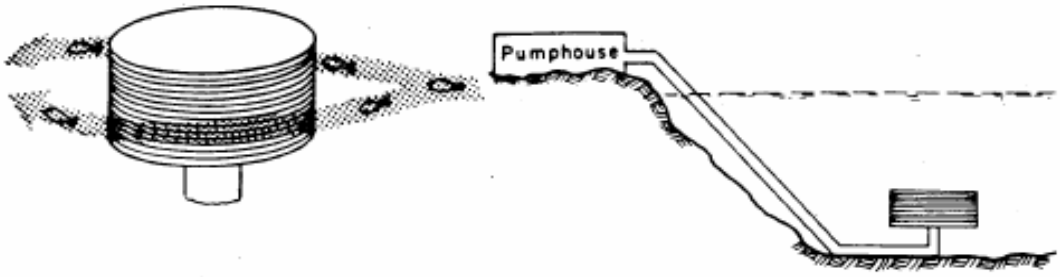
INSTALLATION IN DEEP WATER

NOTE
1. Oil drum shall be thoroughly washed out or steam cleaned before cutting openings
2. All loose rust shall be removed and the drum coated with metal primer. Two coats of machinery enamel or epoxy paint shall be applied before covering with wire cloth

NOTE
All screens shall be installed below minimum water level, shall be easily accessible for cleaning, and shall be cleared of debris at regular intervals

SMALL STATIONARY WATER INTAKE SCREENS

(For pumps of a capacity less than 28.3 L/sec [1cfs, 449 U.S. or 374 Igpm])



DEEP WATER WELL SCREEN

May be installed in lakes and the ocean.

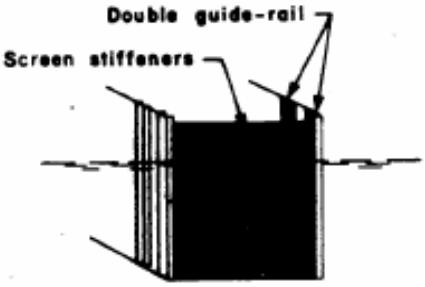
SHALLOW WATER WELL SCREEN

May be installed in lakes, pools, and stable areas in rivers.

Totally submerged cylindrical shaped stainless steel well screens provide for high intake capacity and large percentage of open area permitting water to enter at low velocities. Slot opening shall not exceed 2.54 mm (0.10 inch).

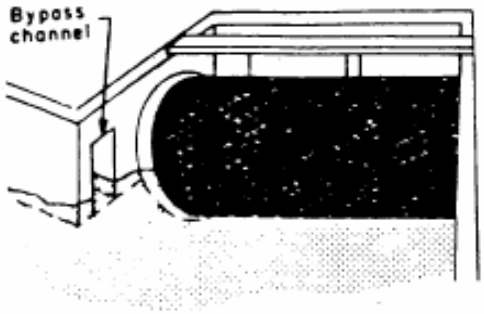
VERTICAL PANEL SCREENS

May be installed in rivers, lakes and the ocean. Generally, requires coarse trashracks, a sluice gate in river installations, double sets of guide-rails, and standby screen panels to allow for cleaning and repairs.



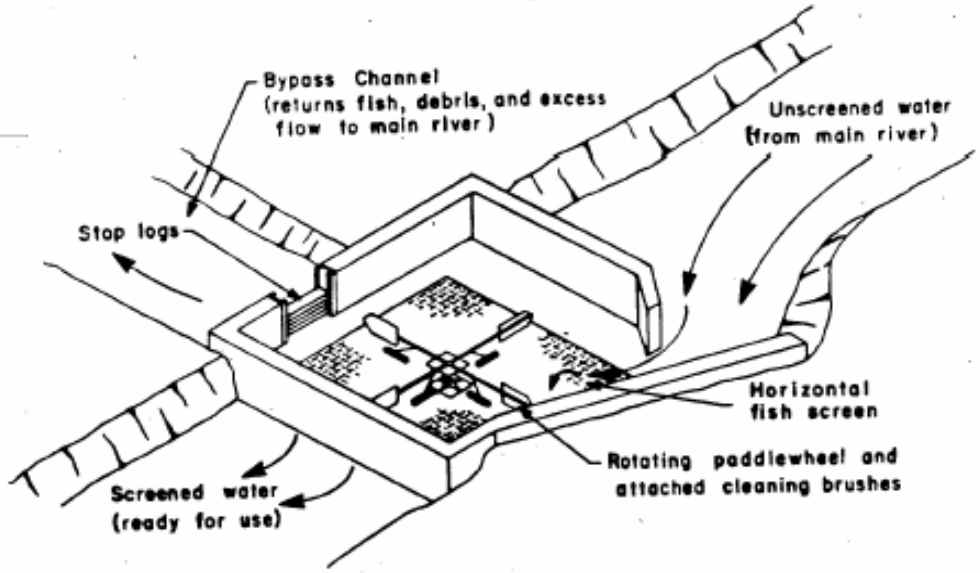
LARGE STATIONARY WATER INTAKE SCREENS

(For pumps of a capacity more than 28.3 L/sec [1 cfs, 449 U.S. or 374 Igpm])



REVOLVING DRUM SCREEN, HORIZONTAL AXIS

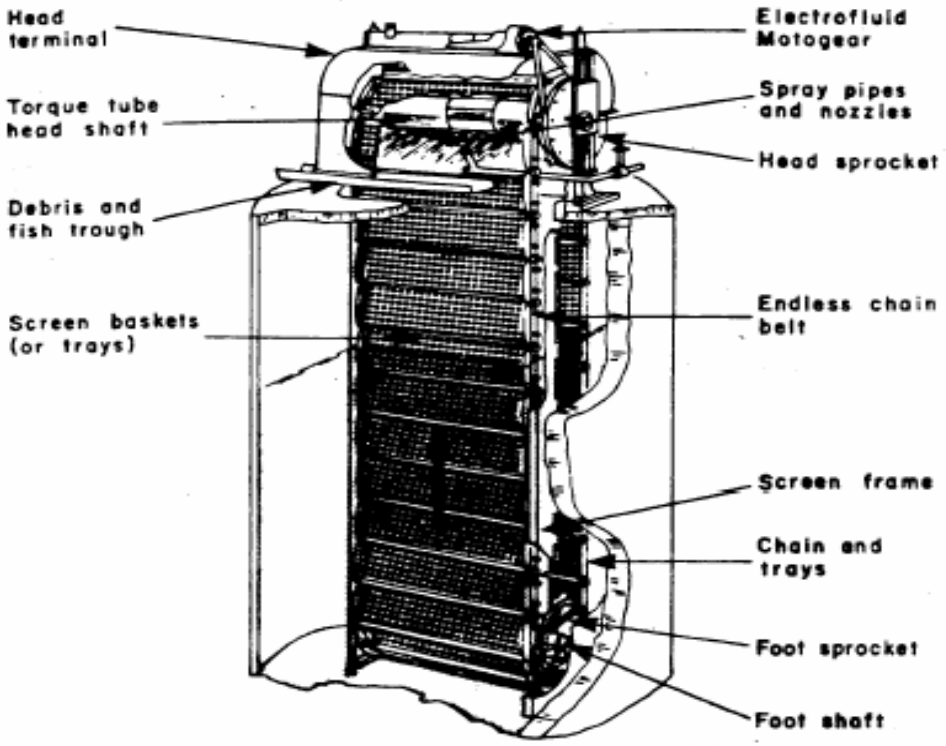
Generally, installed to divert fish from irrigation canals. Can be driven by a small motor or by a paddle wheel. To avoid juvenile fish impingement, a bypass channel is required near the front of the screen. Rubber seals are necessary along the base and sides.



FINNIGAN SCREEN

The horizontal, self-cleaning Finnigan Screen is another concept, generally installed to divert fish from irrigation or enhancement projects. The stationary horizontal screen is kept clean by a set of brushes attached to a revolving paddle wheel powered by the water current entering the structure. A portion of the flow, the suspended debris, and fish are directed to the bypass channel. The remainder of the flow passes through and below the screen for use as required.

IRRIGATION INTAKE SCREENS



CONVENTIONAL VERTICAL TRAVELLING SCREEN

May be installed in rivers, lakes and the ocean. A common screening method utilized by industry, these self-cleaning mechanical screens with modifications can prevent impact upon fish. Mounted flush to the stream bank (shoreline) or as pier intakes within streams and provided with an opening on the downstream end between the intake screens and trashracks, juvenile fish can generally escape entrapment. Rubber panel, side, and boot seals are required to prevent juvenile fish from gaining entry into the pumpwell. A safe bypass system is essential to return juvenile fish with debris back to the watercourse. Automatic controls are also necessary to ensure operation at a specific minimum head differential.

LARGE INDUSTRIAL AND DOMESTIC WATER INTAKE SCREEN