A SALMONID PRODUCTION PLAN FOR THE COWICHAN VALLEY REGIONAL DISTRICT

By
Ted Burns
Biologist

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INTRODUCTION

The salmonid production plan for the Regional District of Cowichan Valley is a sub-product of a broader project termed the Cowichan Valley Regional District Urban Salmon Habitat Protection Program. The project was initiated in 1996 with the goals of mapping all salmonid habitat and associated Fisheries Sensitive Zones on the East Slope of the CVRD. In addition, all other watercourses and wetlands were mapped and, if fisheries sensitive lands or features were associated with them, they were also mapped. Initial mapping was at 1:20,000 TRIM. Purpose of the project was to provide land use planners with a basis to develop rational land use zoning and bylaw designations to protect fish and their habitat in this rapidly growing region. The Urban Salmon Habitat Program (USHP) funded this project.

This product is a compilation of all salmonid production options within the study area (Cassidy to Malahat). For purposes of this assessment, the region was divided into 17 geographical areas termed Operational Management Units. For each of the OMU's, there is a brief overview of land use patterns, factors limiting salmonid production and a prioritized list of production options (enhancement/restoration opportunities). The summary is backed up by a series of files for the individual basins within the OMU's. The files contain data on stream and lake characteristics and fish utilization along with more detailed descriptions of the production options. The options are mapped on the same 1:20,000 TRIM sheets that portray the Fisheries Sensitive Zones and a number of important habitat and land use features. There are 22 maps in the series. A considerable portion of the map information was transposed to the Cowichan Valley Regional District Environmental Planning Atlas 2000 (CVRD, 2000) but not all. The Fisheries Sensitive Zones and a number of stream and land use features were not included.

METHODS

During the course of surveys to document habitat characteristics, the Fisheries Sensitive Zones and important land use features, production options were identified, mapped and described. The surveys occurred between 1982 and 2001. As part of the assessment process, the fisheries literature (previous studies in the region) was reviewed and individuals with historical knowledge of the area were interviewed, During the assessment process, a number of contributing studies were funded by interested government agencies (MOE, DFO) and forest companies (BCFP/TimberWest).

RESULTS

A total of 501 production options were identified for the 320 waterways assessed in the 17 Operational Management Units. A summary is presented in Table 1.

Table 1: A Summary of Production Options by Operational Management Unit

OMU	AREA	No.
1	Ladysmith North	21
2	Chemainus	36
3	Somenos Basin	37
4	Main (Cowichan River)	4
5	Cowichan Sidechannels	81
6	River North	21
7	Lake Cowichan North	30
8	Cowichan Lake	4
9	Lake Cowichan – Youbou	20
10	Lake North	27
11	Lake South	33
12	Lake Southeast	66
13	Lake Cowichan South	19
14	River South	19
15	Koksilah Sidechannels	18
16	Koksilah Basin	50
17	Southend	15
	TOTAL	**501**

A substantial number of production options have been developed: fry salvage and accompanying colonization of salvaged fish has been ongoing since 1986 with a plan and much earlier than that on an opportunistic basis. Not all of the coho – trout colonization areas are serviced by the program but this has more to do with logistics and lack of fish than it does with the plan. A number of Cowichan Sidechannels have also been developed as has rearing habitat on Meade, Sutton, Golf Course and Maple Flat Creeks. Beaver Creek, a small stream in OMU 13, has had a very successful ongoing enhancement program since 1983. However, these activities only make up a small percentage of possible restoration/enhancement options in the region. It will take decades to fully develop all the possibilities.

It is therefore appropriate to present a list of the most beneficial options that can be undertaken in a reasonable time frame. It should be noted that the majority of the options address *Primary* enhancement/restoration needs like providing access and critical period discharge. This is a holistic approach to fish habitat improvement and is a deviation from the opportunistic “sticks and stones” approach that has dominated this area to date. Sticks and stones are *Secondary* options that should only be applied when the *Primary* needs are fulfilled.

Table 2 presents the opportunities which are prioritized on the basis of need and anticipated benefits to the resource. Those options in the Ladysmith North OMU are not listed. Ladysmith North is considered to be in the Nanaimo FsRBC region (Central Island) even though it’s in the CVRD.

Table 2: The Top 30 Production Options

No.	OMU	Location	Activity
1	5	Five Channels	Provide permanent flow to a series of sidechannels
2	12	Robertson Sidechannel	Restore flow to a critical coho spawning area
3	3	Averill Falls	Bypass barrier – provide access
4	3	Averill E and N Culvert	Provide juvenile access
5	3	Averill headwater storage	Provide summer flow
6	3	Bings Falls and associated barriers	Provide adult access
7	3	Quamichan L. outlet control	Allow coho smolt out migration from lake
8	5	Log Jam Sidechannel	Provide permanent flow
9	14	Dale's Creek Falls	Provide adult access
10	17	Garnett Creek Stewardship/Mapping	Establish stewardship group, map intrusions
11	7	Oliver Creek Barriers	Improve adult and juvenile access
12	16	Glenora Oxbow	Provide juvenile access
14	10	Shaw Creek Falls	Provide adult access
15	12	Fairservice Lake	Provide summer flow to Halfway Cr.
16	15	Norrie Creek Culvert Removal	Provide adult access
17	5	Bible Camp Oxbow	Control inflow, protect inlet area
18	3	Quamichan Lake Cutthroats	Improve spawning habitat
19	5	Relic Channel above Black Bridge	Provide spawning and rearing habitat
20	2	Wide Bend Sidechannel	Provide access and flow
21	3	Richards Creek headwater storage	Improve base flow in Richards Creek
22	6	Skutz Creek West culvert removal	Provide access
23	5	Remote Run Sidechannel	Increase base flow
24	2	Bonsall Creek headwater storage	Increase base flow especially above Whitehouse
25	5	Bonsall's Slough	Increase base flow
26	12	Mesachie Lake Weir	Provide permanent flow to Mesachie Creek
27	10	Shaw Creek sidechannels	Provide spawning and rearing habitat
28	15	Hellebore Creek headwater storage	Increase base flow
29	12	Steve's Creek	Increase base flow
30	10	Lakehead Creek	Improve spawning habitat

OPERATIONAL MANAGEMENT UNIT 1: LADYSMITH NORTH

OVERVIEW

Ladysmith North is the drainage area of Ladysmith Harbour and includes five salmonid streams: Thomas, Luke's, Walkers, Bush and Rocky.
The area contains one major lowland riparian unit which has been largely cleared for agricultural purposes and is part of the Cassidy Aquifer at the head of Ladysmith Harbour. Three of the streams are located on this land unit: Thomas, Luke's and Lower Walker. Thomas Creek has been highly impacted by agricultural use, Luke's Creek is largely man made; its upper three reaches were excavated in 1994. Lower Walker creek has been much less intruded.
Bush and Rocky Creeks are basically mountain runoff streams. Bush Creek is one of the least intruded streams in the CVRD but Rocky flows through the Town of Ladysmith for 1700 m and has been impacted by urban and agricultural runoff. Reaches 1 – 3 have also been moved (1972) to make room for the Doman – Western (formerly Pacific) Mill which also covers Rocky Creek's former estuary which was small but rich.

LIMITING FACTORS

Main limiting factors are access, low summer flows and riparian quality. Barriers restrict access on Rocky and Bush and summer flows and /or riparian quality are problems on Thomas, Walkers and Lukes. Thomas also lacks quality spawning habitat in its most habitable reach.

PRODUCTION OPTIONS

Twenty-one opportunities to improve production are present. They are summarized in Table 1.

Table 1: Production Opportunities in Ladysmith North

No.	Sub-Basin	Type	Priority
1	Thomas	Spawning habitat improvement	2
2		Groundwater development	1
3		Rearing pond development	2
4		Riparian improvement	1
5		LWD addition	3
6	Lukes	Spawning habitat maintenance	1
7		Habitat complexing	3
8	Walkers	Barrier improvement	2
9		Headwater storage	1
10		Riparian restoration	2
11		LWD addition	3
12	Bush	Barrier improvement	2
13		Coho colonization	1
14-18		Sidechannel development	1
19	Rocky	Barrier improvement	2

20		Coho colonization	1
21		LWD addition	1
Total 21	Total 6		

Stream Code: 9000641

Stream Name: Thomas Creek

Management Unit: Ladysmith North

CVRD Electoral Area: H

A) BIOPHYSICAL OVERVIEW: Thomas Creek is a small stream that originates in a wetland area near Cassidy Airport and flows south for 3350 m to enter Lady smith Harbour via a small estuarine cove in the northeast corner. Most of its flow is provided by the winter – spring water table (Cassidy Aquifer). Runoff contribution is slight and winter flow fluctuation is minor. Thomas Creek flows through a mix of woodland, farmland and rural residential landscapes.

Air Photos	BC 87046 231,232
Topographic Maps	92G/4, 92G.001
Salmonids	Co to about 2000 m Ct to about 2000 m Possible occ. Cm to 395 m
Obstructions	None
Max. temp.	16 R2 (8/19/96)
Min. disch.	. 002 R2 (8/19/96) .00001 R3 (8/19/96) .0001 L shaped ditch on Davis property (8/19/96) 0 R's 5-9 (8/19/96) except for the following points:

1	spring	437229E 5432000N	1547 m
2`	wetland	437281E 5432166N	1763 m
3	pond	437241E 543235N	2029 m
4	spring	437228E 5432346N	2219 m
5	tributary	437032E 5432535N	2493 m
6	pond	437168E 5432654N	2589 m
7	spring	427046E 5432810N	
8	airport fence	436810E 5433063N	

THOMAS CREEK

	Channel width	Wetted width	Substrate	Slope	Channel Confinement	Channel	Side Length	Area	
Reach1	3	2	2620	0.5	UC		N	63	90
Reach 2	3	2	2440	1.5	FC		L	332	664
Reach 3	3	1	9100	1.0	CON		N	46	46
Reach 4	..9 m culvert						189	NA	
Reach 5	3	0	8110	.5	FC		L	442	0
Reach 6	15	0	1000	.5	)C		L	256	0
Reach 7	3	0	9100	1.0	FC		L	420	0
Reach 8	4	0	8200	1.5	CON		N	422	0
Reach 9	3	0	9100	0.2	UC		H	1222	0
TOTALS								3392	800

B) FISH UTILIZATION AND LIMITING FACTORS

Thomas Creek supports remnant populations of coho salmon and cutthroat trout. Juvenile population estimates or spawner counts have never been undertaken but coho fry and cutthroat parr were seen on a stream walk of 8/19/96 and residents still report the occasional spawner of both species. Occasional chums have also been reported.
Production is highly limited by low to nil summer flow, a lack of suitable spawning substrate and poor water quality in Reaches 1 and 2. The upper 2909 m is largely summer dry, there is a general lack of gravel and what there is highly compacted and there is a serious stockyard runoff problem at Reach 3 along with general deterioration from intensive agricultural use. Riparian condition in Reaches 3 through 7 is poor.

C) PRODUCTION OPPORTUNITES

1.*SPAWNING PLATFORM CONSTRUCTION* at 120, 149, 192 and 217 m in R2 and at points in Reaches 7 and 8 would increase coho – cutthroat fry production and may encourage chum production. Chum eggs could be transferred from nearby Bush Creek spawners (Bush Creek supports a healthy run in most years (r = 200 – 15,000). Eggs could be eyed at Nanaimo River Hatchery then transferred to the spawning platforms or held to the fry stage (Production Option #1)
2.*GROUNDWATER EXPOSURE* via excavation of finger channels at springs could provide base flow in Reaches 3-9 and increase base flow in Reaches 1 and 2. Eight potential sites are present in Reaches 2 through 8. It is suggested that a headwater infiltration/upwelling pond also be excavated in Reach 9 near Cassidy Airport. The finger channels and upwelling pool would also provide valuable rearing habitat and could be complexed if they prove viable. Thomas Creek is located on the Cassidy Aquifer, a strong groundwater feature (Production Option #2)
3.*REARING POND DEVELOPMENT* in Reaches 2 and 5 and 7 through 9 would provide summer rearing refugia. Two of the potential sites are off channel and would provide over winter habitat as well. These are located at 242 m in Reach 2 and 442 m in reach 5. Five existing ponds are present in Reaches 7 and 8 (Production Option #3)
4.*RIPARIAN IMPROVEMENT*, particularly in reaches 5 and 7, would improve bank stability and cover. Fencing will be required along with stockyard or channel relocation (Production Option #4)
5. *LWD ADDITION*: If the above improvements can be undertaken and have some success, LWD addition can begin. Reach 2 has the most critical need because it is and will be the most capable reach. Of course LWD would be added to the relocated channel as a matter of course. Upper reach addition would proceed as base flow is provided (Production Option #5)

D) LAND USE FACTORS

AGRICULTURAL

Approximately 80% of the basin has been cleared for agricultural purposes.

RESIDENTIAL

The basin is in the light rural phase

RISK POTENTIAL

Moderate. Some of the agricultural practices need to be modified considerably to reduce risk.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone which is entirely riparian in nature and seldom wider than 70 m except in the headwater reach (R9) which is largely intact needs to be protected and allowed to revegetate. Agricultural runoff needs to be much better controlled.

Stream Code:

Stream Name: Luke's Creek

Management Unit: Ladysmith North

CVRD Electoral Area: H

BIOPHYSICAL OVREVIEW: Luke's Creek (local name) is a partially man –made stream that drains what was an area of riparian wet woodland at the north end of Ladysmith Harbour. Mr. H. A Davis of nearby Code Rd. cleared a large area around the creek for pasture in the summer of 1994. In order to drain the land more efficiently, the creek was deepened and lengthened somewhat and several finger channels were excavated tributary to the creek. The creek is entirely fed by the water table (Cassidy Aquifer) and flow fluctuation is very minimal.

Air Photos	BC 87046 231-232
Topographic Maps	92G/4, 92G.001
Salmonids	Co to 563 Ct to 563
Obstructions	60 cm concrete pipe culvert at 12 m. 15 cm vertical drop and 1.38 MPS at mean winter flows. Walker back floods it at high flows – it's a juvenile barrier.
Max. temp.	14 (8/23/95)
Min. disch.	.035 (8/25/95)

LUKE'S CREEK

	Channel Width	Wetted width	Substrate	Slope	Confinement	Channel	Side Length	Area	
Reach 1	7	4	3610	.5	FC		L	12	48
Reach 2	8	7	9100	.1	FC	L	50	350	
Reach 3	2	2	8200	.5	FC		L	178	356
Reach 4	2	2	7210	.5	CON		L	35	70
Reach 5	2	2	9100	.1	CON		L	288	576
TOTALS								563	1400

FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout utilize the stream but it is unknown if there is a permanent population. The stream's small size and sedimentary nature limit production.

ENHANCEMENT OPPORTUNITIES

1.SPAWNING PLATFORM MAINTENANCE: Five pools totaling 35 m^2 and five spawning platforms totaling 5.5 m^2 were constructed between August 25 and September 28, 1995. Pools were constructed in Reaches 3and 4. The platforms were constructed in Reach 1 just below Brenton Page road culvert and in Reaches 2and 3. A pool was also constructed in conjunction with the R1 spawning platform.
Subsequent follow up examination revealed that all the platforms except the first two have suffered sedimentation and require cleaning/flushing. Up to 10 cm of silt has accumulated on platforms 3, 4 and 5. Riffles need to be constructed just above the platforms to keep turbulent flow over them to increase flushing (Production Option #6)

2. *COVER ADDITION:* At least two LWD structures could be added to Reach 3 to increase cover (Production Option #7)

LAND USE

Agriculture

Aside from R's 1 and 2, the entire length of the creek was cleared for pasture. However, fencing was established in 1995 and the immediate stream banks are re-vegetating.

PROTECTION NEEDS

There is a possible need for fencing on the finger channels (tributary ditches).

Watershed Code: 9203308

Stream Name: Walkers (Perry) Creek

Management Unit: Ladysmith North

CVRD Electoral Area: H

BIOPHYSICAL OVERVIEW

Walkers Creek originates on a large flat (Walker Sponge) with several wetland basins at an elevation of approximately 100 m. It flows east-southeast for 4455 m to enter the north end of Ladysmith Harbour in a small estuary. Reaches 1 and 2 base flow is provided by groundwater from the Cassidy Aquifer. Headwater wetlands and the configuration of its headwater basin buffer the stream. Only two small mountain runoff tributaries are present above the primary headwater wetland.

Air Photos:	BC 8706 231-232
Topographic Maps	92G/4, 92G.001
Salmonids	Co to 3859 m Ct to 3859 m Cm to 742 m with an occasional fish to 1417 m
Obstructions	Fishway at Island Highway (1988) at 742 m. .4 m vertical drop at outlet. Culvert was previously a point of difficult passage and sometimes had to be sandbagged to allow Co to pass. Series of small falls beginning at 1417 m: 2R5, 2R3 and 2R10. Passable for Co-Ct. .6 m vertical drop culvert underneath dam at 3859 m
Max. temp.	13.2 R2 (9/11/95) 20 R8 (6/9/97) 20 R7 (8/12/97)
Min. disch.	.030 R2 (9/11/97) 0 R3-R5 .0006 R7 (8/12/97) Local residents (Campbell, 5685 Takala: 245-8802) claim that a dam and irrigation reservoir on the nearby Carr property (5735 Takala: 245-4864) cause R7 and reaches below it to dry in mid to late summer during most years. Information passed to Cindy Harlow of DFO by letter (8/4/97).

WALKER CREEK

	Cannel Width	Wetted width	Substrate	Slope	Confinement Channel	Side Length	Area	
Reach 1	25	5	4420	.5	UC	L	64	320
Reach 2	6	3	2440	1.0	FC	L	760	2280
Reach 3	10	0	6220	.5	FC	L	593	0
Reach 4	5	0	1144	5.0	CON	N	223	0
Reach 5	2	0	8110	1.0	OC	L	706	0
Reach 6	2	0	4420	1.0	CON	N	884	0
Reach 7	3	1	1450	3.0	CON	N	805	805
Reach 8	3	1	2620	1.0	CON	N	420	420
TOTALS							4455	3825

FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present up to the Carr Dam at 3859 m. Chum salmon spawn in the intertidal zone and up to the middle reaches of R2; occasionally up to the lower section of R4.
Production in Reaches 3 through 7 is limited by low to nil summer flows.

ENHANCEMENT OPTIONS

1.*BARRIER IMPROVEMENT:* **Modification of the dam** at 3859 m to allow fish passage would allow anadromous fishes (Co-Ct) to utilize another 596 m. It may also be possible to use the reservoir to augment low flows (Production Option #8). Careful attention should be paid to the falls that begin in the ravine at 1417 m. Debris jams in the ravine could render them impassable.
2***. RIPARIAN RESTORATION:*** Bank stabilization, fencing and general riparian improvement is required in Reaches 4, 5 and 6 (Production Option #9).
3***. HEADWATER STORAGE:*** Headwater Storage in Walker Sponge (32 Ha.), the irregular wetland basin that is the primary headwater, would yield .014 CMS for 180 days with 1 m of storage. Because the basin is so irregular and parts are at variable elevations, storage calculations are difficult but it's evident that a great deal of improvement would result especially between the bottom end of the wetland and the Island Highway which is summer dry for the most part. 14955 m^2 of additional wetted area would result. Predicted coho smolt yield @ 1fry/m^2 is 1196 (Production Option # 10).
4. ***LWD ADDITION:*** Addition of Windfall Logs (LWD): Like most area streams, Walker Creek is deficient in LWD cover. Judicious addition of windfall logs or clusters to Reaches 2 and 7 and, if permanent flow can be provided via headwater storage/summer release, Reaches 3 – 6, would increase the carrying capacity of Walker Creek for coho and cutthroats (Production Option #11).

LAND USE FACTORS

Agriculture

Approximately 40% of the basin has been cleared for agricultural use.

Residential

Residential use is still light but sections of Reaches 3 and 6 have been impacted

Forestry

The upper portion of the basin adjacent to Reach 8 is managed forest: early second growth

PROTECTION NEEDS

The Fisheries Sensitive Zone includes riparian and ravine lands and the entire headwater wetland which I have termed the Walker Sponge.

Stream Code: 920327900

Stream Name: Bush Creek

Operational Management Unit: Ladysmith North

CVRD Electoral Area: H

A) BIOPHYSICAL OVERVIEW: A moderate size stream that drains a basin that is relatively broad below the 400 m contour then steepens and narrows above that point. Discharge is partially buffered by a small lake (Coronation) and a number of wetland basins including Little Bush Wetland. Bush Creek holds its flow well: groundwater is an important component of summer base flow. Bush Creek is the least intruded stream in the Nanaimo Lowland portion of the CVRD. Bush Creek has been the subject of research on coho – cutthroat interaction.

Air Photos	BC 87046: 231,232
Topographic Map	92B/13, 92 G/4, 92G.001, 92B.091
Salmonids	Co to 1741 m Cm to 1741 m St to 1741 m Ct to 9130 m plus 3000 m in Coronation Branch and approximately 1000m in Little Bush/ Little Bush Wetland Rb to 9130 m plus 3000 m in Coronation Branch
Obstructions	3XR10 at 1741 m 3XR 12 at 1824 m Series of falls over the Mt. Hayes escarpment: Never Ending Falls (R6): 2R, 4R7, 6R8, 5R7, 20R30, 50R60 and 50R.
Max. temp. (C°)	16 R2 8/20/96
Min. Disch. (m^3)	.0375 R2 8/20/96
Watershed Area	23 km^2

BUSH CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	20	8	9100	.01	UC	H	180	160 (tidal)
Reach 2	12	8	1720	1.0	FC	M	1277	10216
Reach 3	10	8	1450	2.0	CON	N	227	1816
Reach 4	6	4	0163	4.0	ENT	N	105	420
Reach 5	9	4	1360	1.6	CON	N	2000	6000
Reach 6	13	0	1270	2.5	CON	N	156	0
Reach 7	6	6	0028	30.0	FC	L	540	3240
Reach 8	7	4	1360	2.0	CON	N	3600	14400
Reach 9	6	4	1360	7.0	CON	N	1200	4800
Reach 10	3	2	1270	10.0	CON	N	1500	3000
TOTALS							10785	44052

B) FISH UTILIZATION AND LIMITING FACTORS

Bush Creek is utilized by coho and chum salmon, resident and migratory cutthroats, resident rainbows and an occasional steelhead. Production is limited by access, high winter discharge, lack of lateral (off channel) habitat and low summer flows although this creek holds its summer flow relatively well compared to others in the region.
Bush Creek has been the site of a PBS research program on the interactive ecology of juvenile coho and trout in streams (Glova and Mason, 1974, 1976).

C) PRODUCTION OPPORTUNITIES

1. ***BARRIER IMPROVEMENT:*** Improvement of the first falls would provide access to an additional 2000 m of quality habitat for coho, anadromous cutthroats and steelhead. Bob Hurst of DFO did some blasting in

1983 but it was unsuccessful (Hurst, pers. comm. 1990). The obstruction tends to catch large bedload and debris every winter thus renewing itself (Production Option # 12)

2. ***COHO COLONIZATION:*** Coho colonization in Reach 5 would yield 1440 smolts at the 8% biostandard for coho fry to smolt survival (Production Option # 13)

3. ***SIDECHANNEL DEVELOPMENT:*** A number of promising sidechannel development opportunities are present adjacent to Reach 2:

Four opportunities are present in the vicinity of the Island Highway. These would involve excavating existing channels to expose more water and extend their length.
A relic channel just below the old CZ grade offers opportunity to access groundwater for improved rearing and over wintering
A relic channel complex on the south side of the stream beginning at 900 m offers potential channel development of approximately 300m2.
A sidechannel /tributary complex at 1135 m provides a very good opportunity to link a damaged network of ponds, sidechannels and an upland tributary to provide an additional 600 m^2 of quality lateral habitat.
Another relic channel at 1387 m has considerable development opportunity (Production Options #14-18)

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth; logging will likely resume in mid-basin shortly. The Branch 4 area has been flagged for road location.

Mining

Coal mining was once an important activity in the Lower Basin.

Residential

Residential use is very light and confined to a few residences on the Indian reserve in the Lower Basin.

NOTES

Late Summer Coho Fry Densities (from PBS sampling)

Year	Site	No.	No./m^2	% Age 0	Mean FL
1991	Island Highway	198	-	100	53.2
1992	Island Highway	122	1.03	97.5	70.6
1993	Island Highway	306	3.08	100	54.5
1994	Island Highway	281	2.30	100	55.0
1995	Island Highway	222	1.96	99.5	66.4
1996	Island Highway	492	2.42	99.8	57.1
1997	Island Highway	34	0.12	77.8	81.2
1995	End of Christie Rd.	1240	4.10	100	56.2
1996	Upper Christie	163	2.00	100	51.9
1997	Upper Christie	116	1.05	89.3	59.0

De-watering

R6 (the first reach below Never Ending Falls) is subject to summer de-watering due to the depth of bedload in this 156 m section and the hatchery use of water. The intake is just above the top end of the reach. The hatchery operates 3 circular ponds in the summer.

E) PROTECTION NEEDS

The most critical areas for protection are the estuarine and riparian lands of the lower basin and the ravine slopes upstream – particularly those adjacent to Reaches 2 and 3. Another strong area of concern is the Little Bush Wetland Complex.

Stream Code: 9203250

Stream Name: Rocky (Tyee Creek)

Operational Management Area: Ladysmith North

CVRD Electoral Area: H, G and Town of Ladysmith

A) BIOPYSICAL OVERVIEW: Rocky Creek is a moderate sized stream that drains a relatively steep and narrow basin. Flow buffering is limited and the stream is subject to high fall – winter discharge fluctuation. The stream's lower reaches have been highly impacted by urban – industrial encroachment.

Air Photos: BC87046 231-232
Topographic Maps: 92G/4, 92 B/13, 92G.001, 92B.091
Obstructions: Series of man made barriers beginning at 625 m: .8R1.5 8m into tunnel under old CZ Railroad/logging road followed by 19 more small cascades with vertical drops between .4 and .6 m in this 68 m long structure. The entire tunnel above the 8 m point is a velocity barrier. Gradient is 10 – 12% and the channel is only 1.5 – 2 m wide and entirely bedrock. Between the top of the tunnel and the E and N culvert is a 12 m long reach with an 18% gradient with two cascades: 1.25R2 @ 2 m and 1.2R1.5 @ 9 m. The E and N culvert is 77 m long. The first 46 m is U shaped concrete pipe and the final 31 m is a concrete box with a 9% apron at the joint between the old and the new sections. Aside from the apron, the remainder of the section is very shallow: only 3 mm deep at base flow. The first section would be passable if the CZ tunnel was passable. The EN culvert is concrete pipe 4 m in diameter. It joins the Island Highway culvert, which is a concrete box structure. Total length of tunnel, R4 and the E&N culvert is 157 m. It appears that a natural falls was present at the 617 m point before the tunnel was constructed.
A second series of high falls begins at 2179m.
Salmonids: Co to 625 m
Cm to 625 m
Ct to 5830 m
Max. temp. 16 (9/5/96)
Min. disch. .048 R2 (9/5/96)

ROCKY CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	14	5	5410	.5	OC	M	.0017	256	Tidal
Reach 2	7	3	1630	1.2	CON	N	.008	170	510
Reach 3	6	3	127R	2.3	CON	N	.005	191	573
Reach 4	4	2	0127	18	CON	N		12	24
Reach 5	6	3	2440	3.0	CON	N		1040	3120
Reach 6	5	3	2341	3.0	CON	N		350	1050
Reach 7	5	3	1144	5.0	ENT	N		80	240
Reach 8	6	4	1450	2.0	FC	L		1500	6000
Reach 9	4	3	1270	3.5	CON	N		1200	3600
Reach 10	6	4	1450	2.0	CON	N		1000	4000
Reach 11	3	1	3610	1.5	CON	N		1000	1000
Reach 12	2	1	1360	12.0	CON	N		1800	1800
TOTALS								8759	22581

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and chum salmon utilize the lower 617 m but 256 m of this area is tidal. Cutthroats are present for 5830 m. Anadromous fish for 617 m of that. Rocky was never a strong coho producer; maximum reported escapement was 65 (1971). Anadromous cutthroats were also very low. No estimate of numbers has ever been made. Chum salmon were the strongest salmonid in Lower Rocky Creek prior to 1972 when their numbers were as high as 1500. The Saltaire Mill (Pacific then Doman - Western) was constructed in 1972. It

covers the original estuary of Rocky Creek (approximately 6.25 ha) which featured a salt marsh and some quality sections of spawning habitat that were highly utilized by chum salmon in high escapement years; Rocky Creek was diverted to the south in late 1971 to accommodate the mill. The diversion channel lacks quality spawning habitat and is steeper and more constricted than the original channel. Coho, chum and sea-run cutthroat are now at bare survival levels. Only one coho fry was seen in a stream walk on Sept. 5, 1996. In terms of resident cutthroats between the lower obstructions and the falls at 1700 m, these fish were abundant and as large as 38 cm. Resident cutthroats in Upper Rocky are smaller.
Anadromous salmonid production is limited by access and lack of quality spawning habitat. Runoff from the adjacent mill yard and from upstream urbanization has reduced substrate quality.

C) ENHANCEMENT OPPORTUNITIES

1. ***BARRIER IMPROVEMENT:*** Passage of fish around the lower obstructions would provide an additional 1212 m of habitat of higher quality that what is now accessible. Indications are that this will be a difficult if not impossible job for coho and trout and impossible for chums. However, if Rocky Creek coho are to survive, it must be at least carefully considered.
Provision of a spawning platform at the Tunnel Pool and at least two downstream locations should be considered. They will have to be cleaned regularly because of the high sediment input. Ladysmith Sportsmen Club added gravel to the Tunnel Pool in 1990 and placed concrete pylons in the intertidal zone for adult cover. The club also did water quality assessment which resulted in the Town of Ladysmith and Saltaire Mill removing discharges (Clough, pers. comm. 1990) Contact: Greg Smith 245-3660 (**Production Option # 19).**

2. *COHO COLONIZATION:* Available above barrier habitat: 15,890 $m^{2;}$ a stocking rate of 1 fry/m^2 would yield approximately 1271 smolts (Production Option #20)

3. *LWD ADDITION:* Functional LWD is almost non-existent in Reaches 2 and 3 and this limits rearing. These reaches are easily accessible form the Doman – Western mill yard and a good deal of benefit could result from minimal cost and effort. Doman – Western should be encouraged to contribute because their mill covers the old, more productive portion of Rocky Creek and a fine little estuary (Production Option # 21)

D) LAND USE

Urban

Residential development has increased greatly in the last decade and large-scale housing projects have intruded on the Rocky Creek Ravine in the Upper Walkem Road area.

Forestry

The upper basin is in advanced stages of second growth. Logging has resumed in the last few years. The area is mostly private land now under the management of TimberWest.

E) PROTECTION NEEDS

The most important parts of Rocky Creek are within the Town of Ladysmith where rapid development is occurring near the Rocky Creek Ravine. Generous setbacks from the edge of the ravine are required – a much broader protective corridor could have been applied to Rocky Creek.

OPERATIONAL MANAGEMENT UNIT 2: CHEMAINUS

OVERVIEW

The Chemainus OMU stretches from Bonsall Creek in the south to Holland Creek on the north. The unit is a mixture of urban and agricultural uses on the eastern fringe which includes part of Ladysmith and Chemainus, Saltaire and Crofton. The coastal plain is relatively narrow or non-existent and the only major riparian landscape unit is the Chemainus – Bonsall estuary/riparian lowland. Beyond the coastal fringe, the OMU is largely forested upland.

LIMITING FACTORS

Access and low summer flow and, in the case of Chemainus River in particular, lack of stable winter habitat are prime limiting factors in terms of trout and salmon production.

PRODUCTION OPTIONS

36 production opportunities are present in OMU 2. They are outlined along with their priority rating in Table 2.

Table 2: Production Options in OMU 2 (Chemainus)

No.	Sub-Basin	Activity	Priority
22	Holland	Increase base flow	1
23	Stocking	Coho colonization	1
24		LWD (structural improvement)	3
25		Barrier improvement	2
26	Porters	Headwater storage	2
27		Riparian restoration	2
28		Barrier improvement	2
29	Matthew	Headwater storage – Fuller L.	2
30		Water quality improvement	1
31		Structural improvement	2
32	Chemainus	Coho/chinook colonization – barrier removal	1
33-39		Sidechannel development	1
40		LWD addition	3
41		Fry salvage	
42-43	Bonsall	Barrier removal	2
44-46		Headwater storage	1
47		Riparian restoration	3
48		Solly's Lake aeration	2
49	West Bonsall	Fry salvage	1
50		Fencing	2
51	Whitehouse	Barrier improvement	2
52		Riparian restoration	2

53		Coho colonization	1
54		Flow management/str. Imp.	1
55	Groves Creek	Coho colonization	2
56		LWD addition	2
57		Fry Salvage	1
	Water Parsley		
Total 36	Total 10		

Stream Code: 920321500

Stream Name: Holland Creek

Operational Management Unit: Chemainus

Municipal: Ladysmith, CVRD Electoral Area G

A) BIOPHYSICAL OVERVIEW: A moderate sized stream that drains a steep, narrow basin that broadens somewhat above the 300 m contour. Holland Creek is somewhat buffered by Holland Lake and a number of small wetland basins. Holland Lake (Company Dam) is a reservoir (550 ha) on the South Fork. It is the main water supply for the Town of Ladysmith. Water is stored in the reservoir (which receives diverted inflow from Banon Creek) and released in South Holland so it can be withdrawn at a small diversion dam at Chicken Ladder Falls some 8500 m downstream.

Air Photos	BC 87025: 21 - 23
Topographic Map	92B/13, 92B. 091
Salmonids	Co to 2005 m
	Ct to 11038 m
	Rb to 11008 m
	St to 2005 m
	Cm to 800 m
Obstructions	Bore Hole Falls (14R) at 2005 m
	Numerous upstream falls including Chicken Ladder at 4538 m
Max. temp. (C°)	15 (9/15/96 – R2)
	18.3 (7/26/98 –R2 120 m below Dogwood Rd.)
	18.6 (7/21/98 – R5)
	16.9 (7/21/98 – R6)
	18.9 (8/9/98 – R3)
Min. Disch. (m^3)	.0866 (9/5 /96 – R2)
	.66 (7/21/98 – R7)
	.0117 (8/9/98 – R3)
	0 (7/21/98 for 400 m below Chicken Ladder Falls)
	Heart Creek R1 .0077 (8/8/98)
	Stair Creek R2 .0043 (8/9/98)

HOLLAND CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	31	7	4420	1.0	FC	L	125	875
Reach 2	16	7	1720	2.0	FC	L	820	5740
Reach 3	13	4	1450	2.0	CON	N	1060	4240
Reach 4	12	7	1243	4.0	CON	N	265	1855
Reach 5	6	6	1243	4.0	CON	N	268	1853
Reach 6	13	4	1180	6.0	CON	N	2000	8000
Reach 7	13	10	1261	3.5	CON	N	2200	22000
Reach 8	7	5	1261	12.0	CON	N	600	3000
Reach 9	7	5	1450	4.0	CON	N	500	2500
Reach 10	6	5	1351	5.0	CON	N	3200	13000
TOTALS							11038	63063
Anadromous							2005	10855

B) FISH UTILIZATION AND LIMITING FACTORS

Holland Creek supports coho and chum salmon and steelhead and cutthroat trout. Resident rainbow trout are present in Company Dam and occasionally find their way down the creek via the spillway. They are also present in South Holland but have a strong cutthroat influence.
Production is limited by reduced summer flows.
Holland Creek has been the site of important research on the interactive ecology of juvenile trout and coho in streams (Glova and Mason, 1974, 1976).

C) PRODUCTION OPPORTUNITIES

1. ***INCREASED BASE FLOW:*** Production would be improved in the lower 4538 m if some critical period discharge flow could be allotted to Holland Creek. The creek's entire base flow is captured at Chicken Ladder Falls and diverted into the Town of Ladysmith distribution system. The downstream portion of the stream survives the summer on groundwater seepage. Amazingly, by the time the stream reaches its most capable portion for fish in Reach 2, (he confluence of Heart Creek) flow has recovered dramatically. Flow above Chicken ladder was .66 CMS on July 21, 1998. The creek was intermittent (scattered pools, no flow) for approximately 400 m below the dam where flow picked up to 5 LPS. By August 8, this section was dry and the creek was intermittent below it for about 300 m. Flow was highly reduced all the way down to R2 (.0117 CMS) It would be very unrealistic to suggest that a substantial portion of above Chicken Ladder flow be spilled down the creek because most of the flow results from created storage and is needed by the Town of Ladysmith. Still, if just 10% could be spilled (.066 CMS,) it would nearly double Reach 2 base flow and be 5.6 times as much as R3 flow (**Production Option # 22)**

D) LAND USE FACTORS

Forestry

The entire basin is covered by advanced second growth. Blocks of Crown timber are present in mid-basin. They are administered by BCFS Small Business Forest Enterprise Program.

Agriculture

Nil

Residential

Although most of the south portion of the Town of Ladysmith is adjacent to the Holland Creek Ravine, the ravine is protected and a trail network is located within it.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone encompasses the ravine and the lower ends of several tributaries. Within the ravine are a number of moist riparian areas and side hill seepage areas. The Town of Ladysmith appears to have a proactive land use plan for the Holland Creek Ravine. An attractive trail system has been developed which is well utilized by residents of adjoining neighborhoods and the Town in general.

Stream Code: 9203318200

Stream Name: Stocking (Jackman) Creek)

Operational Management Unit: Chemainus

CVRD Electoral Area: G

A) BIOPHYSICAL OVERVIEW: A moderate size complex stream in terms of terrain and basin form. The basin is narrow and confined below the 60 m contour. It then broadens considerably, particularly between the Island Highway and the 500 kV B.C. Hydro right of way. Above this point (about 120 m ASL), it steepens and narrows as it approaches its origins around the 400 m contour. Stocking Lake is the creek's main headwater source. Its main summer flow source is a spring located some 50 m below the lake. The lake is managed for Saltaire's water supply by the CVRD and only spills during winter. Important tributaries are Caskey, Kerr, Harlow, Towhee and Lady fern Creeks.

Air Photos	BC8702 21-23
Topographic Maps	92B/13, 92B.091, 92B.092
Salmonids	Co to 250 m (tidal zone not counted) Cm to 250 m (tidal zone not counted) Ct to 5736 m plus approximately 1400 m in Kerr Creek and 900 m in Caskey Creek.
Obstructions	3R4 at 250 m .8D at 259 m 3R6 at 678 m 8R at 718 m Periodic upstream falls but resident cutthroat are scattered to Stocking Lake
Min. Disch.	.0056 R1 (9/5/96) .0132 R6 (8/9/98)
Max. temp.	15.5 R1 (9/5/96) 15.4 R7 (8/9/98)

STOCKING CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	20	5	5410	.5	UC	M	.0006	430	Tidal
Reach 2	11	5	1810	.8	FC	M	.005	150	750
Reach 3	10	5	145R	1.6	FC	L	.005	100	500
Reach 4	10	5	145R	2.1	FC	L	.0025	468	2290
Reach 5	9	5	1351	2.0	CON	N		136	680
Reach 6	8	5	1450	2.0	FC	L		960	4800
Reach 7	6	4	1252	3.0	CON	N		500	2500
Reach 8	6	4	2620	1.5	FC	L		700	2800
Reach 9	4	2	1360	4.0	CON	N		800	1600
Reach 10	4	2	1360	9.0	CON	N		1600	3200
Reach 11	2	2	1153	15.0	CON	N		50	100
Reach 12	2	1	1450	2.0	CON	N		100	100
Reach 13	3	0	1180	4.0	CON	N		50	0
TOTALS								6044	19320
Anad,								250	1250

B) FISH UTILIZATION AND LIMITING FACTORS

Stocking Creek is utilized by coho and chum salmon and anadromous and resident cutthroat trout. Coho, chums and sea-run cutthroats are stopped by a falls at 250 m. There is the chance of an occasional steelhead in this creek. Resident cutthroats are present up to the Stocking Lake Dam Spillway and in Stocking lake. Lake cutthroats drop down the spillway to spawn in Reach 12. Parr probably move back to the lake in the spring of their second year. There is very little spawning habitat in Reach 12.

Anadromous production is limited by low summer flows and short accessible length. NOTE: Length of the intertidal zone is 430 m. Some chums spawn in the mid to upper levels in Inner Davis Lagoon. Stream data presented here begins at the top of the intertidal zone at the inner edge of Davis Lagoon.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION*:** Modification of the lower falls to allow coho – sea-run cutthroat passage has tempted people but its only 428 m to the next barrier which could also be improved but just 40 m upstream is Overhang Falls (8m) which is not subject to improvement. The most capable coho-cutthroat habitat is above these falls in Reaches 5, 6 and 8 (**Production Option # 23)**.
Coho colonization (fry stocking) is a more appropriate option. Approximately 10,830 m is available for stocking density of. 5 fry/m^2 or 5415 fry and 2800 m is available for 1 fry/m^2 for a total of 8215 fry. In addition, some production is likely to occur in Lower Kerr and Lower Caskey Creeks as well as Lady fern and Towhee Creeks. The latter two offer excellent winter/spring habitat conditions. Probable smolt yield: 657.

2. ***STRUCTURAL IMPROVEMENT*:** LWD addition in R1 would improve coho – cutthroat carrying capacity. I was once told by Ted Epps that Lower Stocking was cleaned of debris with a bulldozer to improve chum spawning **(Production Option # 24)**

3. *BARRIER IMPROVEMENT:* Although improvement of Stocking Creek Falls at 250 m would only allow anadromous salmonids to use another 438 m (R4), this reach is of very high quality and a fishway should be considered at some point (**Production Option # 25)**
NOTE: Someone has built a boulder weir across the pool below the falls pool (1998). This has created more depth, backflooded some high quality LWD and prolonged wetting in a productive sidechannel.

D) LAND USE FACTORS

Forestry

Most of the basin west of the Island Highway is either Crown or private forest. Considerable logging has occurred in 1930-1936 second growth since 1985 and, in particular, since 1990. Logging of a private block adjacent to Reaches 7 and 8 produced some negative impacts from ravine slope erosion. Considerable downstream movement of debris also occurred due to this operation. A logjam composed of this material is present just below the Island Highway. Logging of Crown blocks has been far better in terms of impact.

Agriculture

Some agricultural use below the 60 m contour. Minor impact because most of this area is protected by ravine part of which is regional park.

Residential

Considerable light residential development to the southeast of Reaches 1-5 along the Old Island Highway. Again, negligible impact on the stream because its protected by a ravine in this area. Some commercial – industrial use in a small area west of the Island Highway along Watts Road. Peerless Road Incinerator nearby.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone has been defined for the entire mainstem and important tributaries, No uses should occur within it. Fortunately, much of the most sensitive portion of the creek (between the E and N crossing and the estuary at Davis Lagoon) is located in Stocking Creek Community Park (CVRD). It comprises 7.286 ha of riparian and steep adjacent slope lands and is a mix of CVRD and Crown holdings. It is a nature park with good trails. The park needs to be extended downstream to include the lower falls and Davis Lagoon; there are some very sensitive riparian and moist ravine landscape units in this area.

Stream Code: 920314800

Stream Name: Porter Creek

Operational Management Unit: Chemainus

CVRD Electoral Area: G

A) BIOPHYSICAL OVERVIEW: A small stream that drains a basin that is relatively narrow below the 20 m contour which is located just below the Old Island Highway (Chemainus Road) and quite broad above that point. The upper basin has been extensively modified for intensive agricultural use. The natural buffering capacity of the upper basin has been highly affected by extensive clearing and drainage. Stream flow response to runoff is now much more direct.

Air Photos	BC87024 022,023
Topographic Maps	92B/13, 92B.o92
Salmonids	Co to 1783 m and sometimes beyond Anadromous Ct to 1783 m and sometimes beyond Res. Ct to irrigation res. @ 444375E 5421370N (R5) and beyond on a seasonal basis Cm to 1783 m
Obstructions	E and N culvert at 1784 m. Concrete arch culvert 28 m long with a .4 m vertical drop at its apron. Migration flow velocities range from 1.5 to 3 MPS
Max. Temp. (C°)	16 (R3 9/11/95) 24 (R4 8/10/98) 13.2 @ E and N culvert 9/9/98
Min. Disc. (M3)	.000014 (R3 9/11/95) 0 above ditch confluence @ 1920 m but some int. pools remain and there was 2 m of water in Don Porter's irrigation res. 2520 m and 23.5 ° (8/10/98) .00133 @ E and N culvert 9/9/98

PORTER CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	4	1	5320	2.0	CON	N	35	35
Reach 2	2	2	4330	3.0	FC	L	180	320
Reach 3	5	2	2431	2.5	FC	M	984	1968
Reach 4	3	1	4420	4.0	OC	M	612	612
Reach 5	2	0	5410	2.5	CON	N	875	875
Reach 6	2	0	4600	1.5	FC	N	1175	1175
Reach 7	2	0	5410	3.0	CON	M	200	0
TOTALS							4061	4985
Anadromous							1780	2873

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroat trout utilize the area below the E and N culvert and chums occasionally reached that point historically. Historical coho escapement ranged between 2 and 50 up to 1975. Chums ranged from none observed to 750. Cutthroats are also present above the E and N culvert in the Porter farm section. A fry salvage crew (Cowichan Fishers' Co-op) caught 1265 Ct fry, 85 parr, 344 smelts and 108 adults between July 21 and 29, 1998. Fish were captured below Chemainus Road (Old Highway).
Production is highly limited by low summer flows, substrate quality (agricultural runoff has added a great deal of fine sediment) and lack of instream an overhead cover particularly in the upper basin. There have also been periodic fish kills from high BOD seepage from silos on an upstream farm (Porter's). Most of the upper basin portion of the system has been ditched and important wetlands have been cleared and drained. One 16 Ha wetland survived until about 1990.

C) PRODUCTION OPPORTUNITIES

1.***HEADWATER STORAGE:*** The most important need is provision of more base flow. Heavy irrigation withdrawal is a contributor. A review of irrigation requirements needs to be undertaken and perhaps a well dedicated to maintaining a summer flow of at least 5 LPS should be developed. 1m storage in two headwater wetland basins could yield 1.13 LPS for the 180-day critical discharge period **(Production Option # 26)**.

2. ***RIPARIAN RESTORATION:*** Re-establishment of a riparian corridor in the upper basin along with some instream habitat improvement. Fencing may be required (**Production Option # 27)**

3. ***BARRIER IMPROVEMENT:*** **Improved Adult Access:** Improve passage at the E and N culvert: back flooding the culvert pool and baffles in the 28 m concrete arch culvert should suffice. This option should not be employed until the first two are implemented (**Production Option # 28).**

NOTE: There are said to be some un-used wells in the Porter Creek basin that could possibly used to augment low flow. More research is required to document this possibility.

D) LAND USE FACTORS

Agriculture

The basin, especially the upper 80%, is extensively developed for agricultural use. Irrigation withdrawal has a large impact on stream flow. Natural base flow of Porter Creek is in the order of 1 –2 LPS. During irrigation withdrawal it drops to an almost negligible .14 LPS

Residential

Light

E) PROTECTION NEEDS

The Fisheries Sensitive Zone needs to be completely protected. In some portions of the stream, exact boundaries are difficult to determine so negotiation will be required. Major elements of sensitivity include the small estuary and the ravine that extends almost to the old highway, riparian lands below the E and N grade, former riparian lands on the Porter farm and headwater wetland areas. What this creek needs most is a local stewardship group to take it under its wing and develop a restoration/protection plan.

Stream Code: NA

Stream Name: Matthew Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A small stream that originates in Fuller Lake and discharges into an estuarine marsh and tidal lagoon at the head of Chemainus (Horseshoe) Bay. Flows through suburban neighborhoods, a golf course, pasture and wooded ravine. Upper section summer dry, seepage starts summer flow below Cottonwood Road where the stream enters a wetland (Gudal Slough).

Air Photos:	BC 87024: 022, 023
Topographic Maps:	92B/13, 92B.092
Salmonids	Occ. Coho to 1685m Anadromous Ct to 1685 m Resident Ct to 2974 m Occ. Rb. Fuller Lake is usually stocked with rainbows and some find their way down the creek SmB Fuller Lake OS (Tsb)
Obstructions	3R4 at 1685 m 2.5 m culvert at Cottonwood Road at 2974 m
Max. temp. (C°)	23 (R3 – 7/22/98) 18.1 (R5 – 7/22/98) 22 (R2 – 7/2/98)
Min. Disch. (m^3)	.00221 (R5 – 9/11/96) .0024 (R2 – 9/30/99)

MATTHEW CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	4	2	9100	.1	OC	M	15	30
Reach 2	3	3	4420	.01	OC	M	120	360
Reach 3	20	4	8200	.5	FC	L	891	3504
Reach 4	1	1	1450	3.0	CON	N	108	108
Reach 5	3	1	2440	2.0	CON	N	132	132
Reach 6	1	.5	1000	1.0	CON	N	904	452
Reach 7	1	1	1000	.5	OC	M	443	443
Reach 8	2	0	4240	5.0	CON	N	593	0
TOTALS							3206	5029
ANADROMOUS							1685	4573

FULLER LAKE

Area	Elev.	Volume	Max. Depth	Min. Depth	TDS	Perimeter
21.45 ha	46 m	1,825,580 m^3	17.1 m	8.5 m	33mg/L	2104 m

B) FISH UTILIZATION AND LIMITING FACTORS

Matthew Creek has supported strong populations of cutthroat trout, especially sea-runs and a few coho salmon. Coho are now very sparse or non-existent Anadromous cutthroats are still relatively strong. 9/30/99 fry density was .24/m^2 at a sample site in R4 on the Purdy Farm.
Production is limited by low summer flows, access and habitat deterioration.
270 m of the stream is located on Mt. Brenton Golf Course where it has been ditched; there is little instream cover or pools and bank vegetation is sparse.

A heavy deposit of iron oxide renders much of Reaches 1, 2 and 3 summer uninhabitable. However, high summer temperatures and low summer oxygen are also strongly limiting in this section.
The falls at 1685 m limit upstream migration of anadromous fish.

C) PRODUCTION OPPORTUNITIES

1. ***HEADWATER STORAGE***: Storage and siphoning could be employed at Fuller Lake so that 1 m of water could be utilized to augment critical period discharge, Approximately 10 LPS could be released to Matthew Creek from May through October. In most years the critical discharge period is more likely 100 days which would allow for approximately 18 LPS to be released. The creek's present base flow is 2 – 3 LPS for 80% of its length. (the top 593 m dry). An old dam is present (M+B) adjacent to the Stephen property. It is basically just a pile of rocks although there is a gabion and some bumper guards embedded in it. This structure needs to be replaced by a stop board dam with a siphon hole. A small spawning platform could also be created below the dam's splash plate to accommodate Fuller Lake trout (**Production Option # 29)**

2. ***WATER QUALITY*** IMPROVEMENT***:*** Removal of the iron oxide problem would return Reaches 1,2 and part of 3 to higher levels of productivity. MacMillan Bloedel has sealed the landfill (which contains large amounts of hog fuel) and installed some perimeter drain (Production Option # 30)

3. ***STRUCTURAL IMPROVEMENT*:** Addition of cover-complexity and spawning gravel would increase productivity in Reaches 3 through 6. A project sponsored by the Chemainus Rod and Gun Club treated a portion of Reach 3 in 1996 to increase cover and bank stability **(Production Option # 31)**.

D) LAND USE FACTORS

Industrial

MacMillan Bloedel's Chemainus Mill is located nearby and the company operated a land fill on the west slope of Lower Matthew Creek Valley for a distance of 350 m. Seven small seepage streams are located in this area and three are contaminated by iron oxide and iron bacteria.

Agriculture

Two farm properties are located in the Lower Howe Road area. The main product is hay.

Residential

Housing and Mt. Brenton Golf Course are adjacent to Reaches 5 through 8. Housing is of low density in the Crozier – Cottonwood Road areas where important wetland and seepage areas are located. These are responsible for Matthew Creek's summer flow.

E) PROTECTION NEEDS

It is critical that the central wetland and adjacent seepage areas in the Crozier – Cottonwood neighborhood (locally known as Gudal Slough according to Jamie Stephen of MOE who lives at Fuller Lake) be protected because this wetland IS Matthew Creek in terms of summer flow. The Reach 5 Ravine along Howe Road is also a critical part of the Fisheries Sensitive Zone. It walls are very steep and subject to erosion in places and its canopy is an important factor in cooling the stream. For the most part, it is relatively undisturbed but there is a sheep pasture at the Renema Property at 2589 Howe and some damage to the riparian zone and adjacent slopes has occurred. There is also a collapsed wooden box culvert on the property that should be removed (removed in August, 1998 at the request of MOE).

Stream Code: 920303500

Stream Name: Chemainus River

Operational Management Unit: Chemainus

CVRD Electoral Area: F, I Lower 12.5 km North Cowichan

A) BIOPHYSICAL OVERVIEW: A large river system that drains a long narrow basin. The Chemainus is only very lightly buffered by a few small lakes and wetland basins and responds very rapidly to runoff events then recedes quickly. The basin is composed of three general sections: a lower floodplain and extensive estuary below the 20 m contour (just above the Island Highway), a confined section with stretches of deep canyon from the highway up to the Chipman (Boulder) Creek confluence near the 200 m contour, a long upper basin section that is low gradient and semi – confined and extends up to just above the Coates Creek confluence near the 540 m contour. Finally there is a steep and confined upper reach that extends into the alpine area on the east flank of El Capitan. A number of important tributaries are present: Chipman (Boulder) Creek, Solly (Silver) Creek, Banon Creek, Humbird Creek, Holyoak Creek, Rheinhart Creek, South Chemainus and Happy Creek.

Air Photos:	BC 87024: 19-22, 37-41
Topographic Maps:	92B/13, 92C/16, 92B.082, 92B.092, 92B.081, 92C.100
Salmonids:	Ch to Copper Canyon Falls at 13,200 m summer and fall run St to Wightman Falls at 44,700 m spring and summer run Co to Copper Canyon Falls at 13,200 m. An occasional fish may pass Cm to Sandy Pool at 6200 m Ct to Upper Fallls at Rb to Upper Falls at
Tributaries:	Happy Creek St/Ct to 2R3 falls at 82 m Banon Creek Falls at confluence, resident Ct to 3000 m and 800 m in West Banon Holyoak Creek Steep cascade at Chemainus confluence Solly Creek St/Rb to 5R at 2400 m Humbird Creek St/Rb to 8R at 2212 m lower 881 m highly intermittent. Upper reaches also int. Chipman (Boulder) Creek St/Rb to 10R at 6400 m also in Lower Careful Creek and Lower Curl Creek Rheinhart Creek St/Rb to 2.5 R at 3000 m on mainstem St/rb to 10R at 800 m on West Fork Resident rainbows are also present in Coates Creek up to Spartan (Sherk) Lake, South Chemainus to 50 m, Paintbrush Creek to 300 m, and Clem Creek to 300 m. Miller Creek, a lower river tributary/sidechannel complex is a very important Co – Ct stream up to and including the wetland on Bald Eagle Campsite which is especially important as winter habitat. Westholme Sidechannel on the Halalt Reserve is a very important Co – Cm spawning area and Co – Ct – St winter habitat.
Obstructions	Lower Copper Canyon Falls at 13,200 m – 2R3. Three more falls in the series: 3R5 at 13,500, 3R5 at 13.600 and 3R10 at 13,800. Wightman Falls at 44,700 m: 2R5, 3.5R Upper Falls at
Max. temp. (C°)	25 R2 (7/29/98) 18.5 R6 (7/29/98) 14 R14 (7/29/98) 21.5 R2 (8/2/96)
Min. Disch. (m^3)	.071 R3 (12/2/1956) .275 R14 (7/29/98)

.605 R6 (7/29/98)
.864 R3 (8/2/96)

Boulder .204 R1 (9/21/96)

Solly .044 R1 (9/16/96)

Banon .053 R2 (8/2/96)

CHEMAINUS RIVER

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	42	40	4510	.1	FC	H	1300	52000
Reach 2	35	33	5410	.1	FC	H	1200	39600
Reach 3	40	10	1720	1.0	FC	M	4000	40000
Reach 4	35	20	136R	1.5	CON	N	6800	136000
Reach 5	22	12	1252	4.0	CON-ENT	N	3800	45600
Reach 6	35	15	145R	2.0	CON	N	13600	204000
Reach 7	22	12	1153	5.0	CON	N	1000	1200
Reach 8	55	12	1450	1.5	FC	M	1600	16000
Reach 9	35	10	1450	1.5	FC	M	11000	110000
Reach 10	18	10	136R	2.5	CON	N	3600	36000
Reach 11`12		6	1252	5.0	CON	N	2000	12000
Reach 12	18	10	1450	2.0	CON	N	828	8280
Reach 13	11	5	1225	3.0	CON	N	666	3330
Reach 14							1129	5645
Reach 15							2600	13000
Reach 16							1200	
Reach 17							1200	
Reach 18							1000	
TOTALS							58723	

C) FISH UTILIZATION AND LIMITING FACTORS

Steelhead:

Winter-Spring. Although there are a few typical winter run steelhead that enter the river between late November and March, the majority of the run comes in during late April, May and June and spawns in May and June. They are thought to number less than 200.

Summer: Some summer run fish enter about the same time as the spring run. Their numbers are also very low – less than 200. The summer fish appear to work their way upstream slowly. They appear in the Forestry Pools in July and at Eight Mile, The Gate, Ten Cascades and the Boulder Creek Pool in later July and August.

Chinooks

A few chinook salmon ascend the river during the spring freshet and hold in the deep canyon pools like The Slot. Their numbers are very low. There is also a fall run which has numbered between 10 and 100 in the last decade but has been as high as 200. There has been much difficulty in maintaining chinook runs despite considerable effort including a hatchery program (Seaspring) (Groves, pers. comm. 1997)

Coho

The Chemainus has never been a strong coho producer but their numbers ranged up to 7500 in high escapement years in the 1950's. In recent years, their number has been less than 100.

Chums

Chemainus chums have remained relatively strong. The run is somewhat unique for the region because of its early nature. Fish begin entering the lower river in late September and most have spawned by late October. As many as 100,000 are present in peak years. Westholme Sidechannel is the safest spawning unit for chums in this highly unstable river.

Sea Run Cutthroats

Unknown but numbers are low

Rainbow

Throughout

Resident Cutthroat

Throughout

All species are limited by low summer flows and the unstable discharge regime. Salmon are limited by access. Less than 30% of the potentially accessible potion of the mainstem is accessible due to the barriers in Copper Canyon. If the potential accessible habitat for coho and chinooks in the upstream tributaries was factored in, the figure would be much higher.

There is a need for more inventory of the Upper Chemainus and Rheinhart Creek. There are at least two reaches of the Upper Chemainus above R13 that have not been inventoried as well as lower Coates Creek. More information is also required on Boulder, Solly and Miller Creeks.

D) PRODUCTION OPPORTUNITIES

1. BARRIER IMPROVEMENT/ COHO CHINOOK COLONIZATION

COPPER CANYON FALLS

It might be possible to modify these barriers to allow coho and early chinooks to pass (an occasional coho is able to navigate them at present) but it would be extremely costly and the barriers could easily reform as large boulders wedge in restricted areas. Because steelhead are able to pass the falls and ascend well into the headwaters and because the Chemainus steelhead are so unique, the falls are probably best left as they are with limited coho – chinook colonization above (**Production Option # 32)**.

2. LATERAL HABITAT DEVELOPMENT

Because the Chemainus is such an unstable river and lacks protected off channel habitat, what little there is of extreme importance. Seven important sidechannels have been identified for enhancement and upgrading:

1.Westholme Sidechannel (33)

This major enhancement effort by the Halalt Nation/DFO needs several measures to allow it to continue its role as a very important element of Chemainus River salmonid production. Its upper end needs protection by periodic removal of excess river gravel and reinforcement of the dyke. Provision of a safer method of providing water should be considered as should addition of habitat features such as deeper pools and LWD to increase its winter capability for juvenile coho, cutthroat and steelhead.

2, Miller Creek (34)

The wetland portion should be deepened and extended. Consideration should be given to purchasing this property because there is continued temptation to fill in the wetland portion.

Alternatively, the most valuable and sensitive portion could be placed in a covenant. It is presently used as a riverfront campsite and has been for at least two decades.

3.Elk Spring Sidechannel (35)

Requires deepening and complexing – an important juvenile steelhead over wintering area.

4. Elk Meadow Sidechannel (36)

Also requires deepening and complexing

5. Piant Brush Bar Relic Channel (37)

Requires excavation and possible inlet control

6. Tropical Sidechannel (38)

Needs deepening, complexing and possible inlet protection/control.

7. Wide Bend Oxbow (39)

A portion of the Upper Chemainus cut off by Copper Canyon Mainline (MacMillan Bloedel). Requires inlet and outlet structures to allow juvenile steelhead access for over wintering and early rearing.

(Production Options # 33-39)

3 .HABITAT COMPLEXING

The Upper Chemainus River from the vicinity of the old Copper Canyon Camp to Coates Creek confluence was a sea of log jams in the sixties to mid-seventies. As of 1998, little large debris is left and the river is LWD deficient. Judicious addition of anchored LWD particularly in reaches 9 and 13, is recommended (**Production Option # 40)**

4. FRY SALVAGE

Fry salvage needs are not as high as they are in other systems that undergo extensive drying but because Chemainus River salmonids are at such a high degree of risk, it make good sense to salvage as many as is reasonably possible. Target areas are Holman's Sidechannel, a 383 m long flood channel on the south side of the lower river some 190 m above the Island Highway and flood pools on bars in the upper river above old Copper Canyon Camp. Westholme Channel and flood pools below the highway also deserve attention, Westholme Channel hasn't dried completely in recent years but it does get very low and could be thinned while flow is still fairly strong. All salvaged fish can be released in the mainstem (**Production Option # 41)**

E) LAND USE FACTORS

Forestry

The Chemainus, particularly the upper reaches, was logged rapidly in the 1950's through the 1970's with major impact on fish and channel character. Very considerable cross-stream yarding occurred with accompanying bank and channel damage and huge amounts of debris were left in the river. Massive jams formed, backfilled then broke loose resulting in large-scale destabilization. The river is still very unstable and its channel is overloaded with bedload in many places.
Most of the basin is now covered by advanced second growth and logging has resumed in mid-basin.
Agriculture

The lower basin is extensively farmed but impacts have been light.
Residential

Light

Gravel Removal

The lower river between the bridges had a long history of gravel removal but gravel is seldom taken now.

F) PROTECTION NEEDS

The Chemainus below the Island Highway has a relatively broad floodplain/riparian zone that it shares with Lower Bonsall Creek. This section of the river contains the very important lateral habitat units Miller Creek and its wetland and Westholme Sidechannel as well as the Chemainus Estuary and Swallowfield Channel. The FSZ is very broad in this region but rapidly narrows above the highway as upland closes in. It remains narrow on the river and its tributaries until the river opens again in the Upper Basin where there are sections of floodplain /riparian habitat that include sidechannels and small wetlands.

Stream Code: NA

Stream Name: Humbird Creek

Operational Management Unit: Chemainus

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A medium sized mountain runoff stream that is essentially non-buffered. Drains a steep narrow basin on the north slope of the Chemainus Valley at Ten Mile. Unfortunately, this creek is summer intermittent for most of its length.

Air Photos	BC 87024: 039, 040
Topographic Maps	92B/13, 92B.081
Salmonids	St/Rb to 2212 m
Obstructions	8R @ 2212 m
Max. temp. (C°)	18 7/29/98
Min. Disch. (m^3)	.8 LPS R2 (10/2/99)
	0 (int.) for the remainder

HUMBIRD CREEK

	Channel Width	Wetted Width	Substrate	Slope	Confinement	Side Channel	LWD	Length	Wetted area	Stream Class[2]
Reach 1	8	0[1]	1360	5.0	FC	L		881	0	S2
Reach 2	8	1	1360	5.0	FC	L		701	701	S2
Reach 3	5	1	1261	5.0	CON	N		630	600	S2
Reach 4	7	0	1270	10.0	CON	N		4400	0*	S5
Reach 5								1000	0*	
TOTALS								7612	1301	
Anad.								2212	1301	

[1] contains spots of water in moist summers, dries completely in hot, dry summers
[2] refers to Forest Practices Code designations based on channel width

B) FISH UTILIZATION AND LIMITING FACTORS

Humbird Creek supports a small population of Rb/St trout. Indications are that the fish are resident rainbow because of the small number of fry observed. On 10/2/99, there were 24 rainbow parr and 4 fry in a 600 m sample section of R1.
Production is highly limited by low to nil base flow and high fall – winter discharge and accompanying very active bedload movement.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

Most of the basin is advanced second growth. Logging is resuming in the lower basin. The upper 1600m is bordered by early second growth (10-15 years old in 1999).

E) PROTECTION NEEDS

Reaches 1 – 4 are contained in a ravine that varies considerably in depth and slope. Slopes range from about 15 to 120 %. Distances from the creek channel to the upland range from about 30 to 250 m. For the most part, ravine slopes are relatively stable and there is little evidence of significant failure (most of the ravine was logged in the first pass). There is a significant failure on the west slope adjacent to the 400 m point of R4. About 1400 m^2 failed below a spur road that leaves the 10 Mile Road at the 3.7 km point. The ravine constitutes the creek's Fisheries Sensitive Zone. Logging and roads should be set back at least 15 m from its break with the upland.
Stream Code: 920298700

Stream Name: Bonsall Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A moderate sized stream with two basic components: a lowland, low gradient mainstem that originates from seepage springs mainly located above the Island Highway and a headwater wetland above Somenos Road and a mountain component that drains a steep, narrow basin on Mt. Sicker. The mountain component contributes gravel and fall – winter peak flows but is summer dry in its lower end. The mountain component is West Bonsall Creek. The lowland basin is heavily farmed below the Island Highway. Bonsall Creek is a very productive stream. PBS (Pacific Biological Station) coho biologists have called it " the South Island's Black Creek"

Air Photos	BC 87024: 037, 038
Topographic Maps	92B/13, 92B.082
Salmonids	Co to Somenos Rd. at 8823 m Ct to Somenos Rd. Cm to Island Highway @ 7682 m
Obstructions	Somenos Rd. culvert: .85m vertical drop Increasing gradient in mountain tributary @ 1000m (Mountain trib. is considered mainstem on maps Island Highway culvert is 66 m long and has offset baffles (30 – 90) every 4 m.
Max. temp. (C°)	16.2 (7/21/94 R2) 15 (7/27/98 R2) 15 (8/23/98 R5) 16.5 (9/3/98 R5) 18.5 (9/3/98 R6(
Min. Disch. (m^3)	.001 @ Westholme Rd. 8/12/68 (WSC Gauge) .231 @ Westholme Rd. 7/27/98 .011 @ Highway 8/22/98 .016 @ Highway 9/22/86 .00016 R6 (9/3/98)
pH	6.6 (R2 7/21/94)
O_2	5.9 mg/L)R2 7/21/94)

BONSALL CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	10	10	1000	.2	OC	H	880	8800 (T)
Reach 2	12	10	5500	1.0	FC	M	3213	32130
Reach 3	6	5	7300	1.0	FC	L	1544	7720
Reach 4	6	3	1630	1.5	FC	L	2045	6135
Reach 5	6	3	1540	1.5	FC	L	169	507
Reach 6	3	1	5500	.5	FC	L	722	722
Reach 7	3	0	1000	1.0	CON	N	250	0
Reach 8	3	0	1000	.5	FC	L	650	0
TOTALS							9473	8800 (T) 47214
Anadromous							8823	47214

B) FISH UTILIZATION AND LIMITING FACTORS

Bonsall Creek is utilized by coho and chum salmon and resident and anadromous cutthroat trout. Production is limited by low summer flows, restricted access and areas of degraded streambank.

C) PRODUCTION OPPORTUNITIES

1.BARRIER REMOVAL

Removal of Somenos Rd. culvert would add another 650 m (1300 m^2 with storage release) which calculates to an additional 104 coho smolts at 1 fry/m^2 and 8% fry to smolt survival.
Improvement to the highway culvert to allow chum salmon passage. (**Production Options # 42,43)**

2. WETLAND IMPOUNDMENT/ HEADWATER STORGE

Storage of 1 m in the headwater wetland (150,000 m^2) would yield .0066 CMS for 180 days. This would add flow to both R7 and R8: 900 m and increase existing R6 base flow by approximately 40 x. In addition, fall coho fry could be stocked in the wetland which represents an additional 1800 coho smolts at a stocking density of .15 fry/m^2.
Other impoundment possibilities are present on Solly Creek where two wetlands have yields of .004 CMS (Mt. Richards West) and 00014 CMS (Upper Solly Wetland) (**Production Options # 44, 45 and 46)**

3. RIPARIAN RESTORATION

There are still a number of areas that could benefit from streambank planting. Sections of Reach 3 were done during the Bonsall Creek project (1994 – 1995). This work needs to be monitored and extended. (**Production Option # 47)**

4. ***SOLLY'S LAKE AERATION***

Sollys Lake is a very productive large pond on Solly's Creek. Unfortunately, oxygen levels become very low in the summer. The lake presently winters fish but they have to leave before July in most years. A grid aeration system could carry coho and trout through the summer which would provide significant production gain (Production Option # 48)

D) LAND USE FACTORS

Forestry

The upland component of the watershed is largely in North Cowichan's Municipal Forest. Considerable logging has occurred since 1990 in the Mt. Sicker – Prevost section with negligible impacts because the FSZ (ravine) was protected.

Agriculture

Approximately 70 % of the lowland portion of the basin is intensively farmed with significant impacts such as channel and riparian modification and nutrient input. Some barnyards are very close to the creek. A program to improve drainage by removing obstacles like beaver dams and debris piles was undertaken in 1994 – 1995. Some bank armoring and berming, riparian planting and fencing and habitat complexing was also accomplished and a large sediment trap pool was excavated. Overall habitat condition in Reach 3 improved.

Residential

Light but development along the north slope of the north lobe of Mt. Richards along Nimmo – Bonsall Road is a concern because of steep slopes which are bisected by several runoff creeks, one of which has produced downstream sedimentation due to land clearing and road construction.

E) PROTECTION NEEDS

Lower Bonsall Creek's riparian zone is very broad – up to 800 m in portions of Reach s 2 and 3 which includes portions of Whitehouse and Solly Creeks. Ideally, much more of this area should be in a natural

state than is the case at present. Some places have no riparian cover or only a fringe. A careful study should be undertaken to establish precise protection boundaries in this complex, intensively farmed section.

Stream Code:

Stream Name: West Bonsall

Operational Management Unit: 2

Municipal: North Cowichan located in an active part of North Cowichan's Municipal Forest

A) BIOPYSICAL OVERVIEW: This is the mountain branch of Bonsall Creek that drains a short, steep and narrow basin between Mts. Prevost and Sicker, non – buffered. Reach 1 is a floodplain section and is farmed. The remaining reaches are in North Cowichan's Municipal Forest.

Air Photos
Topographic Maps 92 C.082, 92B/13
Salmonids Co to possibly 1269 m
Ct possibly to 1269 m
Obstructions No clear barrier but gradient begins to increase sharply in R3. The upper limit has been set at the Split Channel cascades 2C4, 2R @ 1269 m
Max. Temp.
Min. Disch. 0

WEST BONSALL

	Channel width	Wetted width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	10	0	1630	1.7	FC	L	.0019	458	0
Reach 2	5	0	1450	3	FC	L	.0019	402	0
Reach 3	5	0	1360	7	FC	L	0	266	0
Reach 4	5		1360	14	FC	L	.002	143	
Reach 5	5		1270	22	CON	N		950	
Reach 6									
Reach 7									

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroat spawning and early rearing in Reaches 1 and 2. For some strange reason, some of Bonsall Creek resident cutthroats also spawn in the West Fork. A pair was seen spawning in R2 just 10 m below North Cowichan's Access road on April 2, 01 and six small redds were counted between this point and the confluence with the mainstem, a distance of 490 m.
Production is limited by early drying and heavy fall – winter flows.

C) PRODUCTION OPPORTUNITIES

1.*FRY SALVAGE:* Fry salvage is required in at least the 490 m between North Cowichan's Road and Bonsall Mainstem (Production Option # 49)

2.*FENCING:* 277 M of R1 has been impacted by free access stock. There is considerable bank damage and sediment produced in this zone carries downstream (Production Option # 50)

D) LAND USE FACTORS

Forestry

The basin is within the North Cowichan Municipal Forest. Second growth logging is underway.

Agriculture

277 m of R1 is within a pasture zone. Considerable bank erosion has resulted from free access cattle

Hydro and VI Gas

BC Hydro's 500 kv line and the Vancouver Island Gas Pipeline cross Reach 3

E) PROTECTION NEEDS

Increased protection is required for the pasture section of R1. I recommend fencing. Reaches 3 –5 are in a ravine with adjacent slopes of 60 – 100 plus percent. These slopes are the main feature of the Fisheries Sensitive Zone and must be retained in an undisturbed state.

F) HISTORICAL NOTES

Stream Code: NA

Stream Name: Whitehouse Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A small stream that features a low gradient, pastoral lower section, a middle section that is considerably steeper and more confined then a broad, low relief upper section before the creek starts to climb the mountain.

Air Photos:	BC 87024: 037,038
Topographic Maps	92B/13, 92B.082
Salmonids	Co to 2539 m Act to 2539 m Cm to 2539 m (Cm are very occasional and, in recent years, tend to spawn in the tributary that carries the hatchery effluent. Res. Ct to 6798 m
Obstructions	Fern Canyon Falls at 2539 m: 2R, 1R followed by a series of small cascades for a total falls of 6R20
Max. temp. (C°)	16 (R3 – 9/17/96) 16 R3 – 9/8/98) 12.8 R2 below south effluent channel (Hatchery effluent water ranges from 9-12 degrees and moderates summer and winter temperatures in Whitehouse downstream of entry points.
Min. Disch. (m^3)	.03 R3 – 9/17/96 The lower 1500 m dried prior to Seaspring Hatchery (Groves) which started in the early 1970's. After 1990 the hatchery became a year round operation, The effluent supplies .02 to .10 CMS. In the summer months the majority is supplied to the south effluent channel/Holman Creek (approximately a 60:40 ratio) to maximize stream flow benefits to Whitehouse .016 R3 just above confluence with south effluent channel/Holman Creek (9/8/98) .1155 R2 a confluence with Groves Creek and Whitehouse (below south effluent confluence) .1633 R1 @ Island Highway (9/9/98) .0478, north effluent channel (9/8/98) .076 south effluent channel (9/8/98) .0005 R8 @ Cranko Rd. (9/9/98)

WHITEHOUSE CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	4	2	9100	.5	CON `	N	900	1800
Reach 2	5	3	1000	1.0	FC	H	870	2610
Reach 3	5	3	3610	1.5	FC	M	579	1737
Reach 4	5	3	1351	2.5	CON-ENT	N	284	852
Reach 5	4	2	6310	3.0	FC	M	996	1992
Reach 6	2	1	8200	2.0	CON	N	1080	1080
Reach 7	1	1	7300	1.0	FC	L	1438	1430
Reach 8	1	1	1450	2.5	OC	L	651	651
TOTALS							6798	12152
Anadromous							2539	6717

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and chum salmon and sea-run and resident cutthroat trout are present up to Fern Canyon (Carin) Falls; Resident cutthroats are present above the falls well into the headwaters. Chums are not present every year and runs are light.
Access and low summer flow limit production.

C) PRODUCTION OPPORTUNITIES

1.***BARRIER IMPROVEMENT:*** I f Fern Canyon Falls were made passable, an additional 4259 m (5443 m^2) would be available for coho and Sea-run cutthroats (Production Option # 51)

2. RIPARIAN PLANTING would benefit parts of Reaches 1 and 6 (Production Option # 52)

3. ***COHO COLONIZATION:*** Coho fry out planting above the falls would yield approximately 435 smolts. The Halalt Band presently stocks some fry from eggs incubated at the Bush Creek Hatchery (Ladysmith Sportsmen s' Club) (Production Option # 53)

4. ***FLOW AUGMENTATION/ STRUCTURAL IMPROVEMENT:*** Maximization of the habitat value of the hatchery effluent water is perhaps the most important opportunity. It is presently being managed at a high level and is extensively used by over wintering juveniles, especially coho in the north channel which is a Chemainus River relic channel that is subject to flooding. Its summer rearing value could be increased by allowing summer access and adding LWD. Its recruitment value could be improved by adding spawning platforms. Chums may use either of the channels if suitable spawning habitat was present. An occasional chum migrates through the North Channel to spawn upstream near Mt. Sicker Road (**Production Option # 54)**.

D) LAND USE FACTORS

Forestry

The forested portion of the basin is part of North Cowichan's municipal forest – advanced second growth.

Agriculture

Agriculture is the primary land use factor. A large percentage of the basin is utilized – about 70%. A massive fish kill occurred July 17,1981 when liquid fertilizer spilled form a split in a pipe conveying the fertilizer form a pond to a field. A 5 m high plume of liquid manure spewed from the pipe for about one hour – approximately 20 LPS. The material ran down a ditch for 120 m then entered the creek wiping out the entire fish population with the exception of some lamprey ammocytes all the way down to Bonsall Creek. The spill occurred on the Groenendyk (Greendike) Farm. Thousands of juvenile coho and cutthroat trout were killed along with a few rainbow trout and many sticklebacks. Previous spills occurred in the summer of 1975 and in April 1976.

Residential

Light

NOTES

Late Summer Fry Densities (from PBS Sampling)

Year	Site	Number	No./m^2	% Age 0	Mean FL
1991	Island Highway	183	_	100	59.4
1992	Island Highway	109	1.33	100	63.9
1993	Island Highway	413	3.47	100	56.0
1994	Island Highway	223	1.97	99.5	55.0
1995	Island Highway	242	3.64	100	56.8
1996	Island Highway	265	4.11	100	56.6
1997	Island Highway	59	0.56	98	69.1

E) PROTECTION NEEDS

Whitehouse Creek has a very broad riparian zone – especially in Reaches 1 and 2. A considerable amount of R 1 riparian land is in intensive agriculture and there is a need to get some of it back. This is also the case in Reaches 6 and 8. Whitehouse Creek needs a stewardship group. Overall it is in a very reasonable state of health considering the long history of intensive agricultural use but this could change and there is a need for area residents to be involved in protection.

Stream Code: NA

Stream Name: Groves Creek

Operational Management Unit: Chemainus

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: A very small tributary of Whitehouse Creek that drains a short, relatively steep basin on the north shoulder of Mt. Sicker. Enters Whitehouse Creek from the south at the 1427 m point.

Air Photos	BC 87024: 037, 038
Topographic Maps	92B/13, 92B.082
Salmonids	Co to 998 m Ct to 998 m
Obstructions	1.1 dam at 998 m. Prior to 1990, a 1.25 m culvert was present at 178 m, Westcoast Energy (PCEC) lowered it to grade in 1990 when the Vancouver Island Natural Gas pipeline went through. The Groves farm road was a shoo fly (access road) for the pipe gang.
Max. temp. (C°)	17 (R4 – 9/17/96) 15 (R3 – 9/8/98)
Min. Disch. (m^3)	0 for 253 m .00086 from pond up to dam at 938m then dry above

GROVES CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	40	0	1000	.2	UC	H		70	0
Reach 2	3	0	2800	1	FC	L		183	0
Reach 3	15	15	1000	0	UC pond	N		60	900
Reach 4	3	1	1360	3	CON	N		685	685
TOTALS								998	1585
Anad.								998	1585

B) FISH UTILIZATION AND LIMITING FACTORS

Production is limited by low to nil summer flows. Fortunately the pond beginning at 253 m serves as a summer low flow refuge.

Coho and cutthroats are present up to the dam at 938 m.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION***: Wood Duck Pond, the reservoir behind the dam at 938 m and the pond by the Groves residence have a combined area of 1500 m^2 (600 for Wood Duck Pond and 900 for Groves Pond). They could be stocked with coho fry at the rate of .15/m^2 - 225 **(Production Option # 55)**

2. ***ADDITION OF LWD*** to Reach 4 would provide cover – complexity benefits. This reach becomes very low in the summer months; it needs more cover (**Production Option # 56)**

3. ***FRY SALVAGE:*** Fry salvage is needed in R's 1and 2. Fish could be released in Groves Pond, Wood Duck Pond or in Whitehouse Creek above the falls (Production Option # 57)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth

Agriculture

Light

Residential

Light

E) PROTECTION NEEDS

Improved fencing on Reaches 1 and 2 would keep cattle away from the riparian zone and marsh (Reach 1 is an Arum – Rubrus – Carex marsh). Impacts have been light to date. The Reach 3 ravine has some very steep sidewalls (100% plus). It and the Reach 1 marsh are the most sensitive components of the Fisheries Sensitive Zone. Reach 1 is also part of Whitehouse Creek's Fisheries Sensitive Zone.

Stream Code

Stream Name : Water Parsley Creek

Operational Management Unit: Chemainus

Municipal : North Cowichan

A) BIOPHYSICAL OVERVIEW: A small, spring – fed tributary of Upper Bonsall Creek. It enters Bonsall approximately 550 m below the Somenos Road crossing which is the upper limit of fish passage in Bonsall. The stream has two basic components: an upper runoff charged section that originates in the ditches along Rosevear Road and from overland runoff west of Rosevear Rd. and a groundwater fed segment that begins just above the E+N rail grade where a small portion of the creek's base flow originates. The main portion of the stream's summer flow originates at a spring that enters from the south 9 m below the railroad grade. The stream is summer dry in the runoff portion and permanent in the groundwater section. This stream is a very important contributor to Upper Bonsall summer flow – it provides about 40 %.

Air Photos	BC 87024: 037,038
Topographic Map	92B/13, 92B.082
Salmonids	Co to 110 m
	Ct to 110 m
Obstructions	None
Max. temp. (C°)	11.6 (R2 7/16/99)
Min. Disch. (m^3)	3.9 LPS (R2 7/16/99)
	.46 LPS (R4 7/17/99)
	0 (R's 5 –6 7/17/99)

WATER PARSLEY CREEK

	Channel Width	Wetted Width	Substrate	Slope	Channel Confinement	Side Channel	Length	Area
Reach 1	3	2	9100	.5	OC	L	14	28
Reach 2	2	1	2620	1.5	CON	N	76	76
Reach 3	3	3	9100	.2	CON	N	20	60
Reach 4	3	1	1000	.1	OC	M	10	10
Reach 5	2	0	1000	.1	FC	L	234	0
Reach 6	2	0	6310	1.2	CON	N	180	0
TOTALS							534	174

B) FISH UTILIZATION AND LIMITING FACTORS

Water Parsley Creek supports a moderate population of coho salmon and cutthroat trout up to a point just below the E+N Rail culvert @ 110m.
Production is only limited by size.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Agricultural

There are some minor intrusions in R 1 where cattle have access to the creek. R6 is a raw ditch thru a pasture.

Residential

Light along Rosevear Rd.

E) PROTECTION NEEDS

The Fisheries Sensitive Zone extends from the confluence with Bonsall Creek up to a point just above the E+N grade where it includes the stream's headwater seepage springs that begin in a 20 m wide circle above the railroad grade. It also extends south of the E=N culvert for 240 m to include the creek's channel and small riparian zone before the creek turns west through the pasture. It extends north of the culvert for 100 m to include a narrow riparian zone and seasonal ditch that also contributes some winter flow to Water Parsley.

OPERATIONAL MANAGEMENT UNIT 3: SOMENOS BASIN

OVERVIEW

Somenos Basin is of relatively low relief with extensive riparian lowlands and two lowland lakes: Somenos and Quamichan. It consists of five sub-basins: Quamichan, Somenos, Richards, Bings-Menzies and Averill.
A substantial portion of the basin - approximately 10 percent – is in high density urban use while another approximate 20 percent is in agricultural use of relatively high intensity. In fact, nearly all of the basin below the 100 m contour is utilized to some degree for urban or agricultural uses.
Despite use intensity and some very compromised fish habitat in parts of the basin, a great deal of capability and potential remain – some of the highest in the region.

LIMITING FACTORS

Primary factors limiting production are access and summer water quantity and quality. Barrier waterfalls are present on Lower Quamichan, Richards , Bings and Averill Creeks and all streams become either dry or dangerously low in the July - September critical discharge period. Water quality in the lakes, especially Somenos, becomes very poor in mid to late summer and occasional fish kills occur.

PRODUCTION OPTIONS

There are 37 Production Options (restoration or enhancement opportunities) in the Somenos Basin. They are presented in brief in Table 3. For more discussion, see the data portion of this section.

Table 3: Somenos Basin Production Options

No.	Sub-Basin	Type	Priority
58	Quamichan	Coho colonization	1
59		Lake level control at outlet	1
60		Water conservation	1
61		Cutthroat spawning improvement	1
62		Fencing, riparian restoration	2
63		LWD addition – R2	2
64	Somenos	Lake aeration	2
65		Riparian restoration/shade establishment	3
66		Summer refuge improvement – Chesterfield Park	1
67		Summer refuge establishment- Fun Pacific	2
68	Richards	Coho colonization (lakes)	2
69		Headwater storage	1
70		Riparian maintenance and improvement	3
71		Coho colonization (creek)	1
72	Averill	Substrate improvement	2
73		Adult barrier bypass	1

74		Coho coloniztion without storage	4
75		Juvenile barrier improvement	1
76		Headwater storage	1
77		Coho coloniztion with storage	2
78		Additional flow augmentation (Crofton)	2
79	Averill (cont.)	Riparian restoration	2
80		Groundwater development	2
81		Pond stocking coho fry	2
82		Fry salvage	2
83	Bings	Spawning improvement	3
84		Coho colonization	2
85		Adult barrier improvement	1
86		Juvenile barrier removal	1
87		Riparian restoration/canopy development	1
88		Upper reaches riparian restoration	3
89	Centennial Park	Coho colonization	3
90	Menzies	Coho colonization	2
91, 92		Headwater storage on West Menzies and fall stocking	2
93		Riparian restoration	2
94		Groundwater well	2
37			

Stream Code: 920 2577 057 016

Stream Name**: Quamichan Creek**

Operational Management Unit: Somenos Basin

Municipal : North Cowichan

A) BIOPHYSICAL OVERVIEW: Quamichan Creek is a 1.39 km long, intermittent, lake buffered tributary of Somenos Creek which it enters just above the Cowichan River.

Air Photos	BC 82007 142-143
Topographic Map	92 B/13. 92B. 072
Watershed Area	11 km^2
Mainstem Length	1390 m
Obstructions	2.3 m. falls at 368 m 2 m dam at 725 m
Salmonids	Quamichan Lake Ct from 820 to 1430 m (spawning and early rearing – fry return to lake late May – June) Co to 368 m Anad. Ct to 368 m Cm to 368 Bt : occ. Ind. To 368 m PMB discovered after a die – off 7/19/99 and in the summer of 1998
Max. Temp. (C°)	15 25/08/87 (R2) 23 (25/05/95 – R3) 21.7 (02/09/98 – R2) 23.4 (7/23/99 – R5)
Min. disch. (m^3)	0 at 300 m above barrier(10/10/85 & 25/08/87 Tutty and Burns). However scattered pools remain and Reach 6 is wetted by standing water. Less than 1 litre/sec groundwater fed pools below barrier with high coho and trout rearing densities during summer. .000112 cms at 270m (8/25/87). .000305 cms at 270 m (9/2/98)

QUAMICHAN CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2)
Reach 1	5.0	1	1000	.01	OC	L	134	134
Reach 2	6.0	2	271R	.5	CON	N	234	468
Reach 3	5.0	0	271R	1.5	CON	N	357	0
Reach 4	15.0	0	9100	.01	FC	N	115	0
Reach 5	5.0	0	243R	1.0	FC	N	419	0
Reach 6	40.0	3	9100	.001	UC	H	100	300
Total							1359	902

QUAMICHAN LAKE

Area (ha)	Elevation (m)	Approx. Volume(m3)	Max. Depth (m)	Total Dissolved Solids (TDS) (mg/L)
310	26	14,848,873	9.45	60-284

B) FISH UTILIZATION AND LIMITING FACTORS

During summer, the first 368 m of Quamichan Creek downstream of the 2.3 m. barrier falls supports cutthroats and coho in groundwater fed pools with summer discharge ofmuch less than less than 1 litre/sec. An occasional brown trout is also reported as were pumpkinseeds in the summer of 1998. Dissolved oxygen was 8.0 ppm. on 25/8/87. Occasional steelhead are also reported from R2.

Quamichan Lake cutthroats are known to spawn in sections of Reachs 4 and 5. Lake resident rainbow may also spawn there. A backfilled reservoir in Reach 4 at 15805 Jaynes Rd. is the primary spawning area for the creek. Trout from the lake have also been reported spawning in a seasonal inlet stream (sometimes called Woodcote Cr.) on the Peter Stone property (1437 Maple Bay Rd.) in very small numbers. However, no adults, redds or fry have been observed in three visits to this creek to look for fish or evidence of their utilization.
Quamichan Lake cutthroats are a unique race noted for their large size and ability to survive in marginal conditions. Their numbers are limited by the quantity and quality of spawning habitat in Quamichan Creek. They are also the target of poachers.

Anadromous cutthroat and coho production is strongly limited by low summer discharge, and the short accessible length. The creek becomes nearly intermittent by late May in most years and Reaches 3, 4 and 5 sometimes dry completely after July in warm, dry summers.

This system is a candidate for summer fry salvage. A Cowichan Tribes E Team salvaged 300 coho and a brown trout from Reach 2 in the summer of 1998. Progeny of Quamichn Lake cutthroats also become stranded in drying pools in Reach 5.

Resident spawners are limited by small areas of suitable gravel. Aside from 70m^2 of low quality gravel (largely replaced in the summer of 1999), there is only one other area of gravel available in Quamichan Creek. It is located between 222 and 250 m of R5 and is of very low quality (compacted, muddy and very angualr – more broken rock than gravel).

Chum salmon also spawn in Reach 2 of Quamichan Creek; particularly in high escapement years and the occasional steelhead is reported.

Quamichan Lake supports cutthroat and rainbow trout colonized coho (1987) and sticklebacks, sculpins and brown bullhead. On 25/08/87 surface temperature was 22°C and dissolved oxygen 8.5 ppm.

MOE, Fisheries Branch stock cutthroat trout annually into Quamichan Lake which support winter, early spring and late fall fisheries.

Fish kills occur in Quamichan Creek, especially in Reaches 3 to 6. The entire creek above the falls killed on July 19, 1999. The creek is usually dry in this area by this time and fish are normally not present. Oxygen dropped to .1 mg./L and temperature was 23 to 25 degrees. Few trout were left in the creek Most of the morts were pumpkinseeds and sticklebacks. Interestingly, no fish died in R's 1 and 2. It is speculated that the oxygenation from the falls and groundwater seepage input made enough differnece to maintain suitable temperature and oxygen below the falls.

C) PRODUCTION OPPORTUNITIES

1.***COHO COLONIZATION*:** Quamichan Lake is the largest lake in the Cowichan watershed inaccessible to anadromous fish. **As part of a co-operative experiment in 1987, the Fisheries Research Branch (PBS) introduced 60,000 coho fry (Production Option # 58)** into the lake to determine if increased coho salmon production can be realized (contact R. Bams, Pacific Biological Station). Similar experiments in 1985 and 1986 in Grant Lake and Kelvin Creek (Koksilah drainage) and in Bings Creek in the Somenos Watershed have proven successful, (Burns et al, 1987). The experiment needs to continue. There was a problem with smolts getting out of the lake because the lake level dropped below the level of the outlet early and it may also be difficult for the fish to find the outlet because it is very indistinct and does't draw much flow during most springs. There is a need to further review the results of the colonization program in Quamichan, relate it to other coho lake stocking program results and design a updated program for Quamichan. Based on the bio – standard of .15 fry /m^2, the fry requirement would be 465,000 which seems high especially since the lake has a valuable cutthrout trout population.

2. ***OUTLET CONTROL:*** A **low level weir near the stream gauge in R5 of Quamichan Creek (Production Option # 59)** combined with cutting an improved outlet channel from the weir to the lake and siphoning the lake to some degree when the outlet falls below the level of the lake would provide:

a) Increased spring release flows extending into the early summer. Through regulation of the weir, enhanced coho smolt emigration to sea may result. If the coho colonization program benefits are significant, it may be considered as part of the permanent enhancement strategy. The weir should provide an option to siphon the lake.

b) The weir may also increase CDP flows in Quamichan Creek and increase its rearing capacity.

NOTE: Allowance for adult and fry passage will be required at the weir

The weir would be located at the 265 m point of R5 on Louise Hamilton's property (2083 Indian Crecent – 746-6306). A stream gauge is present here in a section of the creek that was dredged in the 1950's to lower Quamichan Lake for increased agricultural production. About 195 m of R5 was treated. The ditch is as much as 2 m deep in places. It may be necessary to lower the channel a bit more below the weir.

***3. WATER CONSERVATION*:** Restrict further consumptive water use unless storage is possible (**Production Option # 60)**

***4. IMPROVE CUTTHROAT RECRUITMENT*:** **Gravel improvement to Quamichan Creek above the falls (Production Option # 61)** would increase cutthroat recruitment to Quamichan Lake . A backfilled dam at a property at 15805 Jaynes Rd. is a primary spawning area. A 70 m^2 area near its head supports at least 70% of Quamichan Lake's cutthroat spawners. Its gravel needs cleaning and addition of new . At least 20m^3 of 2 – 5 cm washed drain rock needs to be added to the site already started (summer 1996) on the Jaynes Rd. property. A boulder weir and windfall log should also be considered to direct flow over the redds more effectively and provide some cover for the spawners which are the target of poachers and otters.The spawning platform was going to be mitigation for a land development proposal (Dennis James – Sutton) that was turned down by North Cowichan because of neighbourhood opposition to increased density (senior's housing to repalce a single family dwelling). The property owner (Les Schedel: 748-8270) ageed to some cleaning and additon of new material before the proposal went to council; he is still in agreement with the proposal. Access to the property would be over the Van Boven Farm and a corner of Larry Fiege's property. NOTE: THIS PROJECT WAS COMPLETED IN OCTOBER, 1999. As part of the project, the enhancement crew constructed a waterline to a stock watering station on Van Boven's Farm well away from the creek. In return, Van Boven fenced a section of creek that was highly degraded by cattle using it as a water source (Burns, 1999).

FOLLOW UP:

MAY 1: 2001:

One very large redd and three smaller ones were noted. Went in via Knights of Columbus Park off Indian Road. Saw Les Schedel at Super Store gas pumps. He is happy with the situation and saw fish earlier. He also saw two last night. He is concerned that otters will get them. Van Boven's fencing still looks great.

5. ***RIPARIAN AND WATER QUALITY IMPROVEMENT*:** Fencing is required on the Van Boven Farm. Stock use the creek as a tiolet and linear water hole. Riparian planting should accompany fencing. When flow begins in the fall, the first water is liquid manure from the summer's accumulation in the channel . The Van Boven site is the most serious on Quamichan Creek but there are also a number around the lake such as the Gaylord Stewart property on Lakes Rd. (Production Option # 62) SEE ABOVE NOTES: Van Boven fencing has been accomplished as part of the cutthroat spawning habitat improvement project (1999).

6. ***LWD ADDITION:*** Install cross log/windfall log at 135 m point of R2 to increase cover and depth. Observe for one year then continue complexing R2 if appropriate **(Production Option # 63).**

D) LAND USE FACTORS

Agriculture - Extensive clearing and drainage. At least 40 percent of the lower slopes of the basin has been modified for agricultural use.

Residential - Considerable development along the east side of Quamichan Lake (above and below Maple Bay Rd). and along Lakes Road on the west side.

Risk Potential

Moderate. Quamichan Lake water quality has been enriched considerably. Total dissolved solids increased from 60 MG/L in 1957 to 284 in 1973 (Willis, Cunliffe and Tait, 1974). The lake is highly responsive to eutrophication due to its small catchment area (11 km^2), low flushing rate and shallow nature (mean depth 4.8 m). Algae and rooted aquatic plants have increased markedly and limited summer fish kills have been reported. Of Quamichan Lake's eleven inlets, five are polluted by barnyard and pasture run-off. This is reflected in Quamichan Creek which is also impacted by manure runoff from Van Boven's Farm and from Van Boven cattle having free access to the creek (Van Boven situation largely corrected in 1999).

E) PROTECTION NEEDS

Protecting Quamichan Creek and Lake involves nearly all aspects of life in the basin - much more than a protective corridor is involved. Agricultural impacts need to be directly addressed because of nutrient

input. A survey of all basin farms could be undertaken to establish waste mangement needs. The area below Maple Bay Road north of the Garth is still on septic tanks. Is this contributing to Quamichan Lake eutrophication?

For the interim, the shorezone of Quamichan Lake (almost entirely Class 1 with extensive riparian and shoal development but highly intruded) is a high priority. The Quamichan Creek FSZ is also very high priority. It considts of riparian lanfscape units at the outlet of Quamichan Lake – Reach 6- and at the confluence with Somenos Creek – Reach 1. For most of the rest of the creek, adjacent landscape units are primarily upland and the FSZ is relatively narrow. It is somewhat intruded by urban and agricultural development.

There is a strong need to acquire more greenspace/public land in the Quamican Basin particularly in the QuamichanLake shorezone, the Quamichan Creek Corridor and on the flanks of Mt. Tzoulaem including the area below Maple Bay Rd. This area is one of the most attractive and ecologically rich components of the Dry Douglas Fir Ecozone (with Garry Oak Meadows) and it has been highly intruded.

Fishery Officer Narrative

Stream Code: 9202577057

Stream Name**: Somenos Creek**

Operational Management Unit: Somenos Basin

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: Enters the Lower Cowichan near the confluence of Quamichan Creek after picking up Fish Gut Alley. A very low gradient stream drianing Somenos Basn, a large and complex watershed with wide variation in topography and land use patterns. Cowichan River backfloods the creek and adjacent riparian floodplains extensively. The Somenos Creek floodpalin/riparian zone is over 900 m wide in places and is generally at least 200 m wide. The eastern neighbourhoods of Duncan cover much of the combined Lower Cowichan – Somenos floodplain.

Air Photos	BC 82007 142-143
Topographic Map	92 B/13, 92B.072, 92B.082
Obstructions	None
Salmonids	Co to 3020 m (migrants and seasonal residents). Ct to 3020 m (migrants and seaonal residents) Bt to 3020 m (migrants and seasonal reeidents)
Max. Temp. (C°)	17 (87/08/25) at Tzouhalem Road. 12 (9/4/85) at Lakes Road. 24 (7/30/97) at lake outlet 23 (7/30/97) at 660 m 22 (7/30/97) at 1660 m 24.5 (7/29/98 at Beverly Street Foot Bridge) 22 (7/29/98 Pumping Station Ditch – this ditch which originates from the Chesterfield Park wetland is a cooler water refuge for Somenos fish during the summer months)
Min. Disch(m^3)	0 - cross section of stream remains with standing water. Streamflow is present below Fishgut Alley and consists of background flow from this important Cowichan River Sidechannel and Vancouver Island Hatchery effluent along with mimimal residual flow from Somenros Creek. Fishgut Alley enters Somenos Creek at 189 m.

SOMENOS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2)
Reach 1	20	17	9100	.001	OC	M	688	11696
Reach 2	19	17	1000	.001	OC	L	2332	39644
TOTAL							3020	51340

SOMENOS LAKE

Area (ha)	Elevation (m)	Approx. Volume(m3)	Max. Depth (m)	Total Dissolved Solids (TDS) (mg/L)	Max Surface Temp.
98	4	4,112,960	7.8	65	32.3 (7/29/98)

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, brown trout and sea-run cutthroat pass through Somenos Creek enroute to Bings, Averill and Richards Creek (Lanarc Consultants and Burns, 1999). A few Bings Creek steelhead also migrate through along with a few chums bound for all three tributaries. There is a large in – migration of overwintering juveniles. High densities of coho fry are found at the mouth of Somenos Creek in September and very high densities of these fish were found in the creek in December (Fielden and Holtby, 1987). Somenos fall coho fry/parr are very large with a mean size of 86.2 mm.

Production has been hindered by high summer temperatures in the upper 2800 m although 1983 channel dredging is believed to have improved groundwater upwelling for seveal years. See Agriculture Section. Somenos Lake and Creek supported a significant population of summer juvenile coho in 1986 and 1987. Somenos Lake supports resident cutthroat, rainbow and brown bullhead; some brown trout may also be present. Sticklebacks are very abundant. Pumpkinseeds reported in 1997. Fish, particularly coho, become stranded in pockets of Somenos Marsh as water levels fall in the spring. In some years, smolt mortality is significant.

It is doubtful if Somenos Lake can carry salmonids through the summer in most years. An August 11, 1998 survey revealed that epiliminion temperature is in the 22-24° range and that the epilimnion extends to the bottom in most areas of the lake. Where the metalimnion and hypolimnion are present, oxygen levels are dangerously low. However, fish kills in the summers of 1989 and 1999 revealed that some trout and coho can survive for nmost of the summer in cool years. Fish kills in both these years were triggerd by algae die back in early September when oxygen crashed.

C) PRODUCTION OPPORTUNITIES

1.SOMENOS LAKE AERATION: Somenos Lake (98 ha) has a coho fry carrying capacity of 147,000 at .15 fry/ m^2 . It is subject to occasional fish kills due to low oxygen levels. Such a kill occurred Sept. 3 and 4, 1989. Another took place in the late summer of 1999. Since it cannot relaibly support salmonids through the summer due mainly to low oxygen levels in places where the temperature is favourable, an aeration experiment should be considered to oxygenate the water column in selected areas where depth is sufficient for a thermocline. (Production Option # 64)

2. ***SOMENOS CREEK VEGETATION MANGEMENT,SHADE ESTABLISHMENT*:** Somenos Creek is now largely uninhabitable for salmonids in the summer months due to temperauture and oxygen constaints. Part of this is due to very low flows and lack of flushing which is partly caused by vegetation clogging the channel. The primary reason for the abundance of reed canary grass, sedges, iris, smartweed and other aggressive aquatic vegetaion is an abundance of light which also influences summer temperature. If a more complete canopy could be established via the presence of taller trees than the present red osier - willow shrub forest, shading and reduction of instream vegetation could be accomplished. Under present conditions, less than 10% of the stream is shaded. Improvements to upstream agriculture would also result. An experimental planting of cottonwood or hybrid poplar along with Pacific Willow is recommended for a portion of the west side of lower Reach 2. A slight berm may have to be constructed to encourage growth (Production Option # 65).

3. ***SOMENOS CREEK SUMMER REFUGE IMPROVEMENT- CHESTERFIELD WETLAND AND CREEK:*** A ditch (Chesterfield Creek) that enters Somenos Creek at the 362 m point of R2 (1050 point overall) serves as a summer refuge for coho, cutthroats, sculpins and sticklebacks despite the fact that its temperature and oxygen levels become extremely marginal. Approximately 100 fish spent the summer and early fall of 1998 in the small pool just below Lakes Road Pumping Station despite temperatures of plus 20 degrees (20.2 and as high as 22 °) and oxygen levels of less than 1 mg/L - .88 (Somenos Creek temperatures were plus 24 degrees with almost nil oxygen). The pool at Lakes Road could be enlaged and deepened and and the wetland complex behind Chesterfield Park (old BCFS Koksilah nursery property) could be further tapped to produce more flow. A man made pond is present but summer inflow is minimal and upstream excavation could provide more and cooler water. Winter inflow to the wetland (Nov. – March) averages about .098 CMS at 12.5°. Summer flows at the inlet end are unknown but are nil at Lakes Road some 50 m downstream. This habitat unit should receive considerable more study especially in terms of its potenial water yield. Fish passage between Lakes Road and the wetland complex may be a problem as could fish survival during the pumping process (**Production Option # 66).**

4. ***SOMENOS CREEK SUMMER REFUGE ESTABLISHMENT – FUN PACIFIC:*** A 160 m long man made stream and a 125 m^2 pond are present on the Fun Pacific property in the Beverly St. area of Somenos Marsh. The pond and stream channel were created in 1991 – 92 during construction of the Fun Pacific mini-golf course. Groundwater was exposed and channeled to an existing ditch that runs from the Isalnd Highway to the east end of York Road extension. The existing channel is too shallow (av. depth less than 10 cm.) to support salmonids but it could be deepened and instream cover and streamside canopy could be added to create a summer refuge situation for Somenos Creek salmonids. In addition, another groundwater ditch is present just 22 m west of the Fun Pacific headwater pond. It could be diverted into the pond to increase flow. April 1, 1999 flow in the Fun Pacific stream was 4.1 LPS. Flow in the adjacent ditch was 16.6 LPS. Temperature in the stream was 14.5; ditch temperature was 12.8. Adjacent surface water temperautures were 6 to 7.5. **(Production Option # 67)**
More research is needed to determine the viability of this option: mid – summer oxygen, temperature and streamflow data is required.

D) LAND USE FACTORS

Agriculture

Somenos Lake/Creek lowlands are intensively farmed. The stream was channelled to fisheries specifications in 1983 to hasten spring de-watering of surrounding agricultural lands around Somenos Lake and upstream adjacent to the 5860 m ditched Richards Creek (Reaches 1 and 1a) below Richards Trail. Mitigation for this activity was located in Reach 2 of Richards Creek on the Valley View Farm (Van Euewen).

Residential

Uplands east of Somenos Creek and lowlands west of Lakes Road are major residential areas. Duncan sewage lagoons occupy approximately 12 ha of lowland west of Lower Somenos Creek and discharge into Cowichan River. Residential development in the Beverly St. /Lakes Rd./ Trunk Road area is located on floodplain – riparian lands that are part of the Cowichan River – Somenos Creek Fisheries Sensitive Zone. In fact, there is very little of Duncan /North Cowichan east of Hospital Hill that isn't located on riparian lowland.

Risk Potential

High due to high oxygen demand stimulated during low summer flow period and high biological activity.

WATER QUALITY AND CHANNEL DATA (7/30/97 SOMENOS MARSH SOCIETY USHP PROJECT)

SITE	1	2	3
Location (m)	660	1660	Lake outl;let (3020)
Air. Temp.	22	27	26
Water temp.	23	22	24
Wetted width	18	7	8
Wetted depth	1.53	1.5	1.1
Bankfull width	28	9	11
Bankfull depth	2.5	2	2.3
PH	9.7	7.7	8.2
Oxygen (mg/L)	13	1	4
Turbitity (JTU)	2	20	3.5
Canopy	0	0	0
LWD	0	0	0
Bank stability	Excellent	Excellent	Excellent
Riparian	Reeds	Willow, reeds	Willow, reeds
Velocity	0	0	0
Adjacent land use	Residential	Farm, urban	Marsh, urban

E) PROTECTION NEEDS

Somenos Lake and Creek have a very extensive Riparian Zone. Parts of it are farmed, largely for forage crops. Very large sections have been lost to developments of very low reversibility: urban uses such as stores and parking lots. Witness the continuing alienation of riparain lands in the Beverly Street area. These

uses are entirel;y incompatible with the high resource values of Somenos Riparain Lands. Of the remaining lands adjacent to Somenos Creek, those in most need of immediate attention are the Chesterfield Creek Wetland and adjacent undeveloped lands. Because of the summe refuge value of water in the creek and wetland complex and the ongoing development aspirations of Chesterfield Park Society, a management plan for this area is a very high priority. The Chesterfield Creek Wetland is the last remnant of the wet woodland component of Somenos Marsh outside Cowichan Tribal Lands.

Stream Code: 920 2577 057 806 565 000

Stream Name: **Richards Creek and Crofton Reservoir**

Operational Management Unit: Somenos Basin

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: Richards Creek enters the northeast end of Somenos Lake. It drains Mt. Richards and Maple Mtn. then enters a broad lowland basin before entering Somenos Lake. Its primary flow source is Crofton Lake, a reservoir administered by North Cowichan but numerous springs augment low flow and moderate summer temperature. Flow from Crofton Lake is porovided by a 5 cm pipe which discharges into the creek 60 m below the lake. Flow starts out as 22 degree water in July and August then moderates as springs enter downstream.

Air Photos	BC 82007 142-143
Topographic Map	92 B/13, 92B.082
Obstructions	A Series of falls begin at 6217 m: 2R3 at 6217, 3R4 at 6231, 2R at 6264 , 3R4 at 6315 and 8R at 6342.
Salmonids	(accessible length) Co to 6217m (1,180 m summer productive below obst.) Ct to 6217m (1,180 m summer productive below obst.) Occ. St to 6217)1180 m summer productive below obstruction) Occ. Cm to about 5800 m Ct throughout but more common below the falls. The upstream population is sparse.
Max. Temp. (C°)	20 at Richards Trail culvert (7/8/98) 16.9 410 m above Richards Trail (R2) (7/8/98)
Min. disch. (m^3)	.0166 m^3 (25/08/87) at Richards Trail .0069 (8/15/98 R6)
Dissolved Oxygen	2.0 mg/l (25/08/87) at Herd Road (16° water temp.). 0.40 mg/l (11/08/98) atHerd Rd. (16.8-18.4° water temp. 9-11 mg/l R's 6-9 (8/15/98) 4.9 – 8.9 from McGuiness Farm to Richards Trail 7/3 – 8/7/01 includes Pastula's Farm (Tattam, 01)
TDS	18-19 R's 6-9 (8/15/98)
PH	7.36 R's 6-9 (8/15/98)

RICHARDS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2)
Reach 1	18.0	8.0	9100	.0003	UC	H	2300	18400
Reach 1a	7.0	4.0	1000	.0006	UC	H	3060	12240
Reach 2	6.0	3.0	1540	1.0	FC	L	1275	3825
Reach 3	4.0	2.0	1270	2.3	CON	N	82	164
Reach 4	4.0	2.0	1162	5.0	ENT	N	282	564
Reach 5	3.0	2.0	1351	2.5	CON	N	310	620
Reach 6	3.0	2.0	6310	0.5	FC	L	804	1608
Reach 7	2.0	1.0	1351	3.0	CON	N	151	151
Reach 8	3.0	1.0	4510	1.0	FC	L	215	215
Reach 9	3.0	2.0	262R	2.5	CON	N	460	920
Reach 10	3.0	2.0	1810	1.5	FC	N	304	608
Reach 11	3.0	2.0	3412	2.0	CON	N	85	170
Reach 12	3.0	2.0	3412	3.0	CON	N	438	876
Reach 13	3.0	1.0	7300	2.0	OC	N	585	585
Reach 14	2.0	1.0	6310	1.0	FC	N	238	238
Reach 15	3.0	2.0	1810	3.0	CON	N	38	76
Reach 16	3.0	0	127R	6.0	CON	N	93	0
TOTAL							10717	41260

CROFTON RESERVOIR

Area (ha)	Elevation (m)	Approx. Volume(m3)	Max. Depth (m)	Total Dissolved Solids (TDS) (mg/L)
16	138	unknown	unknown	unknown

B) FISH UTILIZATION AND LIMITING FACTORS

Richards Creek supports coho and cutthroat trout; some trout are anadromous. A few chum salmon are occasionally reported above Richards Trail. Steelhead / rainbow are also said to be occasionally present in small numbers.

Production is concentrated in Reach 2 within the small amount of reasonable spawning and rearing habitat (2,360 m^2) between the falls and the ditched zone downstream of Richards Trail. Coho fry densities are very high. As many as 15 fry/m^2 have been observed in Reach 2. It was originally thought that fish moving up from Somenos Lake to escape deteriorating water quality at least partly accounted for the high densities but no Somenos fish have been recorded by PBS personnel (Kent Simpson, pers. comm.).

Water licenses: Stream is fully recorded.

Reach 1 of Richards Creek is very low in summer oxygen and there is generally nil flow (standing water). However, during heavy irrigation demand, Richards Creek R1 reverses flow very noticably as pumps pull the water upsstream to the central part of Reach 1. This phenomenom was observed on many occasions at the Herd Road Bridge in the summer of 1998 which was exceptioally warm and dry. Low oxygen conditions persist into the late fall and do not improve until streamflow increases significantly. In 1998, low oxygen persisted until mid- December and there was concern that coho might be prevented form reaching their spawning grounds above Richards Trail.
Oxygen levels are not dangerously low throughout R1. The section from McGuiness Farm to Richards Trail which includes all of Pastula's Farm was monitored in July and August of 01 and concentrations were found to range from 4.9 to 8.9 mg/L. Coho and cutthroats were abundant in this section: 594 coho and 109 cutthroats were salvaged from a 235 m segment on September 13 and 14, 01 as part of the water course maintenance program at Pastula's Farm (Tattum, 01).

C) PRODUCTION OPPORTUNITIES

1.COHO COLONIZATION : CROFTON RESERVOIR AND BREEN *LAKE* – Crofton Reservoir is a potential coho colonization site. The impoundment has a surface area of approximately 16 ha. At , .15 coho fry/m^2 , the reservoir's potential smolt yeild is 1920. If Breen Lake is impounded and stocked, an additioal yield of 720 smolts could reult (Production Option # 68). It is likely that Breen Lake would have to be stocked in the fall to avoid marginal summer conditons. The same may apply to Crofton Lake.

2. ***HEADWATER STORAGE – CDP FLOW AUGMENTATION:*** Breen Lake, a mature wetland at the headwaters of Crofton Lake's inlet has an existing 2.5 m dam at its outlet. This dam is very old and its spillway is in disrepair. The wetland is capable of storing at least 168,000 m^3 of water which could yield 7.65 LPS for the 180 day critical discharge period and increase Crofton Lake's useable storage.and allow additional spill form Crofton Lake (**Production Option # 69)**. A new spillway would have to be contructed as well as a flow control structure. Additional flow might improve summer oxygen levels in Reach 1 and make it more habitable **.** More CDP inflow to Crofton Lake might improve water quality in the lake which is a chronic summer problem. More summer release from Crofton lake would also be possible and the feasibility of installing a larger diameter pipe at a lower level should be investigated. The current discharge pipe draws water from above the thermocline which ranges up to 24°. Downstream groundwater input in Reaches 13 and 14 and below cool present flow but it is still a concern in very warm summers. It may be more difficult for groundwater seepage to cool incresed flow from the lake's epilimnion so a deeper summer outlet should be investigated.

3 ***RIPARIAN MAINTENACE AND IMPROVEMENT:*** Instream enhancement in 1983 above Richards Trail on the Valley View Farm property (Vaneuuwn) was mitigation for channelizing lower Richards Creek (see

Section D – Agriculture). Maintenance of these mitigation works was not being undertaken by Mr. Vaneuuwn in 1987 (memo-Tutty to Field 01/09/87). As of Juky, 1998, most of the cribbing work was still in place but the fencing is in need of repair in places. The riparian setback also needs to be increased somewhat because its generally too narrow to allow development of healthy riparian vegetion (Production Option # 70).
NOTE: Fish First undertook to correct the shortcomings in September, 2001 with FsRBC funding,

4. ***COHO COLONIZATION –UPPER RICHARDS CREEK:*** Richards Creek above barrier base flow wetted area = 5991 m^2 (0.5 to 3.0 % gradient). Coho smolt yield potential: 400 to 2000 smolts. Fry required : 5,000 (Production Option # 71).

D) LAND USE FACTORS

Agriculture

The lowland portion of the basin has been totally modified to accommodate crops, grazing and forage production. Habitat compensation in Reach 2 for ditching Somenos and Richards Creek (Reach 1 was undertaken in 1983 by farm fencing, bank restoration, and off-stream cattle watering above Richards Trail (B.D. Tutty - DFO and G. Reid - MOE). Maintenance of cattle fencing by land owner is essential for mitigation plan to work. Observattions in 1998 indicate the timber cribbing portion of the copensation is still functioning well but the fencing portion is badly in need of maintenance.The ditched length of Richards Creek extending from Somenos Lake to a point 35 m below Richards Trail has insufficient dissolved oxygen to support fish life during the summer period. Dissolved oxygen at the Herd Road bridge measured 2.0 ppm on 25/08/87 and .04 ppm 8/15/98.

Forestry - Uplands are covered by advanced second growth. Considerable second growth logging adjacent to upper reaches in North Cowichan Municipal Forest.

Risk Potential - Low. Residential expansion into the narrow upland valley could pose future problems.

Notes

ESCAPEMENT

YEAR	Co	
1990	1201	
1991	393	
1992	124	
1993	246	
1994	446	
1995	372	
1996	97	
1997	476	
1998	746	
1999	121	
2000	79	
2001	1116	
2002	187	
2003		

E) PROTECTION NEEDS

There is a very extensive riparian area adjacent to Reach 1 (which has been divided into 1A and 1B for USHP data analysis). In its natural state, it is largely a red osier – willow shrub forest. However, much of the natural riparian zone has been cleared for agriculture and is now seasonally flooded vegetable or hay fields. In some areas in Reach 1B, the riparian zone is over 600 m wide but there is no more than a fringe of native riparian vegetation along much of it. Most of the channel has been ditched throughout Reach 1. There is a need to return some of this area to a more natural
condition (which has been recommended as an enhancement measure). No further ditching or riparain destruction should be permitted.
Reaches 2 and 3 also feature riparain landscape units, important springs and areas of steep adjacent slopes; these are included in the FSZ. The FSZ narrows through Reaches 4 and 5 where it averages about 30 m on either side of the stream which flows largely through upland landscape units with a narrow riparian zone

which is only a fringe in many areas. Reach 6 features an extensive riparain zone which is over 100 m wide in places, much of it has been cleared. The FSZ narrows to about 20 – 40 m on either side of the creek through Reach 7 although there are broder areas where the riparian zone widens through this is a mainly upland reach. Reach 8 is an upalnd reach wiith a narrow FZS ranging from 20 – 50 m on both sides of the creek but Reach 9 features a narrow riparian band some 15 to 30 m wide on either side of the stream althuogh it widens toward the upper end of the reach. Reach 10 features a broader riparian zone some 50 – 100 m wide. The FSZ narrows again through Reaches 11 and 12 which traverse stable upalnd landscape units with stable slopes ranging from 12 – 50 %. Reaches 13 and 14 have wider riparian components and lesser slopes. Reach 15 is bordered by stable upland with gentle slopes except for a segment on the west slope near the upper end of the reach. Reach 15 is summer dry and is the spillway reach between the Crofton lake Spillway and the discharge pipe.

Stream Code: 920 2577 057 806 000

Stream Name: Averill Creek

Operational Management Unit: Somenos Basin

Municipal: Duncan and North Cowichan

A) BIOPHYSICAL OVERVIEW: Averill Creek is 5.3 km long and drains the southeast slope of Mt. Prevost; enters Somenos Lake from the West. It is a complex system consisting of two major forks: the mainstem which has its primary origins in several wetland basins near the Island Highway in the vicinity of North Cowichan's Municipal offices and the B.C. Hydro right of way and the West Fork which originates on the southwest shoulder of Mt. Prevost and drains southeast through Duncan Lakes Golf Course to enter Averill 2.55 km above Somenos Lake. Important tributaries are Fairview and Herd Creeks which supply Averill's CDP flow, the East Fork and Prevost Creek. Other imporatant basin wetlands are located in the headwaters of a northern branch of Averill I call Christmas Tree Creek that originates near the Fletcher Challenge waterline between the Cowichan River and Crofton Mill.

Air Photos	BC 82007 142-143
Topographic Map	92 B/13, 92B.072, 92B.082
Salmonids	(Accessible length) Co to 951 m Ct.to 1,500 m Cm to 951 m Bt brown trout have been reported by local youths Os brook lamprey are present. St chance of a very occasional fish (see historic notes)
Obstructions	2.3 m over 6 m at 951 m, other minor cascades located immediately upstream. West Fork: 3 m culvert @ Somenos Rd.(569 m), Pink House Falls: 2R4 @ 1000m, 2R @ 1005 m and 1R2 @ 1015 m. 3R @ 1433 m below Main Pond, an impoundment on the golf course. E and N culert @ 598 m is a fry barrier. Culvert and apron are 43 m long. Velocites range from 1.1 to 1.55 MPS in summer. Island Highway culvert at 570 m may also block or restrict upstream fry movement. Low flow velocites are around .7 MPS for 17 m in these twin 2.5 x 1.25 concrete box culverts with very shallow (.5-2 cm) depth at low flows
Max. Temp. (C°)	19 (8/9/85 R2) 21.9 (7/29/98 R2) 26 (7/29/98 Upper R1 @ below Island Highway culvert) 26.9 (8/11/98 Upper R1 below Island Highway Culvert) Fairview Creek 20.4 (9/7/98) Herd Creek 18.4 (9/7/98)
Min. disch. (m^3)	0.0022 m^3 (8/9/85) E & N culvert. Intermittent upstream of 2,000 meters after July in most years. Herd Creek .0011 (9/1/96) Fairview Creek .00121 (9/7/98)
DO	.07 (R1 just below Highway culvert 8/11/98) 6.65 (R1 just above E+N culvert 8/11/98)

AVERILL CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2)
Reach 1	6.0	3.0	8200	0.1	OC	L	570	1710
Reach 1 a	culverts	1-2	0109	1.5	CON	N	71	71
Reach 1b	4.0	2.0	8110	.5	CON	N	100	200
Reach 2	6.0	2.0	3610	1.0	FC	M	210	420
Reach 3	8.0	7.0	1117	2.0	CON	N	300	2100
Reach 4	5.0	3.0	4231	1.0	CON	N	1600	4800

Reach 5	3.0	.5	4330	.5	CON	N	800	400
Reach 6	3.0	1.5	370R	0.5	CON	N	500	750
Reach 4	3.0	0	2710	1.5	CON	N	1200	0
							5150	10510

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat trout, coho and chum salmon utilize the lower 951 m. However, only 122 m of this section has quality spawning and rearing habitat. Numbers are low for all species. Unlike Bings and Richards Creeks, Averill does not get a large swim – up population of coho fry from Somenos Lake . It is thought that the E and N culvert and possibly the Island Highway culvert are velocity barriers to upstream movement (both these structures were improved in 1999). Base flow velocity in the 43 m concrete box E+N structure with a V in the centre is 1.55 MPS . Coho fry were attempting to navigate it on July 29, 1998. They were able to penetrate 20 m into the culvert beacause velocity is somewhat less in the lower section. I tried to chase them upstream and they were able to swim approximately 3 m before they tired and turned back. I returned 1 hour later and they were still in the same place holding below a rock that had washed into the culvert. Somenos Lake surface temperature was 32.3 ° and the creek temperatue just below the culvert was 26 °. The Island Highway culvert is also problematical. This 21 m concrete box structure features very shallow water at base flows: 1 – 2 cm and fish may be reluctant to swim through it during low flows. Velocity in the upper 17.3 m (the problem section) on June 10, 1999 was .714 MPS. Fry were holding below the culvert but none were above it in the holding area between the highway and E+N culverts.

Production is further limited by very low summer flow. The system dries early above 2,000 m where only isolated pools persist from July through September. Dave Aldcroft and T. Burns salvaged pools above the falls between Herd Creek and Drinkwater Rd. on 9/7/98. Catch was 112 Ct fry and 21 Tsb.

C) PRODUCTION OPPORTUNITIES

1. ***SUBSTRATE IMPROVEMENT:*** It should be possible to improve a 100 m section between the falls and E & N culvert by **gravel restoration (Production Option # 72)**. Streamside fencing would also be beneficial. The object is to provide at least one section of quality below barrier spawning habitat in an accessible location so it can be maintained on an annual basis and there would be reasonable coho and chum egg survival in this stream of present low quality substrate particularly in its lower reaches. Averill Creek substrate quality has suffered greatly from upstream development. This project would involve the additon of at least 5 m^3 of washed 2-5 cm gravel (drain rock).

2.*BARRIER IMPROVEMENT- ADULT PASSAGE:* The falls could be made passable (Production Option # 73) but little coho or trout rearing benefit would result due to lack of quality upstream summer habitat. However, headwater storage could alleviate that. There is a small 35 m long bypass channel on the south side of the falls that only carries water in peak flows. At discharge levels of .6 – 1.0 CMS, the channel only flows at about 1LPS. The creek usually only attains this discharge two or three times per winter. The channel needs to be deepened at least 20 cm at its inlet along with widening and deepening at selected spots and two resting pools need to be constructed near its lower end. It is also possible that a small deflector will be necessary above the falls to garuntee sustained flow during the migration period. When the falls are made passable and summer flow increases, it may be advisable to replace the Somenos Road culvert on the West Fork which is a barrier. Further improvement of the falls could be in the form of dishing the top and cutting out a resting platform mid – way up (Doucet, pers. comm.)

3. ***COHO COLONIZATION WITHOUT HEADWATER STORAGE:*** Nine ponds with a total surface area of 22,500 square metres are present on the West Fork on Duncan Lake's Golf Course. With minor modifications in outlet controls, storage regime and channel structure in outlet streams, these could produce coho smolts from **stocked fall fry**. Fry required: 3375. Estimated smolt yield @ 15% survival: 506 **(Production Option # 74).**

4. ***BARRIER IMPROVEMENT – FRY PASSAGE:*** Pacement of baffles or small weirs in the E and N culvert would allow for seasonl fry/parr passage from Somenos Lake to the most habitable portion of Averill Creek. It may also be advisable to do the same in the highway culvert. Baffles should be placed 5 m apart and consist of concrete weirs about 5 cm high with slots down the centre. Purpose of the baffles is to deepen and slow

the water while not speeding flow near the baffles (Production Option # 75.). NOTE: This project was completed in Oct. 1999 with FSRBC funding (Burns, 1999b).

5. ***HEADWATER STORAGE:*** Because nearly 80% of the mainstem of Averill Creek is summer dry or highly intermittant but is otherwise habitable for salmonids, provision of CDP flow is a primary improvement need. Five wetland basins (Muni, Fry, Alligator, Deer Heaven and Deer City) have a combined storage area of 19.29 ha and ,with I m of storage, a 180 day discharge yield of 8.723 LPS (Production Option # 76). NOTE: Fish First, 1650 Koksilah Road :748-8716 has been investigating this option (2000 – 2001)

6. ***COHO COLONIZATION WITH STORAGE AND CDP FLOW:*** Avilable above barrier habitat: 7900 m^2 , potential smolt yield @ 1 fry/m^2 and 8% survival: 632. Coho colonization should not be necessary for very long after the falls is made passable but will probably need to be kept up for at least one generation because coho escapement is presently very low (5 – 10) fish in the 1990's. If the headwater wetlands could support fall fry, another 2315 smolts could result (Production Option # 77).

7. ***ADDITIONAL FLOW AUGMENTATION:*** The Crofton Pulp Mill water pipeline passes very close to the Averill headwater wetlands (Deer Heaven and Deer City). The possibility of drawing some water from this source to augment storage should be investigated (Production Option # 78).

8.***RIPARIAN RESTORATION:*** An area of upper R5 extending from from 1210 – 1335 m on both banks requires tratment as does considerable tributary area in particualar the East Fork from Municipal Wetland, a 600 m long stream that flows largely through pasture with denuded banks which are eroding in many places. Its channel is becoming clogged with spike rush and canary grass due to lack of canopy.
(Production Option # 79)

9. ***GROUNDWATER DEVELOPMENT – HERD CREEK, EAST FORK, SNOWBERRY CREEK :*** Sloped riparian wetlands and springs near the heads of Herd and Snowberry Creeks on Upper Drinkwater Road are the primary summer headwaters of Averill Creek but flows are very low (base flow 1-2 LPS). A headwater aquifer below North Road on the Mayer Property as well as the springs along Upper Drinkwater may support wells that could provide additonal high qualaity water Existing well logs should be examined and a test drill should be conducted in the summer of 1999. The East Fork flows from Municipal Wetland to join Averill Creek in Reach 5 . There are at least 3 springs on the adjacent Hayhoe Property that appear capable of yielding more summer flow. Winter flow in the main spring was measured 1/14/98 at 1.615 LPS @ 8.9°. This spring flows all summer and is largely responsible for the puddles in Averill Creek between Herd Creek confluence and the East Fork confluence. Test drills should be conducted in the summmer of 1999 and if the well proves out, well heads installed in the fall of 1999 (Production Option # 80).

10. *POND STOCKING*: At least nine ponds with a total surface area of 22,500 m^2 are present on the West Fork on Duncan Lakes Golf Course. With minor modifications in outlet controls, storage regime and channel structure in outlet streams, these could produce coho smolts from stocked fall fry. Fry required 3375. Smolt yield @ 15% : 506 (**Production Option # 81). NOTE: I have discussed this option briefly with the golf course owners and they were not enthused by the idea (1998).**

11. ***FRY SALVGE:*** a small number of coho and chum fry become stranded in Pea Gravel Floodchannel, a 64 m long by 2 m wide channel with 6 pools in mid R2. Although yield is slight, local residents place high value on rescuing these fish. Usual coho and chum escapement is so low that every fry is important in many years (Production Option # 82)

D) LAND USE FACTORS

Agriculture

Intensive use of most of the basin below the 100 m contour has caused chronic degradation: sedimentation, bank damage, cover removal and pollution form barnyard runoff.

Residential

The area below the 100 m contour is about 10 percent urbanized and residential expansion is becoming rapid (1994). Duncan Lakes Golf Course was constructed in 1990. It covers a major portion of the West Fork Basin.

Risk Potential

High.

Fishery Officer Narrative

Historical Notes

Coho have been able to pass the falls in years of prolonged high flow and high escapement. Mr. Mike Huber (6267 Fairview Way, Duncan V9L 2J4 – 748-9042) saw fish above the falls in 1971 and 1972 and even moved some above the falls in those years. He also reports that coho spawned in Fairview Creek as late as the late 1960's. Mr. Huber also saw a steelhead above the falls in the early 1970's. Escapement estimates:

ESCAPEMENT ESTIMATES

Year	Co	Cm
1998	30	200
1999	15	0

E) PROTECTION NEEDS

Averill Creek's Fisheries Sensitive Zone has extensive riparian components many of which have been converted to pasture. The largest riparian component is Somenos Marsh which has a significant inland extension on Averill Creek above the highway – E and N right of way. After the marsh segment, Averill enters a semi – enclosed ravine with steep silt-clay walls in for considerable length, there has been some residential intrusion into the FSZ in this area and adjacent Fairview Creek. The ravine becomes increasingly shallow until it gives way to riparian area above Drinkwater Road. The remainder of the mainstem is largely adjcaent to riparian landscape units up to the Fry Swamp - Powerline area. Above this point, the stream climbs up a ravine to its headwater wetland basins. The FSZ also covers tributaries (Fairview – highly intruded, Herd which features ravine and extensive intruded riparian and an important headwater aquifer zone below North road, the West Fork, Municipal Creek (East Fork) and Prevost Creek).

Stream Code: 920 2577 057 669 000

Stream Name: Bings Creek (Holmes Creek, Buckham's Creek)

Operational Management Unit: Somenos Basin

Municipal: Duncan and North Cowichan

A) BIOPHYSICAL OVERVIEW: Enters Somenos Lake from the west; drains the southeast shoulder of Mt. Prevost. Summer dry (dries early) above Highway 18, summer groundwater fed below. Essentially non-buffered abd subject rapid runoff.

Air Photos	BC 82007 142-144
Topographic Map	92 B/13, 92B.072, 92B.081, 92B.082
Watreshed Area	15.5 km^2
Salmonids	(Distance Upstream) Co to 1,882 m. Anadromous Ct to 1,882 m. Cm to 1,882 m. Ct to 5,500 m. St to 1,882 m. Bt Unknown but present above and below the falls. Fish above falls are introduced and are now resident while fish below are largely anadromous. Os the brook lamprey is present in Bings Creek. Numbers are strong in Reaches 1 and 2
Obstructions	1. 3.2 m falls at 1882 m (greatest vertical drop = 2m) 2. 2R5 cascade at1982 m 3. 1.5 m falls at 2007 m 4. 1.2 m dam at 2107 m 5. 1.5 R4 cascade at 2342m 6. CN culvert (50M) at 2347 m. Migration velocities over the 6.3 m long apron surpass 3 MPS at times and average 1.85 MPS at normal winter – spring flows. The culvert itself may also require baffles 7. A series of three chutes (total vertical drop: 3 m) in a 25 m bedrock zone at 2494 m. 8. 0.6 m vertical drop @ OLC Rd. culvert at 5865 m.
Max. Temp. (C)	15 (8/9/85) Mary Rd. summer temperatures decrease to 9° at the summer headwaters (6,600m). 22 (7/29/98 – Upper R1 @ the Eand N crossing) 20.9 (7/29/98 – R2 at Mary Rd.)
Min. disch. (m^3)	0.014 (7/23/70) Mary Road. 0.026 (8/9/85) Mary Road. 0.002 (8/20/85) 10 m above Cowichan Lk. Rd (above Menzies confluence). Upper Bings Creek below the Judge Farm was intermittent at times during August and September of 1987 due to withdrawal for irrigation. .0259 (8/21/87 R4 at Agira Rd. fence site) .0307 (R2 – 8/12/98 Mary Rd.) .003 (R1 – 10/65)
Max. Disch.	14.8 (R1 @ Mary Rd. – 1/14/68)
DO (mg/L)	.7 (R1 @ 6.9 m 8/15/98) 2.8 (R1 @ 75 m 8/15/98) .025 (R1 @ beaver 90 m below Island Highway 8/11/98) 6.6 (R1 @ downstream side of E+N 8/11/98) 8.5 (R1 B @ Mary Rd. 8/11/98)
TDS	54.6 – 90 (R's 1 – 11 8-9/98)
PH	6.94 – 7.6 (R's 1-11 8-9/98)

BINGS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2
Reach 1	4.0	3.0	1000	0.01	UC	H	340	1920 (Somenos Marsh)
Reach 2	3.0	2.0	5500	0.4	FC	L	225	450 (Somenos Marsh)
Reach 2A	11.0	4.0	9100	.1	CON	N	39	156
Reach 2B	6.0	4.0	6400	.5	OC	M	859	3436 (Misery Meadows)
Reach 3	10.0	5.0	2620	1.5	FC	M	303	1515
Reach 4	9.0	4.0	0127	4.0	CON	N	327	1308
Reach 5	10.0	5.0	1540	1.5	CON	N	94	470
Reach 6	7.0	5.0	1342	2.0	CON	N	72	360
Reach 7	6.0	4.0	1540	2.0	FC	L	1836	7344
Reach 8	5.0	2.0	2800	1.3	FC	L	692	1384
Reach 9	4.0	2.0	1234	3.0	CON	N	157	314
Reach 10	5.0	3.0	2800	1.0	FC	L	589	1767
Reach 11	4.0	2.0	2350	1,5	CON	N	267	534
Reach 12	4.0	2.0	2710	0.7	FC	L	1158	2316
Reach 13	4.0	0	1450	2.5	CON	N	unknown	
TOTAL							6928	21324

B) FISH UTILIZATION AND LIMITING FACTORS

Bings Creek supports coho and chum salmon and cutthroat trout (residents, sea-run and Somenos Lake spawners). Brown trout have been introduced above the falls and an anadromous population is present up tp the falls. Steelhead have also been reported. Some steelhead occasionally ascend the barriers and spawn in Upper Bings or Menzies Creeks. Several steelhead smolts were trapped in May, 1989.

Lower Bings Creek is noted for its large population of coho juveniles; some very large. Densities of 10 fry/m^2 have been observed and late summer fish as large as 30 cm have been recorded. It is suspected that some coho fry rear in Somenos Lake in the spring months then return to the creek in mid-summer when the lake warms. Some fish, particularly the large ones, return to Somenos Lake in winter. Somenos Lake ofttten becomes summer anoxic. A major fish kill occurred in early Sept. of 1989. Many hundreds of young coho and trout moved into Bings Creek to avoid high temperatures (24 degrees plus) low oxygen (<1 ppm). Beavers sometimes dam Lower Bings and this could prevent upstream access in critical periods. A dam was located in Reach 2 just below the highway and should be removed (1998). This dam was first noted in 1994 but has been present for much longer than that. Another dam is present near the top of Reach 2B. Its removal is also necessary (NOTE: Dams below the highway were removed in September, 2000)

Introduced brown trout have established as a resident population above the falls. Migrant browns from Somenos Lake or the Lower Cowichan are also present. Many of the larger browns (60 cm plus) are anadromous.

Anadromous salmonids are restricted to the lower 1882 m but only 1342 m are quality habitat.

Production is limited by summer flow. The system dries above the 100 m contour. Fortunately, habitat loss is not great because of increasing gradient and decreasing channel width above this point.
Coho density was .554/m^2 in a 155.1 section of R's 1 and 2 in late August ,00. Cutthroat density was .068.

C) PRODUCTION OPPORTUNITIES

1.*SUBSTRATE IMPROVEMENT:* **Substrate improvement and replacement** in Reach 3 **(Production Option # 83)** should increase recruitment. Somenos Lake (98 ha) has a coho fry carrying capacity of 147,000 at .15 fry per m^2 . Bings, Richards and Averill Creeks contain less than 5,000 m^2 of quality spawning habitat . Like Averill, the object is provide at least one quality spawning site that can be easily maintained.
!998 Note: Reach 2 has become much less stable since this recommendation was made in 1987. Fine bedlaod has increased and is much more mobile This option is now a very low priority.

2.*COHO COLONIZATION:* Above barrier summer wetted area: 15,797 m^2. Fry required: 15797 **(Production Option # 84)**. Theroetical yield :1263. Actual smolt yields ranged from 862 to 1,700. From 13,000 salvaged fry . If the barriers were made passable, upstream stocking would not be required .

3. ***BARRIER IMPROVEMENT(ADULT):*** The series of falls beginning at 1882 m limit anadromous fish to only 22% of suitable habitat. Improvement **of the falls at 1882 m, removal of the dam at 2107 m and removal**

of the CN culvert and apron at 2347 m would allow coho, steelhead and migrant brown trout to utilize 5138 m of additional habitat in Bings Creek and 3756 m of habitat in Menzies Creek **(Production Option # 85).**

4.***BARRIER REMOVAL (JUVENILE):*** Because of the critical need for Somenos Lake coho to move into Bings, Averill and Richards to escape dangerous temperature and oxygen conditions in the lake in late spring – realy summer, these waterways must be free of even the slightest impediment in their lower segments. Two beaver dams are present dangers to fry migration in Lower Bings: one is located just below the highway at the 458 m point in R1 and the other just below Mary Road at the 1200 m point. The lower dam is probably not a barrier because its very old and quite low but it should still be at least partly removed. The upper dam is more recent and much larger. A local resident lowers it from time to time but beavers rebuild it consistently. This dam is also responsible for considerable flooding in the area and needs to be completely removed. Beavers should be trapped here to discourage dam replacement (Production Option # 86). NOTE: The lower dam was removed in late summer 2000.

5. ***CANOPY DEVELOPMENT – SUMMER TEMPERATURE IMPROVEMENT - REACH*** 1: Reach 1 is choked with Reed Canary Grass and other aggressive aquatic vegetation. This restricts drainage thus prolonging flooding and enhancing pressure to dredge the creek channel and /or Somenos Creek. Establishment of a higher canopy to shade the stream and dicourage heavy growth of instream vegetation is required. A test section should be started in the spring of 1999 using the following species: Pacific Willow, Sitka Willow, Black Cottonwood and hybrid poplar. A berm of more porous soil may be required to elevate some of the species (particularly the poplars) somewhat and discourage lateral flooding in the spring – summer months. To improve the summer temperature regime, selective deepening and instream berming may be required to extend creek water further out toward the lake and minimize inland lake influence . NOTE: A 155 m section was deepened and widened between Aug. 30 and Sept. 1 00. Willow, cottonwood and red osier cuttings were planted along with some conifers on higher ground (Burns, 2000) (Production Option # 87)

6. ***RIPARIAN IMPROVEMENT: REACH 12:*** Portion s of Reach 12 have been polluted and physically damged by cattle access. Although attempts have been made to control the animals, they need to be improved on by moving the fences further back and having the cows cross at bridges rather than through the creek. There are sinply too many animals to use the creek safely.in environmental terms. On September 25, 1998, cow dung was 12 cm deep on the creek bottom at the cattle crossing at 180 m. (Production Option # 88).

D) LAND USE FACTORS

Agriculture

A significant portion of the basin below the 100 m contour is utilized for grazing and forage production. Intensity is generally low but a 500 m section that passes through the Judge dairy farm suffers erosion and sedimentation from unrestricted access of cattle into the stream channel in places.

Residential

Generally light above Reach 5 but there have been some serious intrusions below. The worst is the RCMP station which is built squarely on the creek's FSZ on an inland extension of Somenos Marsh.

Forestry

Mainly advanced second growth with some recent logging on the lower slopes of Mt. Prevost. Minimal impact should result from logging this basin because of low relief and municipal management (North Cowichan).

Risk Potential

Moderate to high

E) PROTECTION NEEDS

The lower 1409 m of Bings Creek are highly riparian. The first 520 m are within Somenos Marsh while the remainder of the lower section is within what was once part of the marsh and is still quite wet. The inland extension of Somenos Marsh is known as Misery Meadows. The RCMP building is located on top of Lower

Misery Meadows The Bings Creek FSZ is a combination of riparain areas and small ravines all the way to the headwaters on Mt. Prevost. For the most part, the coridor is in reasonable health but there are significant intrusions in the form of the police station, encroaching residential areas along Mary Rd. and Old Lake Cowichan Road (Reach 10) where there is a small sewage discharge pipe and agricultural encroachment along Reaches 7 (Knight) and Reach 11 (Judge). Much of Reaches 6 – 9 is paralleled by the old railroad grade which serves as highly utilized trail in a very attractive setting. There is an excellent opportunity to establish a Greenway Corridor here and formalize the trail system.
Bings Creek needs a specific stewardship group to protect and restore the stream. The Cowichan Community Land Trust (Pam Fry) held a local meeting on March 29, 01 to garner interest in a group. It was well attended and perhaps something will come out of it.

Historical Notes

Several hundred coho were reported to have made it over the falls in 1956.

Escapement:

Year	Co	Cm	Comments
1987	30	1000	
1988	150	100	

Reaches 1 and 2 Restoration 2000

Channel widening and deepening took place in the upper 19 m of R1 and the lower 136.1 m of R2 between Aug. 30 and September 1, 00. Average depth was incresed by about .8 m and average width incresed by about 1 m. Reed Canary Grass was removed and initial planting of willows occurred (Burns, 2000).

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Centennial Park Creek

Operational Management Unit: Somenos Basin

Municipal: Duncan and North Cowichan

A) BIOPHYSICAL OVERVIEW: A small groundwater fed stream partially contained in underground drains; a tributary of Lower Bings Creek. Likely once flowed into Somenos Lake or creek before it was diverted into Bings. A remnant segment is present near the Canadian Tire store on the Beverly Street extension. This creek has a flapgate at its upper end to prevent backflooding and recieves considerable storm drain runoff – I have termed it "Green Frog Creek".

Air Photos	BC 82007 141-142
Topographic Map	92 B/13, 92B.072
Salmonids	Coho wintering and early rearing in R1. Fish move up from Bings Creek.
Obstructions	No leaps but the stream is in an underground drain for 350 m. from near the end of Duncan St. to the outlet of the lower pond in Centennial Park.
Max. Temp. (C)	15 in park (R4), 19.2 (R4 – 9/2/98) 22.2 Upper R1 15 m below culverts (7/29/98)
Min. disch. (m^3)	0.0022 m^3 (R4) .0056 Upper R1 15 m below culverts (7/29/98)

CENTENNIAL PARK CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2)
Reach 1	3.0	1.0	9100	0.1	CON	L	798	798
Reach 2	1.0	1.0	PIPE	0.01	CON (PIPE)		350	350
Reach 3	20.0	20.0	9100	0.0	POND	N	70	1400
Reach 4	2.0	1.0	8200	0.1	FC	N	25	25
Reach 5	10.0	10.0	9100	0.0	POND	N	35	350
Reach 6	1.0	1.0	7300	0.5	CON	N	200	200
TOTALS							1478	3123

B) FISH UTILIZATION AND LIMITING FACTORS

Wintering coho parr and early season (April – May) coho fry of the year have been found in Reach 1 Production is limited by poor habitat quality in Reach 1 and lack of access to reaches 4 through 6. Reach 1 becomes anoxic at times in summer.The south culvert at the three at the top end of the reach delivers low quality effluent.

Slight chance of an occasional coho spawner. A pocket of gravel (10 m^2) often accumulates just below the culverts at the head of R1 and a pair of coho could spawn there. The gravel largely comes from road runoff and is of marginal quality and shallow.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Stocking coho or anadromous cutthroat fry in reaches 4 to 6 could yield returns. Fry required : stream = 225 at 1 fry /m^2 and the pond with 262 fry at .15 fry/ m^2. An incubation box in Reach 7 could supply the fry. Anticipated yield = 70 smolts, 10 adults, 2 adult returns. Adults may have to be trapped at the entrance to the Reach 2 culvert. NOTE: a beaver dam at 84 m in R1 must be monitored in the spring to make sure it is not a fry barrier. (Production Option # 89)

D) LAND USE FACTORS

Reaches 3-6 are in Centennial Park and are thus protected Reach 2 is underground and Reach 1 is an old diversion channel that follows the E and N right of way ..

Risk Potential Moderate

E) PROTECTION NEEDS

Because most of the creek is either in Centennial Park or underground, the only portion with significant protection needs is Reach 1. A narrow band of riparian habitat parallels the creek in Reach 1 and is still productive despite its intruded nature (Railroad, Highway, Canada Ave.). Some of this habitat is west of the Eand N Grade which separates it from the creek channel proper. Reach 1 formerly flowed north under the faorgrounds and present Canadian Tire Store to join Somenos Creek in upper Reach 2. There is still a remnant known as Green Frog Creek from Beverly Street to Somenos Creek. A Mr. Grocer store was being constructed on former Somenos Marsh land east of Reach 1 of Centennial Park Creek during the fall and winter of 1998-99.

Stream Code: 920 2577 057 669 418 221 000

Stream Name: Menzies Creek

Operational Management Unit: Somenos Basin

Municipal: North Cowichan

A) BIOPHYSICAL OVERVIEW: Enters Bings Creek from the northwest 4,388 m above Somenos Lake. Drains the southwest shoulder of Mt. Prevost.

Air Photos	BC 82007 142-144
Topographic Map	92 B/13, 92B.072, 92B.081, 92B.082
Salmonids	(Length Useable) Ct to 3579 m. Bt to 3579 m.
Obstructions	None, Reach 4 (65m) is an almost continuos cacade at peak flows but the greatest vertical drop is only .5 m – easily passable. Summer dry at 3579 m. Total stream length is 8838 m.
Max. Temp. (C)	16.2 R5 (9/27/98)
Min. disch. (m^3)	0.023 (8/20/85) Sahtlam Road. Summer flow is ground water seepage . .0063 R1 (9/27/98) .0052 R3 (9/27/98)

MENZIES CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m2)
Reach 1	5.0	2.0	1810	1.0	CON	N	47	94
Reach 2	3.0	3.0	2440	.5	CON	N	123	246
Reach 3	5.0	2.0	2800	1.2	FC	L	1810	3620
Reach 4	4.0	2.0	1117	2.7	CON	N	65	130
Reach 5	5.0	2.0	1720	1.2	FC	L	1096	2192
Reach 6	4.0	2.0	1540	1.5	CON	N	435	870
Reach 7	4.0	0.0	1450	2.0	CON	N	-	-
Reach 8	-	-	-	-	-	-	-	-
Total							3756	7152

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports resident cutthroat and brown trout for 3756 m. Above this point, it dries in summer. Production is also somewhat limited by riparian zone degadation due to livestock access on the Ratcliffe property in reach 3 and, more seriously, on three proerties I Reach 5 in the Sahtlam Road area.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION***
Potential coho smolt yield : 572, fry required: 7152 **(Production Option # 90)**. If Bings Creek barriers are removed, colonization won't be necessary .

2. *HEADWATER STORAGE/ FALL FRY STOCKING* (20 ha) on West Menzies **(Production Option # 91)** could provide .008 cms to this stream during its 60 day dry period; 3,000 fry could be supported. This would also increase mainstem minimum flow below the West Fork by a factor of 1.54. West Menzies could also provide additional coho smolts if it were stocked with fry after the fall rains. Possible yield: 240 (Production Option # 92).

3. ***RIPARIAN RESTORATION***

Fencing and streamside planting in the impacted zones of Reaches 3 (minor) and 5 would increase productivity in the treated sections. LWD placement could accompany the treatment. Menzies Creek is not LWD deficient but it could use more in the areas requiring riparian treatment.
Length requiring treatment is 570 m but only fencing is required for 350 m of this distance (Production Option # 93)

4. ***GROUNDWATER WELL***

There is a small artesian spring just below the Dougan Gravel Pit near Tansor Junction that produces at least .032 LPS of 11° water . It flows into a small tributary of Reach 5. The gravel pit is about to be utilized by Hayes Forest Services. There is a danger that the spring's source could be obliterated if the floor of the pit is paved. It may be possible to increase the spring's output by deepening the well. The spring is presently tapped by a standpipe. The water goes subsurface in the summer but emerges just as the tributary it contributes to enters Menzies Creek at a point about 50 m above Sahtlam Road. In the winter and spring months, there is a constant flow between the well and Menzies. In fact a substantial creek comes out of the pit then and the spring is only a small part of it. Its mean winter flow is about .045 CMS. Much of it came from wetlands that had developed within the pit. These have been removed but the area has not been paved. as yet (Production Option # 94)

Of course, the main improvement measure for Menzies would be the improvement of Bings Creek Falls so that adult coho could utilize the very cpable Menzies Creek.

D) LAND USE FACTORS

Agriculture

Small holdings along Cowichan Lake and Sahtlam Roads. Riparian impacts have resulted from excessive clearing and lack of stock control. These lands are on the urban fringe. Temptation to develop will increase.

Urban

Light.

Forestry

Municipal forest. Advanced second growth, some recent logging.

Risk Potential

Low

E) PROTECTION NEEDS

Menzies Creek could be an important component of a larger Greenway Corridor that would start at Somenos Lake and extend up Bings and Menzies to at least Highway 18. The corridor wpould protect sensitive wetaln, riparain and ravine habitats that are part of the Fiheries Sensitive Zone. The Menzies Creek agricultural community needs to be brought into the stewardship concept.

OPERATIONAL MANAGEMENT UNIT 4: MAIN (COWICHAN RIVER)

OVERVIEW

The Cowichan River is the major stream in the CVRD. It is 50.4 kilometres long from the outlet of Cowichan Lake to its estuary.
For a river with such a long history of settlement by B.C. standards, the Cowichan River Corridor is relatively unintruded. The major exceptions are on its estuarine lands where agriculture has extended too far seaward and converted marsh and riparian wet woodland to pasture and intrusive industries are present in the outer estuary and on its lower river riparian lands (especially on the north side) where urban development has alienated some 400 ha of the combined Lower Cowichan – Somenos Riparian Lowlands. Smaller areas of riparian intrusion are present in the Riverbottom Reach where there has been minor residential intrusion and spot dyking and in the Town of Lake Cowichan where residential alienation has occurred along Cowichan Ave. (Money's Wetland and Lower Money's Creek) and between the weir and the Duckpond on the north side of the river. There are also small losses in Central and Saywell Parks (fill). A number of other properties in Lake Cowichan have degraded the riverbank by stripping riparian vegetation and replacing it with riprap or concrete bulkheads/retaining walls.

LIMITING FACTORS

The primary limiting factor is summer temperature which often exceeds the optimum or even lethal level for salmonids for several weeks in hot, dry summers when temperatures range between 20 and 24° or more from early July to mid or late September.

PRODUCTION OPTIONS

Cowichan River production options are outlined and prioritized in Table 1.

Table 1: OMU 4 – Cowichan River – Production Options

No.	Page	Location	Activity	Priority
94	91	Lake outlet	Cool water discharge/additional base flow, spike flow and careful flow changes	1
95	91	Various	fertilization	2
96	91	Various	LWD	2
97	91,92	Stoltz Bluff and other sites	Stabilization	2
4				

Stream Code: 9202577

Stream Name: Cowichan River

Operational Management Unit: Main

A) BIOPHYSICAL OVERVIEW: Flows NW to SE from Cowichan Lake to Cowichan Bay - 50.4 km. Spring thorough fall discharge regulated by a weir at the outlet of Cowichan Lake. Winter discharge moderated by Cowichan Lake and lack of major direct tributaries to the river. Exceptionally stable and productive by coastal standards. A major salmonid producer and one of the most important recreational fishing waters in the province.

Air Photos	BC 82007 77-80 103-110 134-143 160-163 192-196
Topographic Maps	92B/12, B/13, C/9, C/16, F/1
Watershed Area	River 343 km^2 Lake 608 km^2
Salmonids	Co 50,400 m Ch 50,400 m Cm 50,400 m St 50,400 m Rb 50,400 m Ct 50,400 m ACt mainly lower 12,500 m Bt 50,400 m but mainly upper 14,400 m DV 50,400 m but rare
Obstructions	3R30 chute low water chute at 32,500 m in Marie canyon just above the confluence with Mayo Lake Creek impedes low flow migration. It's passable at low flows but causes fish to jam up below it making them vulnerable to poaching and predators. It becomes a 1R3 cascade at higher flows. .5m over 4 cascade at 35,000 m is another low flow impediment. Skutz Falls at 36,000 m has a total drop of 5.4 m over 90 m and is bypassed by two vertical slot fish ways.
Max. Temp.	23 (8/15/85). Cowichan River is subject to high temperatures but they are moderated by groundwater seepage and upwelling which lower the temperature and provide numerous refugia for fish. 27 (7/29/98) bifurcation (R3) 23.6 (9/1/98) R11
Min. Disch.	0.4 (9/10/44). However, since 1958, spring through flows have been regulated to attempt to provide at least 7 CMS below the Crofton Pulp Mill intake at 13,000 m. Regulation usually begins in April or May and extends to Oct. 15. Discharge sometimes falls somewhat below the stipulated minimum after Oct. 15 in years of extended summer drought causing migration difficulties for chinook salmon. If sufficient storage remains in the lake in late September/early October, flow pulses are released to aid chinook migration.

COWICHAN RIVER

	Channel Width(m)	Wetted Width(m)	Substrate	Slope(%)	Channel Confinement	Side Channel	Length (m)	Wetted Area(m^2)
Reach 1 (N. Fk.)	25	20	2710	..01	FC	M	4500	90000
Reach 2 (S. Fk.)	25	23	3610	.02	FC	M	3000	69000
Reach 3	100	45	1810	1.0	FC	M	4500	202500
Reach 4	40	30	163R	1.5	FC	L	10000	300000
Reach 5	60	30	1720	1.5	FC	M	10000	300000

Reach 6	28	20	1342	1.5	CON - ENT	N	3000	60000
Reach 7	35	25	1450	1.5	FC	L	1000	25000
Reach 8	20	16	1351	2.0	CON -ENT	N	1000	16000
Reach 9	45	40	1450	1.5	FC	L	12500	500000
Reach 10	70	65	2530	.1	CON	N	300	19500
Reach 11	60	55	2530	.5	CON	N	350	16500
Reach 12	110	100	2530	.01	FC	L	250	25000
Total							50400	1,614,000

B) FISH UTILIZATION

The Cowichan River supports strong populations of coho, chum and fall chinook salmon (Neave, 1948, Taylor, 1963, Marshall, et. al, 1976). A small population of spring chinooks is present but little is known about these fish except that they were once much stronger (Brown . Sockeye and pink salmon are rare. Steelhead are abundant but sea-run cutthroats are not. There is a resident population of cutthroat trout in the Cowichan and some individuals attain large size. They too are rather sparse. Year round resident rainbows are present in very limited numbers but there is a strong seasonal (late fall through late spring) population of lake-based rainbows in the Upper Cowichan (above Skutz Falls). Brown trout are moderately abundant above Skutz Falls and scattered below. A few sea-run individuals are present. Dolly Varden are found throughout the river but are very rare. An occasional Eastern Brook Trout and white sturgeon are reported

C) LIMITING FACTORS

COHO SALMON

Factors limiting Cowichan River coho production are not clearly evident. However high escapement variability and a large annual variations in summer fry density indicate that ocean factors may be more important than in stream limits. The Cowichan is a remarkably stable river with an abundance of high quality coho habitat for all life history stages. Unlike most coastal rivers, the Cowichan does not suffer from extreme, rapid discharge fluctuations nor does it experience extreme low flows. Winter temperatures are relatively high and anchor or frazil ice are almost non-existent. It is subject to bed load movement in prolonged periods of high flows and its probable that losses of eggs and parr occur at these times.

One possible limiting factor is summer temperatures. In prolonged periods of very warm weather, water temperature climbs above 23 degrees and coho sometimes vacate large stretches of river. In the summer and early fall of 1998, they were absent from Reach 11 of the Cowichan for a period of at least 44 days from August 1 to October 13. When they returned, they were larger but far less abundant.
Argue, et. al. 1979 provided coho smolt yield estimates for the Cowichan River based on trapping results. 1937 estimate was 1,144,000, 1965 406,000, 1973 1, 406,000.

CHINOOK SALMON

Instream conditions are similarly favorable for chinooks and it is expected that estuary/ocean survival factors are at least as important than those associated with the river.

In the last few decades until the early 1990's, Cowichan mainstem chinook habitat was highly underutilized in most years. Escapement declined from a mean of some 6000 prior to 1980 to just 1200 fish in 1986 and 1987. Production of fall chinooks has increased somewhat since then due to conservation and enhancement activities. A lake pen rearing program ran from 1987 to 1997 and an increase in escapement was reflected – 10,000 returned in 1991 The information level on fall chinooks is increasing. A counting fence has operated at the City Pump House Pool since 1990 and PBS operates an ongoing research program. Unfortunately there is little information on the almost extinct spring chinook run. **The early chinook run that began entering the river as early as March or April at one time and peaked in June or July, is now barely represented. There are indications that the spring run was once stronger than the fall run. Early white settlers and Cowichan elders reported that these fish were very abundant (Brown,. Ernie Elliot said that, in the fifties and before, most of his family's annual catch of spring salmon was taken before school ended for the summer (E. Elliot, pers. comm. Nov. 28, 00). Arvid Charlie said that elders used to camp on the bar on the south side of the river near the mouth of Somenos Creek in May to catch the spring chinooks. Arvid said the runs persisted until the 1960's but they were not abundant then (A.Charlie, pers. comm.Sept. 16, 99). Arvid said that the fish used to ascend Shaw Creek and were present there until at least the 1950's. Occassional chinooks are still seen in Shaw Creek. Art Watson remembers a large fishery there. Reports of chinooks in other**

Cowichan Lake tributaries are received on a more or less regular basis. Both adults and fry have been reported from Robertson, Meade, Sutton, Nixon and Patricia (Pastuch) Creeks in the past five years. MOE snorkel counters usually see 20 to 60 early chinooks when they swim the river in late June or early July (R. Axford and L. Carswell pers. comm., 1980 – 2000).

CHUM SALMON

Chum production is limited by fall - winter flow conditions. There is an abundance of excellent spawning habitat but fry production varies with winter flow fluctuation. Cowichan chums tend to spawn heaviest in the most unstable areas of the river. They also spawn "high" and many redds are isolated by falling water levels particularly in Reaches 3, 5, 7 and 9. There is a great deal of variation in run size. Escapement estimates range from 15,000 to 200,000. Most fish are mainstem and sidechannel spawners but the tributaries are also utilized to some degree. In high escapement years, chums spawn in a number of Cowichan Lake tributaries as far west as Shaw Creek. Beach spawning has been observed in Cowichan Lake at Youbou.

STEELHEAD

Despite fluctuations in escapement and early summer fry density, the late summer juvenile population appears fairly constant. It is suspected that winter and ocean survival are strongly limiting. Cowichan steelhead responded remarkably to the imposition of catch and release regulations and escapement in the mid 1980's was very high. The system appeared to be operating near carrying capacity at that time. In the following years, escapement dwindled despite no increase in the catch or significant change in habitat conditions. Thus it is suspected that marine survival factors, especially predation in El Nino years and early ocean survival in Georgia Strait, were primary survival factors. One obvious instream mortality factor that could be significant in low escapement years is the problem of rapid dewatering when the weir goes on control. Many late run Cowichan steelhead spawn relatively high and their redds are subject to drying during flow reduction to hold storage in the lake. In most years, the redds are re - flooded before a problem develops. But it may be worthwhile to consider delaying storage until most of the fry emerge in some years (some Cowichan steelhead do not spawn until very late June). The river supports a strong winter run, a significant spring run and a very occasional summer run. A summer steelhead was caught in the Pool Above the Trestle on August 27, 01.

A preliminary estimate of run size based on a Keogh River model is 3082 (Lirette, et. al., 1987).

An interesting feature of Cowichan steelhead is the proportion of repeat spawners. Bull, 1966 found that 12. 8 % of first spawners survived to spawn twice and of these fish, 21.1% survived to spawn a third time.

RESIDENT RAINBOWS

Year round resident rainbows are now very sparse in the river. However, long time anglers report that these fish were once plentiful. It is suspected that heavy fishing pressure in the first three decades of this century decimated the population. Regulations since then, despite their increasingly conservative nature, may have been too liberal to allow recovery; particularly below Skutz Falls. Resident rainbows are barely surviving there. I have been observing a 500 m index section in Reach 5 (Riverbottom) since 1982. Every year about ten 30 to 50 cm fish are present in the early summer. By mid-fall, almost all have been caught and killed. There is a need for a total catch and release regulation on the Cowichan River with the possible exception of the November to April opening between the weir and Greendale Trestle which is almost wholly populated by lake based fish in that period. Lake based rainbows enter the river in the fall when the first chinook spawners appear, spend the winter in the river, spawn between February and April and return to the lake when the river begins to warm and drop in mid-May. These fish are relatively strong in numbers.

RESIDENT CUTTHROATS

Resident cutthroats are similar to resident rainbows in that they are supplemented by lake fish in the spring and fall and are not as numerous as they once were. Habitat requirements of resident coastal cutthroats in large coastal streams have not been examined in detail. The Cowichan population is unique. They are a special race of cutthroats that can attain large size. There is evidence that resident cutthroats similar to the Cowichan fish were once present in other Island Rivers that are lake headed like the Nanaimo and Little Qualicum. They are very sparse in the Cowichan; even less numerous than resident rainbows.

According to old timers, they were once fairly plentiful but not as numerous as rainbows. It is

suspected that the same heavy angling mortality that almost killed off the resident rainbows, did the same to the cutthroats.

SEA-RUN CUTTHROATS

Anadromous cutthroats are present in significant numbers only in the Lower Cowichan and are very uncommon above the White Bridge. Lack of small tributaries above Fishladder Creek is a probable reason. Most production probably occurs in Bings, Averill, Richards Quamichan and Fishladder Creeks and in a few Lower River Sidechannels like Rotary Park - Fish gut Alley and Major Jimmy's. Coho competition is likely the Major limiting factor in these streams.

BROWN TROUT

Occur mainly above Skutz Falls. The population appears relatively stable; about 400 adults. Spawning occurs in Hatchery, Beadnell, Tiny, Stanley, Fairservice and Beaver Creeks and in a few Upper River sidechannels such as Outer Joginder's (Giddes Creek) and the Double D channels adjacent to Block 51. Spawning also occurs in the mainstem. Competition with coho and steelhead juveniles and somewhat limited spawning and early rearing habitat are suspected to be the main limiting factors. Brown trout are also present below Skutz Falls and in Bings Creek. A resident population is present in Upper Bings and Menzies Creeks and in Lois Lake. Sea-run browns have been caught in the Lower Cowichan and Bings Creek. Cowichan browns were introduced in 1932, 1933, 1934, 1935 and in 1939 and 1940, all fish were yearlings from hatcheries in Montana and Wisconsin (Neave and Carl, 1940). Total number of fish stocked was 107,669. The first spawning runs of brown trout were observed in Oliver and Beadnell Creeks in the second week of November in 1937. Most fish spawn in November and December but fish have been observed spawning as late as February 20 when a spawning pair was seen at the downstream end of Green's Island (Cowichan mainstem) in 2001.
Cowichan browns are highly pisciverous after they reach a length of 45cm but only 47.7 % of fish eaten were salmonids (Idyll, 1942). Sticklebacks and sculpins also make up a large percentage of their diets.

DOLLY VARDEN

Dollies are present throughout the Cowichan mainstem but are very rare. They are usually seen or caught in the colder months. It is expected that they drop down from the lake during the main salmon spawning period and a few remain until the river warms in late May. A few are present in all the larger tributaries of Cowichan Lake. A total of 29 fry and parr were salvaged from Robertson River, Nixon, Sutton, Ashburnham and Meade Creeks during the summer of 1986. The Cowichan River population is marginal and limited by competition with other salmonids and warm temperatures. Spawning fish are seen in Robertson River, Sutton Creek and Shaw Creek. Numbers have been low in recent years.

D) ENHANCEMENT OPPORTUNITIES

Most enhancement opportunities are present in tributaries or sidechannels. See sub - basin and sidechannel sections and the following reports:

Burns, T. and B. D. Tutty 1986. Coho Colonization Potential of the Cowichan - Koksilah Watershed: A Habitat Evaluation. Can. MS Rep. Fish Aquat Sci. No 1865

Burns et. al. 1988. A Detailed Fry Salvage Plan and Coho Colonization Strategy for the Cowichan River Watershed. Can MS Rep Aquat Sci. No. 1985

Burns, T. E. A. Harding and B. D. Tutty 1988. Cowichan River Assessment (1987): The Influence of River Discharge on Sidechannel Habitats. Can. MS Rep. Aquat Sci. No. 1999

Burns, T. and B.D. Tutty 1988. Cowichan River Sidechannel Strategies: Sidechannel Restoration/Development Potential for Increased Salmonid Production. DFO South Coast Div. MS Rep.

Burns, T. Resident Trout and Salmon Fisheries of the Upper Cowichan System: Present Status and Opportunities for Enhancement. B.C. Environment

Harding, T., T. Burns and B. D. Tutty 1992. Assessment of Potential Coho Rearing Above Migration Barriers in the Koksilah Watershed, B.C. in: Proceedings of the 1992 Coho Workshop at the Coast

Bastion Inn, Nanaimo. Presented by the Association of Professional Biologists of B.C. and the North Pacific International Chapter of the American Fisheries Society.

1) *DEEPWATER* ***LAKE DISCHARGE AND IMPROVED DISCHARGE MANAGEMENT:*** Because the Cowichan River becomes so warm in the summer months and because this is primarily due to the fact that the river draws from the lake's surface, it is recommended that the possibility of installing a deepwater discharge pipe at the lake's outlet be examined. The thermocline is very deep in Cowichan Lake (15 to 20 m) and the outlet is shallow for a considerable distance – it may be as much as 1200 m before there is sufficient depth to provide a thermocline. Additional base flow would also be beneficial in that usable area would increase and many sidechannels would become much more habitable with additional base flow which is presently 7 CMS (250 CFS) above the Norske Skog intake and 2.8 CMS (100 CFS) below it. More flow would be especially beneficial below the pulp mill intake. Parts of the lower river, especially the North Fork have been summer dry in past years because of bedload build – up. Additional storage would also aid chinook migration. Present flow spikes are provided in late September or early October if enough water remains at the end of the summer but this is often not the case. Improved management of the weir in the area of slowly introducing or ramping flow changes would also benefit production. Fry and smolt losses are sometimes significant when river flow drops quickly and steelhead redds are sometime exposed **(Production Option # 95). NOTE: The possibility of increased storage was put forward by MOE/DFO in 1990 and again in 1999/2000. Negative public feedback was significant both times.**

2) FERTILIZATION: The technology of stream fertilization is becoming more refined and, although the Cowichan is a relatively fertile river by coastal standards, this option should be considered (**Production Option # 96).** ***Gomphonema*** has colonized the Cowichan and Koksilah Rivers (2000).

3) ***LWD ADDITION:*** The river lacks this element of habitat in a general way. No specific locations are provided here but close to bank windfall logs could be added at a number of locations but particularly in Reaches 9 and 11 (**Production Option # 97)**

4) ***STOLTZ BLUFF STABILIZATION*** : Stoltz Bluff erosion contributes substantial amounts of fine sediment to the Lower Cowichan River. The lower 27.4 km of river is turbid from the onset of winter flows sometime in late October or early November to the cessation of high flows sometime in April or May> Bioengineering techniques using aggressive riparian vegetation (willow watttle fences, willow racines, willow, cottonwood and red osier cuttings, live pole drains and seeding, fertilization and mulching) can be applied to particularly unstable areas on the face of the silt – clay bluff. An existing channel to the south (A 65 – Stoltz Active Channel) could be modified to receive more water or a new channel could be constructed to the south **(Production Option # 98). NOTE: Planting stabilization occurred in 1999 and 2000 with beneficial results. Considerable material came down in the early winter of 2001-02. Another problem area is in the Bk 57 area above Skutz Falls where the Sawdust Pile Pool cutoff channels (85A, 88A)) have eroded strongly and now (since 2/1991) carry the majority of the river's flow in a single channel. More material came down this winter- 2001- 02 (Rimmer, pers. comm.).**

NOTE: The sewage lagoons at Marchmont Road offer considerable potential to rear coho juveniles if BOD can be controlled. Conditions in the final pond may be acceptable. Coho juveniles crowd the discharge diffuser pipe in the Cowichan River and are a remarkable size. Conditions in at least the final pond should be investigated.

SIDECHANNELS

In terms of sidechannel opportunities, out of a total of 159 sidechannels, 72 have improvement potential in five categories (see **Burns, et. al. 1988).**

1. create semi-natural channel from relic
2. direct flow into sidechannel
3. increase habitat complexity
4. reduce flow in sidechannel
5. improve spawning habitat

Total enhanceable area is 242,622 m^2 and total species yield is estimated to be the following:

Coho 80,388 - 202,024 smolts
Chinook 25,069 smolts
Chum 56,214,500 fry

Estimates were not made for trout and steelhead but yield would be substantial.

Several sidechannels have been enhanced in recent years including Watercress West-Fallen Log Relic Channel - also known as Fin's (106R), Inside Relic (107R also known as Saysell's) Art Watson's Floodchannel (117F) and the Slot Run Relic Channel (Lamb's – 127R).

107R was excavated in 1991 after Outer Double D Sidechannel (97A) became the main channel of the Cowichan River following major floods in 1990 and 1991. The formerly 10-15 m wide channel widened to up to 150 m as it cut new ground. It still is. 107R was excavated as a bleed off channel to try and relieve winter flow pressure on 97A and draw some water back to the old channel, particularly in the summer. The diversion caused almost complete drying of 1700 m of the old channel as well as 397 m of Inner Double D Sidechannel. Juvenile losses were estimated to be over 100,000. Initial excavation was unsuccessful so the project was undertaken again in 1996 under a USHP grant to the Steelhead Society of B.C. This time the excavation was 2-3 m deeper to expose groundwater.

106R was developed in 1992 as another response to the loss of the old channel to Outer Double D. It involved 540 m of new channel to blend with the wetted portion of 106R and with channel 105R. This channel receives input from Watercress West Creek. The total complex is about 1500 m long. It carries winter flows ranging from about 1.0 to 3.0 CMS. Summer base flow is about .5 CMS. The inlet has to be excavated from time to time as a gravel berm builds. It was first done on August 4, 1996 and has been done several times since. CLSES usually co – ordinates this volunteer effort. The inlet is located 140 m down the Cowichan Footpath from the 70.2 trestle.

Art Watson's Floodchannel is an ongoing project by the Watson family. The channel has been hand excavated and the inlet berm strengthened. Nearby Art Watson's Creek (116R), a modified relic channel is another ongoing project of the Watson's. It consists of dug out ponds near the lower end and a partially excavated channel in the upper portion.

Inner Joginder's Active Channel (Giddes Creek)- 115A is another Upper Cowichan Sidechannel Complex that has received some enhancement effort in the form of substrate improvement. Boulders and cobbles have been moved to expose gravel in a number of areas and spawning gravel has been added. This channel receives as many as 400 coho and 50 chums.

In August, 1997, the Slot Run Relic Channel (Lamb's) – 127R was improved by excavation and installation of an inlet pipe from the mainstem.

The first Cowichan River sidechannel to be improved was Bonsall's Slough (23B). It was excavated to improve chum spawning and coho rearing in 1974. It now dries in summer and is in need of scarification and flow improvement. Rotary Park has also been improved (1977,1983,1987).

In 2000 and 2001, the four channels of the lower Cowichan Five Channel Project was undertaken. In 2000, an inlet control structure was added to John's Channel and substantial portions of the channel were deepened and a section was looped. Wally's Channel, a tributary relic channel was excavated. In 2001, Dyke Road Channel (Hatchery Creek0 was connected to Lower Major Jimmy's Channel which now contains permanent flow thanks to the work on John's Creek.

Tributary sidechannels on Robertson, Meade, Sutton and Nixon Creek have been developed.

STREAMS

A number of improvements have been carried out in the sub-basins (see tributary descriptions for more detail) Table 1;

TABLE 1: SUMMARY OF ENHANCEMENT ACTIVITIES UNDERTAKEN ON TRIBUTARIES TO 1998

NAME	YEARS	PROPONENT	ACTIVITY
Miracle Creek	1997	**CLSES**	**Spawning platform**
Swordfern Creek	1997	**CLSES**	**Spawning platform**
Sutton Creek	1996, 1999	**Hancock/,CLSES**	**Groundwater channels**
Nixon Creek	1996-1998	**TimberWest/DFO**	**Groundwater channel**
Beadnell Creek	1995-96	**CLSES, Valley Fish and Game**	**Barrier improvement**
Maple Flat Creek	1996	**Hancock**	**Rearing ponds**
Meade Creek	1995-96	**CLSES, Hancock**	**Rearing ponds**
Golf Course Creek	1995	**Hancock**	Headwater storage, rearing ponds
Tiny Creek	1994	**CLSES**	**Spawning platform, pool creation**
Robertson Blind Channel	1994	**CLSES, DFO**	**Groundwater channel**
Robertson Sidechannel	2000-01	**CLSES/FsRBC**	**Remove bedload to restore winter – spring flow**
Bings Creek	2000	**SMWS, MOE/Nature Trust**	**Restore channel and riparian condition**

Averill Creek	1999	**SMWS/FsRBC**	**Juvenile access improvement**
Oliver Creek	1999	**CLSES/FsRBC**	**Juvenile access improvement/LWD**
Garnett Creek	2000, 2001	**Fish First/FsRBC**	**Restore riparian condition, spawning habitat, LWD**
Norrie Creek	2000, 2001	**Fish First/FsRBC**	**Adult access, restore riparian**
Nixon West	1990	**TimberWest/MOE**	**Barrier improvement**
Holt Creek	1990	**Cowichan Fish and Game**	**Barrier improvement**
Lakehead Creek	1989	**CLSES, MOE**	**Spawning platforms**
Swampwater Creek	1989	**CLSES, MOE**	**Spawning platforms**
Beaver Creek	1983-1997	CLSES, DFO/MOE, USHP, Valley Fish and Game	Channel and substrate restoration, headwater storage, smolt release dam
Skutz East	1982	**MOE**	**Barrier improvement**
Bear Creek	1976	MOE	Barrier improvement

E) PROTECTION NEEDS

The Cowichan River Recreational Fishing Corridor was established in 1991 (Burns, 1991). The corridor also includes the river's FSZ. The Cowichan River's FSZ has two major components: riparian floodplain landscape units and steep adjacent slope landscape units. Because this river is so productive and has a very high degree of recreational use, it is recommended that as many corridor properties as possible be brought into the public trust. There is still a surprising amount of semi – wild land in the corridor outside of the Duncan – Lower Sahtlam North and Lake Cowichan areas. The next decade probably represents the last good opportunity to acquire this land for public values.

OPERATIONAL MANAGEMENT UNIT 5: COWICHAN SIDECHANNELS

OVERVIEW

There are 159 Cowichan River Sidechannels. They begin at Marriner's Pool on the North Fork and near Clem Clem Bridge on the South Fork and extend all the way up to Tony Green's near the east boundary of the Town of Lake Cowichan (Burns, et. al. 1988) The sidechannels provide important spawning, rearing and over wintering habitat for the river's trout and salmon and, perhaps more important, many provide cooling and cool water summer refugia to this river that becomes dangerously warm in many summers. There are four types of sidechannels:

FLOOD: Generally only carry water at high flows. Often far out in the floodplain and lack stability – limited fish habitat value.

BACK: Backwatered by the river. Generally wetted at all seasons but more so in the winter months. Often high value fish habitat particularly in winter when they provide an important element of stability.

ACTIVE: Usually flow all year and have more or less direct connection to the river, often groundwater influenced – almost always important fish habitat.

RELIC: Removed from river inundation except perhaps in special circumstances. Generally wetted by the winter water table and perhaps some upland seepage or runoff. Often have high potential for fish with modification.

GHOST: Channels that are far removed from the mainstem and are generally not wetted at all except perhaps by the water table in the wettest part of the year. Usually only evident in cleared land and often seen best from the air. Although ghost channels are present in the system, none have any practical enhancement potential and they are not included in this report.

LIMITING FACTORS

Primary factors limiting sidechannel production are stability, access and summer discharge. Secondary factors are habitat features such as spawning gravel and cover.

PRODUCTION OPTIONS

Of the river's 159 sidechannels, 81 provide opportunities to improve their capability – productivity for salmonids. These options are outlined in Table 1. More information is provided in a sidechannel catalogue (Burns, et. al. 1988) that can be provided on request. The catalogue features site maps and drawings of individual sidechannels along with more discharge data.

Table 1: Cowichan Sidechannel Production Options

No.	S.C. ID	Activity	Priority

99	5A	Excavate high spot	3
100	6R	Excavate, provide inlet	2
101	7A	Improve inlet	2
102,103	B8, ASF8, A11,ASF11,R 18, R19	Provide year round water, add habitat features	1
104	R9	Excavate	2
105	A10/1	Provide lateral access	2
106	FSF10	Infiltration pool	2
107,108	F13	Improve inlet or provide diversion	2
109	F14	Improve inlet via porous berm	2
110	F15	Diversion	1
111	F16	Connection to Fish Gut	1
112	B17	Connection to Fish Gut	1
113	R20	Excavate, inlet berm	2
114	F21	Buried drain	3
115	R22	Excavate, inlet berm	1
116	B23	Scarify, improve inlet	1
117	F26	Improve inlet	5
118	R27	Link to A28	2
119,120	A28	Improve inlets or deepen pools	2
121	A33	Improve inlet, raise berm, LWD	2
122	R34	Link with A35/1	2
123	A35/1	Improve inlet	1
124 ,125	B/35/2	Improve inlet	2
126	F36	Improve inlet	3
127	F38	Improve inlet	4
128	F39/1	Improve inlet	4
129	F41	Improve inlet	5
130,131	A42	Improve inlet	2
132	A45/2	Buried drain	2
133	R47	Excavate, provide berm	2
134	R48	Excavate, install inlet	2
135	F49	Excavate, berm, inlet	5
136	A50	Excavate	1
137	F52	Excavate, berm	4
138	F53	Excavate	4
139	R54	Excavate	4
140,141, 142	A55/2	Excavate, sp. pl.	2
143	F58	Excavate, inlet control	3
144	F59	Improve inlet	2
145	F64	Excavate, berm	4
146	A65	Improve inlet	3
147	F66	Excavate, berm	4
148	F67	Excavate, berm	4
149	R69	Spawning platforms	3
150	A72	Improve inlet	1
151	R73	Improve inlet	3
152	F76	Improve inlet	4
153	R77	Culvert installation	1
154	F79	Improve inlet, infiltration pool	4
155	R80	Improve inlet	3

156	F82	Improve inlet	3
157	A83	Improve inlet	1
158	F84/1	Improve inlet	4
159	F86	Infiltration pool	1
160	A90	Improve inflow	1
161	R103	Excavate, inf. pool	3
162	R104	Improve inlet	2
163	R105	Clean inlet annually	1
	R107	Done but periodic monitoring and maintenance required	2
164	A111	Excavate, imp. inlet	1
165	R112	Improve inlet, excavate	2
166	F113	Excavate, improve inlet	2
167, 168, 169	A115	Spawning platforms, beaver dam maintenance, LWD	1
170	R116	Extend inland	2
171	F117	Excavate, improve inlet	3
172	A118/1	Infiltration pool	2
173	R118/2	Buried drain	2
174	R120	Berm, excavate	2
175	R121	Improve inlet	2
176	R123	Excavate, improve inlet	3
177	R124	Excavate	3
178	R127	Done	1
179	R128	Excavate	2
81			

Side Channel I.D. tB1 Back Tidal MARRINER'S BACKCHANNEL (1)

Average Wetted Width (m)	15	% slough 100
Channel Width (m)	15.00	
Minimum Flow	Unknown	
Channel Length (m)	350.0	
Debris (%)	5	
Gradient	.01	
Elevation (m)	0	
Turbidity (cm)	nil	

Site Location: 150 m. below head Date: 87/6/12 Crew: TB Air Photo Location No. BCC 394 nos. 148,149
Weather: clear Air Temp. 25 Water Temp. 15 Access Tzouhalem Rd.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Possibility of wintering coho; coho rearing

Enhancement Assessment

No improvement required.

Side Channel I.D. tBsf1 Back Tidal LOG POND TIDE CHANNEL (2)

Average Wetted Width (m)	0 - 10	% Pool	0
Channel Width (m)	10.00	% Riffle	0
Minimum Water Flow Class	Unknown	% Run	0
Channel Length (m)	1100.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient Class	Unknown		
Elevation (m)	0		
Turbidity (cm)			

Site: Tzouhalem Rd. Date: 86/10/23 Crew: TB
Air Photo Location N.: BCC 394 no. 148,149 Weather: clear, cool
Air Temp. 10

Substrate Composition		Last Updated
		Updated By
Fines	9 %	
Gravel	1 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Transient use by chinooks and chums during estuarine phase. *Neomysis* are very abundant in Doman's log storage pond.

Enhancement Assessment

No evident improvement possibilities.

Side Channel I.D. tB2 Back Tidal NEAR PIMBURY (3)

Average Wetted Width (m)	4	% Pool	0
Channel Width (m)	15.00	% Riffle	10
Minimum Flow	Unknown	% Run	0
Channel Length (m)	210.0	% Glide	0
Debris (%)	20	% Slough	90
Gradient Class	Unknown		
Elevation (m)	0		
Turbidity (cm)			

Site Location: Near Outlet Date: 87/6/12 Crew: TB Air Photo Location No. BCC 394 Photo nos. 148,149
Weather: cloudy, mild Air Temp. 21 Water Temp. 15 Access: from dyke near Pimbury Bridge

Substrate Composition

Last Updated
Updated By

Fines	8 %
Gravel	2 %
Cobbles	0 %
Boulders	0 %
Bedrock	0 %
Compaction	H

Fish Utilization

No salmonids have been observed in this channel. It becomes very low during low tide and even dries in places in the summer. It carries more water in the winter and may support coho then.

Enhancement Assessment

No enhancement required.

Side Channel I.D. tBsf2 (4)	**Back Tidal**	**RODENBUSH TIDE CHANNEL**	
Average Wetted Width (m)	0 - 8	% Pool	0
Channel Width (m)	8.00	% Riffle	0
Minimum Flow Class	Unknown	% Run	0
Channel Length (m)	340.0	% Glide	0
Debris (%)	2	% Slough	100
Gradient Class	Unknown		
Elevation (m)	0		
Turbidity (cm)			

Site: near culvert Date: 86/10/23 Crew TB Air Photo Location no: BCC 394 no. 148, 149
Weather: clear, cool Air Temp.: 10 Access: Tzouhalem Rd.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Chum, chinook and coho fry/smolts find their way into this channel. Long-term use is doubtful with the possible exception of wintering coho.

Enhancement Assessment

No Improvement opportunities are evident.

Side Channel I.D. tF3 Flood Tidal FLOOD CHANNEL NEAR PIMBURY (5)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow Class	Unknown	% Run	NA
Channel Length (m)	160.0	% Glide	NA
Debris (%)		% Slough	NA
Gradient Class	Unknown		
Elevation (m)	0		
Turbidity (cm)			

Site Location: Date: 87/6/12 Crew: TB Air
Photo Location No. BCC 394 Photo Nos. 148,149
Weather: cloudy, warm Air Temp. 21 Access: from dyke near Pimbury bridge

Only wetted at high flows - high tides.

Substrate Composition		Last Updated
		Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None other than possible transient use by coho fry.

Enhancement Assessment

None evident

Side Channel I.D. tBsf3 Back Tidal SNOWBERRY TIDE CHANNEL (6)

Average Wetted Width (m)	0 - 8	% Pool	0
Channel Width (m)	8.00	% Riffle	0
Minimum Flow Class	Unknown	% Run	0
Channel Length (m)	840.0	% Glide	0
Debris (%)	15	% Slough	100
Gradient Class	Unknown		
Elevation (m)	0		
Turbidity (cm)			

Site: 150 m. above outlet Date: 86/10/23 Crew: TB Air Photo
Location No. BCC 394 Photo No. 148-149
Weather: clear, cool Access: Tzouhalem Rd.

Prior to dyking the North Fork, this channel carried North Fork overflow for several months(1978-1984). It is still wetted by the winter water table and has water of its own until May or June.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Possibility of wintering coho.

Enhancement Assessment

No evident improvement possibilities.

Side Channel I.D. tB4 Back Tidal PRIESTS' BACKCHANNEL (7)

Average Wetted Width (m)	30	% Pool	0
Channel Width (m)	30.00	% Riffle	0
Minimum Flow	tidal	% Run	0
Channel Length (m)	200.0	% Glide	0
Debris (%)	5	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near head Date: 87/6/12 Crew:TB Air Photo Location NO. BCC 394 Photo nos. 148,149
Weather: cloud and sun Air Temp. 25 Water Temp. 15 Access: Tzouhalem Rd.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho rearing and wintering

Enhancement Assessment

No improvement required.

Side Channel I.D. tBsf4 Back Tidal BLACKBERRY TIDE CHANNEL (8)

Average Wetted Width (m)	0 - 8	% Pool	0
Channel Width (m)	8.00	% Riffle	0
Minimum Flow	tidal	% Run	0
Channel Length (m)	220.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site: 50 m. above outlet Date: 86/10/23 Crew: TB Air Photo
Location no.: BCC 394 Photo No. 148,149
Weather: clear, cool Air Temp.: 10 Access: Tzouhalem Rd.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

No improvement possibilities

Side Channel I.D. A5 Active PRIESTS' MARSH (9)

Average Wetted Width (m)	30	% Pool	0
Channel Width (m)	100.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	1500.0	% Glide	0
Debris (%)	NA	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: 200 m. above outlet to back channel portion Date: 87/6/12 Crew: TB Air Photo Location No. BCC 394 Photo nos. 148,149
Weather: cloud and sun Air Temp. 22 Water Temp. 15 Access: Faint track from Tzouhalem Rd. through field

Not a true sidechannel; Best description: A backwater marsh- wet woodland complex, wetted mainly by the winter water table. This system is largely independent of river flow.

Substrate Composition		Last Updated Updated By
Fines	9 %	
Gravel	1 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho summer rear and over winter in the back channel portion. It's suspected that many also winter upstream in the marsh - wet woodland section of this complex. Holtby found densities of 6.18 Co/m^2 and .11 Ct/m^2 in Dec. 1986.

Enhancement Assessment

Dredging a high area about 200 m above the back channel may provide better egress for coho that might winter in the upper part of the complex (Burns, et. al. 1988)

Production Option # 99

Side Channel I.D. tBsf5 Back Tidal FAR FIELD TIDE CHANNEL (10)

Average Wetted Width (m)	0 - 10	% Pool	0
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	tidal	% Run	0
Channel Length (m)	155.0	% Glide	0
Debris (%)	15	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site: near Head Date: 86/10/23 Crew: TB Air Photo Location No. BCC 394
Weather: clear, cool Air Temp. 10 Water Temp. 12 Access: Boy's Rd. to hatchery then thru fields.

Tide channel wetted by tidal surge and depleted by tidal ebb. Some winter back flooding from the river.

Substrate Composition		Last Updated
		Updated By
Fines	9 %	
Gravel	1 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None other than the possibility of a few over wintering coho.

Enhancement Assessment

No improvement possibilities.

Side Channel I.D. R6 Relic BLOCKED RELIC CHANNEL (11)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	15.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	750.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient Class	.001		
Elevation (m)			
Turbidity (cm)			

Date: 87/8/8 Crew: TB Air Photo Location No. BCC 147,148
Weather: clear,hot Air Temp. 35 Water Temp. 20 Access:
Tzouhalem Rd., Quamichan Village Rd., Dyke Rd.

Wetted by winter water table.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None. Channel is inaccessible and does not hold water long enough to be a production factor.

Enhancement Assessment

If Black Creek could receive permanent flow, a diversion to this channel would be beneficial. The outlet requires a culvert under the dyke at the very least, this channel could winter coho fry.

Wetted area increase = 11,250 m^2
Yield Potential = 900 Co smolts

A drain under the upper dyke and some excavation of the upper channel area is also necessary.
Production Option # 100

Side Channel I.D. tBsf6/1 Back Tidal WHITEFACE TIDE-RELIC CHANNEL (12)

Average Wetted Width (m)	0 - 7.2	% Pool	0
Channel Width (m)	7.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	480.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient Class	.001		
Elevation (m)			
Turbidity (cm)			

Site: Central Date: 86/10/15 Crew: TB Air Photo Location No.: BCC 394 Photo nos. 148,149
Weather: clear, cool Air temp. 10 Access: cattle trails from Tzouhalem Rd.

Wetted by tidal surge and winter back flooding; otherwise dry and almost always dry in the upper 200 m. which is relic and somewhat dyked.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

No viable enhancement options.

Side Channel I.D. tRsf6/2 Relic Tidal (13)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	0.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	0.0	% Glide	NA
Debris (%)	0	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Substrate Composition		Last Updated
		Updated By
Fines	%	
Gravel	%	
Cobbles	%	
Boulders	%	
Bedrock	%	
Compaction		

Fish utilization

Enhancement Assessment

Side Channel I.D. A7 Active QUAMICHAN VILLAGE SIDECHANNEL (BLACK CREEK) (14)

Average Wetted Width (m)	4.76	% Pool	0
Channel Width (m)	15.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	400.0	% Glide	0
Debris (%)	1	% Slough	100
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near outlet Date: 87/7/24 Crew: TB Air Photo
Location No. BCC 394 135,136
Weather: cloudy, isolated showers Air Temp. 22 Water Temp. 21
Access: Tzouhalem Rd., Quamichan Village Rd., Dyke Rd.

A major sidechannel that I thought never dried. It was flowing at .3 cms at minimum river flow in 1986. Either its inlet berm increased in elevation and compaction last winter (unlikely) or recent high evapotranspiration (ETP) has caused abnormal drying.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	8 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho and chums spawn in this channel along with occasional steelhead and chinooks. Coho likely over winter; steelhead may too. Chum and chinook fry and coho and steelhead smolts leave well before drying but some coho fry are trapped, mainly in the large pool. They probably survive.

1986 fry densities(from Holtby, Pers. Comm)
21/8/86 Co 1.179 Rb .019
16/12/86 Co .014 Ct parr .004

Enhancement Assessment

Permanent wetting could easily be provided with a French Drain or buried waterline and some excavation.

Wetted area increase = 5190 m^2
Yield potential = 1660 Co smolts

Production Option # 101

Side Channel I.D. Fsf7 Flood SOUTH FORK BAR FLOOD CHANNEL (15)

Average Wetted Width (m)	0 - 0.17	% Pool	100
Channel Width (m)	7.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	100.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site: South Fork Bar Date: 87/6/12 Crew: TB Air Photo
Location No.: BCC 394 Photo Nos. 148,149
Weather: cloudy, warm Air Temp.: 21 Water Temp.: 21 Access:
North Fork Dyke

Three pools remain: 1x5, 1x2, 2x5 = 17m^2 . The bar and channel are inundated in high flows.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

This channel is inundated in high flows and dries quickly with falling river levels; it doesn't attract many fish. A few coho and chum fry may be trapped in some years.

Enhancement Assessment

No improvement possible.

Side Channel I.D. B8 Back MAJOR JIMMY'S SIDECHANNEL (16)

Average Wetted Width (m)	6.8	% Pool	38
Channel Width (m)	14.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	583.0	% Glide	0
Debris (%)	2	% Slough	62
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		
Compaction	L		

Site Location: 600 m. above confluence Date: 87/7/30 Crew: TB
Air Photo Location No. BCC 394 135,136
Weather: mostly cloudy Air Temp. 17 Water Temp. 15 Access: off Dyke Rd. from Boys Rd.

MAJOR JIMMY'S SLOUGH

	Channel width	Wetted width	Substrate	Slope	Con.	SC	LWD	Length	Wetted area
R1	15	13	9100	.1	FC	L	L	298	3874
R2	13	8	6400	.5	FC	L	L	40	320
R3	9	9	8200	.1	CON	N	L	168	1512
R4	9	8	3700	.3	FC	L	L	184	1472
R5	13	0	3700	.2	FC	L	L	210	0

Note: R5 is located above John Charlie's Creek confluence

Fish Utilization

Coho and chum spawning, steelhead also said to spawn here. Coho rearing and over wintering.

Upper Site	Sept. 17/86	Co 14/m^2
		St/Ct 3.1/m^2
	Dec. 9/86	not calculated
Lower Site	Sept. 17/86	Co 2.62/m^2
		St/Ct .18/m^2
	Oct. 9/86	Co .27/m^2
		St/Ct .02/m^2

Enhancement Assessment

Part of the Lower River South Side Complex. Which is sometimes called Five Channels. By providing additional summer flow at its uppermost point (Silver Bridge Relic Channel), 45,932 m^2 more summer wetted area would result in the six channels that make up the complex. Major Jimmy's would gain 8692 m^2
Fry salvage required **(FS1)**

Note: As of the early 1990's, Major Jimmy's is summer wetted via John Charlie's Creek. Freshwater Farms hatchery effluent water enters Upper John Charlie's providing a base flow of approximately 50 LPS to both John Charlie's and Major Jimmy's (lower 690 m).
Note: In the late summer of 2000, Cowichan Tribes provided an intake to the Cowichan River at an upper branch channel of John Charlie's Creek. This is further assures that the lower four reaches of major Jimmy's will be summer wetted.
Production Option #102

Side Channel I.D. Asf8 Active DUCKWEED ACTIVE CHANNEL(17)

Average Wetted Width (m)	11	% Pool	90
Channel Width (m)	15.00	% Riffle	10
Minimum Flow	0	% Run	0
Channel Length (m)	785.0	% Glide	10
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Central Date: 87/8/10 Crew: TB Air Photo Location No. BCC 394 Photo Nos. 147,148
Weather: clear, hot Air Temp.: 35 Water Temp.: 17 Access: Boys RD., Dyke Rd. to hatchery then drive along field edge

Substrate Composition		Last Updated Updated By
Fines	5 %	
Gravel	5 %	TB 9/99
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho and chum spawning, coho rearing and wintering. Heavy chum spawning in some years. Seined in a 277 m^2 section above small road crossing 9/28/99. Coho density was .115/m^2. This figure likely under represents density because there was escape habitat that couldn't be sampled well. Mean size was 78 mm. Flow was 204 LPS and temperature was 11.5.

Wetted By:

1. Winter water table;
2. Seepage from Major Jimmy's via Dyke Road (Hatchery Creek).
3. Hatchery effluent(summer flow is greatly reduced when the hatchery is not operating)
4. Back flooding especially during high flow-high tides

Enhancement Assessment

Part of the South Side Sidechannel Complex often termed Five Channels(lower river). By providing flow at the head of the Silver Bridge Relic channel, 45,932 m2 of additional summer wetted area could result; Duckweed would add 3140 (PO 102). In recent years, (after 1999) summer flow has been reduced in the South Fork. This option will improve low flow conditions there.
This improvement is discussed in more detail on 19R
LWD is also sparse and judicious placement could aid production (PO 103).

Production Option s # 102 and # 103

Side Channel I.D. R9 Relic RELIC COMPLEX ON MAJOR JIMMY'S ISLAND (18)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	7.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	1000.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.001		
Elevation (m)			
Turbidity (cm)			

Site Location near head of main channel Date: 87/8/9 Crew: TB
Air Photo Location No. BCC 394 135,136
Weather: clear,hot Air Temp. 34 Access: Boy's Rd., Cross MVR.
Jimmy's Slough @ Dyke Rd. access, bushwhack true north

Wetted by:
1: Back flooding(lower 200 m.)
2: Winter water table
3: Occasional spill from the mainstem in large floods

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho over wintering and spring rearing.

Enhancement Assessment

Excavation from the mainstem could result in permanent flow which would benefit coho and chum salmon. Chinook rearing should also benefit

Wetted area increase	=7000 m^2
Yield potential	= 2240 Co smolts
	= 1120 ch smolts
	3 500 000 Cm fry

Production Option # 104

Side Channel I.D. Bsf9 Back BIFURCATION BACKCHANNEL (19)

Average Wetted Width (m)	4	% Pool	0
Channel Width (m)	6.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	150.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient	.001		
Elevation (m)			
Turbidity (cm)			

Date: 87/6/12 Crew: TB Air Photo Location No.: BC 394 Photo nos. 148, 149
Weather: cloudy, warm Air Temp. 21 Water Temp. 10 Access
Off end of dyke
Tidal

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho rearing and wintering

Enhancement Assessment

No improvement required

Side Channel I.D. A10/1 Active ROTARY PARK ACTIVE CHANNEL (20)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	5.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	600.0	% Glide	NA
Debris (%)	1	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: First bridge Date: 87/7/30 Crew: TB Air Photo Location No. BCC 394 136,137
Weather: clear, warm Air Temp. 26 Access: Dobson and McKinstry Roads.

This assessment provides before and after data on this channel which was deepened and slightly widened late this summer (1987) as dyking mitigation. 3000 m^2 of permanent habitat was gained in Rotary Park Channel along with approximately 9600 m^2 in Fish Gut Alley. Rotary Park was also excavated slightly in 1973 (Lill, et. al. 1975), 1977 and 1983.

Substrate Composition		Last Updated	Date	Temp.
		Updated By	8/26/99	17.9
Fines	2 %			
Gravel	7 %			
Cobbles	1 %			
Boulders	0 %			
Bedrock	0 %			
Compaction	L			

Fish Utilization

Coho and chum spawning. Prior to enhancement, 1000-5000 coho were trapped and required salvage (Burns et. al. 1987, Elliot, 1987)
Coho also over winter in this channel. 10,579 smolts were produced in 1976 and 19,121 in 1975 (Armstrong and Argue, 1975; Argue et. al. 1979). However, most probably came from the pond and below which is Fish Gut Alley.
Large numbers of steelhead juveniles winter in Rotary Park and cutthroat trout are also present.
Winter water temperatures are surprisingly high (up to 14 degrees). It appears that summer river water slowly seeps into the channel and that there is a lag time of several months. Summer temperature is usually 16 – 19 degrees.
Coho Escapement: 1977 719, 1989 242, 1990 553, 1991 155, 1992 69, 1993 111, 1994 69,1995 10, 1996 31.
Sockeye salmon also utilize the channel in some years. It appears that some Cowichan Lake kokanee smolt to produce a small return of sockeye adults. When they return to the river in the early fall, temperatures are high (often around 20 degrees). It is thought that these fish enter Fish Gut Alley by default to escape the high river temperatures.

Enhancement Assessment

Summer wetted area has been increased by 8750 m^2 by deepening Rotary Park Channel. The last excavation occurred in 1987. The channel now dries or withdraws to standing water pools above the pond – excavation is required again. However, in relatively moist summers following winters of high precipitation (like the summer of 1999), the channel stays wetted and productive to within 10 m of McKinstry Road. Fry salvage is also necessary in most summers**(FS2)**

The possibility of providing lateral access from the river for over wintering coho should be investigated. Dyke construction cut off two channels that linked Rotary Park with the mainstem. There is evidence that the culverts at the outlet of Rotary Park Pond are restricting juvenile coho upstream access**. Production Option # 105**

Side Channel I.D. F10/2 Active INNER FISHGUT ALLEY ACTIVE CHANNEL (21)

Average Wetted Width (m)	0 - 2	% Pool	62
Channel Width (m)	10.00	% Riffle	12
Minimum Flow	.019	% Run	0
Channel Length (m)	1200.0	% Glide	26
Debris (%)	5	% Slough	0
Gradient .	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/8/8 Crew: TB Air Photo Location No. BCC 394 137,138
Weather: clear, hot Air Temp. 33 Access: Marchmont Rd., sewage lagoons dyke. Water temp. 18.

Substrate Composition		Last Updated 8/26/99 Updated By TB	Date	Temp.
				8/26/99 14.5
Fines	3 %			
Gravel	6 %			
Cobbles	1 %			
Boulders	0 %			
Bedrock	0 %			
Compaction	L			

Fish Utilization

Coho and chum spawning. Coho rearing and overwintering. Rainbow and cutthroat trout are present and steelhead spawning occurs. Early rearing chinook fry enter this channel.

Enhancement Assessment

Summer wetted area has been increased by 9600 m^2 by deepening Rotary Park Channel. Minimum summer discharge has increased by .702 cms. No further improvement required.

Side Channel I.D. Fsf10 Flood BIFURCATION FLOOD CHANNEL (22)

Average Wetted Width (m)	0 - 2.06	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	150.0	% Glide	0
D			
debris (%)	2	% Slough	0
Gradient Class	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Central Date: 87/6/12 Crew: TB Air Photo
Location No. BC 394 Photo nos. 148,149
Weather: cloudy. warm Air Temp. 21 Water Temp. 14 Access
Off dyke from Pimbury or wade river

Three pools remain: 10 m^2, 200 m^2 and 100m^2

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawn in this channel and attempt to rear in it. Wetted area is drastically reduced when mainstem flows fall to summer levels. Many fry are lost during this period.

Enhancement Assessment

Excavation of a deep pool near the inlet and periodic dredging of the lower channel would provide permanent wetting

Wetted area increase	= 855 m^2
Yield potential	= 273 Co smolts

Production Option # 106

Side Channel I.D. A 11 Active JOHN'S CREEK (23)

Average Wetted Width (m)	5	% Pool	39
Channel Width (m)	6.00	% Riffle	10
Minimum Flow	0	% Run	0
Channel Length (m)	1600.0	% Glide	20
Debris (%)	10	% Slough	31
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Behind John Charlie's Date: 87/6/29 Crew: TB
Air Photo Location No. BCC 394 146, 147
Weather: clear, warm Air Temp. 26 Water Temp. 16.5 at Rd.Xing, 22.5 in slough section
Access: Road from JC's via Boy's Rd.

Wetted by:

1. Winter-spring water table
2. Spill from the trailer park ponds at mainstem flows greater than 60 cms.
3. Under the dyke seepage via Relic Channels such as Wally's
4. As of early 1990's, via effluent from Freshwater Hatchery which supplies an average base flow of about 50-60 LPS.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	8 %	TB 9/99
Cobbles	0 %	TB 9/26/00
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho and chum spawning; considerable coho wintering and spring rearing in some years. Access may be limited at times by marginal connection with Major Jimmy's. The lower sections of Johns Creek have been excavated on occasion to facilitate access but are subject to plugging due to lack of flushing. Major backhoe work may be required to guarantee access.
Lower John Charlie's was seined on 9/27/99 (126 m^2). Coho density was 1.52/m^2, mean size was 65 mm.

Enhancement Assessment

This channel, in combination with the Trailer Park Ponds, Major Jimmy's Slough, Dyke Rd. and Duckweed Sidechannels has the greatest enhancement potential in the system. If .1 cms could be introduced at the Silver Bridge Relic Ch, 45,932 m^2 would be enhanced in this complex.
Releasing effluent from Vancouver Island Hatchery (.07 cms, 10 degrees) would also provide considerable benefit by moderating temperature. It reaches 23 degrees in Johns Creek (R2 slough section) which would benefit by 6400 m^2.
Accessing at least one relic-flood channel connector (see plan view in sidechannel catalogue) may help coho find this channel in winter and add 1200 m^2 of summer-wetted area. This would require an open or controlled drain under the dyke. NOTE: Done by excavating Wally's Channel (8/2000). This was PO # 102.

JOHN'S CREEK UPDATE
The following table represents the new configuration of John's Creek as of September 2000. A relic section of Upper John's (R6) was connected to the Cowichan River via a 25 inch pipe with a gate valve. The pipe extends 5 m out into the river and is some 40 cm below its surface at low water. In addition to adding river water, Wally's Channel, a 308 m relic lateral connector channel between John's and the Cowichan River was excavated to a depth of 1 – 1.5 m which resulted in a mean depth of standing water of about .65 m at low water. An extra link channel 235 m long was also constructed between Wally's and John's.

JOHN'S

	Cw	Ww	Sub	Slope	Con	SC	LWD	L	Wa
R1	9	9	6400	.5	FC	L	.0027	244	2196
R2	23	18	1000	.001	UC	N	.008	416	7488
R3	16	15	8200	.1	FC	L	.0048	208	3120
R4a	6	6	9100	.1	FC	L	.039	97	582
R4b	5	5	5500	.6	FC	L	.045	97	485
R5	10	8	8200	.1	FC	L	.008	462	3696
R6	6	5	5410	.5	CON	N	.169	190	950
Tot								1714	18517

190 m (R6) is new channel and 316 m of John's in R5 was modified by deepening and widening it somewhat. Therefore the modified channel total is 1049 m. 190 new in John's, 316 modified in John's, 308 new wetted in Wally's and 235 new in John's new link to Wally's.

WALLY'S

	Cw	Ww	Sub	Slope	CON	SC	LWD	L	Wa
R1	10	10	8200	.01	CON	N	.020	93	930
R2	10	10	9100	.01	FC	L	.110	215	2150
Link	7	4	4600	.5	CON	N	.032	235	940

NEW TEMPERATURES AND FLOWS

LOCATION	Temp.	Flow	Date
Lower John's below Wally's	16	690 LPS	9/26/00
Wally's R2	19.5	Standing water	9/26/00
Wally's R1	17	253 LPS	9/26/00
Upper John's R6	17	276 LPS	9/26/00

This upgrade was termed 4 Channels and was financed by FsRBC and administered by Cowichan Tribes (Cheri Ayers, RPBio). It was called 4 Channels as opposed to the 5 Channels (or South Side Combo) proposal which included Silver Bridge Sidechannel and Trailer Park Ponds Sidechannel. The Silver Bridge Sidechannel Link would require boring under the highway and is judged to be too expensive. The owner of the Trailer Park Ponds would not agree too restoration of that channel and including it in the linked channels project. The channels effected by the present project include John's, Wally's and Major Jimmy's.

Production Options # 102, 103 (LWD was also added)
Part of Southside Combo or Five Channels

Side Channel I.D. Asf11 Active DYKE ROAD ACTIVE CHANNEL (Hatchery Creek or Hatchery Channel)) (24)

Average Wetted Width (m)	0 - 0	% Pool	NA
Channel Width (m)	5.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	610.0	% Glide	NA
Debris (%)	10	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Central Date: 87/8/8 Crew: TB Air Photo
Location No. BCC 394 Photo Nos. 147,148
Weather: clear,hot Air Temp. 34 Access: Dyke Rd.
Wetted by winter water table and seepage from Major Jimmy's Slough. Prior to this summer (1999), I had never seen the channel dry; stagnant appearing and intermittent but more wet than dry. High FE content in area. Flow influenced by tides.

Substrate Composition		Last Updated Updated By
Fines	5 %	
Gravel	5 %	TB/8/99
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho and chum spawning, coho rearing (spring, early summer) and overwintering. Many coho densities are as high as $7/m^2$ in this channel and salvage is required **(FS3)**.
Possible Yield: 21,350

Note: September 1999: Doug Millard of the hatchery said that the crew doesn't salvage Dyke Road Channel any more – very few fry are present now. He said an occasional coho pair may still spawn in the channel but fry numbers are very low. Checked the channel with Cowichan Fisher's Co-op on Sept. 28, 1999: stagnant, intermittent water – no fry.

Enhancement Assessment

Part of the South Side Sidechannel Complex that could be wetted from the top end: six channels would benefit John's Creek and Major Jimmy's are now wetted by Freshwater Farms effluent in the summer (and as of August 2000, an intake from the Cowichan River at Upper John's Creek) # (102). A culvert between Major's and Dyke Road would provide summer wetting in the order of 50 LPS (# 106)
LWD placement would also aid production and it may also be of benefit to excavate some of Upper Dyke Road Channel to a small degree (.5 m) (#103). **Note:** Channel connected to Major Jimmy's with a gate valve culvert (1 m) in 2001. Channel length extended by 68 m (road moved) and 109 pieces of LWD added to new section. Flow: .326 cms 1/20/02 @ river disch. 84 cms.

Production Option # 102 , # 103. Part of Southside Combo (5 Channels)

Side Channel I.D. F12 Flood JOHN'S FLOODCHANNEL (25)

Average Wetted Width (m)	6.6	% Pool	60
Channel Width (m)	8.00	% Riffle	5
Minimum Flow	0	% Run	0
Channel Length (m)	138.0	% Glide	0
Debris (%)	0	% Slough	35
Gradient	.8		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Central Date: 87/6/28 Crew: TB Air Photo Location No. BCC 394 146,147
Weather: clear, warm Air Temp. 27 Water Temp. 24.5 in int. pools, 18 in backwater Access: along dyke via John Charlie's Rd.

Coho, chinook and chum fry are highly attracted to this channel because its backwater section provides refuge in an area where there is little. Chinooks and chums leave before the pools close but many coho are trapped. 6000 were salvaged on June 25, 1987. 1999 Note: a large log jam has formed on the bar on the outside of this channel.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	8 %	TB 9/99 (log jam note)
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, chinook and chum fry are attracted to this channel's backwater section because it provides refuge in an area where there is little. Chinooks and chums usually leave before the pools close but many coho are trapped. 6000 were salvaged on June 25, 1987.

Enhancement Assessment

No enhancement necessary or possible. Annual fry salvage required**(FS4)**

Side Channel I.D. F13 Flood OUTER FISH GUT ALLEY FLOODCHANNEL (26)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	300.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/5/24 Crew: 23 Air Photo
Location No. BCC 394 035,036
weather:clear,warm Air Temp. 23 Access Trunk Rd., Marchmont
Lagoon Rd., Fish Gut Connector

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	4 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho and chum spawning, early chinook and coho rearing. 1000-3000 fry are trapped and require salvage**(FS5)**.

Enhancement Assessment

Construction of an improved berm and buried drain could provide permanent flow. This channel is readily accessible and a good one to test improvement methods **Production Option # 107**
Another possibility is diversion from Inner Fish Gut which can
now afford to lose some flow **Production Option # 108**

Wetted area increase	= 2400 m^2
Yield potential	= 768 Co smolts

Side Channel I.D. F14 Flood FISH GUT ALLEY CONNECTOR FLOODCHANNEL (27)

Average Wetted Width (m)	2	% Pool	100
Channel Width (m)	5.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	190.0	% Glide	0
Debris (%)	1	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/4/2 Crew: TB Air Photo Location No. BCC394 135,136

Substrate Composition: A thin veneer of gravel over clay.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, chinook and chum fry find their way into this channel and become trapped requiring salvage. 500 chums and 25 chinooks were taken on April 2, 1987. However, recent cat work has filled the pools; future salvage may not be necessary because of this and the possibility of permanent flow.

Enhancement Assessment

If permanent flow can be achieved in outer Fish Gut, the same can be done for this channel with the installation of a porous inlet berm of 20 to 30 cm diameter angular rock. The present berm is too unstable to control high flows **Production Option # 109**

Wetted area increase	= 950 m^2
Co smolt yield potential	= 76

Side Channel I.D. F15 Flood FISH GUT ALLEY SPILL CHANNEL (28)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	220.0	% Glide	NA
Debris (%)	15	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/4 Crew: TB Air Photo Location No. BC394 136,137
Weather: clear, warm Air Temp. 25 Access: McKinstry Rd.,Dyke

A former spill channel from Rotary Park Pond, Fish Gut Alley. Its now cut-off by the dyke. Water flowed into and out of the pond via this channel and some upstream connectors. Flow began when mainstem discharge surpassed 50 cms measured at Lake Cowichan. The channel still flows but it's lost its connection with Rotary Park Pond. It still connects with Fish Gut Alley 5 m.
below the Rotary Park Pond outlet culverts when mainstem flows are above 93 cms. measured at station 08HA002 (Lake Cowichan).
Upstream fry passage is questionable due to culvert velocities.

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	4 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Chum spawning in years of high return-adequate flow. 276 chum carcasses were counted in 1988. All eggs were probably lost because the channel was dry most of the incubation period. However, the major function of this channel may have been to provide access to Rotary Park Pond for wintering salmonids - especially coho. 10,599 to 18,928 coho smolts were trapped below the pond in the late 1970's (Argue,et.al 1979).

Enhancement Assessment

Diversion from Fish Gut Alley could provide permanent wetting. It may be most appropriate to provide winter water only for chum spawning and incubation. Fish Gut Alley is better rearing habitat. However, this channel may have provided over wintering coho and trout important access to Rotary Park-Fish Gut Alley **Production Option # 110**

Increased wetted area	= 2200 m^2
Potential	= 1,100,000 Cm fry

Side Channel I.D. F16 Flood BATHTUB OUTLET CHANNEL (29)

Average Wetted Width (m)	2	% Pool	100
Channel Width (m)	5.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	60.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Central Date: 87/10/10 Crew: TB Air Photo
Location No. BCC 394 136,137
Weather: clear, warm Air Temp. 20 Water Temp. 14 Access:
Trunk Rd, McKinstry Rd., Dyke, short spur Rd., path

A flood channel in technical terms but also wetted by the winter water table, back flooding and lateral percolation through the bar.

Substrate Composition		Last Updated Updated By
Fines	5 %	
Gravel	5 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho rearing and wintering. Coho fry that enter the channel become trapped by June; they number 100-200 and must be salvaged. Salvage conditions are difficult because of debris and vegetation **(FS6).**

Enhancement Assessment

Connection Bathtub to Fish Gut Alley would provide permanent flow

Wetted area increase	= 300 m^2
Yield potential	= 108 Co smolts

Production Option # 111

Side Channel I.D. B17 Back BATHTUB BACKCHANNEL (30)

Average Wetted Width (m)	5	% Pool	0
Channel Width (m)	6.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	100.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient	0		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Head Date: 87/8/8 Crew: TB Air Photo
Location No. BCC 394 136,137
Weather: clear,hot Air Temp. 35 Water Temp. 20 Access: Trunk Rd., McKinstry Rd., Dyke, short spur Rd and path

Wetted by the winter water table and mainstem back flooding during high flows; possibility of some lateral infiltration from the river at high discharge.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho fry rearing and wintering. Fry become trapped when outflow ceases in early summer. Although the channel remains wetted over the summer, it becomes shallow and warm. No coho fry survive this period and salvage is required. Numbers range between 600 and 1200 based on early May densities of 1-2 fry/m^2 **(FS7)**

Enhancement Assessment

Excavation of a connector channel to the mainstem of Inner Fish Gut active channel would provide replenishment water and insure survival of coho fry. Very little diversion would be required. This would be far better than salvage because salvage is very difficult in this channel due to the presence of escape cover, algae, debris and sediment.

Wetted area increase = 600 m^2
Yield potential = 192 Co smolts

Production Option # 112

Side Channel I.D. R18 Relic TRAILER PARK PONDS (31)

Average Wetted Width (m)	15	% Pool	0
Channel Width (m)	18.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	782.00	% Glide	0
Debris (%)	2	% Slough	100
Gradient	.001		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/8/9 Crew: TB Air Photo Location No.BCC 145,146
Weather:clear, hot Air Temp. 35 Water Temp. 23 Access: Boys Rd.

Substrate Composition		Last Updated Updated By
Fines	7 %	Three reaches:
Gravel	3 %	1. 20 (18) CON .001 9100 lower fence to mid – road culvert
Cobbles	0 %	2. 18 (15) CON .001 7300 mid – road culvert to old dam
Boulders	0 %	3. 20 (15) OC .001 1000 riparian forest portion
Bedrock	0 %	
Compaction	L	

Fish Utilization

Occasional coho and chum spawning and coho rearing and wintering. Nearly all summer rearing coho are lost to predation or inhospitable conditions (Burns, 1982). Occasional large chum escapement prior to Trailer Park establishment, owner dislikes carcasses and smell. Fish access is now cut – off (2000).

Enhancement Assessment

Part of the Lower River South Side Sidechannel complex which comprises six sidechannels. Addition of summer water at the head of Silver Bridge Relic would add 45,232 m^2 to the base wetted area, an increase of 158%

This sidechannel would gain 2700 m^2. However this figure is misleading because the present residual wetted area is not habitable due to stagnation. A better estimate is 18,200.

Note: Cowichan Tribes/DFO (Michelle Bigg) surveyed the trailer park residents in 1999. They were in favour of the channel being re-connected but the owner was not. The ownership of the property is being contested and the owners said the residents didn't like the smell of dead fish.

Production Option # 102, 103

Part of Southside Combo (5 Channels)

Side Channel I.D. R19 Relic SILVER BRIDGE RELIC CHANNEL (32)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	14.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	325.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 100m below head Date: 87/1/20 Crew TB Air
Photo Location No. BCC 394 138,139

Part of an extensive sidechannel system that was cut-off in the 1950's by construction of the present Island Highway. Since then, its been further isolated by dyking. The channel is now only sporadically wetted by the winter water table. It is the uppermost of Five Channels but if it was used to access water, the highway would have to be bored (1995 cost est: $80,000)

Substrate Composition		Last Updated
		Updated By
Fines	4 %	
Gravel	5 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

None

Enhancement Assessment

Introducing water at the channel head would increase downstream wetted area by the following amounts in the Lower River South Side Sidechannel Complex:

1. Silver Bridge Relic (19R) 4550 m^2
2. Trailer Park Slough (18R) 18200
3. John's Creek (11A) 7600
4. Major Jimmy's (8B) 8692
5. Dyke Road (sf11A) 3050
6. Duckweed (sf8A) 3140

Total = 45,232 m^2
Yield potential = 14,698 co smolts

Production Option # 102
Top End of Southside Combo (5 Channels)

Side Channel I.D. R20 Relic RELIC CHANNEL ABOVE BLACK BRIDGE (INSIDE) (33)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	14.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	500.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 150 m. below head Date: 87/1/20 Crew: TB Air
Photo Location No. BCC394 138,139
Access: Allenby or Trunk Rds. to IR Rd.

Substrate Composition		Last Updated Updated By
Fines	4 %	
Gravel	5 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

None

Enhancement Assessment

Good potential for a chum spawning channel width an length are not limited to present dimensions but have been utilized to calculate yield. Complete excavation up to the inlet berm is necessary.

Wetted area increase	= 7000 m^2
Yield potential	= 3,500,000 cm fry
	= 2240 co smolts
	= 1120 ch smolts

Production Option # 113

Side Channel I.D. F21 Flood GARBAGE BEND FLOOD-BACK CHANNEL (34)

Average Wetted Width (m)	0	% Pool	0
Channel Width (m)	5.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	84.0	% Glide	0
Debris (%)	30	% Slough	100
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/10/8 Crew: TB Air Photo Location No. NA
Weather: clear, cool Air Temp. 18 Water Temp. 15 Access: Boys Rd., E & N Rail.

This channel is as much a back channel as it is a flood channel.

Substrate Composition		Last Updated Updated By
Fines	%	
Gravel	%	
Cobbles	%	
Boulders	%	
Bedrock	%	
Compaction		

Fish Utilization

Chance of coho over wintering in back channel portion. A few coho also summer rear in this segment.

Enhancement Assessment

A buried drain could be installed below the inlet berm to provide year round flow.

Wetted area increase	= 290 m^2
Yield potential	= 104 Co smolts

Production Option # 114

Side Channel I.D. R22 Relic RELIC CHANNEL ABOVE BLACK BRIDGE (OUTSIDE) (35)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	920.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/1/20 Crew: TB Air Photo Location No. BCC 394 138,139

Access: Allenby or Trunk Rds. to IR Road

Substrate Composition		Last Updated Updated By
Fines	4 %	
Gravel	5 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

None

Enhancement Assessment

Good potential for a chum spawning channel. Length and width are not limited to channel dimensions. The floodplain lobe here is approximately 7.5 hectares and offers perhaps half that area as potential chum spawning area. Complete excavation up to the inlet berm is required.

Wetted area increase = 2560 m^2
Yield potential = 1,280,000 Cm, 816 Co, 409 Ch

Production Option # 115

Side Channel I.D. B23 Back BONSALL'S SLOUGH (36)

Average Wetted Width (m)	14	% Pool	0
Channel Width (m)	15.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	200.0	% Glide	0
Debris (%)	2	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/5/24 Crew: TB Air Photo Location No. BCC 394 139,140
Weather: clear Air Temp. 22 Water Temp. 15 Access: Indian Rd., Side Rd.

Wetted by winter water table and percolation through the bar.

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	4 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Chum spawning, coho wintering.

Enhancement Assessment

Scarification and inlet maintenance required periodically. If enough flow could be provided to flush the channel, 4155 m^2 of chum spawning habitat would result. If some flow persisted through the summer, so could coho fry. Most leave the channel by May.

Yield potential = 2,077,500 cm fry
= 1,329 coho smolts
Construction of a more porous inlet system (French drain?) is required.

Production Option # 116

Side Channel I.D. F24 Flood FLOOD CHANNEL BELOW S POOL (37)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	135.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Near Inlet Date: 87/5/16 Crew: TB Air Photo Location No. BCC 394 141
Access: rough rd. from Indian Rd., wade river

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

None

Enhancement Assessment

No enhancement potential.

Side Channel I.D. F25 Flood S POOL FLOODCHANNEL (38)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	113.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/9 Crew: TB Air Photo Location No. BCC 394 141
Weather: clear, hot Air Temp. 34 Access: Rough Rd. from Indian Rd.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	8 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Possibility of chum spawning.

Enhancement Assessment

No opportunities for improvement are present.

Side Channel I.D. F26 Flood REDBONE FLOODCHANNEL (39)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	3.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	98.0	% Glide	NA
Debris (%)	15	% Slough	NA
Gradient	0		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/5/16 Crew: TB Air Photo
Location No. BCC 404 036,037
Access: Riverbottom Rd.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

A few coho fry enter the channel in April

Enhancement Assessment

Installation of a drain under the berm could provide permanent flow.

Wetted area increase	= 294 m^2
Yield potential	= 23 Co smolts

Production Option # 117

Side Channel I.D. R27 Relic RELIC CHANNEL NEAR BAHR POOL (40)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	4.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	320.0	% Glide	NA
Debris (%)	10	% Slough	NA
Gradient .	01		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/8 Crew: TB Air Photo Location No. BCC 404 036,037
Weather: clear, hot Air Temp. 34 Access: wade river or hike
Footpath from Holt Creek

This channel may not dry every year.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho wintering and spring rearing.

Enhancement Assessment

It may be possible to link this channel with Bahr Pool active channel.

Wetted area increase	= 1600 m^2
Yield potential	= 512 Co smolts

Production Option # 118

Side Channel I.D. A28 Active BAHR POOL ACTIVE CHANNEL (TWIN CREEKS) (41)

Average Wetted Width (m)	4	% Pool	54
Channel Width (m)	16.00	% Riffle	32
Minimum Flow	.079	% Run	0
Channel Length (m)	370.0	% Glide	14
Debris (%)	2	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/8/8 Crew: TB Air Photo Location No. BCC 404 036,037
Weather: clear, hot Air Temp. 32 Water Temp. 17-21.5 Access: Cowichan Footpath from Holt Cr. or wade river

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, steelhead and chum spawning; coho summer rearing.

Enhancement Assessment

Buried drains under the inlet berms could provide more summer flow (# 119).

Wetted area increase	= 5180 m^2 square
Yield potential	= 1657 Co smolts

Or excavation of pools which would be much cheaper and accomplish the same result (# 120).

Production Options #'s 119 , 120

Side Channel I.D. A29 Active TZARTLAM ACTIVE CHANNEL (42)

Average Wetted Width (m)	2	% Pool	76
Channel Width (m)	5.00	% Riffle	24
Minimum Flow	.01	% Run	0
Channel Length (m)	500.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near upper end Date: 87/8/4 Crew: TB Air
Photo Location No. BCC 404 037,038
Weather: clear, warm Air Temp. 29 Water Temp. 12 Access:
Riverbottom Rd., then path that leads to Picnic Pool.

Wetted by:
1. winter water table
2. seepage from upland
3. occasional light spill from mainstem
4. Tzartlam Cr. (Nov. - May, lower 10 m)

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho and chum spawning, coho summer rearing and overwintering. Tzartlam channel produced 1.04 coho smolts per square meter in 1976 (Argue et. al, 1979). They called it "Cowichan Sidechannel."
A few Cutthroat trout and lampreys are also present.

Fry densities(m^2) from Holtby (pers. comm.)
16/9/86 Co 2.5 Ct 1.0
12/10/86 Co .225 Ct .13

Enhancement Assessment

No improvement necessary.

Side Channel I.D. R30 (43)	**Relic**	**PERCHED RELIC CHANNEL**	
Average Wetted Width	0.009	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	550.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 100m below channel head Date: 87/8/8 Crew: TB
Air Photo Location No. BCC 404 036,037
Weather: clear, Hot Air Temp. 32 Access: Cowichan footpath from Holt Cr. or wade or boat across river in Picnic Pool area

No connection with river; inaccessible.

Substrate Composition		Last Updated Updated By
Fines	9 %	
Gravel	2 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

No opportunities exist.

Side Channel I.D. A31 Active EAGLE'S ROOST ACTIVE CHANNEL (44)

Average Wetted Width (m)	7	% Pool	39
Channel Width (m)	12.00	% Riffle	17
Minimum Flow	.282	% Run	0
Channel Length (m)	400.0	% Glide	14
Debris (%)	10	% Slough	30
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/8/8 Crew: TB Air Photo Location No. BCC 404 037,038
Weather: Clear,hot Air Temp. 32 Water Temp. 17.5 Access: Riverbottom Rd., road and path to Tzartlam and Picnic Pool or Cowichan footpath.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho and chum spawning, coho spring - summer rearing and overwintering. Cutthroat trout also spawn and rear in this channel.

Enhancement Assessment

No improvement required.

Side Channel I.D. F32 Flood EAGLE'S ROOST FLOOD CHANNEL (45)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	160.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 50 m. above outlet Date: 87/5/16 Crew: TB Air Photo Location No. BCC 404 037,038
Weather: warm, dry Air Temp. 20 Access: Cowichan footpath from Holt Cr.

A true flood channel only flowing in floods. May go several years without carrying water.

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

None.

Enhancement Assessment

Not suitable for enhancement.

Side Channel I.D. A33 Active ACTIVE CHANNEL BELOW BIBLE CAMP BRIDGE (46)

Average Wetted Width (m)	3	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	270.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/9 Crew: TB Air Photo Location No. BCC 404 038,039
Weather: clear,hot Air Temp. 33 Water Temp. 13-17 Access:
Riverbottom Rd., Bible Camp, bridge, path

Wetted by:

1. Mainstem spill (Nov.-April)
2. Winter Water Table
3. Groundwater Upwelling

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, steelhead and chum spawning, coho and steelhead rearing. Fry salvage required. Usual yield: 500-1000 coho.

Enhancement Assessment

Installation of a buried drain underneath the inlet berm could provide permanent flow. The berm should also be raised and more cover (LWD) added to the channel.

Wetted area increase = 2052 m^2
Yield potential = 656 Co smolts

Production Option # 121

Side Channel I.D. R34 Relic WALL'S RELIC CHANNEL (47)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	20.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	270.0	% Glide	NA
Debris (%)	10	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/1/21 Crew: TB Air Photo Location No. BCC 404 038,039

An over mature channel long removed from river influence. A few puddles surface during high river flows.

Substrate Composition		Last Updated Updated By
Fines	9 %	
Gravel	1 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

This channel could be linked with the Bible Camp Back channel to provide additional winter habitat for coho. Minor excavation and a small culvert(.3 m.) would allow back flooding.

Wetted area increase	= 5400 m^2
Yield potential	= 5400 Co smolts

Production Option # 122

Side Channel I.D. A35/1 (48) **Active** **BIBLE CAMP OXBOW**

Average Wetted Width (m)	2	% Pool	90
Channel Width (m)	50.00	% Riffle	5
Minimum Flow	.0015	% Run	0
Channel Length (m)	1010	% Glide	5
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil (high in winter months as of 1998-99)		

Site Location: central Date: 87/8/9 Crew: TB Air Photo Location No. BCC 404 039, 040
Weather clear, warm Air Temp. 33 Water Temp. 14 River Bottom Rd., Bible Camp

An active channel within a relic channel. Average active channel width is 4 m. Aug. 6-11/87 drawdown caused the loss of 740 m^2 of wetted area.

Substrate Composition		Last Updated Updated By
Fines	9 %	TB/AL 2/98
Gravel	1 %	TB/AL 5/98
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M (high in upper 434 m)	

Fish Utilization

Coho spawning, overwintering and summer rearing. This channel produced 2870 coho smolts in 1976 (Argue et. al, 1979); .98/m^2

Fry densities(m^2) from Holtby (pers.comm)
16/9/86 Co 4.0 Ct .096
12/7/86 Co 24.0 Ct .19

Chum spawning in lower 125 m. Occasional brown trout and cutthroat trout are reported. Lampreys are also present in good numbers.

Enhancement Assessment

The entire channel could be excavated for chum spawning resulting in 36,500 m^2. However, the channel is best suited for coho production. Installation of a drain beneath the inlet berm might provide permanent flow. NOTE: Upper portion of channel on Hooper property. River bank has lost approximately 7.6 m at a point just upstream. Anthony Lee is living on the property (1998). DFO considered development (1990) but M.Hooper wanted minimal change while DFO wanted considerable.
Inlet berm eroded away by early winter 1998. Channel now open to flooding and spill water is turbid. It is evident that considerable work will be required to defend the inlet and the bank upstream.

Wetted area increase = 2360 m^2
Yield potential = 755 additional Co smolts

Installation of inlet berm and drain. Install deflector logs upstream to defend bank and start willow bundles behind logs. Use combination of bundles and stakes (cuttings). Some rebar may be necessary to stake bundles. Start cottonwood forest behind bundles.
Upper 434 m silted in badly in the winter of 1998-99.
Three reaches in channel:

R1 = 6(3)FC .1 7300 125m
R2 = 2(1) FC .1 1000 451m
R3 = 4(2) FC .1 1000 434m

Production Option # 123

Side Channel I.D. B35/2 Back LOWER PART OF BIBLE CAMP OXBOW (49)
(Bible Camp Backchannel)

Average Wetted Width (m)	9	% Pool	0
Channel Width (m)	20.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	125.0	% Glide	0
Debris (%)	1 (5 pieces)	% Slough	100
Gradient	0		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/9 Crew: TB Air Photo Location No. BCC404 Nos. 039,040
Weather: clear,hot Air Temp. 34 Access: Riverbottom Rd.

Wetted by water table, back flooding and occasional spill from the river via a breakout channel.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	6 %	
Cobbles	2 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho and chum spawning; coho rearing and wintering.

Coho fry densities(/m2)

15/9/86 3.7
7/12/86 3.3

Anthony Lee operated a downstream trap at the confluence of this channel and the Cowichan River in the spring of 2001.

Enhancement Assessment

A buried drain under the breakout channel berm might provide permanent wetting. NOTE: breakout channel no longer enters this channel; it goes back into the Cowichan River due to the presence of Wall's Berm. Channel could be re-connected and inflow controlled. Breakout channel was probably an important source of gravel for the upper end of this channel.

Wetted area increase = 1190 m^2
Yield potential = 95 Co smolts

This channel was partially excavated in 1983 by an EBAP crew.
Addition of LWD (windfall logs) would improve carrying capacity (#125)

Production Options #'s **124 , 125**

Side Channel I.D. F36 Flood ACROSS FROM BIBLE CAMP FLOOD CHANNEL (50)

Average Wetted Width (m)	0.143	% Pool	0
Channel Width (m)	40.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	350.0	% Glide	0
Debris (%)	1	% Slough	100
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/8/8 Crew: TB Air Photo
Location No. BCC 404 039, 040
Weather: clear, hot Air Temp. 34 Water Temp. 20 Access:
Riverbottom Rd., Bible Camp Bridge

Wetted by winter water table and spill. Also by a tributary channel and upland run-off and seepage. Lower 100 m backfloods.

Substrate Composition		Last Updated Updated By
Fines	5 %	
Gravel	3 %	
Cobbles	2 %	
Boulders	1 %	
Bedrock	TR %	
Compaction	L	

Fish Utilization

Chum spawning, coho spring-summer rearing in backwater segment.
Fry salvage required. Usual yield: 500 -1000 Cm (FS8)

Enhancement Assessment

Not suitable for improvement due to instability. However, if flood defense measures were incorporated; this channel could yield important benefits.

Wetted area increase	= 13,500 m^2
Yield potential	= 4320 Co smolts
	= 2160 Ch smolts
	= 6,750,000 chum fry

Note: This production is questionable because chum spawn naturally in this channel. However, in most years, very high egg loss occurs due to drying. In the 1982-1988 period, flows were not high enough in one year (1983) to permit good survival.

Production Option # 126

Side Channel I.D. R37 Relic WHITE FENCE RELIC CHANNEL (51)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	415.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/1/22 Crew: TB Air Photo
Location No. BCC 404 039,040
Access: Riverbottom Rd.

An old post - glacial channel far removed from river influence. Wetted by the winter water table and upland runoff in periods of very high flow. Spills across Riverbottom Rd. at the White Fence and just east of the Sandy Pool access road.

Substrate Composition		Last Updated Updated By
Fines	7 %	TB/AL 2/98
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None except slight chance of wintering coho moving in at high flows

Enhancement Assessment

Beyond the range of river influence and enhancement.

Side Channel I.D. F38 Flood BIBLE CAMP BREAKOUT CHANNEL (52)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	100.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/1/21 Crew: TB Air Photo
Location No. BCC 404 039,040
Access: Riverbottom Rd.

Substrate Composition		Last Updated Updated By
Fines	2 %	TB 5/2000
Gravel	6 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction		

Fish Utilization

None prior to the 1990's. Coho fry numerous in May 2001. Channel configuration has changed due to the construction of a deflector berm created by the Bible Camp managers. The channel no longer enters Bible Camp Oxbow; it goes back into the Cowichan River (2000).

Enhancement Assessment

Installation of a berm and controlled inflow could provide permanent wetting to this channel and the Bible Camp Backchannel.

Wetted area increase = 600 m^2
Yield potential = 192 co smolts

Production Option # 127

Side Channel I.D. F39/1 Flood FLOOD CHANNEL TRIBUTARY TO ACROSS FROM BIBLE CAMP FLOODCHANNEL (53)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	180.0	% Glide	NA
Debris (%)	10	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)			

Site Location: upper section Date: 87/8/8 Crew: TB Air
Photo Location No.BCC404 Nos. 039,040
Weather: clear, hot Air Temp. 34 Access: Riverbottom Rd.,
Bible camp

Wetted by a temporary stream, the winter water table, groundwater seepage from the upland and occasional spill from the mainstem.

Substrate Composition		Last Updated Updated By
Fines	5 %	
Gravel	4 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho and chum spawning, coho and chinook spring rearing and coho wintering. Fry salvage required. Usual yield: 500 Co, 50 Ch, 1000 cm (FS 9).

Enhancement Assessment

Excavation of a deep pool near the head of the breakout channels and a buried drain might provide permanent flow.

Wetted area increase	= 2160 m^2
Yield potential	= 688 co smolts
	= 345 ch smolts

Production Option # 128

Side Channel I.D. R40 Relic RELIC CHANNEL TRIB. TO FLOODCHANNEL ACROSS FROM BIBLE CAMP (54)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	5.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	250.0	% Glide	NA
Debris (%)	10	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/4/20 Crew: TB Air Photo Location No. BCC 404 039,040

A very mature channel that has not carried flow for many years. A few puddles are present in mid-winter when the water table is high.

Substrate Composition		Last Updated Updated By
Fines	9 %	
Gravel	1 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

Not subject to improvement without very high cost.

Side Channel I.D. F41 Flood THIN SLICE FLOODCHANNEL (55)

Average Wetted Width (m)	0.32	% Pool	100
Channel Width (m)	4.00	% Riffle	0
Minimum Flow	0 (int.)	% Run	0
Channel Length (m)	65.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.3		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 60 m. below inlet Date: 87/8/9 Crew: TB Air Photo Location No. BCC 404 039,040
Weather: clear,hot Air Temp. 34 Water Temp. 17 Access: Riverbottom Rd., Wade or Boat River at Powerline or hike from Bible Camp

Wetted by the winter water table and river flows above 16 cms. Becomes int. when the mainstem drops below 16 cms.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	4 %	
Cobbles	2 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho spring-early summer rearing.

Enhancement Assessment

Possible to provide permanent wetting by excavating an inlet pool and removing high spots.

Wetted area increase = 788 m^2
Yield potential = 248 Co smolts
Fry salvage (FS 9)

Production Option # 129

Side Channel I.D. A42 Active POWERLINE ACTIVE CHANNEL (56)

Average Wetted Width (m)	3	% Pool	59
Channel Width (m)	14.00	% Riffle	14
Minimum Flow	.00174	% Run	0
Channel Length (m)	200.0	% Glide	27
Debris (%)	5	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 80 m. above outlet Date: 87/8/9 Crew: TB Air Photo Location No. BCC 404 038,040
Weather: clear, hot Air Temp. 34 Water Temp. 21 Access: Riverbottom Rd., wade River or hike from Bible Camp
This channel is in close phase with mainstem discharge.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	6 %	
Cobbles	2 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho and chum spawning, coho spring-summer rearing. Some coho likely winter in this channel but its capability is not high due to high freshet flows and lack of groundwater input.
Many coho fry were lost to drying and predation -a large number of garter snakes showed up when the river was lowered to 4.48 cms. on Aug. 9, 1987.

Enhancement Assessment

It might be possible to strengthen the inlet berm to buffer high flows and install a drain beneath it to enhance low flows (# 130). The addition of LWD would further increase capacity (# 131).

Wetted area increase	= 2900 m^2
Yield potential	= 428 Co smolts

Production Options #'s 130, 131

Side Channel I.D. R43 Relic MASSEY'S (57)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	5.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	70.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient			
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Relic channel near dry bend. Date:87/6/17
Crew: TB Air Photo Location No. BCC 404 038,040
Weather: clear Air Temp. 19 Access: Riverbottom Rd., private road near powerline crossing

Wetted by winter water table and backflooding from the mainstem. Possibility of some coho wintering.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Possibility of coho wintering.

Enhancement Assessment

Could be excavated to prolong wetting but little benefit would result.

Side Channel I.D. F44 Flood FLOODCHANNEL OPPOSITE DRY BEND (58)

Average Wetted Width (m)	0.33	% Pool	25
Channel Width (m)	15.00	% Riffle	25
Minimum Flow	.023	% Run	0
Channel Length (m)	120.0	% Glide	0
Debris (%)	2	% Slough	50
Gradient	2.0		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: flood channel opposite dry bend Date: 87/6/17
Crew: TB Air Photo Location No. BC 404 039,040
Weather: clear Air Temp. 18 Water Temp. 15 Access:
Riverbottom Rd., Massey's.

Lower 60 m. flowing slightly (1LPS). One 50 m^2 pool at 40 m.; contained 50 coho fry
Channel inundated by flood flows.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	5 %	
Cobbles	2 %	
Boulders	2 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho fry utilize the approximate lower half of this channel from emergence to autumn. Overwintering is doubtful due to probable high turbulence and lack of groundwater. The possibility should not be discarded however; especially in the backwater section.

Enhancement Assessment

No improvement necessary or possible. The berm could be lowered but this would allow the full force of flood flows and it would soon rebuild. Installing a pipe beneath the berm is impractical due to the unstable nature of the berm.

Side Channel I.D. R45/1 Relic (59)

Average Wetted Width (m)	15	% Pool	0
Channel Width (m)	20.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	80.0	% Glide	0
Debris (%)	1	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/4 Crew: TB Air Photo Location No. BCC404 Nos. 040,041
Weather: clear,warm Air Temp. 30 Water Temp. 13 Access: wade river or hike footpath from Bible Camp
A small backchannel at the confluence of dry bend active channel and the mainstem.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho rearing and wintering. Lesser use by chinook, chum, steelhead and cutthroat fry.

Enhancement Assessment

None required.

Side Channel I.D. A45/2 Active DRY BEND (CARSON'S CORNER) ACTIVE – RELIC COMBINATION CHANNEL (60)

Average Wetted Width (m)	9	% Pool	100
Channel Width (m)	18.00	% Riffle	0
Minimum Flow	0 (.015)	% Run	0
Channel Length (m)	900.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near Beaver Dam. Date: 87/8/4. Crew: TB Air
Photo Location No. BCC404 040,041
Weather: clear,warm Air Temp. 30 Water Temp. 13 Access: Wade River or hike footpath form Bible Camp

Four Reaches:

1. 20(20) 0 8200 60-80 m - Backwater
2. 7(0) .01 4600 70 m - Channel Below Beaver Dam
3. 20(20) 0 8200 350 - Beaver Pond
4. 20(0) .01 8200 400 - Relic

Dry Bend Creek, the winter water table and back flooding provide wetting. The creek is permanent but the channel dries below the dam. Stream flow is captured by gravel underlying the pond.

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	4 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho salmon spawning, summer rearing and overwintering. Spawning occurs on the creek mouth fan.

Enhancement Assessment

Excavation and a buried drain would provide permanent wetting to the relic portion and, quite likely to the reach below the beaver dam.
Production Option # 132

Side Channel I.D. F46 Flood DRY BEND FLOODCHANNEL (61)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Length	200	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient (%) .	1		
Elevation			
Turbidity	nil		

Site Location: Lower end. Date: 87/5/18 Crew: TB
Air Photo Location No. BCC 404 040-041
Weather: Cloudy, cool, showers AT 15 Access: wade river or hike footpath from Bible Camp
Only wetted in floods, may not flow for several years

Substrate Composition Last Updated

Fines	6%
Gravel	4%
Cobbles	0%
Boulders	0%
Bedrock	0%

Fish Utilization

None

Enhancement Assessment

No practical options.

Side Channel I.D. R47 Relic DRY BEND RELIC CHANNEL (62)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	260.0	% Glide	NA
Debris (%)	15	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near outlet Date: 87/5/18 Crew: TB Air Photo Location No. BCC404 040,041
Weather: cloudy, cool, showers Air Temp. 15 Access: Boat from Asha's or hike from Bible Camp
I have never observed flow in this channel.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

Channel excavation and construction of an inlet berm could provide permanent wetting. It would also provide benefit to 45A.

Wetted area increase	= 1560 m^2
Yield potential	= 499 Co smolts
	= 780,000 Cm fry
	= 249 ch smolts

Production Option # 133

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	9.00	% Riffle	NA
Minimum Flow `	0	% Run	NA
Channel Length (m)	452.0	% Glide	NA
Debris (%)	L	% Slough	NA
Gradient	.2		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 50 m. below head Date: 87/6/29 Crew: TB Air
Photo Location No. BCC404 040,041
Weather: clear, warm Air Temp. 25 Access: Riverbottom Rd. to
Durrance Property 6.1 km west of Old Lake Cowichan Road. Path downstream to Bergstrom's and Whitehead's.
A few low spots are wetted by the winter water table. Permanent groundwater is present at variable depths. One pool remains throughout summer: Lizzie's Duckpond. Occasional winter flow in lower end on Whitehead property but mostly from two tiny tributaries (Hodding and Whitehead Creeks). Bruce Hodding now lives on Durrance (Forbes's) property (1997). He has or will soon be purchasing it from his mother (Elizabeth Forbes).
Substrate Composition Last Updated 6/1/98
Updated By TB

Fines	3 %
Gravel	6 %
Cobbles	1 %
Boulders	0 %
Bedrock	0 %
Compaction	M

Fish Utilization

None

Enhancement Assessment

Channel excavation would provide coho and chum spawning and coho rearing and wintering. The dyke provides an excellent inlet berm. Some erosion of the rip rap dyke occurred in the winter of 1996-97. Needs reinforcement. Best method of wetting would likely be a buried pipe that could extend from the river to Lizze's Duckpond. It is hoped that little excavation work should be required on the channel except at the bottom end on the Whitehead Property. However, the river level at the inlet is rather low and considerable excavation could be necessary. Spawning capability should be added in several places in the upper channel while the lower channel would have higher spawning potential and likely attract chums as well as coho.
Whitehead Creek could be diverted into the channel because it presently runs into the Cowichan via the lower horse pasture on the Williams Property (Rancho Del Rio) where some impact usually results. This is a very low priority item.
Wetted area increase = 4068 m^2 (residual water is not habitable or accessible)

Yield potential	= 1301 Co smolts = 650 Ch smolts = 2,034,000 cm fry	= 2,034,000 Cm fry

Production Option # 134

Note: Channel was examined by Russ Doucet and Mel Sheng on May 28,1998. Too much excavation would be required to access water, this wouldn't be acceptable to property owners.

Side Channel I.D. F49 Flood RIVERSTONE FLOODCHANNEL (64)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	11.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	140.0	% Glide	NA
Debris (%)	2	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 20 m. below head Date: 87/6/29 Crew: TB Air Photo Location No. BCC404 040,041
Weather: clear, warm Air Temp. 25 Access: Riverbottom Rd. to Durrance Property
Only wetted during high winter flows.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Chum spawning in most years. Eggs are usually lost however because the channel is dry at normal winter water levels.
Twenty-two chums spawned in this channel between Dec.1 and 10, 1987. By Dec. 20, it was dry. It didn't flow again before spring.

Enhancement Assessment

Lowering the inlet and installing a drain will prolong wetting. The berm above it should be strengthened.

Wetted area increase	= 1540 m^2
Yield potential	= 777,000 cm fry

Object of enhancement should be to prolong wetting until chum fry emerge. Providing permanent flow is impractical and the channel has low capability for rearing.

Production Option # 135

Side Channel I.D. A 50 **Active** **ASHA'S SIDECHANNEL (65)**

Average Wetted Width (m)	2	% Pool	40
Channel Width (m)	8.00	% Riffle	30
Minimum Flow	.004	% Run	0
Channel Length (m)	600.0	% Glide	30
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 30 m. above confluence Date: 87/7/17 Crew: TB
Air Photo Location No. BCC404 040,041,042
Weather: clear, warm Air Temp. 22 Water Temp. 14 Access:
Boat or wade Cowichan at bottom of Asha's Run (At Bruce Hodding's property 5634 Riverbottom Rd.) or hike footpath from above via Sahtlam Lodge cable car.
from Dale's Cr.
Part of the largest sidechannel complex in the system.
Located on a 20 HA flat laced with relic channels.
Wetted by groundwater that likely originates from the river
aquifer because flow fluctuates in phase with river discharge.
However, flow recedes somewhat following minimum mainstem low
water so other groundwater also contributes.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	5 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawn and overwinter in this channel. Spawning is heavy some years 100-300 m. above the confluence. Cutthroat trout and lampreys are present. Both spawn in this channel.

Fry densities(m^2) from B. Holtby
15/8/86 Co 2.3 Ct .99
12/4/86 Co .186 Ct .40

Enhancement Assessment

It should be possible to provide more direct access for river flow by trenching but cost would be high and extra winter flow might reduce habitat value. Networking with relic channels might be feasible with extra summer flow. This possibility requires more study as does the entire question of providing more flow to this sidechannel. This would be a very high priority channel if a practical method of supplying flow could be discovered. It's possible that the channel could simply be excavated down to the summer water table especially in the lower reaches where a summer groundwater pool is present. **Production Option # 136**

Side Channel I.D. R51 Relic LEANNE'S SIDECHANNEL (66)

Average Wetted Width (m)	1	% Pool	30
Channel Width (m)	10.00	% Riffle	30
Minimum Flow	0	% Run	0
Channel Length (m)	200.0	% Glide	40
Debris (%)	5	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 150 m. above outlet Date: 87/7/17 Crew: TB Air Photo Location No. BCC404 040,041,042
Weather: clear, warm Air Temp. 22 Water Temp. 14 Access: Boat or wade across Asha's Run on Riverbottom Rd.
Upper 78 m. is a flood channel that is seldom wetted. The functional length of this channel is 122 m.

Substrate Composition		Last Updated
		Updated By
Fines	6 %	
Gravel	3 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho fry utilize this channel in winter, spring and early summer. By late summer, only one 40 m. square pool remains as a refuge for less than 100 fish. Other pools are present but too small and shallow to hold fry.

Enhancement Assessment

Excavation of a deep infiltration pool at 122 m. would, in combination with spot trenching, might provide permanent flow. But yield could not justify cost.

Side Channel I.D. F52 Flood SAMMY'S FLOODCHANNEL (67)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	230.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.3		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near bottom end Date: 87/8/9 Crew: TB Air
Photo Location No. BCC404 041,042
Weather: clear, hot Access: Wade or boat Asha's Run
Wetted by winter water table and large freshets; may not flow in low run-off winters.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho fry find their way into the lower end during the winter and early spring. Since the channel dries by May or early June, some are lost. Number is usually less than 100.

Enhancement Assessment

The channel could be excavated for combination chum spawning - coho rearing but priority should be low due to benefits and because better sites are present.

Increased wetted area	= 1560 m^2
Yield potential	= 499 co smolts
	= 249 ch smolts
	= 780 000 cm fry

Inlet berm modification will be necessary.

Production Option # 137

Side Channel I.D. F53 Flood WASHOUT FLOODCHANNEL (BUSTER'S) (68)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	20.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	200.0	% Glide	NA
Debris (%)	1	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near centre Date: 85/3/5 Crew: TB Air Photo
Location No. BCC404 041,042
Weather: cloudy, cool Air Temp. 10 Access: from Riverbottom
Rd. Its possible to drive down this channel most of the year
Only wetted in high flows. At "normal" winter discharge
(approx. 60 cms), a few shallow pools are present. Much of this channel is on Buster Rowan's property.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	5 %	
Cobbles	2 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

It would be possible to excavate this channel. Chum salmon would benefit most but coho advantages should also result.

Wetted area increase	= 4000 m^2
Yield potential	= 1280 Co smolts
	= 2,000,000 cm fry
	= 640 Ch smolts

Production Option # 138

Side Channel I.D. R54 Relic RELIC CHANNEL ACROSS FROM MONK'S OXBOW (69)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	4.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	310.0	% Glide	0
Debris (%)	15	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Central Date: 87/7/17 Crew: TB Air Photo Location No. BCC404 041,042
Weather: Mostly clear, warm Air Temp. 25 Access: Boat or wade from Kakalatza

Substrate Composition		Last Updated
		Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho wintering and spring rearing in the lower 60 m.

Enhancement Assessment

Excavation could produce a small chum salmon spawning channel and improved coho rearing. The berm should be left intact.

Wetted area increase	= 1240 m^2
Yield potential	= 396 Co smolts
	= 620,000 Cm fry
	= 198 Ch smolts

Production Option # 139

Side Channel I.D. F55/1 Flood (70)

Average Wetted Width (m)	0	% Pool	0
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	50.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient			
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 5 m. below Riverbottom Rd. Date: 87/9/8 Crew: TB
Air Photo Location No. BCC404 Nos. 041,042
Weather: clear, hot Air Temp. 33 Access: Riverbottom Rd.
Backflooded by moderate to high river flows, dries in late summer.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction		

Fish Utilization

Coho wintering and spring, early summer rearing.

Enhancement Assessment

Enhancement of 55A will provide permanent wetting of the channel centre.

Side Channel I.D. A55/2 Active MONK'S OXBOW (71)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	610.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	NIL (lower end turbid at high flows due to river backflooding)		

Site Location: near outlet Date: 87/9/17 Crew: TB Air Photo
Location No. BCC 404 041,042
Weather: clear, hot Air Temp. 33 Access: Riverbottom Rd. , Carolyn Rd.
Outlet area rip rapped by Archibald-Chamberlain as part of downstream property defense (1994). Loren Duncan reported the water ran dirty at times in the winter of 99/00. Reported to DFO but nobody came or called. Probable source was logging on M+B lands east of Stoltz Hill.

Wetted by
1. Winter water table
2. Winter back flooding (lower 50 m.) when Cowichan discharge is > 93 CMS at the Lake Cowichan stream gauge
3. Three small groundwater tributaries
4. A temporary tributary system that originates near Stoltz Hill

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	3 %	TB 5/99, 3/00
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho spawning, overwintering and spring – early summer rearing, chum spawning. 32 chums spawning Nov.26, 1991. CLSES set three minnow traps 4/27/1998: 20 coho smolts, one rainbow, one chinook and two sticklebacks. Channel is fry salvaged by Cowichan Hatchery. 1997 results: 1850 Co, 2650 Cm and 70 trout. Obviously St and Ct also winter in the channel.
(FS 10)

Enhancement Assessment

A deep infiltration pool and spot excavation might provide permanent wetting. Construction of spawning platforms near upper end would increase chum yield. LWD addition would increase carrying capacity for coho. As many as 300 chums use this channel in high escapement years.

Wetted area increase = 6000 m^2
Yield potential = 1920 Co smolts

Production Option # 140, 141, 142

Sidechannel I.D. R56 Relic KAKALATZA RELIC CHANNEL (72)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	200.0	% Glide	NA
Debris (%)	NA	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)			

Site Location: near river Date: 87/9/18 Crew: TB Air Photo
Location No. BCC404 041,042
Weather: clear, warm Air Temp. 28 Access: Riverbottom Rd.
An old post-glacial channel long removed from active status;
never wetted except by spill from Monk's during very high flows. Such was the case on Feb. 24, 1998 when water was running across the road and down this channel.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None - channel never wetted.

Enhancement Assessment

Beyond the range of enhancement.

Side Channel I.D. F57 Flood KAKALATZA FLOOD CHANNEL (73)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	265.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Date: 87/7/1 Crew: TB Air Photo Location No. BCC 404 041,042
Weather: clear, warm Air Temp. 29 Access: Riverbottom Rd.
Inundated by floods.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, chinook and chum fry enter the channel from its lower end in April and May but become trapped when water recedes in May and June. Fish are very difficult to salvage and annual losses approximate 100-300 fry; mostly coho.

Enhancement Assessment

The area is too unstable to support most measures.

Side Channel I.D. F58 Flood WILDWOOD FLOODCHANNEL (74)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	12.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	194.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.3		
Elevation (m)			
Turbidity (cm)			

Site Location: central Date: 87/4/1 Crew: TB Air Photo
Location No. BCC404 042,043
Weather: cloudy Air Temp. 10 Access Riverbottom Rd., Wildwood Rd. behind Latta House which is now Cowichan River Park headquarters.
Only occasionally wetted during freshets.

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Chum spawning especially in years of high escapement.

Enhancement Assessment

Conditions are favourable for chum salmon spawning if the channel were excavated. An inlet control structure would be necessary as would protection from mainstem lateral cutting and inundation.

Wetted area increase	= 2328 m^2
Yield potential	= 1,164,000 chum fry

It would be impractical to provide permanent flow to this channel. It need only persist until May.
Note: This channel is in the Cowichan River Park now and right behind park headquarters at the Latta House.

Production Option # 143

Side Channel I.D. F59 Flood DALE'S FLOODCHANNEL (75)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	348.0	% Glide	NA
Debris (%)	5	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)			

Site Location: central Date: 87/ /1 Crew: TB Air Photo
Location No. BCC404 042,043
Weather: clear, hot Air Temp. 30 Access: Skutz Falls - Holt
Cr. Rd., CN Tracks, Cow. Footpath. Link rd. from Skutz Falls BCFS Rd. deactivated 1995. Alternate access via Dave Hignall's cable car. New footbridge from park proposed for Davie Corner (Loren Duncan, 2/99). Could wade or swim across from Loren Duncan's in summer.
Flow provided by the winter water table and spill from the mainstem. Channel was not flowing above the sample site 2/22/97. Approximately 20 LPS was upwelling at the site. Mainstem discharge at Lake Cowichan was 66 CMS.

Substrate Composition Last Updated 2/22/97
Updated By TB

Fines	3 %
Gravel	6 %
Cobbles	1 %
Boulders	0 %
Bedrock	0 %
Compaction	L

Fish Utilization

Coho and chum salmon spawning. Coho rearing until early summer. 300-700 fry are lost to drying which usually occurs from late May to late June, salvage required (FS 11).

Enhancement Assessment

Excavation of an infiltration gallery near the inlet combined with drainage under the inlet berm should provide permanent wetting.

Wetted area increase	= 948 m^2
Yield potential	= 1136 Co smolts
	= 1,740,000 cm fry

Production Option # 144

Side Channel I.D. R60 Relic STOLTZ RELIC CHANNEL (76)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	900.0	% Glide	NA
Debris (%)	NA	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)			

Site Location: near head Date: 87/4/1 Crew: TB Air Photo Location No. BCC404 043,044
Weather: cloudy Air Temp. 10 Access: Riverbottom Rd.
A post-glacial channel long removed from river influence.

Substrate Composition		Last Updated Updated By
Fines	9%	
Gravel	1%	
Cobbles	0%	
Boulders	0%	
Bedrock	0%	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

No improvement possible

Side Channel I.D. B61/1 Back DAVIE CORNER LAGOON (77)

Average Wetted Width (m)	35	% Pool	0
Channel Width (m)	100.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	70.0	% Glide	0
Debris (%)	40	% Slough	100
Gradient	0		
Elevation (m)			
Turbidity (cm)	20		

Date: 87/5/26 Crew: TB Air Photo Location No. BCC404 043,044
Water Temp. 14 Access: Skutz Falls - Holt Cr., Access Rd.
Backfloods in winter, becomes detached in spring or early summer but receives permanent (albeit small) inflow from groundwater seepage.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho wintering and summer rearing. Brown trout are said to favour the lagoon at times.

Enhancement Assessment

No improvement required.

Side Channel I.D. R61/2 Relic DAVIE CORNER RELIC NO. 2 (78)

Average Wetted Width (m)	0.58	% Pool	57
Channel Width (m)	11.00	% Riffle	32
Minimum Flow	.0018	% Run	0
Channel Length (m)	180.0	% Glide	11
Debris (%)	15	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/9 Crew: TB Air Photo Location No. BCC404 043,044
Weather: clear, hot Air Temp. 32 Water Temp. 12 Access:
Skutz Falls - Holt Cr. Rd., Cow footpath

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho spring-summer rearing and probability of overwintering.

Enhancement Assessment

No improvement required.

Side Channel I.D. R62 Relic DAVIE CORNER RELIC NO.1 (79)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	300.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.001		
Elevation (m)			
Turbidity (cm)			

Date: 87/4/6 Crew: TB Air Photo Location No. BCC404 043,044

Wetted by the winter water table and backflooding.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Possibility of coho wintering but smolt emigration is questionable.

Enhancement Assessment

Not subject to enhancement - no practical opportunities present.

Side Channel I.D. F63 Flood FLOODCHANNEL ABOVE DAVIE CORNER (80)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	65.0	% Glide	NA
Debris (%)	2	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Site Location: near head Date: 87/4/6 Crew: TB Air Photo Location No. BCC404 Nos. 043,044
Wetted only very occasionally by mainstem spill.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

No improvement opportunities are present.

Side Channel I.D. F64 Flood STOLTZ BAR FLOODCHANNEL (81)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	8.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	400.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 100m above outlet Date: 87/4/4 Crew: TB Air Photo Location No. BCC404 043,044
Weather: cloudy, cool Air Temp. 7 Water Temp. 8 Access: from Stoltz Rd.
Only flows in highwater.

Substrate Composition		Last Updated Updated By
Fines	4 %	
Gravel	6 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, chinook and chum fry enter this channel from its bottom end in the spring. Numbers may be high in years of early emergence. 500 chinook fry, 300 coho fry, 500 chum fry and 5 coho pre-smolts were salvaged between April 4 and 28, 1987 (FS 12).
312 chums spawned in this channel between Dec.6 and 10, 1987. An additional 221 spawned in the upper reach which is the road to Benellack's Pool. All eggs were lost to drying.

Enhancement Assessment

No practical enhancement options. The channel could be excavated to prolong flow but benefits would be very temporary due to the unstable nature of the channel and adjacent bar. However, it may be possible to defend a channel against most floods. More study required.

Wetted area increase	= 3200 m^2
Yield potential	= 1 600 000 Cm fry
	= 512 Ch smolts

Production Option # 145

Side Channel I.D. A65 Active STOLTZ ACTIVE CHANNEL (82)

Average Wetted Width (m)	5	% Pool	66
Channel Width (m)	16.00	% Riffle	29
Minimum Flow	.0054	% Run	0
Channel Length (m)	709.0	% Glide	5
Debris (%)	5	% Slough	0
Gradient	1.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/8/4 Crew: TB Air Photo
Location No. BCC404 043, 044
Weather: clear, hot Air Temp. 33 Water Temp. 15.5 Access:
Skutz Falls - Holt Cr. Rd. or wade river from Stoltz. Can also bike down CN grade/Trans Canada Trail from Mars Trestle.

A major sidechannel; carries heavy discharge in freshets; summer base flow is groundwater.

STOLTZ CHANNEL

	Channel Width	Wetted Width	Substrate	Slope%	Confinement	LWD	Length	Wetted Area
Reach 1	16	5	1810	.5	OC	.0008	237	1185
Reach 2	16	4	1720	1.2	FC	.0016	315	1260
Reach 3	15	0	1720	1.3	FC	.006	121	200
Reach 3A	8	0	1630	1.0	FC	.009	66	100

Fish Utilization

Coho and chum salmon spawning, coho summer rearing. The overwintering capability of this channel is suspect due to heavy flushing and bedload transport at times. Cutthroat and steelhead are also present.

Enhancement Assessment

Excavation of an infiltration pool near the inlet might provide permanent wetting, particularly in conjunction with a buried pipe or French Drain. To reduce erosion at the toe of Stoltz Bluffs which are immediately downstream, a small diversion/training weir at the inlet should also be investigated. If this option is selected, it will reduce the winter habitat value of the channel.

Wetted area increase = 6903 m^2
Yield potential = 2208 Co smolts

Improvement of the inlet berm would reduce scour. It would have to be removed if 65A were used to reduce bluff erosion. Addition of LWD, especially windfall logs would benefit production. LWD is sparse (see above table) .

Production Option # 146

Side Channel I.D. F66 Flood STOLTZ FLOODCHANNEL "A" (83)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	5.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	100.0	% Glide	0
Debris (%)	20	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Date: 87/4/6 Crew: TB Air Photo Location No. BCC404 043,044
Weather: cloudy, cool Air Temp. 12 Water Temp. 8 Access:
Skutz Falls - Holt Cr. Rd. then hike down old trail to Qualits and walk U/S on Cowichan Footpath. Can also wade across from Stoltz or bike down from Mars Trestle which received new decking in the summer of 2000.

Wetted by the winter water table and occasional spill from the river.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	8 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Light coho and chum spawning; 450 chum and 50 coho fry were salvaged 6/4/87 (FS 13).

Enhancement Assessment

Excavating an infiltration pool near the inlet may prolong wetting. Additional measures are not justified. This would guarantee chum fry survival.

Wetted area increase	= 500 m^2
Yield potential	= 250,000 cm fry

Production Option # 147

Side Channel I.D. F67 Flood STOLTZ FLOODCHANNEL "B" (84)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	5.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	200.0	% Glide	NA
Debris (%)	1	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Date: 87/6/4 Crew: TB Air Photo Location No. BCC404 043,044
Weather: cloudy, cool Air Temp. 12 Access: Skutz Falls - Holt Creek Rd., wade across from Upper Stoltz or bike down from Mars Trestle.

A difficult channel to characterize. Wetted by flooding but on an infrequent basis; once in 5 to 10 years.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

Major excavation would be required to bring this channel into production. It has fair potential as a chum spawning channel and could also rear coho as a secondary benefit.

Wetted area increase	= 1000 m^2
Yield potential	= 500,000 chum fry
	= 320 coho smolts
	= 160 chinook smolts

Production Option # 148

Side Channel I.D. F68 Flood MOSQUITO RUN FLOODCHANNEL (85)

Average Wetted Width (m)	6	% Pool	100
Channel Width (m)	8.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	140.0	% Glide	0
Debris (%)	2	% Slough	0
Gradient	.3		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/4 Crew: TB Air Photo Location No. BCC404 082,083
Weather: clear, hot Air Temp. 30 Water Temp. 20.5 Access:
Skutz Falls - Holt Cr. Rd., Cowichan footpath

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spring and early summer rearing.

Enhancement Assessment

No enhancement opportunities are present. The inlet is too unstable for modification to hold.

Side Channel I.D. R69 Relic MOSQUITO RUN RELIC CHANNEL (86)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	7.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	180.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: 150 m. above lower end Date: 87/6/27 Crew: TB
Air Photo Location No. BCC404 082,083
Weather: clear, warm Air Temp. 21 Access: Baahem Rd. than path
from W. Riverbottom Rd. Some private properties in this alcove including a UVIC cabin.

Sustains standing or slowly flowing water from Nov. to early May. Wetted by seepage from the upland and the winter water table.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

A few chums spawn in this channel. As many as 30-40 are seen in high escapement years.

Enhancement Assessment

Addition of several spawning platforms would benefit chum spawning. The channel is highly deficient in quality gravel.

Yield potential = 50,000 Cm fry

Production Option # 149

Side Channel I.D. A70/1 **Active** **KILLDEER LAGOON (87)**

Average Wetted Width (m)	15	% Pool	100
Channel Width (m)	15.00	% Riffle	0
Minimum Flow	.017	% Run	0
Channel Length (m)	50.0	% Glide	0
Debris (%)	0	% Slough	0
Gradient	.001		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/6/27 Time: 1500 Crew: TB Air Photo Location No. BCC404 084,085
Weather: clear, warm Air Temp. 25 Water Temp. 15 Access: Cowichan footpath

A unique groundwater upwelling basin. 20% of its flow is supplied by groundwater (on this date) - 86/6/27. Coho, steelhead, cutthroat and brown trout fry were present

Co 45-65 mm.	Ct 38 mm.
St 35 mm.	Bt 44 mm.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	6 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	1 %	
Compaction	L	

Fish Utilization

Coho, cutthroat, steelhead and brown trout fry are summer residents. It's suspected that they are progeny of spawners because the lagoon enters a steep riffle just above Marie Canyon and its outlets are swift in the spring (.33 and.5 m/sec on June 27/87). Strong possibility of overwintering by all resident species.

Enhancement Assessment

None necessary

Side Channel I.D. A70/2 Active KILDEER LAGOON'S MAIN INLET (88)

Average Wetted Width (m)	2	% Pool	20
Channel Width (m)	3.00	% Riffle	80
Minimum Flow	.0057	% Run	0
Channel Length (m)	30.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/6/27 Crew: TB Air Photo Location No. BC404 Nos. 084,085
Weather: clear, warm Air Temp. 25 Water Temp. 16.5 Access: Cowichan R. footpath

Spring - summer flow provided by seepage through the inlet berm which is occasionally overtopped by winter flows.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	4 %	
Cobbles	5 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Supports about 40 coho fry in summer. Very slight chance of a few coho spawners. Overwintering capability is considered nil.

Enhancement Assessment

No improvement required. Accessing the inlet berm to mainstem flow could reduce the capability of this highly unique complex.

Side Channel I.D. A70/3 Active KILDEER LAGOON'S SECOND INLET (89)

Average Wetted Width (m)	0.5	% Pool	30
Channel Width (m)	2.00	% Riffle	70
Minimum Flow	.0017	% Run	0
Channel Length (m)	120.0	% Glide	0
Debris (%)	30	% Slough	0
Gradient	.3		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/6/17 Air Photo Location No. BC404 Nos. 084,085
Weather: Clear and warm Air Temp. 26 Water Temp. 10.5 Access: Cowichan footpath from Skutz Falls or wade river at lower Horseshoe Bend

Primary flow source is upland seepage and the winter water table. Flood flows may occasionally wet the upper 90 m.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Too small for coho spawning or summer rearing; possible coho winter habitat.

Enhancement Assessment

Excavation of a deep infiltration pool near the berm may provide enough summer flow for coho rearing. However, only 240 fry could be carried and there is no access for heavy equipment.

Side Channel I.D. R71 Relic TOP OF CANYON RELIC (90)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	3.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	112.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: 50 m. above outlet Date: 87/4/2 Crew: TB Air Photo Location No. BCC404 084,085

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

None

Enhancement Assessment

No practical improvement opportunities.

Side Channel I.D. A72 Active LOWER HORSESHOE BEND ACTIVE CHANNEL (91)

Average Wetted Width (m)	3.7	% Pool	55
Channel Width (m)	10.00	% Riffle	40
Minimum Flow	.002	% Run	0
Channel Length (m)	314.0	% Glide	10
Debris (%)	2	% Slough	0
Gradient	1.0		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/8/8 Crew: TB Air Photo
Location No. BCC4 04 084,085
Weather: clear, warm Air Temp. 30 Water Temp. 12.5 Access:
Mayo Rd., BCFS Rec. Site Rd., trail

This channel is wetted by subsurface water through the berm and laterally through the bar.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	5 %	
Cobbles	3 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

This channel supports coho and chum spawning and coho summer rearing. A few (<500) coho fry are trapped in the middle section between May and July when fry salvage is required (FS 14). Fry densities from Holtby (pers. comm.)

Co .67 10/9/86
Co 4.90 12/4/86

Enhancement Assessment

Peak flows are far too high and summer discharge is too low. Raising the inlet berm and excavating the upper 30 m. could reduce high flows and increase summer discharge.

Wetted area increase = 2305 m^2
Yield potential = 737 Co smolts

Production Option # 150

Side Channel I.D. R73 Relic MILE 11 SIDECHANNEL (92)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	7.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	266.0	% Glide	NA
Debris (%)	30	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Date: 86/5/11 Crew: TB Air Photo Location No. BCC404
Weather: cloudy, cool Air Temp. 8 Access: Cowichan Footpath. Cut in from top of first hill on BCFS Rd. across Skutz Falls Bridge.

Substrate Composition: Gravel and cobbles underneath

Wetted by winter water table(a few pools) and occasional light spill from the mainstem in very high water. Lower 20 m. backfloods.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	1 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

A few coho may utilize the backwater portion of this channel in the spring; chinooks also.

Enhancement Assessment

Excavation of a deep infiltration pool below the inlet berm could provide permanent wetting. Equipment access is very poor.

Wetted area increase	= 1862 m^2
Yield potential	= 595 Co smolts
	= 297 Ch smolts

Production Option # 151

Side Channel I.D. A74 Active HORSESHOE BEND ACTIVE CHANNEL (93)

Average Wetted Width (m)	8	% Pool	100
Channel Width (m)	12.00	% Riffle	0
Minimum Flow	int.	% Run	0
Channel Length (m)	250.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Mid-channel constriction Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 085,086
Weather: clear, hot Air Temp. 32 Water Temp. 18 Access: Mayo Rd.

The channel is buffered by a mature berm.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	5 %	
Cobbles	2 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho spawn, rear and winter in this channel; 22 spawned here in 1985. A few chums also utilize this channel. In 2002, chums were very numerous. CLSES took DNA samples (opercular punches) and brood stock from this channel on 11/21/02.

Enhancement Assessment

No physical modification is required but due to very high spring - early summer coho fry densities, thinning is necessary to prevent large-scale attrition over the summer. Early summer fry usually number about 10,000 (3.3 per m^2) and late summer carrying capacity @ 1 fry/m^2 is 1250, 8750 coho fry should be salvaged in most years. 6750 were salvaged in 1986 (Burns, et. al 1987). (FS 15)

Side Channel I.D. F75 Flood HORSESHOE BEND FLOODCHANNEL (94)

Average Wetted Width (m)	1	% Pool	100
Channel Width (m)	6.00	% Riffle	0
Minimum Flow	int.	% Run	0
Channel Length (m)	150.0	% Glide	0
Debris (%)	2	% Slough	0
Gradient	1.0		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near outlet Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 085,086
Weather: clear, hot Air Temp. 32 Water Temp. 20 Access: Mayo Rd.

Upper 80 m. dry early but lower 70 are permanent as long as mainstem flows are above 5 CMS.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	5 %	
Cobbles	2 %	
Boulders	2 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Supports coho and chum spawning; heavy chum spawning in high escapement years. Chum fry salvage is usually necessary; 45,000 were rescued on April 25, 1987 (FS 16).

Enhancement Assessment

It may be possible to increase the height of the inlet berm and excavate an infiltration pool below it to reduce high flows (peak flows are about 50% too high) and increase summer flow.

Wetted area increase	= 750 m^2
Yield potential	= 240 Co smolts

Production Option # 152

Side Channel I.D. F76 Flood HOCKEY POOL FLOODCHANNEL (95)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	130.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	1.0		
Elevation (m)			
Turbidity (cm)			

Site Location: near inlet Date: 87/4/25 Crew: TB Air Photo Location No. BCC404 085,086,
Weather: clear, mild Air Temp. 15 Water Temp. 9 Access: Mayo Rd., W. Riverbottom Rd.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	3 %	
Cobbles	3 %	
Boulders	3 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Some coho and chum spawning in some years. Considerable early coho fry rearing into the lower 50 m. which is a backwater in the spring. Approximately 200 to 400 become trapped. Salvage is difficult because of the boulder substrate (FS 14).

Enhancement Assessment

No opportunities evident.

Side Channel I.D. R77 Relic BOTTLECAP SIDECHANNEL (96)

Average Wetted Width (m)	0.5	% Pool	30
Channel Width (m)	3.00	% Riffle	10
Minimum Flow	.00081	% Run	0
Channel Length (m)	236.0	% Glide	20
Debris (%)	30	% Slough	40
Gradient	.001		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 5 m. below culvert on Cowichan Footpath Date: 87/6/27 Crew: TB Air Photo Location No BC404 086,087
Weather: clear, warm Air Temp. 20.5 Water Temp. 13 at outlet, 9 at source Access: Cowichan footpath from Skutz Falls

Culvert at 15 m. prevents access. Good possibility of coho overwintering if it were replaced (a 1 m. arch culvert would do the job).
Bottle cap Spring, the channel's main source, flows steady at approximately .02 cms between 9 and 10 degrees. Sidechannel flow is independent of river flow but is not reflective of source discharge.

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

Replacement of a culvert underneath the Cowichan Footpath (15 m. from the river) would allow entry of coho fry for overwintering. A 1 m. diameter arch culvert set flush with the stream would do the job. This channel is excellent winter habitat-little flow fluctuation and 9 degree water. Fish may have trouble finding it however because of its size and adjacent river velocity.

Yield potential= 705 coho smolts

Production Option # 153

Side Channel I.D. R78 Relic LORENZO'S RELIC CHANNEL (97)

Average Wetted Width (m)	0	% Pool	0
Channel Width (m)	3.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	500.0	% Glide	0
Debris (%)	20	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: 30 m. from mainstem Date: 87/6/27 Crew: TB Air Photo Location No. BCC404 086,087
Weather: clear, warm Air Temp. 21 Access: Skutz Falls-Holt Creek Rd. branch, path

Flows from November to April-May; independent from river. Coho fry have been observed in winter.

Substrate Composition		Last Updated Updated By
Fines	9 %	
Gravel	1 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

A few coho fry have been observed in late winter; The channel is excellent winter habitat.

Enhancement Assessment

No evident opportunities for improvement. The channel is wetted by periodic upland seepage and the winter water table. Deepening would benefit production somewhat.

Side Channel I.D. F79 Flood FLOODCHANNEL COMPLEX ACROSS FROM BEAR CREEK (98)

Average Wetted Width (m)	0	% Pool	30
Channel Width (m)	6.00	% Riffle	50
Minimum Flow	0	% Run	0
Channel Length (m)	265.0	% Glide	10
Debris (%)	10	% Slough	10
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/6/27 Time:1600 Crew: TB Air Photo Location No. BC404 086,087
Weather: clear, warm Air Temp. 22 Access: footpath from upper campground at Skutz Falls.

A flood channel complex featuring three channels. The two innermost are only completely wetted in floods but the winter water table wets their lower ends. The outer channel carries flow from November through July or early August.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

A few coho spawn in the outer channel and some mainstem fry enter it in the spring. About 500 coho fry become trapped by mid-July. Chum spawning.

Enhancement Assessment

Excavation of a deep infiltration pool near the head of the channel might provide continuous summer rearing. Fry salvage is not practical because of low numbers available, access and catchability difficulties.

Wetted area increase	= 1590 m^2
Yield potential	= 508 Co smolts

Production Option # 154

Side Channel I.D. R80 Relic ABOVE BEAR CREEK RELIC CHANNEL (99)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	140.0	% Glide	0
Debris (%)	40	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: near outlet Date: 87/5/13 Crew: TB Air Photo
Location No. BCC404 086,087
Weather: cloudy, light rain Air Temp. 17 Water Temp. 9
Access Mayo Rd., Holt Cr. Rd.(BCFS), Old Grade, wade Bear Cr., Old Grade, bushwhack upstream

Wetted by:

1. winter water table
2. seepage from the upland in winter and spring
3. very occasional bank overtopping from the river

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho winter in this channel and a few early fry enter it to rear. Coho smolts leave before it dries but 100-500 fry are trapped.

Enhancement Assessment

Excavation of a deep infiltration pool near the inlet could improve rearing capability, summer and winter.
This channel is relatively inaccessible for heavy equipment.

Wetted area increase	= 1400 m^2
Yield potential	= 448 Co smolts

Production Option # 155

Side Channel I.D. A81 **Active** **HARDING'S CHANNEL (100)**

Average Wetted Width (m)	7.5	% Pool	55
Channel Width (m)	9.00	% Riffle	13
Minimum Flow	.011	% Run	0
Channel Length (m)	410.0	% Glide	6
Debris (%)	15	% Slough	26
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 20 m. above outlet Date: 87/8/8 Crew: TB Air
Photo Location No. BCC404 086,087
Weather: clear, hot Air Temp. 30 Water Temp. 19 (pockets of
11 degree groundwater) Access: Cowichan Footpath from Skutz Falls

Main channel branches off the log jam backchannel. Its stable and of very low gradient. A flood channel from the lower log jam backchannel contributes winter - spring flow as does a breakout channel 130 m. downstream.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawn and summer rear in this channel. Winter capability is moderate to high. **Note: Large numbers of coho in high escapement years.**
Chums also utilize this channel, particularly in years of heavy escapement.

Enhancement Assessment

No improvement required.

Side Channel I.D. F82 Flood ABOVE BEAR CREEK FLOODCHANNEL (101)

Average Wetted Width (m)	0.01	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	215.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.2		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/5/26 Crew: TB Air Photo Location No. BCC404 086,087
Weather: cloudy, drizzle Air Temp. 17 Water Temp. 9 Access: Mayo Rd., Holt Cr. Rd., Old Grade, wade Bear Cr., Old Grade, Bushwhack

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	8 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawn in this channel and spring fry attempt to rear.
Peak flow velocities are too high for wintering coho.
Chum also spawn here, especially in big years like 1985 and 1987.

Enhancement Assessment

If the inlet berm could be raised and an infiltration pool could be excavated near the inlet, summer and winter rearing value would be improved.

Wetted area increase	= 2150 m^2
Yield potential	= 688 Co smolts

Production Option # 156

Side Channel I.D. R83/B Back LOG JAM (backchannel portion) (102)

Average Wetted Width (m)	7	% Pool	0
Channel Width (m)	30.00	% Riffle	0
Minimum Flow	.0091	% Run	0
Channel Length (m)	150.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient	0		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/17 Crew: TB Air Photo Location No. BCC404 Nos. 087,088
Weather: clear, warm Access: Cowichan footpath, Bushwhack from top of 81A

Backflooded at all but minimum flows. Does not dry.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho rearing and wintering.

Enhancement Assessment

None required.

Side Channel I.D. A83 Active LOG JAM ACTIVE PORTION (103)

Average Wetted Width (m)	04	% Pool	68
Channel Width (m)	5.00	% Riffle	31
Minimum Flow	.0091	% Run	0
Channel Length (m)	500.0	% Glide	1
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/17 Crew: TB Air Photo Location no. BCC404 087,088
Weather: clear, warm Air Temp. 20 Water Temp. 9.5 Access: CN grade from Skutz, Cowichan footpath

A very complex channel system. Prior to the mid 1960's, a portion of the river was said to flow through the jam area providing excellent rearing and over wintering habitat for coho and resident trout juveniles. Brown trout were said to be especially abundant (L. Erickson, pers. comm. 1989) Lloyd Erickson MOE Nanaimo is very knowledgeable about the history of this channel. Some of the logs are remnants of the old turn of the century log drives. The log jam area is now seldom wetted even during high mainstem flows. It has a perimeter channel system (documented here) that is almost totally independent of river flow and a lagoon wetted by the perimeter stream and backflooding of the mainstem.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho use this channel for summer rearing and wintering. A few spawners are also present.

Enhancement Assessment

The upper 800 m. is now relic but could be wetted from the Drop Off Pool Flood Channel by breaching the 0.5 m. berm that separated them and excavating a deep infiltration pool just below. Assuming a minimum wetted width of 4 m., 3600 m2 of additional habitat might be produced. Dave N. put in an FsRBC Prop. 5/99. It was turned down.

Yield potential = 1,800,000 Cm fry
= 1152 Co smolts

Production Option # 157

Side Channel I.D. F84/1 Flood ABOVE BEAR CREEK COMBO
FLOOD/ACTIVE CHANNEL (104)

Average Wetted Width (m)	7	% Pool	0
Channel Width (m)	8.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	60.0	% Glide	0
Debris (%)	5	% Slough	100
Gradient	.0001/.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 60 m. above outlet, Backchannel Date: 87/5/13
Crew: TB Air Photo Location No. BCC404 Nos. 086,087
Weather: cloudy, light rain Air Temp. 17 Water Temp. 9
Access: Mayo Rd., BCFS Holt Cr. Rd., Old Bear Cr. grade, wade creek., old grade, bushwhack

This channel is often wetted by high mainstem flow but velocity is usually low.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction		

Fish Utilization

A few coho fry enter the backchannel portion of this channel in the spring; 17 were counted on May 13, 1987. Some may also winter in the channel.

Enhancement Assessment

Excavation of an infiltration pool near the inlet could provide summer flow throughout the channel.

Wetted area increase	= 630 m^2
Yield Potential	= 201 Co smolts

Production Option # 158

Side Channel I.D. A85 (105) **Active** **SAWDUST PILE POOL CUTOFF NO.2**

Average Wetted Width (m)	5	% Pool	48
Channel Width (m)	11.00	% Riffle	34
Minimum Flow	.049	% Run	0
Channel Length (m)	647.0	% Glide	18
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 100m below inlet Date: 87/8/8 Crew: TB Air
Photo Location No. BCC404 087,088
Weather:clear,warm Air Temp. 31 Water Temp. 18.0 Access: BK 51 Rd. from Skutz Falls Rd., wade river, bushwhack. Possible to hike down from Campbell Group(Hancock Timber) Bear Creek Rd. at a point .7 km from gate.

A major sidechannel. The lower 170 m are influenced by a tributary which provides gravel and cool water. It also produces sediment. In 1991, the river cut- off the upper 400 m of this channel which now carries about 50% of the Cowichan River's winter flow.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	6 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

This channel supports coho and steelhead spawning. It carries numerous coho fry(approx. $3/m^2$) over the summer and may sustain even more through winter. A few cutthroat fry are also present in the summer and brown trout fry have been reported (Burns, 1987).
Large numbers of chum salmon utilize this channel in big years.
NOTE: THIS CHANNEL NOW CARRIES ABOUT HALF THE RIVER'S FLOW AND IS THE SOURCE OF UPSTREAM TURBIDITY, THE SECOND MAJOR SOURCE AFTER STOLTZ BLUFF.

Enhancement Assessment

No improvement is required and its doubtful any is feasible - a meander cut-off channel subject to high winter velocities. However, its possible the river could take this course and strengthening the berm may be prudent. Two other possible breakout points are present nearby(see plan view). 4800 m square of habitat would be lost if the Cowichan took a short cut here.
NOTE: THIS IS NOW THE CASE. RIVER DIVERTED IN FEB.1991.

Side Channel I.D. F86 Flood FLOOD-RELIC COMBO ABOVE DROP OFF POOL (106)

Average Wetted Width (m)	3	% Pool	46
Channel Width (m)	6.00	% Riffle	42
Minimum Flow	0	% Run	0
Channel Length (m)	190.0	% Glide	12
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: centre Date: 87/5/11 Crew: TB Air Photo Location No. BCC404 087,088
Weather: rain Air Temp. 15 Water Temp. 15 Access: Cowichan footpath

Relic segment is 150 m.
6(0)E .01 8200

Substrate Composition		Last Updated Updated By
Fines	4 %	
Gravel	5 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho fry enter this channel in the spring and there is some coho spawning in most years. Almost all fry leave before the channel dries. Why fry are able to exit some channels before drying while others are trapped in similar situations is a mystery.

Chums use this channel in high escapement years. 189 carcasses were counted in Jan./1988. They were so thick in places that growths of the filamentous bacterium *Sphaerotilus* were present.

Enhancement Assessment

Permanent wetting might be provided by excavating an infiltration pool at the head of the relic section. Assuming a minimum wetted width of 2 m., 680 m^2 of additional habitat would result.

Wetted area increase	= 680 + 1020(1140-120) = 1700
Yield potential	= 544 co smolts

Production Option # 159

Side Channel I.D. F87 Flood COUGAR RUN FLOODCHANNEL (107)

Average Wetted Width (m)	2	% Pool	47
Channel Width (m)	3.00	% Riffle	50
Minimum Flow	.002	% Run	0
Channel Length (m)	60.0	% Glide	3
Debris (%)	5	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: centre Date: 87/5/11 Crew: TB Air Photo Location No. BCC404 087,088
Weather: cloudy, rain Air Temp. 15 Water Temp. 15 Access: Cowichan footpath

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	5 %	
Cobbles	2 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

A few (<50) coho fry enter this channel in the spring.

Enhancement Assessment

No improvement is necessary.

Sidechannel I.D. B87 Back COUGAR RUN BACKCHANNEL (108)

Average Wetted Width (m)	0 (int. pools in summer)	% Pool	0
Channel Width (m)	50.00	% Riffle	0
Minimum Flow	.0002	% Glide	0
Channel Length (m)	400	% Run	0
Debris (%)	5	% Slough	100
Gradient (%)	0		
Elevation (asl)	118		
Turbidity (cm)	nil		

Site location: centre, Date: 2/9/95, Crew: TB, AP loc. BCC 404 087,088
Weather: cloudy, AT: 5, WT: 6, Access: Cowichan Footpath

Prior to Feb. 1991, this was the main channel. Since then, it has been a backchannel that is completely wetted by mainstem backflooding in winter but is summer intermittent. This channel was a sharp meander.

Substrate Composition

Last Updated :
Updated by:

Fines	3 %
Gravel	6 %
Boulders	1 %
Bedrock	0 %
Compaction	L

Fish Utilization

Coho overwintering and partial summer rearing, early chum rearing. Coho, chinook and chum fry become trapped by falling water levels; fry salvage is necessary (FS 17).

Enhancement Assessment

None.

Side Channel I.D. A88 (109) **Active** **SAWDUST PILE POOL CUTOFF NO. 1**

Average Wetted Width (m)	5	% Pool	35
Channel Width (m)	10.00	% Riffle	37
Minimum Flow	.083	% Run	0
Channel Length (m)	120.0	% Glide	28
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 30 m. below inlet Date: 87/8/8 Air Photo Location No. BCC404 087,088
Weather: clear, hot Air Temp. 32 Water Temp. 20 Access: BK51 access Rd. from Skutz Falls Rd., wade or boat river, bushwhack or cut down from Hancock Rd. .7 km in from gate

Was a meander cut-off channel. Inlet berm was subject to considerable winter force. It was breached in Feb. of 1991. This channel and **85A** some 100 m south now share the Cowichan's flow.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawning and summer rearing. Steelhead summer rearing. The channel's winter capability is believed to be nil because of high flows. This was a cut - off channel with winter velocities higher than the mainstem. It is now the mainstem (1995).
Brown trout fry have been reported from this channel (Burns, 1987).
Large numbers of chums spawned in some years.

Enhancement Assessment

Strengthening the inlet berm might have reduced winter flows and increased winter habitability for coho and steelhead. It probably wouldn't have saved the channel. The bend was too sharp.

Side Channel I.D. R89 Relic SAWDUST PILE CREEK (110)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	15.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	1700.0	% Glide	NA
Debris (%)	20	% Slough	100
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 200 m. above outlet Date: 86/9/25 Crew: TB Air
Photo Location No. BC81009 057,058
Weather: NA Air Temp. NA Access: from Skutz Falls Rd. to BK51 and BK57 (TimberWest)

An old post-glacial channel complex well removed from the present river regime except in the lower 500 m. where the winter water table provides sporadic wetting and intermittent flow. This channel is also connected to a temporary creek.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None. There is excellent coho winter habitat in the lower portion for this complex but it is not wetted until late winter and a steep riffle at the confluence prevents coho fry from entering.

Enhancement Assessment

There are no improvement opportunities evident at this point. A number of small wetland basins are located in the headwater zone of a temporary tributary. Their impoundment might provide permanent flow in the tributary and about 500 m. of the sidechannel. **More detailed assessment is required however.**
It may also be possible to wet the lower 500 m by division of 90A.

Side Channel I.D. A90 Active REMOTE RUN ACTIVE CHANNEL (111)

Average Wetted Width (m)	5	% Pool	75
Channel Width (m)	10.00	% Riffle	20
Minimum Flow	.002	% Run	0
Channel Length (m)	360.0	% Glide	5
Debris (%)	5	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Upper (88 m. below inlet) Lower(outlet) Date: 87/8/8 Crew: TB Air Photo Location No. BC1009 057,058 Weather: clear, warm Air Temp. 32 Water Temp. 16.5 Access: BK 51, BK 57 access.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	6 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho summer rearing and the probability of overwintering in Reach 1. High probability of coho spawning. Chums also spawn in this channel.

Enhancement Assessment

High winter flows limit habitability. A breakout channel near the inlet could be bermed to limit high flows. Deepening the infiltration pool could increase summer flow.

Wetted area increase	= 1800 m^2
Yield potential	= 576 co smolts

Excavation of high spots may also be necessary.

Upper Site

Upper site is difficult to measure in low flows while the lower site is impossible to monitor in high flows.

Production Option # 160

Side Channel I.D. F91 Flood (112)

Average Wetted Width (m)	5	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	60.0	% Glide	0
Debris (%)	1	% Slough	0
Gradient	0		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/5/25 Crew: TB Air Photo Location No. BCC404
087,088
Weather: mostly cloudy, cool Air Temp. 17 Water Temp. 12
Access: from Skutz Falls Rd. through BK 51

Another channel is sometimes present on the point bar at the top of the meander. The bar changes annually so this occasional channel has not been mapped. In years when it's present, it's very temporary and not a production factor.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	8 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho fry are trapped in this channel, 100 to 300. In some years, water persists until autumn and about half survive. In other years, drying occurs by late July or August.

Enhancement Assessment

No enhancement practical. Salvage is not even a worthwhile option because of numbers and the difficulty of catching fry here. A willow tangle is present on the deep side of the channel and fish hide quickly.

Side Channel I.D. R92 Relic (113)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	320.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Site Location: 30 m. below upper end Date: 87/5/13 Crew: TB
Weather: Partly cloudy, cool Air Temp. 14 Water Temp. NA
Access: hike up from Bear Cr. or wade/boat across from BK 57, river only wadeable <7

Wetted by winter water table and occasional bank overtopping. **NOTE: THIS CHANNEL WAS ELIMINATED IN FEB. 1991.**

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

It might be advantageous to wet this channel via a buried pipe or French drain. At least 640 m square of coho summer rearing habitat would result but, more importantly, bleeding off some water here would remove some pressure from the two meander cut-off channels just downstream and lessen the chance of a major mainstem breakout. **CHANNEL LOST IN 1991.**

Side Channel I.D. R93 Relic THREE FIRS RELIC CHANNEL (114)

Average Wetted Width (m)	4	% Pool	100
Channel Width (m)	6.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	115.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/4/2 Crew: TB Air Photo Location No. BCC404 089,090

Wetted by the winter water table and backflooding (40 m.).

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Chance of overwintering coho in lower 40 m. which is a backchannel.

Enhancement Assessment

No practical opportunities for improvement.

Side Channel I.D. R94/1 Relic OLD STUMP RELIC (115)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	20.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	298.0	% Glide	NA
Debris (%)	NA	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: near head Date: 87/9/8 Crew: TB Air Photo Location No. BCC404 Nos. 089,090
Weather: clear, warm Air Temp. 25 Water Temp. NA Access: Skutz Falls Rd., BK 51 Rd.

An old postglacial relic channel that is never wetted. Tributary to One Pool Relic Channel.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction		

Fish Utilization

None

Enhancement Assessment

No enhancement is possible

Side Channel I.D. R94/2 Relic ONE POOL RELIC (116)

Average Wetted Width (m)	0.05	% Pool	100
Channel Width (m)	4.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	180.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: lower Date: 87/9/8 Crew: TB Air Photo Location No. BCC404 Nos. 089,090

Weather: clear, warm Air Temp. 25 Access: Skutz Falls Rd., BK 51 Rd.

Carries minor flow in high water. Main source of winter wetting is water table.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	6 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

A few coho fry enter from the Maple Tree Pool flood channel in April. Most are lost to drying.

Enhancement Assessment

Excavation is possible but impractical.

Side Channel I.D. F95 Flood MAPLE TREE POOL FLOOD CHANNEL (117)

Average Wetted Width (m)	8	% Pool	10
Channel Width (m)	22.00	% Riffle	80
Minimum Flow	0	% Run	0
Channel Length (m)	100.0	% Glide	10
Debris (%)	2	% Slough	0
Gradient	1.0		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 10 m. downstream from head Date: 87/5/12 Crew: TB Air Photo Location No. BCC404 089,090 Weather: partly cloudy Water Temp. 13 Access BK51 Rd. from Skutz Falls Rd.

Inundated by high winter flows.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	6 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Early coho fry are attracted in large numbers. An estimated 2400 were present on May 12, 1987. Unfortunately I was not able to determine if they left before the channel dried. Because it dries from the upstream end, its likely most escaped.
Early emergent steelhead fry also use this channel Steelhead
spawn within 10 m. of the inlet.

Enhancement Assessment

No improvement necessary. The bar could be lowered to prolong summer flow but this would open the channel to the erosive effects of high winter discharge.

Side Channel I.D. A96/1 Active CLAYBANK SPRING SIDECHANNEL (118)

Average Wetted Width (m)	1.5	% Pool	80
Channel Width (m)	4.50	% Riffle	20
Minimum Flow	.0073	% Run	0
Channel Length (m)	100.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Reach 1 Date: 87/6/4 Crew: TB Air Photo Location No. BCC404 Nos. 089,090 Weather: clear Air Temp. 17 Water Temp. 10 Access: BK 51

6(2) E.1 6400 100m. Backs up in winter.

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	4 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho summer rearing and wintering.

Enhancement Assessment

No improvement required

Side Channel I.D. A96/2 (119) **Active** **CLAYBANKS SPRING SIDECHANNEL**

Average Wetted Width (m)	1.5	% Pool	64
Channel Width (m)	4.50	% Riffle	28
Minimum Flow	.0073	% Run	0
Channel Length (m)	50.0	% Glide	8
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: reach 2 Date: 87/6/4 Crew: TB Air Photo Location No. BCC404 Nos. 089,090 Weather: clear Air Temp. 17 Water Temp. 10 Access: BK51

3(1) E.5 2350 50 m.

Seeps through berm and picks up groundwater seepage; some gentle winter overtopping of mainstem.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	3 %	
Cobbles	5 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho summer rearing and wintering.

Enhancement Assessment

No improvement required.

Side Channel I.D. A97 Active OUTER DOUBLE D SIDECHANNEL (120)

Average Wetted Width (m)	10.5	% Pool	31
Channel Width (m)	13.00	% Riffle	38
Minimum Flow	.62	% Run	8
Channel Length (m)	1300.0	% Glide	23
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 150 m. above outlet Date 87/8/17 Crew: TB Air Photo Location No. BC 81009 055,056 Weather: clear, hot Air Temp. 33 Water Temp. 19.5 Access: Skutz Falls Rd. BK.51 Rd., wade or boat Maple Tree Pool. Alternate access: hike down from south side of 70.2 trestle on paths and old grades including Marwoods' Paths: approximately 40 minutes to south side of Maple Tree Pool (Jap Camp).

A major side channel: the largest in length and wetted area. **IN FEB. 1991, THIS CHANNEL BECAME THE MAINSTEM. The channel is now up to 150 m wide and is still cutting. An erosion bank extends 200 m upstream from the channel head and is over 6m high in places. About 3500 m of the original channel was dewatered in the summer by this diversion. Flow has since been returned to all but the upper 300 m by excavating a channel upstream (105R).**

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	6 %	
Cobbles	2 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, steelhead, cutthroat and brown trout spawn, summer rear and winter in this channel. Late summer coho fry density is approximately 7/m^2 in pools and glides. **THIS IS NOW THE MAIN CHANNEL (1995).**

Enhancement Assessment

No enhancement necessary.

Side Channel I.D. A98 Active INNER DOUBLE D SIDECHANNEL (121)

Average Wetted Width (m)	8.6	% Pool	32
Channel Width (m)	10.00	% Riffle	33
Minimum Flow	1.58	% Run	20
Channel Length (m)	464.0	% Glide	15
Debris (%)	5	% Slough	0
Gradient	1.5		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 050,051 Weather: clear, hot Air Temp. 33 Water Temp. 20.5 Access: Skutz Falls Rd., BK 51 Rd., boat or wade Cowichan. 99/8/23 Walk down CN grade from 70.2 trestle, turn right at Y then right again and walk rd. to Pool Above the Y. Wade old channel then bushwhack. Water temp. 19.1

This channel carries more flow than any other; but it's a heavy flow with difficult wading even at minimum discharge. Riffle and run velocities range from 1-3 m/sec. Pools are short and turbulent. Inner double D is a meander cut-off channel that was likely started by a log jam. If another were to form below its inlet (unlikely), the mainstem could be isolated. **SINCE OUTER DOUBLE D IS NOW THE MAINSTEM, THIS CHANNEL CARRIES LESS WATER AND HABITAT CONDITIONS HAVE LIKELY IMPROVED, PARTICULARLY IN WINTER. NEEDS UPDATE ASSESSMENT.**

Substrate Composition Last Updated 8/23/99
Updated By TB

Fines	1 %
Gravel	5 %
Cobbles	3 %
Boulders	1 %
Bedrock	0 %
Compaction	L

Fish Utilization

Supports coho and steelhead spawning and summer rearing; brown trout fry have also been reported (Burns, 1987). Production is limited by high velocities which restrict rearing to pools and glides and probably preclude overwintering.

Enhancement Assessment

No practical opportunities exist. It would be advantageous to create a strong berm at the inlet. This would be costly and difficult and might not yield high benefits in the short term. In the long term, it may prevent the meander from being completely cut-off and diverted. The habitat value of the meander is much superior to that of the sidechannel. **DISREGARD, SITUATION CHANGED BY 97A CAPTURING RIVER.**

UPDATE: 8/23/99
The channel was surveyed again on August 23, 1999 – eight years after the river diverted south to capture Outer Double D Channel (97A) as its main channel. It was feared that Inner Double D production would be lost to drying with the new flow regime. It was for two years. However,

following construction of Finn's Channel in 1993, base flow in the old channel increased from near zero to about .07 CMS and, because the entrance to Inner Double D is slightly lower than the old channel , it draws some flow but not enough to provide continuous wetting. There is a 148 m section near the middle that dries. In the wetted reaches, coho fry are extremely numerous (density greater than 10 fry/square metre in places) and trout fry and parr are common.
Table 1 presents a reach assessment of Inner Double D conducted on 8/23/99.

INNER DOUBLE D

	Channel width	Wetted width	Sub	SL	CON	LWD	L	WA	Disch.
R1	10	9	2350	.2	FC	.0138	36	324	.023
R2	8	5	1360	.9	FC	.023	125	625	.023
R3	11	0	1360	1.6	CON	.007	148	0	0
R4	11	7	1540	1.0	FC	.004	99	693	.0012
R5	7	5	2710	.5	FC	.023	56	280	.0012

NOTE: A floodchannel from 97A (the main channel since 1991) is cutting in toward Lower Inner Double D and comes very close in R's 1 and 2.

Side Channel I.D. R99 Relic Y POOL RELIC CHANNEL (122)

Average Wetted Width (m)	0.29	% Pool	100
Channel Width (m)	4.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	112.0	% Glide	0
Debris (%)	5	% Slough	0
Gradient	.2		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 112 m. above outlet Date: 87/9/8 Crew: TB Air Photo Location No. BCC404 050,051 Weather: clear, warm Air Temp. 23 Water Temp. 16.5 Access: Skutz Falls Rd., BK51 Rd.; wade, boat or swim Cowichan at Y pool or Above Y Pool

The upper 84 m. of this channel is relic; Flood waters never reach it. The lower 112 m. is semi-active, wetted by the winter water table.

Substrate Composition		Last Updated Updated By
Fines	2 %	TB 8/99
Gravel	6 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawn in this channel; numbers are low. Some fry attempt to rear over the summer but most are lost due to drying. Approximately 500 survive in the infiltration pool.

Enhancement Assessment

Excavation could provide permanent flow in the lower 112 m.

Wetted area increase	= 318 m^2
Yield potential	= 101 Co smolts

Updated 8/23/99: No longer possible to wet channel in summer from water table or old Cowichan Channel – not enough water.

Side Channel I.D. R100 Relic ABOVE Y POOL RELIC CHANNEL (123)

Average Wetted Width (m)	0.51	% Pool	18
Channel Width (m)	7.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	210.0	% Glide	0
Debris (%)	3	% Slough	82
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 140 m above outlet Date: 87/5/12 Crew: TB Air Photo Location No. BCC404 050,051 Weather: clear, warm Air Temp. 17 Water Temp. 12 Access: Skutz Falls Rd., BK51 Rd., Branch Rd. to Above Y Pool, swim, boat or wade Cowichan

A rather complex channel. The upper 70 m. is mainly relic with no clearly defined channel; three small flood channels 2-3 m. wide are present on an old floodplain about 50 m. wide. These consolidate 140 m. above the confluence to form an intermittent section 84 m. long followed by a 56 m. backwater.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	2 %	TB 8/99
Cobbles	5 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

A few coho fry enter this channel in April and rear over the summer. Only the top pool dries. A 56x6 m. backwater is present at the lower end and is responsible for most of the rearing.

Enhancement Assessment

It would be possible to prolong flow by deepening an infiltration pool near the inlet and excavating the relic portion of the channel.

Increased wetted area	= 1058 m^2
Yield potential	= 338 Co smolts

Updated 8/99: No longer practical to prolong flow, not enough water available without compromising original Cowichan River Channel

Side Channel I.D. B101/1 Back WATERCRESS EAST BACK CHANNEL (124)

Average Wetted Width (m)	8	% Pool	0
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	.0074	% Run	0
Channel Length (m)	50.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient	0		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 051,052 Weather: clear, warm Air Temp. 30 Water Temp. 16, 12.5 in creek, 22 in river Access: Skutz Falls Rd., BK 51 Rd., Cowichan footpath

This channel is fed by Watercress East Creek, a complex groundwater system that, in part, occupies a very old relic channel.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

This channel may be utilized by overwintering coho and trout and is heavily utilized by coho fry in the spring and summer.

Enhancement Assessment

No evident enhancement opportunities.

Side Channel I.D. R101/2 Relic UPPER WATERCRESS EAST (125)

Average Wetted Width (m)	8	% Pool	0
Channel Width (m)	10.00	% Riffle	0
Minimum Flow	.0074	% Run	0
Channel Length (m)	50.0	% Glide	0
Debris (%)	10	% Slough	100
Gradient			
Elevation (m)			
Turbidity (cm)	nil		

Substrate Composition

Last Updated
Updated By

Fines	8 %
Gravel	2 %
Cobbles	0 %
Boulders	0 %
Bedrock	0 %
Compaction	H

Fish Utilization

Coho spawners and fry

Enhancement Assessment

None required

Side Channel I.D. A102 Active POOL ABOVE Y ACTIVE CHANNEL (126)

Average Wetted Width (m)	2	% Pool	66
Channel Width (m)	6.00	% Riffle	44
Minimum Flow	.0040	% Run	0
Channel Length (m)	160.0	% Glide	0
Debris (%)	1	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: central Date: 87/7/1 Crew: TB Air Photo
Location No. BCC404 051,052
Weather: clear, warm Air Temp. 20 Water Temp. 15.5 Access:
BK51 Road network then footpath

Winter flows are substantial. This channel operates like a flood channel and would be classed as such if it dried.

Substrate Composition		Last Updated Updated By
Fines	1 %	TB 8/99
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

This channel supports coho spawning in its lower 50 m. Some 300 coho fry rear in it over the summer. Its winter carrying capacity is judged to be nil due to variable high flows and lack of cover. The channel is almost straight with no undercut banks, deep pools, log jams, etc. Winter flow velocities often exceed 1 m. /sec. Fry salvage is usually required (FS 17)

Enhancement Assessment

There is no opportunity for enhancement. More summer water would be beneficial but its doubtful if it could be provided without increasing winter flow. This channel could be eliminated by a large flood.

Updated 8/99: No substantial change but channel de-waters sooner. This channel should now be considered to have more flood channel characteristics than active channel ones.

Side Channel I.D. R103 Relic BREAKFAST POOL RELIC CHANNEL (127)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	120.0	% Glide	NA
Debris (%)		% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Date: 87/7/1 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, warm Air Temp. 24 Water Temp. NA Access:
wade river just above Pool Above Y

Wetted sporadically by winter water table.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

Excavation of a deep infiltration pool near the inlet could provide summer flow. Additional downstream excavation may be required.

Wetted area increase	= 720 m2
Yield potential	= 230 Co smolts
	= 115 ch smolts

Note: Update required since 97A diversion
Production Option # 161

Side Channel I.D. R104 Relic RELIC CHANNEL BELOW INNNER DOUBLE D INLET (128)

Average Wetted Width (m)	2	% Pool	100
Channel Width (m)	5.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	130.0	% Glide	0
Debris (%)	20	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)			

Date: 87/7/1 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, warm Air Temp. 24 Water Temp 19.5 Access: cross bottom of Maple Tree Pool, hike Old Grade, cross head of outer Double D or wade river.

Wetted by winter water table. Occasional light spill from river in floods.

Substrate Composition		Last Updated Updated By
Fines	6 %	TB 8/99
Gravel	4 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho spawn in this channel; mainly in the lower 80 m. Approximately 300 fry are trapped in isolated pools. Losses are low however because pools persist until autumn and temperature does not exceed 20 degrees. There is some slight near surface groundwater seepage and the channel is completely shaded. Coho may winter in this channel.

Enhancement Assessment

A buried pipe that would provide slight flow and not allow high winter flow could optimize the yield of this channel.

Wetted area increase = 390 m2
Yield potential = 124 Co smolts

NOTE: Update required since 97A diversion Updated 8/99: no substantial change
Production Option # 162

Side Channel I.D. R105 Relic WATERCRESS WEST RELIC CHANNEL – FINN'S (Active as of August, 1993) (129)

Average Wetted Width (m)	2.2	% Pool	69
Channel Width (m)	40.00	% Riffle	18
Minimum Flow	0	% Run	0
Channel Length (m)	500.0	% Glide	13
Debris (%)	10	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near outlet Date: 87/8/8 Crew: TB Air photo Location No. BCC404 051,052
Weather: clear, hot Air Temp. 32 Water Temp. 10 Access: BK51, Cowichan footpath. Update 8/23/99 Water temp. 23

This channel is occupied by a groundwater creek in its lower 1030 m.

Substrate Composition Last Updated: 2/3/95, 12/21/96, 10/99, 6/02
Updated By: TB

Fines	8%	2
Gravel	2 %	6
Cobbles	0 %	2
Boulders	0 %	0
Bedrock	0 %	0
Compaction	L	L

Fish Utilization

Coho - cutthroat spawning, rearing and wintering. Following excavation of the upper end and more winter water, chum salmon also spawn in this channel. 60 coho holding near the culvert which is located 70 m below the inlet (12/21/96). 100 chum carcasses in upper 500 m of channel (12/21/96). Chinook spawning 10/99 near confluence of relic and excavated portion.

Enhancement Assessment

No improvement necessary, except periodic cleaning of inlet. Channel is operating near capacity.

UPDATE

This channel was extended upstream by 545 m in 1993 to provide wetting to a 3.5 km section of the Cowichan that has been dewatered by the diversion of the mainstem into Outer Double D Sidechannel in Feb. 1991. Flow is captured at a point some 140 m below the 70.2 trestle and flows through an excavated channel to join 105R which is now 105A. Winter flows range from about .3 cms to approximately 2.8 cms. 12/21/96 flow was 1.8 CMS. Length of new channel is 545 m. Berm occasionally forms at upper end of channel. It had to be excavated by hand on August 4, 1996 and nearly every summer since. The work is done by volunteers or CLSES E – Teams.

New channel dimensions are 10 (9) CON 1.0 2620. Flow can become very low if the berm builds up and cuts off input from the Cowichan. It was nearly 0 before the berm was removed in August of 1996. August 23, 1999 flow was .195 CMS.

Update (6/27/02)

Channel attempting to break out to the Cowichan near bridge crossing. Rock revettment required.

Production Option # 163

Side Channel I.D. R106 Relic FALLEN LOG RELIC CHANNEL (130)

Average Wetted Width (m)	0 (10 – 20 m since 1993)
Channel Width (m)	50.00
Minimum Flow	0
Length	1030 m below confluence of Finn's
Debris (%)	20
Elevation (m)	
Turbidity (cm)	nil
Gradient	.001

Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, hot Air Temp. 32 Access: BK51, Cowichan footpath

Wetted by water table and, as of Aug. 1993, 105A. Minimum flows are now in the order of .6 - .9 CMS.

Substrate Composition Last Updated: 2/3/95
Updated By: TB

Fines	8 %
Gravel	2 %
Cobbles	0 %
Boulders	0 %
Bedrock	0 %
Compaction	H

Fish Utilization

Coho and trout overwintering. Since diversion, Chinook, coho and chum spawning near the confluence of Finn's.

Enhancement Assessment

Excavation might provide permanent flow, particularly if combined with mainstem diversion. Head will pose a problem for diversion. **Diversion accomplished via 105.**

UPDATE

Channel is now summer wetted by 105A.

Wetted area increase	= 20 000 m^2
Yield potential	= 6400 Co smolts
	= 3200 Ch smolts
	= 10,000,000 Cm fry

Side Channel I.D. R107 Relic INSIDE (Ann's) RELIC CHANNEL (Joe Saysell's Channel)
(131)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	15.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	370.0	% Glide	NA
Debris (%)	15	% Slough	NA
Gradient	.001		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 30 m. above mainstem Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, hot Air Temp. 32 Access: BK51, Cowichan footpath
This channel is wetted by the winter water table and minor back flooding from the river.

Substrate Composition Last Updated: 2/3/95
Updated By: TB

Fines	8 %	1	2
Gravel	2 %	4	6
Cobbles	0 %	5	2
Boulders	0 %	0	0
Bedrock	0 %	0	0
Compaction	H	L	L

Fish Utilization

Coho overwintering and spring -early summer rearing. **UPDATE:** Channel no longer has rearing value; its dry 90% of the time. A few chums waste their eggs by spawning in this channel.

Enhancement Assessment

Excavation and mainstem diversion could provide permanent wetting. Excavation done 1991 but periodic monitoring – maintenance required. River thalweg is moving south.

UPDATE 2:
A new channel was constructed in 1991 in the approximate position of 107R. It was intended to provide some wetting to the section of the mainstem cut off by the Feb., 1991 diversion of the river down Double D Sidechannel and reduce the river's tendency to take the southern route. The channel is now dry except during very high flows and only serves a few chum spawners.

UPDATE 3:
Channel was re-excavated and re-positioned further downstream and more toward the river in the summer of 1996 via a USHP grant to Joe Saysell and the Steelhead Society. Channel was cut down several metres and is now wet throughout the winter. 78 chums spawned in Dec. 1996. Channel is now 6(0) CON .2 2620 280 m. Last examined 12/21/96. Now called Joe's or Saysell's

Side Channel I.D. R108 Relic OTTER SPRING CHANNEL (132)

Average Wetted Width (m)	3	% Pool	93
Channel Width (m)	5.00	% Riffle	2
Minimum Flow	.00079	% Run	0
Channel Length (m)	140.0	% Glide	5
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/8 Crew: TB Air Photo Location No. BCC404 051,052

Weather: clear, hot Air Temp. 32 Water Temp. 9.5 Access:
wade Cowichan from footpath or hike down from 70.2 trestle on the south side of the river via the Marwood Trail.

Wetted by:

1. Seepage through the inlet berm
2. Winter water table
3. Upland seepage
4. Very occasional surface run-off

Substrate Composition		Last Updated
		Updated By
Fines	6 %	
Gravel	4 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho summer rearing and probable overwintering.

Enhancement Assessment

No improvement required.

Erosion bank above the diversion (97A) is working its way up to this channel which is the first one on the south side of the river above 97A.

Side Channel I.D. F109 Flood JUNGLE CREEK FLOODCHANNEL (133)

Average Wetted Width (m)	1.6	% Pool	50
Channel Width (m)	7.00	% Riffle	50
Minimum Flow	0	% Run	0
Channel Length (m)	110.0	% Glide	0
Debris (%)	2	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/7/1 Crew: TB Air Photo Location No. BCC404 051,052
Weather: clear, warm Air Temp. 24 Access: hike up from outer
Double D after crossing the river at lower Maple Tree. Easier to hike down from CN Grade near 70.2 trestle on faint path that the Marwoods have used for quad access.

Upper 60 m. is permanently wetted. The lower 50 m. is only wetted by winter flows.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawning and spring-early summer rearing.

Enhancement Assessment

No evident opportunities. Channel is inundated by the river for much of the winter, dry the rest of the year

Side Channel I.D. R110 Relic RELIC TRIBUTARY TO WATERCRESS WEST (134)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	15.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	2000.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/7/30 Crew: TB Air Photo Location No. BCC404 051,052
Weather: rain Air Temp. 10 Water Temp. 7 Access: Skutz Falls Rd., BK51 Rd.

A groundwater creek (Watercress West) occupies this channel. The stream is permanent below 650 m. (from the mainstem) but highly intermittent above. It dries completely by June in most years.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho - cutthroat wintering.

Enhancement Assessment

No improvement possible without extensive excavation and channel improvement.

Side Channel I.D. A111 Active FAIRSERVICE SIDECHANNEL (135)

Average Wetted Width (m)	7	% Pool	70
Channel Width (m)	8.00	% Riffle	30
Minimum Flow	0	% Run	0
Channel Length (m)	280.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/6/15 Crew:Tb Air Photo
Location No. BC81009 003,004
Weather: cloud and sun Air Temp. 18 Water Temp. 12 Access:
Hudgrove Rd. or CN Tracks, walk down path from small parking area near 70.2 trestle.

Flow is from seepage through the inlet berm which is occasionally overtopped in winter. There is also winter - spring back flooding from Fairservice Creek.

Substrate Composition		Last Updated
		Updated By
Fines	3 %	
Gravel	6 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

An important coho spawning, rearing, and wintering channel. Fish enter from Fairservice Creek. Chum spawning in big years.

Enhancement Assessment

Deepening at the upper end may provide permanent flow along with some excavation of high spots.

Wetted area increase	= 560 m^2
Yield potential	= 176 Co smolts.

Production Option # 164

Side Channel I.D. R112 Relic ABOVE BRIDGE RELIC CHANNEL (136)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	15.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	382.0	% Glide	NA
Debris (%)	10	% Slough	NA
Gradient			
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 100m below inlet Date: 87/8/7 Crew: TB Air Photo Location No. BC81009 001,002
Weather: clear, hot Air Temp 34 Access: Cowichan footpath from BK51 or wade river from end of Hudgrove Road

Unlike many relic channels, this one is never wetted except for some short stretches near its outlet where it becomes soggy and hosts a few puddles supplied by the winter water table.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

Trenching the top end, installing pipe, burying it and excavating below it could create a viable active channel.

Wetted area increase	= 5730 m^2
Yield potential	= 2,865,000 cm fry
	= 1833 Co smolts
	= 916 Ch smolts

Production Option # 165

Side Channel I.D. F113 Flood ABOVE BRIDGE FLOOD CHANNEL (137)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	264.0	% Glide	NA
Debris (%)	1	% Slough	NA
Gradient	.5		
Elevation (m)			
Turbidity (cm)			

Site Location: central Date: 87/8/7 Crew: TB Air Photo Location No. BC81009 001,002
Weather: clear, hot Air Temp. 34 Access: Cowichan Footpath from BK51 or wade river from end of Hudgrove Rd.

A relatively stable flood channel.

Substrate Composition		Last Updated
		Updated By
Fines	2 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho and chinook fry were present in the two pools still remaining on May 4, 1987, ten coho, ten chinooks. Although coho spawning is possible, its probable the fish entered from the mainstem. The bar adjacent to this channel is an important coho, steelhead and chinook spawning site. Chum spawning in some years.

Enhancement Assessment

Excavation might provide permanent flow. The channel is relatively stable and far enough removed from the river that improvement should persist.

Increase wetted area	= 1584 m^2
Yield potential	= 792,000 cm fry
	= 506 Co smolts
	= 253 Ch smolts

Production Option # 166

Side Channel I.D. A114 Active OUTER JOGINDER'S (138)

Average Wetted Width (m)	2	% Pool	60
Channel Width (m)	6.00	% Riffle	20
Minimum Flow	.012	% Run	0
Channel Length (m)	720.0	% Glide	20
Debris (%)	20	% Slough	0
Gradient	.4		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Cowichan confluence Date: 87/5/27 Crew: TB Air Photo Location No. BC81009 003,004
Weather: cloudy, cool Air Temp. 14 Water Temp. 8 Access:
Hudgrove Rd. from near Brotherston's.

Portion of flow is from a sidehill spring at 600 m. It accounts for 29 percent of winter flow and a much larger proportion of summer discharge.

Substrate Composition		Last Updated
		Updated By
Fines	7 %	
Gravel	2 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho spawn, rear and winter in this coldwater channel. Brown trout fry have been reported (Burns, 1987).

Enhancement Assessment

No improvement necessary. However, gravel is limited and spawning platform construction would increase fry yield.

Side Channel I.D. A115 Active INNER JOGINDER'S (GIDE'S CREEK) (139)

A major sidechannel; springs provide all of its summer flow. Originates in an upwelling pool on Al Watson's property at a base flow rate of about 1LPS. Picks up large springs as it moves downstream. Two springs located about mid – channel have a combined flow of .086 CMS.

	CW	WW	SUB	SL%	CON	SC	LWD	L	WA
R1	7	6	9100	.8	FC	L	.063	16	96
R2	50	45	9100	.001	UC	N	na	389	17505
R3	6	5	2440	.5	FC	M	.006	400	2000
R4	3	1	4600	.5	FC	L		256	256
R5	3	1	2710	1.2	CON	N	.021	91	91
								1152	19948

Site Location: Inner Joginders Date: 87/5/27 Crew: TB Air
Photo Location No. BC81009 003,004
Weather: mostly cloudy Air Temp. 14 Water Temp. 12 Access:
Hudgrove Rd. Trial on east side for most of R1 then wade or bushwhack. Art Watson counts spawners in this channel.
Flows: .252 CMS R1 7/27/00
.204 CMS R2 2 Rd. xing. 8/27/87

Fish Utilization

Coho, steelhead and brown trout spawn, summer rear and winter in this channel. Chum salmon are also common in many years. As many as 500 coho and 100 chums have been observed. Cutthroat trout are also present. Production is somewhat limited by lack of quality spawning habitat and LWD.
Note: Kinsey Cuthbert bought the Brotherston Property in 1999.

Enhancement Assessment

Spawning habitat is limiting despite the high escapements. **Construction of at least five spawning platforms (# 167)** would provide considerable benefit. Art and Len Watson have been adding gravel and moving boulders on a limited basis. A 300 m^2 platform was constructed in R4. **A large beaver dam 16 m above the Cowichan confluence requires periodic maintenance for fish passage. The dam should be breached in the summer months to allow juvenile salmonid migration from the Cowichan. A small channel on the east side should be sufficient. Watson's installed a page wire access pass in late 1992. (# 168). Adult spawners have impaled themselves on beaver cuttings while trying to ascend the dam. Strategic addition of LWD would increase rearing value (# 169).**

Production Options # 167 Sp.Pl. # 168 beaver dam management # 169 LWD addition

Side Channel I.D. R116 Relic ART WATSON'S CREEK (140)

Average Wetted Width (m)	1	% Pool	87
Channel Width (m)	4.00	% Riffle	13
Minimum Flow	0 >260 m , .01 <260 m	% Run	0
Channel Length (m)	960.0	% Glide	0
Debris (%)	20	% Slough	0
Gradient	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Art Watson's Creek Date: 87/4/7 Crew: TB Air Photo Location No. BC81009 003,004
Weather: rain Air Temp. 7 Water Temp. 7 Access: Hudgrove Rd.

Dugout ponds at lower end used for domestic rainbow rearing. on occasion

Substrate Composition		Last Updated
		Updated By
Fines	5 %	
Gravel	5 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho spawning and overwintering. A few brown trout fry are present in the dug out ponds which also serve as a temporary holding area for coho fry salvaged in this area. Chums also utilize this creek, as do cutthroats.

1987 escapement:
Co 60
Cm 50

Enhancement Assessment

Extending excavation upstream and adding spawning gravel could yield considerable benefit

Wetted area increase	= 46200 m^2
Yield potential	= 1478 Co smolts
	= 2,310,000 Cm fry

Production Option # 170

Side Channel I.D. F117 Flood ART WATSON'S FLOODCHANNEL (141)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	4.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	190.0	% Glide	0
Debris (%)	1	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near outlet Date: 87/8/8 Crew: TB Air Photo Location No. BC81009 003,004
Weather: sunny, hot Air Temp. 32 Water Temp. NA Access: Hudgrove Rd.

Wetted by river seepage through the berm and the water table.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	8 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho and chum salmon spawn in this channel and early coho fry enter it from the mainstem to rear. A few coho overwinter in this channel and small numbers of chinook fry rear in it in the spring. Up to 18,000 coho fry have been salvaged from this 760 m^2 channel. 1987 salvage figures were 5000 coho fry, 70 coho pre-smolts, 600 chum fry and 250 chinook fry - pre-smolts. 400 coho pre-smolts were salvaged in March 2001. (FS 15)

Enhancement Assessment

This channel was created by pick and shovel labour to provide water to steelhead redds subject to drying when mainstem flows dropped. It could be further improved by more excavation and the addition of a buried water line

Wetted area increase	= 750 m^2
Yield potential	= 240 Co smolts

Production Option # 171

Side Channel I.D. A118/1 (142) **Active** **BELOW MURKY**

Average Wetted Width (m)	3	% Pool	75
Channel Width (m)	6.00	% Riffle	25
Minimum Flow	0	% Run	0
Channel Length (m)	385.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.1		
Elevation (m)			
Turbidity (cm)	30 in lower 100m		

Site Location: central Date: 87/8/7 Crew: TB Air Photo
Location No. BCC404 052,053
Weather: clear, hot Air Temp. 32 Water Temp. 13 Access :
hike Cowichan footpath from 70.2 trestle or wade/boat river from Hudgrove Rd points such as Art Watson's Bar.

Wetted by seepage through the inlet bar and the winter water table. Surface flow is not a factor except in extreme floods. Even then, flows are not abrasive. Lower approx. 330 m backfloods.

Substrate Composition		Last Updated Updated By
Fines	6 %	
Gravel	3 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Coho fry winter and summer rear in this channel. There is a high probability of spawning. A few cutthroat fry were seen on August 7, 1987.

Enhancement Assessment

Excavation of a deep infiltration pool at the upper end of wetting would improve summer flow.

Wetted area increase = 1155 m^2
Yield potential = 396 coho smolts

Production Option # 172

Side Channel I.D. R118/2 (143) **Relic** **MURKY SIDECHANNEL**

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	.0012	% Run	NA
Channel Length (m)	200.0	% Glide	NA
Debris (%)	15	% Slough	NA
Gradient	.01		
Elevation (m)			
Turbidity (cm)			

Date: 87/8/7 Crew: TB Air Photo Location No. BC81009 Nos 001,002
Weather: clear, hot Air Temp. 32 Access: Cowichan footpath from BK 51 or wade river at Art Watson's

This channel is obscure and rather ill defined. I debated whether or not to include it. It is never wetted except for backflooding in extreme mainstem flows, even then water only backs up for less than 30 m.

Substrate Composition		Last Updated Updated By
Fines	5 %	
Gravel	5 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

In the long, long view, this channel could provide permanent flow by trenching the berm, installing a pipe or French drain, reconstructing the berm, and then excavating the channel.

Wetted area increase	= 1200 m2
Yield potential	= 384 Co smolts
	= 192 Ch smolts
	= 600,000 Cm fry

Production Option # 173

Side Channel I.D. A119 (144)	**Active**	**LOWE'S SIDECHANNEL**	
Average Wetted Width (m)	18	% Pool	70
Channel Width (m)	20.00	% Riffle	30
Minimum Flow	.0224	% Run	0
Channel Length (m)	70.0	% Glide	0
Debris (%)	0	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/6/15 Crew: TB Air Photo Location No. BC81009
003,004 Weather: sun and cloud, cool Air Temp. 16 Water Temp. 17
Access: Hudgrove Rd. to Art Watson's Rd.

Inundated at high flows.

Substrate Composition		Last Updated Updated By
Fines	2 %	
Gravel	8 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Supports coho spawning and summer rearing. Early steelhead fry also rear hear along with a few parr.
This is an important coho holding pool during upstream migration- a good brood stock collection site. Heavy chum spawning in some years. (FS 18)

Enhancement Assessment

No improvement required

Side Channel I.D. R120 (145)	**Relic**	**LOWRY'S SIDECHANNEL**	
Average Wetted Width (m)	0.69	% Pool	100
Channel Width (m)	10.00	% Riffle	0
Minimum flow	0	% Run	0
Channel Length (m)	240.0	% Glide	0
Debris (%)	10	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	0		

Site location: near inlet Date: 87/8/8 Crew: TB Air Photo Location No. BC81009 002,003 Weather: clear, hot Air Temp. 30 Access: Hudgrove Rd. turn left at bottom of big hill 3.2 km from start of gravel and proceed to fifth driveway (the easternmost of two- it has a cable across it)

A berm has been bulldozed near the inlet. A single pool remains through the summer.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	7 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	M	

Fish Utilization

Important coho- cutthroat winter habitat. 600 coho pre-smolts, 50 cutthroats (including a 30 cm. fish) and 50 sticklebacks were seined April 4, 1986. The coho parr ranged from 60 to 100 mm. Fish were in a 10 m^2 pool. near the lower end known as the Iris Pool. Usual seasonal fry salvage results: 2000-4000 Co fry, several hundred pre-smolts and up to 5,000 chum fry. Chum spawning in most years. (FS 19)

Enhancement Assessment

A buried pipe, deeper infiltration pool and spot excavation could provide permanent flow. Care must be taken to insure winter flows remain low. Breakout from the river is a possibility in this channel. A new berm may be required to protect channel. Examined by Russ Doucet and Mel Sheng in June 1998.

Wetted area increase	= 3600 m^2
Yield potential	= 1152 Co smolts
	= 576 Ch smolts
	= 1,800,000 Cm fry

Production Option # 174

Side Channel I.D. R121 Relic RELIC CHANNEL NEAR CABIN POOL (146)

Average Wetted Width (m)	0	% Pool	100
Channel Width (m)	6.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	400.0	% Glide	0
Debris (%)	20	% Slough	0
Gradient Class	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: Between Ross and Cabin Pools Date: 87/6/9
Crew: TB Air Photo Location No. BC81009 003,004
Weather: cloudy Air Temp. 16 Water Temp. 10 Access:
Cowichan footpath from Ripps Rd. entrance.

Backfloods 70 m. in winter then is sporadically wetted by high water table during normal winter flows. In floods, there is occasional light spill from the mainstem. Three pools remain until early summer. Only one persists until fall rains begin. It is fed by a tiny upwelling of groundwater.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction		

Fish Utilization

A few coho fry enter this channel during high flows but become trapped when flow ceases in February, March or April. Less than 100 survive the summer. None survived the summer of 1987. (FS 18)
Seven steelhead parr wintered in the channel in 1986-87. They were trapped by April and salvaged to the mainstem along with a few coho pre-smolts.

Enhancement Assessment

A buried drain underneath the berm followed by a deep infiltration pool and spot excavation would provide permanent flow.

Wetted area increase	= 2400 m^2
Yield Potential	= 768 Co smolts
	= 384 Ch smolts
	= 1,200,000 cm fry

Production Option # 175

Side Channel I.D. A122 Active ROSS POOL ACTIVE CHANNEL (147)

Average Wetted Width (m)	10	% Pool	30
Channel Width (m)	10.00	% Riffle	70
Minimum Flow	.002	% Run	0
Channel Length (m)	100.0	% Glide	0
Debris (%)	1	% Slough	0
Gradient	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near inlet Date: 87/6/9 Crew: TB Air Photo
Location No. BC81009 003,004 Weather: cloudy, cool Air temp. 16 Water Temp. 16 (10 at upwelling spots) Access: Cowichan Footpath from Old Lake Cowichan Rd. at Ripps Rd. just west of Three Mile near fly fishing only sign.

Inundated in floods.

Substrate Composition		Last Updated Updated By
Fines	3 %	
Gravel	6 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Heavily utilized by coho for spring - summer rearing. Densities approach 10/m^2 around groundwater upwelling sites after mid-July. Chinook fry and pre-smolts also use this channel. A chinook smolt was captured on June 9, 1987 .

Enhancement Assessment

No improvement necessary. It might be possible to provide some annual short term gains by breaching the inlet berm. It closes when mainstem flow falls below 6 CMS. Because it's composed of fine, loose gravel, a shovel would do the job. However, wetted area loss is minimal when the bar closes and the channel is only accessible by foot so this measure is probably not worthwhile.

Side Channel I.D. R123 Relic RELIC CHANNEL BETWEEN PRINCESS AND ROSS POOLS (148)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	6.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	190.0	% Glide	NA
Debris (%)	NA	% Slough	NA
Gradient	.1		
Elevation (m)	0		
Turbidity (cm)			

Date: 87/6/9 Crew: TB Air Photo Location No. BC81009 003,004
Weather: cloudy, cool Air Temp. 16 Water Temp. NA Access:
Cowichan Footpath from Old LC Rd. near Ripps Rd.

Wetted by winter water table, back flooding and occasional light spill from mainstem. Coho winter in the lower 70 m. and a few are sometimes trapped. One pool remained on 4/19/87. It contained three coho parr.

Substrate Composition		Last Updated Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Coho fry enter from the lower end during high water. Most leave before flow ceases in late winter or early spring but a few are trapped. One pool remained on April 19, 1987; it held three coho parr-pre-smolts.

Enhancement Assessment

It should be possible to provide permanent wetting with a buried drain underneath the berm and downstream excavation.

Wetted area increase	= 1140 m^2
Yield potential	= 364 Co smolts
	= 182 Ch smolts
	= 570,000 Cm fry

Production Option # 176

Side Channel I.D. R124 Relic LONG WALK RELIC CHANNEL (149)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	300	% Glide	NA
Debris (%)	15	% Slough	NA
Gradient	.1		
Elevation (m)			
Turbidity (cm)			

Site Location: near outlet Date: 86/9/28 Crew: TB Air Photo Location No. BC 81009 003,004 Weather: cloudy, cool Air Temp. 14 Access: Hudgrove Rd. or wade river

Wetted by the winter water table and back flooding.

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	3 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None

Enhancement Assessment

Could be excavated to provide permanent flow.

Wetted area increase	= 3000 m2
Yield potential	= 960 Co smolts
	= 480 Ch smolts
	= 1,500,000 cm fry

Production Option # 177

Side Channel I.D. B125 Back BASS POOL LAGOON (150)

Average Wetted Width (m)	13	% Pool	0
Channel Width (m)	20.00	% Riffle	0
Minimum Flow	NA	% Run	0
Channel Length (m)	40.0	% Glide	0
Debris (%)	5	% Slough	100
Gradient Class	0		
Elevation (m)	0		
Turbidity (cm)	nil		

Site Location: near centre Date: 87/9/18 Crew TB Air Photo
Location No. BC81009 004,005 Weather: clear, warm Air Temp. 23 Water Temp. 20 Access: trails from Old L.C. Road.

One of a number of protected backwaters on the Upper Cowichan.

Substrate Composition Last Updated
Updated By

Fines	8 %
Gravel	2 %
Cobbles	0 %
Boulders	0 %
Bedrock	0 %
Compaction	M

Fish Utilization

Heavily utilized by chinook and early coho fry. Coho use continues through the summer and fall and perhaps the winter.
Cutthroat fry are present in the tiny groundwater tributary for a distance of 40 m.

Enhancement Assessment

No improvement required.

Side Channel I.D. F126 Flood JOHNNY S FLOODCHANNEL (151)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	105.0	% Glide	NA
Debris (%)	50	%Slough	NA
Gradient Class	Unknown		
Elevation (m)	0		
Turbidity (cm)	0		

Site Location: near outlet Date: 87/9/20 Crew: TB Air Photo
Location No. BC81009 004,005 Weather: clear, warm Air Temp. 23 Access: Hudgrove Rd. Wade across river from Lamb's.

Inundated by high flows.

Substrate Composition	Last Updated Updated By
Fines	5 %
Gravel	3 %
Cobbles	1 %
Boulders	1 %
Bedrock	0 %
Compaction	H

Fish Utilization

None, although there is a chance of some overwintering coho.

Enhancement Assessment

Improvement is not possible. The channel is too close to the mainstem and is inundated by high flows.

Side Channel I.D. R127 Relic SLOT RUN RELIC CHANNEL (LAMB'S) (152)

Ave. wetted width	0	% pool
Channel width	5/4	% riffle
Min. flow	0 (one pool remains @ low flows)	% glide
Length	355	% run
Debris	10	
Gradient	.5	

Site Location: near centre Date: 87/9/20 Crew: TB Air Photo
Location No. BC 81009 004,005
Weather: clear,, warm Air Temp. 22 Access: Hudgrove Rd.

Wetted by winter water table and light spill from the mainstem in high water. Flow ceases by late April or early May. Scattered pools remain until August.

Substrate Composition Last Updated: 10/16/97 Flow: .188

Fines	6 %	2	1
Gravel	3 %	6	3
Cobbles	1 %	2	6
Boulders	0 %	0	0
Bedrock	0 %	0	0
Compaction	M	L	L

Fish Utilization

Coho spawning and overwintering, cutthroat and steelhead overwintering. Coho fry emergence is very early in this sidechannel. Some are often out by late March - early April.
New residential development is occurring in this area (1994). During construction of a house in 1995-1996, a ditch was excavated that drained a wetland above Hudgrove Rd. and carried considerable silt/clay into the lower end of the sidechannel.

Enhancement Assessment

Fry salvage is required. 1997 results: Co 250, Ch 1, Ct 41.
1996 results: Co 5000, Ct 100, and some Co smolts
Excavation could provide permanent wetting

Wetted area increase	= 1120 m^2
Yield potential	= 358 Co smolts
	= 179 Ch smolts
	= 560,000 Cm fry

Note: Channel was excavated down 1-3 m in August,1997. A 10" inlet pipe was installed to provide permanent flow (89.5 LPS 8/26/97). Channel's winter capability may be compromised. Channel now has three reaches: R1 5(3) CON .3 6310 129 m, R2 4(3) CON 1.0 2620 161 m, R3 3(0) CON 1.5 1360 65 m. The intake pipe is contained in R3 which is wetted by river spill when the Cowichan exceeds approximately 110 CMS. An 18" overflow pipe is located above the intake pipe. A berm approximately 15 m long and

2 m high should have been constructed at the inlet. The channel needs more cover and spawning habitat.

Production Option # 178

Side Channel I.D. R128 Relic LUCKY'S RELIC CHANNEL (153)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	8.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	155.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient Class	.01		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: near centre Date: 87/9/20 Crew: TB Air Photo
Location No. BC 81009 005,006 Weather: clear, warm Air Temp. 22 Access Hudgrove Rd. Lucky Berner's driveway and river access.

Wetted by winter water table. Flow ceases by April or early May. Isolated pools remain until late May or June. Minor backflooding.

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	2 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Possibility of overwintering coho.

Enhancement Assessment

Excavation may provide permanent wetting but at high cost.

Wetted area increase =	1240 m^2
Yield potential	396 Co smolts
	198 Ch smolts
	620,000 cm fry

Production Option # 179

Side Channel I.D. R129/1 Relic COOK'S RELIC CHANNEL (154)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	12.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	360.0	% Glide	NA
Debris (%)	20	% Slough	NA
Gradient Class	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: road crossing Date: 87/3/12 Crew: TB Air
Photo Location No. BC81009 004,005 Weather: cloudy, cool Air Temp. 10 Access: Cooks driveway from Cowichan Lake Road

Lower 100 m wetted by the winter water table and back flooding from the river via Diespecker's Backchannel.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None, although there is chance of overwintering coho at the confluence with Diespecker Pool Backchannel.

Enhancement Assessment

There are no evident enhancement opportunities.

Side Channel I.D. B129/2 Back DIESPECKER'S BACKCHANNEL (155)

Average Wetted Width (m)	10	% Pool	0
Channel Width (m)	25.00	% Riffle	0
Minimum Flow	na	% Run	0
Channel Length (m)	70.0	% Glide	0
Debris (%)	1	% Slough	100
Gradient Class	0		
Elevation (m)			
Turbidity (cm)	nil		

Date: 87/8/10 Crew: TB Air Photo Location No. Bc81009 005,006
Weather: partly cloudy, cool Air Temp. 17 Water Temp. 21
Access: Private Drive from Cowichan Lake Rd.

A large backchannel that is in direct phase with river flow. Little eddying occurs even at high flows.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Heavily utilized by newly emergent fry - coho, chinook and steelhead. Coho remain over the summer. High probability of coho and steelhead overwintering.

Enhancement Assessment

No improvement necessary.

Side Channel I.D. R130/1 Relic HOLMES POOL (156)

Average Wetted Width (m)	0	% Pool	NA
Channel Width (m)	10.00	% Riffle	NA
Minimum Flow	0	% Run	NA
Channel Length (m)	250.0	% Glide	NA
Debris (%)	21	% Slough	NA
Gradient Class	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: near head Date: 87/6/11 Crew: TB Air Photo Location No. 81009 Nos. 006,007
Weather: cloudy, warm Air Temp. 24 Access: Hudgrove Rd., BR28 logging road
Wetted by winter water table which produces a slight flow: .064 cms (2.25 cfs) at 30 cms in the mainstem. Coho wintering conditions are excellent but none have been seen. Becomes int. by early to mid-April in most years.

Substrate Composition		Last Updated
		Updated By
Fines	8 %	
Gravel	2 %	
Cobbles	0 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

None. Winter conditions are conducive to coho rearing but the channel dries early - long before smoltification.

Enhancement Assessment

No practical opportunities are evident.

Side Channel I.D. R130/2 Relic BLOCK 28 RELIC (157)

Average Wetted Width (m)	0.05	% Pool	100
Channel Width (m)	11.00	% Riffle	0
Minimum Flow	0	% Run	0
Channel Length (m)	360.0	% Glide	0
Debris (%)	15	% Slough	0
Gradient Class	.01		
Elevation (m)			
Turbidity (cm)			

Site Location: central Date: 87/6/11 Crew: TB Air Photo Location NO. 81009 Nos. 006,007
Weather: cloudy, warm Air Temp. 24 Water Temp. 1 Access: Hudgrove Rd., BR28 logging Rd. or sewer pipeline rd.

Wetted by:

1. Backflooding
2. Winter water table
3. Occasional light spill from the mainstem
4. Upwelling in lower 50 m.

Becomes INT. by mid-April in most years.

Substrate Composition		Last Updated Updated By
Fines	7 %	
Gravel	2 %	
Cobbles	1 %	
Boulders	0 %	
Bedrock	0 %	
Compaction	H	

Fish Utilization

Possibility of overwintering coho. Light spawning and summer rearing in lower 50 m. where upwelling provides summer wetting and there is patchy gravel.

Enhancement Assessment

No opportunities apparent. Excavation of an infiltration pool would not provide permanent flow.

Side Channel I.D. A131 Active GREEN'S CHANNEL (158)

Average Wetted Width (m)	7	% Pool	30
Channel Width (m)	8.00	% Riffle	51
Minimum Flow	.0021	% Run	0
Channel Length (m)	237.0	% Glide	19
Debris (%)	0	% Slough	0
Gradient Class	.5		
Elevation (m)			
Turbidity (cm)	nil		

Site Location: 40 m. below inlet Date: 87/8/2 Crew: TB Air
Photo Location No. BC81009 006,007 Weather: clear, warm Air Temp. 24 Water Temp. 21.5
Access: Greendale Rd., Trevor and Yvonne Green's driveway.

The channel is cut off by the berm in some years. When it happens, the Greens lower the berm because the channel is their water supply. Berm elevation varies somewhat between years but is easily modified due to the fine nature of its gravel.
Wetted by the river and a small spring 50 m. above the outlet. Beavers occasionally place a dam near the lower end.

Substrate Composition		Last Updated Updated By
Fines	1 %	
Gravel	7 %	
Cobbles	1 %	
Boulders	1 %	
Bedrock	0 %	
Compaction	L	

Fish Utilization

Coho, steelhead and cutthroat fry are present as summer residents. The channel flows swiftly in fall-winter but has reasonable winter habitat capability. Spawning has not been reported except for steelhead in some years. Coho and chums likely spawn in this channel as well and perhaps brown trout and resident rainbow.

Enhancement Assessment

Creation of a larger, more stable berm and increasing channel complexity - cover could enhance rearing value. But, in the main this channel is doing just fine on its own with occasional help from the Greens.

Sidechannel I.D. 132 A Active TONY GREEN'S SIDECHANNEL (159)

Average Wetted Width (m)	7	% pool	100
Channel Width	8	% riffle	0
Channel Length	128 (119 wetted)	% glide	
Debris (%)	1	% run	
Gradient	.1	% slough	
Elevation			
Turbidity	nil		

Site Location: central. Date: 9/1/98 Crew: TB Air photo location No: BCC 81009: 06, 07
Weather: clear and hot AT 30. WT 19.1 Adjacent river 24.6 Access: thru Tony Green's

Wetted by: Water table and winter flooding. Inundated in high flows. For most of the winter, the channel is simply part of the river. Tony cleared the riparian zone of this channel in 1990 and was charged by Trevor Fields of DFO. The riparian zone extends inland some 50 m from the north edge of the channel to the inland edge of a small slope that separates the upland from the riparian/floodplain. No development was placed in the FSZ and it has been allowed to re-vegetate. Some gravel spills into the downstream end of the channel from nearby Stanley Creek; chums spawn in it. The redds occasionally become de-watered. Chris Morley and I have dug chum fry out of this gravel on occasion.

Substrate Composition:

Fines	8
Gravel	2
Cobbles	Tr
Boulders	0
Bedrock	0

Fish Utilization

Coho and chum spawning, coho and trout rearing.

Enhancement Assessment

Selective deepening might improve summer conditions – not a priority.

Reminder: More information is available in a sidechannel catalogue that was prepared in conjunction with the 1987 sidechannel assessment – (Burns et. al. 1988).

OPERATIONAL MANAGEMENT UNIT 6: RIVER NORTH

OVERVIEW

River North runs up the north side of the Cowichan Valley from the western part of the Somenos Basin (Menzies Creek) to the eastern flanks of the Town of Lake Cowichan. This OMU is entirely rural in character with small areas of settlement at Sahtlam (Upper and Lower), Paldi, Skutz Falls and Three Mile. The streams drain Hill 60 and associated bench lands.

The area is largely upland but there are some significant lowland riparian and wetland areas along Inwood Creek, Currie Creek, Mayo Lake Creek (especially above the lake), Skutz East and West, Watercress East and West and Josiah Creeks.

Aside from the above mentioned creeks, the OMU contains the following other salmonid streams or streams with the potential to support trout and salmon: Wake, Tzartlam, Bluff, Lagoon and Green Timbers East and West.

LIMITING FACTORS

Primary limiting factors are access and low summer flows. For example, Inwood and Mayo Lake Creeks have large waterfalls not subject to improvement at their lower ends and Currie Creek dries almost completely.

PRODUCTION OPTIONS

A total of 21 production options are present on the 15 streams in the OMU. (Table 4) .

Table 4: River North Production Options

No.	Location	Activity	Priority
180	Inwood Creek	Coho colonization	2
181, 182		Headwater storage	3
183,184	Currie Creek	Headwater storage – Coho colonization	2
185	Wake Lake and Creek	Coho colonization	3
186	Tzartlam Creek	Headwater storage	4
187, 188 189	Bluff Creek	Slope stabilization	3
		Wetland impoundment	3
		Coho colonization	3
190,191	Mayo Lake Creek	Improve cutthroat recruitment	2
192	Skutz East	Improve barrier	3
193,194	Skutz West	Barrier removal	1
195,196		Coho colonization	4
		LWD addition	1
		Channel relocation	3
197,198	Watercress East	Base flow improvement :	1
		excavation, headwater storage	2
199,200	Josiah Creek	Pond stocking coho or brown trout	1

Stream Code: 9202577149200

Stream Name: Inwood Creek

Operational Management Unit: River North

CVRD Electoral Area: E and North Cowichan

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan at the S pool 15.5 km above the estuary. Drains a broad, low relief basin for most of its length then enters the Cowichan River through a shallow canyon.

Air Photos	BC 82007 140-141
Topographic Map	92 B/13. 92 B.071, 92B.072, 92B.081
Salmonids	Co to 200 m. Ct to 5,200 m. Cm to 55 m. St to 200 m.
Obstructions	A 7.6 m falls 200 m upstream and a 70 m long culvert with an outlet velocity of 1-2 m/sec. at 6,000 m. Two falls 3 m over 4 and 2 m over 5 - at 8,500 and 8,520 m.
Max. Temp. (C)	15 (8/20/85)
Min. disch. (m^3)	0.000025 (8/20/85) Menzies Road. (Reach 3)

INWOOD CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	12.0	0	1720	1.5	CON	N	55	0
Reach 2	12.0	3	1315	2.0	EN	N	145	435
Reach 3	12.0	3	1234	1.0	CON	N	2500	7500
Reach 4	12.0	3	2431	0.5	OC	L	2500	7500
Reach 5	6.0	2	1360	1.5	OC	L	3000	6000
Reach 6	4.0	2	1117	10.0	CON	N	200	400
Reach 7	4.0	2	4600	0.5	OC	L	1880	3760
Reach 8	1.5	0	1360	13.0	CON	N	1500	0

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 55 m is subject to dewatering. This section is followed by 145 m of wetted habitat, largely bedrock. Resident cutthroats are present above the falls for 8,000 m.

Production is limited by low late summer discharge and short accessible length for anadromous salmonids.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Barrier to anadromous fish at 200 m. **Above barrier coho smolt yield potential**:1,980 - 9,900/Fry requirement: 24,760 **(Production Option # 180)**. Coho fry should be stocked in the fall to avoid the possibility of drying. However, Reach 7 can be stocked in the spring or summer because it never dries.

2.*HEADWATER STORAGE:* **Headwater storage potential** of 10 HA (surface area) at the head of a tributary that enters at 7500 m. **(Production Option # 181)**. Impoundment of 1 m could provide 0.009

cms for 180 days. This would significantly increase minimum flow and add 10,000 m^2 of rearing habitat.

An additional 8.2 HA of **impoundment opportunities** are located further downstream: **(Production Option # 182).**

1.2 HA at the headwaters of Hillcrest Creek

2.5 HA at the head of a tributary that enters at 4,500 m.

3.2 HA adjacent to the mainstem at 5,700 m.

The development of Hillcrest Creek would add an additional 0.007 cms and make Hillcrest Creek habitable in the summer period adding another 2,000 m^2 of habitat. The amount of additional wetted channel could provide 960 - 3,840 additional coho smolts. If the reservoir habitat were also colonized with coho fry, 984 additional smolts might result from stocking at 1500 fry per hectare.

D) LAND USE FACTORS

Agriculture

A significant portion of the basin is in agricultural production. Hillcrest Creek, an ephemeral tributary that enters 2,000 m upstream, has been highly modified. Potential impacts to Inwood Creek are considered minimal.

Residential

Light development along Cowichan Lake and Hillcrest Roads.

Forestry

Outside the agricultural zone, most of the basin is covered by advanced second growth although logging has resumed on a small scale.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

The Reaches 1 and 2 are contained by ravine/canyon and are within the Cowichan Corridor. Reach 3 is also relatively well confined with a narrow FSZ. Reaches 4,5 and 7 have significant riparian components and broader FSZ's.

Note: Bank protection (shot rock) at downstream end of Cowichan Lake Road Culvert (Old Lake Cowichan Highway) in September 2000 (JJM).

Stream Code: 9202577149000

Stream Name: Currie Creek

Operational Management Unit: River North :

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Currie Creek enters Inwood Creek from the west 2,500 m above the Inwood Creek - Cowichan River junction. The drainage area is a broad, low relief basin with a southeast aspect.

Air Photos	BC 82007 139-141
Topographic Map	92 B/13, 92B.071, 92B.072, 92B.081
Salmonids	Ct migrate from Inwood Creek in the spring they perish in most summers but a few survive in isolated pools in wet summers.
Obstructions	none
Max. Temp. (C)	N/A
Min. disch. (m^3)	0

CURRIE CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	6.0	0	1540	1.0	CON	N	1000	0
Reach 2	4.0	0	1450	1.0	FC	L	6500	0
Reach 3	4.0	1	1450	0.5	FC	L	500	500

B) FISH UTILIZATION AND LIMITING FACTORS

Currie Creek dries almost completely most summers. In wet years, it retains a few isolated pools and Reach 3 maintains a slight flow. Amazingly, a few cutthroat trout fry and parr can still be found resident in these pools and in R3.

C) PRODUCTION OPPORTUNITIES

1.*IMPOUNDMENT AND COHO COLONIZATION* (Production Option # 183) of a 25 HA headwater wetland basin (Mowat Swamp) to a depth of 1 m could provide 0.011 cms for 180 days and wet 3 m of channel width for 6,000 m providing 18,000 m^2 of quality rearing habitat in the stream. This could potentially yield from 1,440 -5,760 smolts from **colonized coho fry (Production Option # 184))**. If Mowat Swamp could carry coho fry through the year, another 300 smolts could result from a stocking rate of .15 fry/m^2. Twelve other wetlands are present in the basin and could also be utilized to augment CPD.

D) LAND USE FACTORS

Agricultural

A few small holdings. Minimal impact.

Residential

Clusters along Cowichan Lake Road between Sahtlam and Paldi town site. Light impact.

Forestry

Aside from the Cowichan Lake Road - Upper Riverbottom Road strip and Paldi town site, the basin is covered by advanced second growth.

E) PROTECTION NEEDS

For much of its length, Currie Creek is contained in a ravine with steep side slopes. The ravine constitutes the bulk of Currie Creek's Fisheries Sensitive Zone.

Fishery Officer Narrative

Stream Code: 9202577204

Stream Name: Wake Creek and Lake

Operational Management Unit: River North

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the north 19.7 km above the estuary. The system is composed of Wake Lake, a small, mature lake situated on a bench at an elevation of 105 m, several wetland basins and Wake Creek, a very small temporary stream that is inaccessible to anadromous salmonids.

Air Photos	BC 82007 140-141
Topographic Map	92 B/13, 92B.071, 92B.072
Salmonids	None
Obstructions	Two culverts at reservoir outlets 500 and 600 m below the lake - the lower has a 3 m vertical drop; the upper, a drop of 4 m. High gradient for the first 300 m prevents anadromous fish access.
Max. Temp. (C)	N/A
Min. disch. (m^3)	0

WAKE CREEK

	Channel width	Wetted width	Substrate	Slope	Confinement	Side Channel	Length	Wetted Area
Reach 1	2.0	0.0	1360	30.0	CON	N	300	0
Reach 2	1.5	0.0	6400	2.0	CON	N	600	0

WAKE LAKE

Area	Elevation	Volume	Max. depth	TDS
23	105			

B) FISH UTILIZATION AND LIMITING FACTORS

The system contains no fish. The stream dries early and the lake is privately owned.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Wake Lake has a coho smolt yield potential of 1,840 - 7,360 **(Production Option # 185)**. However, two small reservoirs are present on the Duncan property 500 m below the lake. Their levels could drop below their outlet culverts before smolts reach them so they would have to be incorporated in a storage/release plan.

D) LAND USE FACTORS

Agricultural

Light

Forestry

Advanced second growth.

Risk Potential

Low, if spring water levels are high enough to permit smolts to migrate out.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Tzartlam Creek

Operational Management Unit: River North

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan from the north 19.5 km above the estuary via the lower end of Tzartlam Active Channel. Drains a low gradient basin containing several wetland s.

Air Photos	BC 82007 140-141
Topographic Map	92 B/13, 92B.071
Salmonids	None. A few coho fry may occasionally move upstream for an unknown distance from Tzartlam Sidechannel in May. They cannot move further than Riverbottom Road where a culvert with an approximate .5 m drop at its outfall is present.
Obstructions	Increasing gradient at 530 m might pose an obstruction to adults, this is not confirmed
Max. Temp. (C)	N/A
Min. disch. (m^3)	0

B) FISH UTILIZATION AND LIMITING FACTORS

This stream supports no fish due to spring - summer dewatering. Drying usually occurs in mid to late May below Riverbottom Road then by mid – June or sooner for the rest of the creek. A three hundred metre section above Riverbottom Road was checked for fish on May 23, 2001 when ample flow was present. No fish were seen.

C) PRODUCTION OPPORTUNITIES

1.*HEADWATER WETLAND IMPOUNDMENT* (4.8 HA) could yield 0.002 cms for 150 days which would provide considerable benefit in the small channel of Tzartlam Creek **(Production Option # 186)**. Greenhouse Wetland is the primary headwater wetland basin and the main target for impoundment. Other smaller wetlands are also present and could add to the total storage. Greenhouse Wetland owners have modified it for various purposes which have increased its open water component.

D) LAND USE FACTORS

Forestry

Mainly advanced second growth; some logging has resumed.

Agriculture

There is some agricultural use of the area below Greenhouse Wetland and a portion of the creek in that area has been channeled to improve drainage. Greenhouse Wetland has been partly dredged and there is a small soil removal operation.

Residential

Light. There is some development along Culverton Road – Bel Air Crescent in the Upper Basin

Risk Potential

Low.

Stream Code: N/A

Stream Name: Bluff Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: The creek enters the Cowichan from the north through a gap in Stoltz Bluffs 2.5 km downstream from the confluence of Mayo Lake Creek with the Cowichan. A steep, largely groundwater fed stream. Several small wetlands at headwaters near Old Lake Cowichan Road.

Air Photos	BC 82007 139-140
Topographic Map	92 B/13, 92B.071
Salmonids	Co to 100 m.
	Ct to 100 m.
Obstructions	Small log jams and steepening gradient above 100 m.
Max. Temp. (C)	15 (8/6/86)
Min. disch. (m^3)	0.048 (8/6/86)

BLUFF CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4	1.5	3340	3.0	CON	N	100	150
Reach 2	3	1	3340	3.0	CON	N	400	300
Reach 3	3	1	5230	1.0	FC	L	90	90
Reach 4	3	1	9100	.1	OC	M	110	110
Reach 5	2	1	1720	1.5	CON	N	250	250

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present for the first 100 m. A total of 23 coho fry and 7 cutthroat fry were counted on August 6, 1986. Resident cutthroats are present upstream well into the headwaters. Fish as large as 40 cm were present in a .5 ha beaver pond that was present in R4 90 m above West Riverbottom Rd. The dam blew out on July 10, 1999. An estimated 15,000 cubic metres of water flashed downstream and at least 60 cutthroat morts were found. Cause of death was likely low quality water from the bottom of the pond.

Production is limited by accessible length, high gradient, small channel size and a high proportion (30 percent) of substrate fines. Probable summer rearing habitat only.

C) PRODUCTION OPPORTUNITIES

1.***SLOPE STABILIZATION ON THE RAVINE WALLS***.: Bluff Creek is a part of the Stoltz Bluff complex that contributes seasonal turbidity and sedimentation to the Cowichan River and to itself. Productivity would improve both in the creek and in the river. One stabilization project has already been accomplished on an approximate 600 m^2 slope failure adjacent to lower Reach 1 (Polster, pers. com. 1997). Slope failures are also responsible for obstructing fish passage in Bluff Creek.(Production Option # 187)

2. *WETLAND IMPOUNDMENT:* Restoration of the R4 wetland that blew out on 7/10/99 would provide 10,000 cubic metres of water with 2m of storage. This would provide .8 LPS for Bluff Creek's 90 day critical discharge period and restore the cutthroat population that thrived in the beaver pond that was located there (Production Option # 188)

3. ***COHO COLONIZATION:*** Salvaged fry from nearby Cowichan River Sidechannels (Stoltz, Dale's) could be released in Bluff Creek Target: 700 (Production Option # 189)

D) LAND USE FACTORS

Forestry - advanced second growth covers most of the basin.

Residential - light use along Old Lake Cowichan Road.

Risk Potential - Low at present. Future logging could pose substantial impact. The lower 400 m of Bluff Creek flows through a very unstable ravine.

E) PROTECTION NEEDS

Reaches 1 and 2 are located in a highly unstable ravine that features sidewalls that are nearly vertical in places. A number of small slope failures are present along with areas of soil creep. One area was partly stabilized with willow wattles but many more remain. The FSZ includes the ravine and approximately 30 m of upland on either side. It also includes the lower end of Little Bluff Creek, a tributary from the east that has a mini - ravine of its own.

Stream Code: 9202577366

Stream Name: Mayo Lake Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: The creek enters the Cowichan from the northwest 32.5 km above the estuary. The Mayo Lake drainage area includes the southeast toe of Hill 60, an area high in groundwater. The stream receives thirteen tributaries below the lake. The basin is of low relief. Mayo Lake is a shallow, eutrophic reservoir. Above the lake, much of the creek has been impounded by beavers and some very large beaver ponds are located there.

Air Photos	BC 82007 139-140
Topographic Map	92 B/13, 92 B.071, 081
Salmonids	Rb to 4,000 m.(sparse). Ct to 4,000 m. Ct are also present in Club and LePage Creeks for a distance of 1000 m.
Obstructions	A series of seven falls and cascades 0 - 100 m above the Cowichan. Total drop: 20 m. Greatest vertical drop: 3 m. Two culverts at Mayo Road: both are barriers to upstream fry movement but may be passable for yearling trout at higher flows. Vertical drop is .5 - .6 m for both at normal winter flows.
Max. Temp. (C)	19.1 R2 50 m above Riverbottom Road 8/16/97
Min. disch. (m^3)	0 (int. in very dry summers), Aug. 16, 1997: .0153 R2, Lower Club .002 17°and Lower LePage .007 20°. Upper Mayo Lake Creek is now wetted during the summer due to increased beaver impoundment (1998). R1 Upper Mayo Lake Creek: .0003168 (9/23/98)

MAYO LAKE CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Confinement	Side Channel	Length	Wetted Area
Reach 1	10.0	0.0	1117	20.0	EN	N	100	0
Reach 2	15.0	5.0	1630	1.5	FC	L	1000	5000
Reach 3	8.0	5.0	1720	1.2	FC	L	3000	15000
Reach 4	5.0	int	5500	0.5	FC	M	150	0
Reach 5	12	1.0	6310	0.5	FC	L	500	500
Reach 6	15 -150	ponds	9100	0.2	OC	H	2400	variable

MAYO LAKE

Area	Elevation	Volume	Max. depth	TDS
3.5	175		3	

B) FISH UTILIZATION AND LIMITING FACTORS

Rainbow and cutthroat trout are present in Mayo Lake (a reservoir). Rainbows are stocked, cutthroats are natural. The lake was drained 9/10/86. 205 Ct and 15 Rb were salvaged. Occasional monitoring of catch suggests that rainbow and cutthroats are caught in about equal numbers.

The creek diminishes to isolated pools late in dry summers. Numerous cutthroat fry are trapped. Many are thought to be progeny of Mayo Lake spawners and are probably unable to enter the lake until their second year because of culverts at Mayo Road and a beaver dam at the lake's outlet. These are judged to be velocity barriers to trout smaller than 10 cm. The beaver dam was replaced by a concrete dam with a stop board spillway in August of 1997. The dam apron is impassable to fry (.2 m) but larger juveniles could probably negotiate it. It is likely that the dam will always have at least one stop board which would produce an impassable condition.
Possibility of some spawning in a 80 m section of Mayo Lake's inlet below Skutz Falls Rd. No fry have been observed and the gravel is patchy, angular and compacted. This stream has dried by mid – June or early July in the 1970 – 1990 period. However, increasing headwater storage in the form of beaver impoundments provided minor summer flow last year (1997).

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION :*** Mayo Lake (3.5 HA) has a potential coho smolt yield potential of 2,800 - 14,000. However, because of its high sport fishing value (outstanding spring and fall trout fishing) it is not recommended for coho colonization.

2. ***IMPROVE RECRUITMENT POTENTIAL – MAYO LAKE:*** Since trout fry returns from outlet spawning below Mayo Lake may not be possible, inlet gravel improvement could improve recruitment and reduce or eliminate stocking. Many adult trout kelts are now prevented from re-entering Mayo Lake after their first spawning reducing the number of adult trout larger than 20 - 30 cm in the lake. However, it is suspected that some yearling trout, mainly cutthroats, return to the lake in the spring of their second year when outlet culvert passage might be possible. Fish are occasionally seen jumping at the culvert in the spring. This possibility could be improved by constructing a wing dam at the outlet of the main culvert pool or at the pool below an overflow culvert on a tributary just upstream **(Production Option # 190)** to raise levels thus reducing culvert flow velocity and vertical drop. An alternative enhancement option would be to improve the spawning habitat in the inlet stream **(Production Option # 191)** and to reduce the need for upstream migration into the lake.

An increase in Mayo Lake storage would render Mayo Creek more habitable in summer dry periods (a dam was constructed by MOE in the summer of 1996).

Annual trout fry salvage from Mayo Lake Creek could also reduce or eliminate stocking need.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth but logging has resumed in a minor way. Fifteen HA have been harvested since 1982.

Residential

A 1,500 m strip between Highway 18 and Cowichan Lake Road has been subdivided into two hectare parcels. Most are occupied. Five seasonal streams cross the development but impact has been minimal. There has been some minor impact from residential development along MacLean Road. Some residents have cleared to the streambank which has accelerated local bank erosion.

Risk Potential

Low

E) PROTECTION NEEDS

Mayo Lake Creek receives a large number of very small tributaries, most from the north: many of these drain pocket wetlands and moist woodland. They need to be avoided in forestry or land development projects. Reach 2 is bordered by some moist slopes with a number of seepage zones that should remain undisturbed. The riparian zone in Reach 2 and parts of Reaches 3 through 6 is active and very moist in places. A zone of steep slopes is adjacent to the lower 400 m of Club Creek.

Stream Code: 9202577416

Stream Name: Skutz Creek (East)

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the north 50 m below Skutz Falls. The drainage area includes the bench at the southeast end of Hill 60. The stream originates in a maze of small wetlands on this bench before dropping down to the Cowichan in Reach 3. Summer flow provided by groundwater seepage.

Air Photos	BC 82007 139-140
Topographic Map	92 B/13. 92B.071, 92B.081
Salmonids	Ct from 20 to 800 m.
Obstructions	A series of falls at Cowichan confluence: 5 m over 17. Greatest vertical drop 0.7 m.
Max. Temp. (C)	8.5 (8/21/85)
Min. Temp. (C)	5 (2/85)
Min. disch. (m^3)	.022 m^3/sec (8/21/85).
Max. disch. (M^3)	.44 m^3/sec (3/4/87).

SKUTZ CREEK (East)

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2.0	1.0	0109	25.0	EN	N	20	20
Reach 2	2.0	1.0	1540	1.0	OC	L	780	780
Reach 3	2.0	0.0	1440	2.0	CON	N	1000	0
Reach 4	3.0	0.0	4600	0.2	OC	L	2000	0

B) FISH UTILIZATION AND LIMITING FACTORS

A few resident cutthroat trout are present above the falls. Production is limited by low summer flow, narrow channel width and lack of deep pools.

Anadromous salmonids cannot utilize the stream because of a series of small falls at its confluence with the Cowichan.

C) PRODUCTION OPPORTUNITIES

1 ***FURTHER BARRIER IMPROVEMENT/BROWN TROUT COLONIZATION:*** The Provincial Fish and Wildlife Branch improved the falls in 1982 so that colonized brown trout would return. Observation of the falls at optimal flow suggests that adult browns should be able to navigate them but with considerable difficulty. The probability that they cannot and that annual fry stocking will be required should be considered. Several minnow trapping efforts in Reach 2 caught no browns (Production Option # 192).

D) LAND USE FACTORS

Forestry

Advanced second growth covers most of the basin but logging has resumed. 10 HA have been logged since 1980.

Residential

Light.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

A large number of wetlands are present in the upper basin of Skutz East along with a network of tiny seasonal tributaries and moist soils. Careful treatment is required in any forestry or land development operation. Reach 3 is located in a ravine where adjacent slopes are near 70% in places and there are areas of high soil moisture. Adjacent logging has caused major lowdown of streamside and adjacent slope trees here.

Stream Code: N/A

Stream Name: Skutz Creek (West)

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan at Skutz Falls. The drainage area includes the southeast end of Hill 60. Summer flow provided by groundwater seepage. The stream originates in a number of wetlands near TimberWest's Block 51 Road.

Air Photos	BC 82007 139-140
Topographic Map	92 B/13, 92B.071
Salmonids	Ct to 475 m Co to 35 m Cm to 35 m
Obstructions	Culvert at 35 m: velocity barrier. Velocity at mean winter discharge = 1.79 MPS. This is a wood stave culvert 17 m long and 1.4 m in diameter. Attempts have been made to backflood it but the angle is too steep.1 m culvert at 485 m.
Min. Temp. (C)	4 (2/85)
Max. Temp. (C)	12 (8/21/85)
Min. disch. (m^3)	0.023 (8/21/85)
Max. disch. (m^3)	0.36 (3/4/87)
Mean winter	.08 (3/10/00)

SKUTZ CREEK (West)

	Channel width	Wetted width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	3	1	1450	2.0	CON	N	0	35	35
Reach 2	3	1	1720	1.8	FC	L	.013	475	475
Reach 3	2	0	2620	2.5	CON	N		750	0
Reach 4	6	0	1000	.2	OC	L		800	0

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and an occasional chum utilize the lower 35 m where a culvert blocks passage. Resident cutthroats are present in the lower 510 m. The cutthroats are present in low numbers because of the lack of cover, low summer flows and lack of winter habitat.

Anadromous salmonid access is blocked by a culvert at 35 m which is a velocity barrier. The culvert is an old wooden structure 17 m long. Velocities are approximately 1.6 to 2.0 m/sec at moderate to high flows. The stream dries during the summer, at a point 20 m above the second culvert at 475 m upstream.

C) PRODUCTION OPPORTUNITIES

1. ***BARRIER IMPROVEMENT:*** The Fish and Wildlife Branch back flooded the culvert pool in 1982. Their objective was to allow brown trout passage at high flows. It was unsuccessful and needs to be removed. Brown trout colonization at 1 fry/m^2 would require 475 fry. Removal of the first culvert or diversion of the stream to an old channel 50 m east. Diversion would add 150 m^2 of summer habitat **(Production Option # 193)**. **There is a barrier (1.53 R) at the confluence with the Cowichan that would also require minor improvement for fish passage**.

2. *COHO COLONIZATION:* Above barrier coho smolt yield potential: 38 Fry required: 475 **(Production Option # 194)**.

3. ***LWD ADDITION:*** Reach 2 lacks LWD. Density is only .013 and consists entirely of old cedar logs left as slash from the first cut. R2 is reasonable fry habitat but pool depth and cover is limiting for parr plus fish. Scour logs should be the first LWD priority. (**Production Option # 195)**

4. ***CHANNEL RELOCATION:*** Relocation of a portion of R2 to the west would extend R2 length and reduce gradient. It would also place the new channel in an area of elevated groundwater **(Production Option # 196).**

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth; logging has resumed on a small scale. TimberWest has been logging wet of Skutz Falls Road for several years.

Residential/Agricultural

Very light. There are two residences on Connolly Road. The westernmost borders the creek and some modification has occurred but impacts are not significant. Two small pastures border the creek but use is very sporadic and riparian leave zones are intact.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Skutz West is very similar to its counterpart, Skutz East. Its upper basin features a number of small wetlands and an extensive riparian area and its Reach 3 and the upper 217 m of Reach 2 are in ravines with sensitive slopes which need protection along with the Reach 4 riparian zone and wetlands, A small riparian zone which features considerable seepage including a seepage stream from a small wetland that is located just above the old E and N grade 50 m west of Skutz Falls Road, is present on the west side of the creek above Connolly Road. The riparian zone extends south of Connolly then turns west to join Skutz West. This riparian feature may be an old channel of the creek.

Stream Code: N/A

Stream Name: Watercress Creek East

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A complex groundwater system supplied by upland seepage and perhaps by Cowichan River groundwater. Recent beaver activity in the mid-basin has increased storage and the opportunity to improve summer flow which is nil for nearly 70% of the stream's accessible length. Partially located in a post-glacial relic channel of the Cowichan. The lower 100m is Cowichan back channel 101B - see OMU 5.

Air Photos	BC 82007 138-139
Topographic Map	92 B/13, 92B.071, 92B.081
	Co to 872 m.
	Ct to 872 m.
Obstructions	None. Dries at 872 m.
Max. Temp. (C)	8 (9/20/85)
Min. disch. (m^3)	.014 to 872 m (9/12/86)
	0.006 Upper 500 m of 872 m (9/20/85)

WATERCRESS EAST

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	10	8	8200	.001	CON	N	101	808
Reach 2	12	2	2800	.5	FC	L	471	942
Reach 3	6.5	1.5	3700	.5	FC	L	300	450
Reach 5	5.0	0	1630	2.0	FC	N	1400	0
Reach 6	25.0	0	1000	.1	OC	H	400	0
Reach 7	4.0	0	3700	.5	OC	H	350	0
Reach 8	3.0	0	1450	15.0	CON	N	1200	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present throughout the stream's wetted length. Production is limited by low summer flow.

C) PRODUCTION OPPORTUNITIES

1. ***SUMMER FLOW IMPROVEMENT - EXCAVATION:*** Habitable area might be extended upstream by excavation. A few isolated pools are present for 300 m above the end of summer flow. **Excavation** may also increase flow **(Production Option # 197)**. Wells should also be considered. A well that provides 6 C water at four litres per second is located 1000 metres downstream (Kennedy's Well).

2. ***SUMMER FLOW IMPROVEMENT – HEADWATER STORAGE:*** Recent beaver (1997) beaver impoundment in Reaches 6 and 7 has provided an opportunity to provide downstream summer flow to 1800 m of summer dry habitat. The largest impoundment has an estimated volume of 88,400 m^3. This would provide 11.36 LPS for three months. Estimated wetted area increase would be 5400 m^2 which could produce an estimated 432 coho smolts (Production Option # 198).

D) LAND USE FACTORS

Forestry

The area is covered by advanced second growth. Approximately 20 hectares adjacent to the stream were logged in the early 1980's. A large percentage of the mid-basin was logged by the Doman (Aldermere) Group in the latter part of the 1980's and early 1990's.

Residential

Very light however the Doman Group (Aldermere) have proposed a land development that could affect part of the basin.

Fishery Officer Narrative

E) PROTECTION NEEDS

A very large portion of the stream adjacent lands (SAL) are fisheries sensitive. The upper basin (R8) because of steep adjacent lands on the most precipitous portion of Hill 60 Ridge where slopes are vertical in places. Fortunately, they are largely bedrock slopes. All other reaches except Reach 5 are sensitive because of extensive riparian lands including marsh and swamp. Reach 5 is a transitional reach between the lowland reaches on the Cowichan Floodplain and the bench reaches (6 and 7) at the toe of Hill 60.

Stream Code:N/A

Stream Name: Watercress Creek West

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan from the northwest 300 m west of Watercress East. Another complicated groundwater system located in a complex of postglacial relic channels of the Cowichan River. Upland groundwater seepage contributes to low summer stream flow. Blends into Finn's Channel and is an important factor in wetting and cooling the old Cowichan River Channel between the Double D diversion and the Maple Tree Pool.

Air Photos	BC 82007 138-139
Topographic Map	92 B/13, 92B.071, 92B.081
Salmonids	Co to 750 m.
	Ct to 750 m.
Obstructions	None. Dries above 750 m.
Max. Temp. (C)	10 (8/8/87)
Min. disch. (m^3)	.0631 (8/8/87)

WATERCRESS WEST

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4	4	7300	0.01	CON	L	500	2000
Reach 2	5	2.2	2610	0.5	CON	N	250	550
Reach 3	15	0	8200	0.01	OC	NA	490	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few cutthroats are present for about 750 m. The amount of wetted channel varies somewhat between wet and dry years.

C) PRODUCTION OPPORTUNITIES

It might be possible to capture groundwater by excavation or with a well but these would be costly gambles for little benefit.

D) LAND USE FACTORS

Forestry

Advanced second growth covers most of the basin. 20 HA of early regeneration are present adjacent to reach 2. Logged in 1976.

Risk Potential

Low.

E) PROTECTION NEEDS

Rather extensive riparian lands are located in the Watercress East Basin.

Stream Code: 9202577545

Stream Name: Josiah Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the north, five kilometres below Cowichan Lake. Its flow comes from a complex network of seepage channels along the toe of Hill 60.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, B13. 92B.081, 92C.090
Salmonids	Co to 1260 m. Ct to 1260 m.
Obstructions	1 m over 2 cascade at 1260 m, sharply increasing gradient above. E & N culvert at 200 m on the West Fork is a velocity barrier (1.7 m/sec). 1 m vertical drop culvert outfall is present at Cowichan Lake Road (250 m) on the West Fork.
Max. temp. (C)	12.5 (5/7/87). Maximum temperatures usually occur in the first heat of the season when surface water is still contributing to the run-off. When the contribution from surface run-off is reduced, Josiah Creek falls back to 9.5 C.
Min. disch. (m^3)	0.007 (8/31/85).

JOSIAH CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4.0	2.0	1360	6.0	ENT	N	50	100
Reach 2	5.0	2.0	7200	.5	OC	M	780	1560
Reach 3	3.0	1.0	3700	1.0	FC	L	330	330
Reach 4	2.0	1.0	1450	3.0	CON	N	100	100
Reach 5	-	-	-	25.0	ENT	N	1500	-

WEST FORK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2.0	1.0	3700	1.0	CON	L	200	200
Reach 2	2.0	1.0	2810	3.0	CON	N	50	50
Reach 3	-	-	-	45.0	CON	N	1500	-

B) FISH UTILIZATION AND LIMITING FACTORS

Josiah Creek supports a small population of resident cutthroats and sporadic coho runs. No coho fry were observed between 1982 and 1986. On April 19, 1987, about 5,000 coho fry were counted by walking the stream margin.

Production is limited by a small area of useable habitat.

C) PRODUCTION OPPORTUNITIES

1. *COHO PONDING:* Two backyard ponds (Eric's Ponds now the property of Cheapman Joe), 60 m^2 each, are present in reach 4. In the spring of 1986, the Cowichan Lake Salmonid Enhancement Society stocked the ponds with 16,000 1 gm. coho fry, a rate of 133 gm/m^2 (surface area). The fish were doing well until predators decimated them. Two thousand survived and smolted **(Production Option # 199)**.

2. ***BROWN TROUT PONDING AND STOCKING :*** If 12,000 1 gm brown trout were stocked (100 gm/m^2 is the recommended rate - Clemmons, 1985) and predator control measures undertaken; the ponds should be capable of yielding some 6,000 yearlings.
It would also be worthwhile to **stock brown trout fry** in Josiah Creek at 1 fry/m^2 and 10 percent survival to age 1,234 yearlings would be provided to the upper Cowichan from the 2,090 m^2 of suitable habitat in Josiah and 250 in its West Fork (2,340 total) **(Production Option # 200).**

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. Logging will resume in the next decade.

Residential

Light. Scattered along Cowichan Lake Road.

Risk Potential

Moderate due to the number of small seepage streams that provide much of the flow. Ten have been located. How far they extend up Hill 60 is unknown. Very careful pre-logging reconnaissance will be required. Each should be flagged. The area near the creek will be skidder logged so the impact potential is significant. Soils in the lower basin are moist with high organic and clay content.

E) PROTECTION NEEDS

Josiah Creek Basin contains a large number of seepage areas, tiny tributaries and pocket wetlands. These need to be included in DPA's or special zoning . They are so numerous and so small that only a mapping program at the scale of 1:1,000 or more would portray them.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Lagoon Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Description: A very small groundwater fed stream tributary to Bass Pool Lagoon, a Cowichan River Backchannel No. 125A.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92 C.090
Salmonids	Ct 40 m
Obstructions	A 6 m over 20 cascade at 40 m
Max. Temp. (C)	13 (9/18/87)
Min. Disch. (m)	0.0007 (9/18/87)

LAGOON CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	1	.5	3620	.5	FC	N	40	20
Reach 2	1	.5	1360	4.0	CON	N	-	-

B) FISH UTILIZATION AND LIMITING FACTORS

A few cutthroat fry utilize the first 40 m. Production is limited by small usable area.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Area forest cover is advanced second growth.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

The most sensitive portion is located in the Cowichan Corridor. The FSZ extends upstream to cover steep adjacent slopes. The stream is located in a steep ravine for much of its length on Hill 60.

Stream Code:N/A

Stream Name: Last Creek

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Overview: A small, groundwater fed stream tributary to the north side of Cowichan River 100 m above Bass Pool Lagoon.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	Ct 120 m
Obstructions	2 m falls at 120 m
Max. Temp. (C)	13 (9/18/87)
Min. Disch. (m)	0.0096 cms (9/18/87)

LAST CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2	1.0	2710	.5	FC	N	60	60
Reach 2	1.5	.8	1720	3.0	CON	N	500	400

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat fry and parr utilize the lower 120 m. Production limited by small productive area.

C) PRODUCTION OPPORTUNITIES

This stream is a good candidate for small-scale incubation measures and is a good location for brown trout but no specific measures are recommended. The stream is very small and access is difficult.

D) LAND USE FACTORS

Undeveloped forest - advanced second growth.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Stream Code: N/A

Stream Name: Green Timbers East

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Overview: Enters the Cowichan from the north 4250 m below the weir. Drains a steep, narrow basin on the south face of Hill 60.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090 Co to 428 m Ct to 800 m Bt to 428 m
Obstructions	Culvert at Cowichan Lake Road is a velocity barrier.
Max. Temp. (C)	13 (10/17/87)
Min. Disch. (m)	0.0092 (8/10/87) a 65 m section between 343 and 408 m dried in August 1987.

GREEN TIMBERS EAST

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	3	1	1540	2.0	CON	N	428	428
Reach 2	3	1	1360	4.0	CON	N	300	300
Reach 3	2	1	136R	10.0	ENT	N	1500	1500

EAGLE EYE CREEK (E FORK)

Reach 1	2	1	1430	2.0	FC	L	100	100
Reach 2	1	1	1360	5.0	CON	N	-	-

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroats, coho and few brown trout have been reported. A survey on August 9, 1987 revealed only cutthroat fry and parr (35 - 70 mm). Densities were high (2.7/m) and it is suspected Cowichan River cutthroat spawn in this stream. Fry emergence is exceptionally early (April 15 in 1987) which indicates spawning probably occurs in November or early December as it does in Beadnell Creek.

Production is limited by short accessible length.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Approximately 40 percent of the stream's length was logged in 1987. The remainder is scheduled to start in 2020.

Risk Potential Moderate.

E) PROTECTION NEEDS

For much of its length and in particular, above R2, the creek is in a steep walled ravine/gully that will require careful forest development planning in terms of road and landing location and yarding set up.

Stream Code:N/A

Stream Name: Green Timbers West (Exeter Creek)

Operational Management Unit: River North

CVRD Electoral Area: F

A) Biophysical Overview: Enters the Cowichan from the north 3250 m below the weir. Drains a steep, narrow basin on the south face of Hill 60.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	Co, Ct, Bt 280 m
Obstructions	E & N culvert at 280 m (1m vertical drop)
Max. Temp. (C)	10 (6/17/87)
Min. Disch. (m)	0.017 (6/17/87)

GREEN TIMBERS WEST

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	3	1	1360	3.0	CON	N	280	280
Reach 2	3	1	1270	5.0	CON	N	320	320
Reach 3	3	1	127R	10.0	ENT	N	1500	1500

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, cutthroats and brown trout are present in small numbers.

Production is limited by the small accessible area and relatively high gradient. Spawning potential is minimal.

C) PRODUCTION OPPORTUNITIES

Removal of E&N culvert would provide an additional 300 square metres of habitat.

D) LAND USE FACTORS

Forestry

Logging is under way in the lower basin. The upper watershed is scheduled for logging in 2020. Pacific Forest Products logged a 40 Ha setting just to the west in 1994.

Residential

A few residences along and below Old Lake Cowichan Rd.

Risk Potential

Low.

E) PROTECTION NEEDS

The FSZ is rather narrow (15m) below Highway 18 but the stream enters a steep sided ravine above the highway and this landscape unit is included in the FSZ.

OPERATIONAL MANAGEMENT UNIT 7: LAKE COWICHAN NORTH

OVERVIEW

OMU 7 consists of the north side of the Town of Lake Cowichan and nearby Greendale Road which is technically not part of the town but is only somewhat less “townlike” and adjacent uplands. Aside from riparian lowlands along Greendale Road that front on Tiny Creek and the Cowichan River (the Cowichan has an OMU of its own and is not part of this one) and riverine riparian lowlands adjacent to Reaches 11 and 12 of the Cowichan (Park Road area and adjacent to the Upper Pool along Wavell Rd.), most of the unit is upland and part of the Hill 60 Complex. A significant upland riparian landscape unit forms the summer headwaters of Oliver Creek and is just below Teleglobe Canada.
The OMU contains 8 streams: Tiny, Stanley, Birdcage Spring, Atchison, Beadnell, Oliver (Hatchery), Tern and Maple Leaf Brook. Maple Leaf Brook exists as a remnant only. Tern and Beadnell have been highly compromised by urban development. Maple Leaf Brook and Tern were never major producers but Beadnell was a very good coho-cutthroat producer. The major production impediment in Beadnell is a 500 m concrete flume that comprises R2. Birdcage Spring and Atchison Creeks are very short spring creeks that are not normally salmonid producers.

LIMITING FACTORS

Access and low summer flow are the prime limiting factors in this OMU. Urban runoff/water quality are also factors.

PRODUCTION OPTIONS

30 production options are present in the OMU. They are presented in Table 5.

Table 5: Lake Cowichan North Production Options

No.	Sub-Basin	Activity	Priority
201	Tiny Creek	Instream incubation	2
202		Spawning platforms	1
203		Cover addition	2
204		Headwater reconnection	2
205		Runoff retention	1
206		Summer storage	2
207	Stanley Creek	Fry salvage	1
208		Spawning platforms	5
209		Pool maintenance	1
210	Birdcage Spring	Fry stocking	1
211		Incubation boxes	1
212			
213	Atchison Creek	Incubation boxes	3
214	Beadnell Creek	Flume removal	1

215		Flume improvement/Cowichan Lake Rd. culvert imp./concrete sec. Imp.	1
216		Neva Cr. barrier removal	2
217		Annual refuge pool construction	1
218		Lower Neva channel improvement	3
219		Selective excavation – Reach 3	2
220		LWD addition	2
221	Oliver (Hatchery)	Adult barrier removal	1
222-223-224		Juvenile barrier removal	2
225		LWD addition	1
226		Riparian restoration	2
227	Tern Creek	Spawning platform	1
228		Incubation boxes	1
229		Juvenile barrier removal	1
230		Coho colonization	1
		Total	30

Stream Code: N/A

Stream Name: Tiny Creek (Little Creek, Greendale Brook, Brooks Creek)

Operational Management Unit: Lake Cowichan North

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan 2,500 m below the weir; a groundwater stream that originates in springs near Old Lake Cowichan Road. Original course continues up Hill 60 above Highway 18. It was diverted into Stanley Creek during construction of Highway 18 in early 1970's.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 465 m. Ct to 465 m. Bt to 465 m.
Obstructions	E&N culvert; .5m vertical drop to 1998 then rusted away inside the CSP. This culvert is a velocity barrier but only excludes fish from 26 additional metres of habitat. Stream originates from seepage areas near the E+N Grade and upstream along Old Lake Cowichan Road. Some of the water comes from an area under residential development (1992-1994...). The creek used to originate on the slopes of Hill 60 but Highway 18 construction (1970) diverted the upper portion into nearby Stanley Creek. A resident of upper Tiny Creek (Nels Olson) also diverted some springs from Upper Tiny to Stanley Creek.
Max. Temp. (C)	9 (8/31/85) 14.5 R2 (8/5/98)
Min. disch. (m^3)	0.0025 (8/31/85) at Greendale Rd. The lower 218 m dries in most years (Greendale Rd. to the Cowichan River).
O_2	11.6 @ 12.6° R1 8/30/01
PH	7.7 – 8.3 8/30/01
TDS	25 – 27 mg/L 8/30/01

TINY CREEK

	Channel Width	Wetted Width	Substrate	Slope%	Channel Confinement	Side Channel	LWD	Length	Area
Reach 1	1	0	2710	1.5	CON	N	0	218	0
Reach 2	1	1	6400	.5	FC	L	.016	183	183
Reach 3	.8	.8	2710	2	CON	N	.019	64	51
Reach 4	.7	.7	2710	2	FC	L	0	26	18
Reach 4b	2	1	9100	.5	CON	N	0	61	61
Reach 4c	1	.4	9100	.5	CON	N	0	58	23.2

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, resident cutthroats and brown trout use the stream. Occasional chums are also reported and a few steelhead were present prior to diversion of the upper portion of the creek into Stanley Creek. According to area residents, chums were sometimes very numerous in this little stream and they helped keep its gravel clean and loose. Tiny Creek is one of only five Cowichan tributaries used by brown trout. Major production limits are size and length. Gravel quality and instream cover are also somewhat limiting. Up to 150 coho have been counted in Tiny Creek. Runs since 1985 have generally averaged around 20 but in 1997, escapement was even less than that.

Migratory cutthroat trout from the Cowichan River or Cowichan Lake also spawn in Tiny Creek, sometimes very early similar to Beadnell Creek. A spawning pair was observed on Nov. 24, 1998. They spawn sporadically up to as late as mid-April.

Tiny Creek's summer base flow appears to have been improved since Nahirnick's Spring (Reaches 4b and 4c) was ditched along the E&N grade in 1997 to enter the creek at the 401 m point. Another

portion of the groundwater on the Nahirnick Property is located lower down toward the Scholey Property which it traverses before entering Tiny Creek via a ditch Mike Scholey dug to drain his property somewhat. The ditch enters Tiny Creek at 330 m just 33 m upstream from Trudy Amman's Pool. This ditch is responsible for much of the recent sedimentation in the creek (2001).

C) PRODUCTION OPPORTUNITIES

1.***SUPPLEMENTAL INCUBTION*:** Well suited for a small hatchery or incubation boxes. Flow fluctuation is minimal and temperatures generally range between 3 and 9 (**Production Option # 201)**

2. ***GRAVEL ADDITION/SPAWNING PLATFORMS:*** Gravel quantity was reduced above Greendale Road. Only about 20 m^2 of high quality spawning habitat remained in this section. CLSES added new gravel (8 cubic metres) in the summer of 1994. **More gravel restoration work is required. Three spawning platform sites are located in upper Reach 2 at:**

1. The point just below Tiny turns into a .5 m ditch before it turns and follows the E and N grade: gravel required – 1.2 m^3
2. A point 17 m downstream, gravel required - .6 m
3. A site 24 m downstream from the upper site and 11 m below the middle location. Gravel required - .6m^3

Production Option # 202). Most fry likely emigrate to the Cowichan to rear although this creek does support rearing and overwintering coho and trout. NOTE: These sites received gravel in the summer of 1999. An E – TEAM worked on them.

***3.COVER ADDITION*: Instream cover improvement is required (Production Option # 203).** CLSES dug a pool in the summer of 1994 and about 15 cutthroat trout ranging between 15 and 30 cm now reside there more or less permanently. Gord Mutch and Trudy Amman, the property owners, feed them. Optimal areas for cover addition are in lower Reach 2 adjacent to the lawn section of the Mutch-Amman Property and upper Reach 2 adjacent to the proposed sites for additional spawning habitat. Overhang crib logs could be utilized to mimic bank undercut or lunkers could be used as well as small windfall log LWD . Pool creation has also proved viable in this small creek. Trudy's Pool at 298 m has persisted well and other pools could be excavated in Upper Reach 1 or Lower Reach 2.

4. *LINK STREAM WITH HEADWATERS*; Restore the diverted section of the channel by simply removing the low berm constructed to divert the stream, re-constructing the channel and installing a small weir to allow peak flows to enter Stanley Creek **(Production Option # 204)**. This measure would probably double the early summer rearing area of Tiny Creek. Unfortunately, it wouldn't change minimum late summer flows because this 300 m long portion of the creek dries in mid to late summer. It would also improve flushing and gravel quality.

5. CONSTRUCT RUNOFF RETENTION POND: A runoff retention pond is needed to detain storm water runoff from Lake Park Estates. This development has been a problem since 1993. Problems with runoff are somewhat less now that most construction is finished but a retention pond is still needed. (**Production Option # 205)**

6. *INSTREAM SUMMER STORAGE:* A small dam is present on the Auger Property at 114 m. It can be utilized to backflood the creek in the summer months to create a rearing pond. This portion of the creek is usually dry from sometime in August to sometime in mid to late October (**Production Option # 206)**

D) LAND USE FACTORS

Agricultural : There is farm operation on the Scholey property on Greendale Road which has intruded the FSZ of Tiny Creek and is producing impacts in the form of periodic sedimentation from ducks and geese in the creek or a man made channel tributary to Tiny Creek. Mr. Scholey would like to increase his farm activities but they are already at an unacceptable level. If Mr. Scholey cannot control impacts from his operation, this property should be either purchased or zoned out of farming via tax relief. Note: Rick Poole, a Scholey employee, constructed a pen for the ducks and geese in September 2001.

Residential: Light over the lower basin but Lake Park Estates, a residential development located adjacent to Old Lake Cowichan Rd. and the headwaters of Tiny Creek, has been a problem since construction began in the spring of 1993. The present headwaters of Tiny Creek are a series of seeps in the ditch between the property and Old Lake Cowichan Rd. Runoff from construction activities has

entered the stream on many occasions between the spring of 1993 and the winter of 1997. The developer (Wayne R. Allen, 988 Khenipsen, Duncan, 746-7825) has been contacted on a number of occasions as has DFO, the Village and the Ministry of Environment. The major problem with this development is that it went ahead without a plan or contract so there are no clear lines of responsibility. The secondary problem is that the contractors have been working in periods of heavy runoff.

Risk Potential Low. The stream normally receives little surface runoff. However there has been a good deal of it since the winter of 1993-94 when developers attempted to work in unsuitable weather.

E) PROTECTION NEEDS

Much of Tiny Creek Basin is riparian /floodplain some of which is covered by housing and a small farm. There have been and will be attempts to drain and fill the moister portions of these lands. A property owner on the west side of Tiny Creek (Scholey) has attempted to drain the lower portions of his property on at least two occasions. On the latest attempt, a ditch was constructed. Fill should not be permitted and any drainage measures should be very carefully considered. It is quite likely that significant drainage improvement is impossible given the nature of the land. This property should either be purchased or given tax relief in the riparian portion in exchange for conservation.

F) Historical Notes:

Coho escapement has ranged between 12 and 100 in the 1986 to 1998 interval. 1988 escapement was 100. The 1998 (80) return is typical of the manner in which coho spawners utilize the stream. The first wave of fish consisted of 22 which entered on Nov. 24 in a period of high water. 98 mm of rain fell in the previous three days and 72 mm fell on Nov. 24. Tiny Creek does not fluctuate much with runoff events but it is so small that any increase is significant in terms of coho migration. There were 38 fish in the next group which entered on Dec. 12, after another period of substantial rain. Rainfall had dropped off between Nov. 25 and Dec. 12. The last run (20 fish) came in between Jan . 5 and Jan. 8, This was not a rainy period although 27 mm did fall on Jan. 8. Chris Morley documented the 1998 return. Coho spawners have entered Tiny Creek as late as Jan. 16.

ESCAPEMENT HISTORY

Year	Co	Ct	Cm	Comments
1998	80			
2001	84	1	2	79 Co came in Jan. 8, 02. Water highly turbid from Scholey's ducks. He dug a new pond. Gary Horncastle investigating (continuing). Steve Voller also came out. Info. From Chris Morley (749-2949). Chum report of two carcasses in R1 came from Phil Birosh. First report of Cm for many years.
2002	18		36	

Stream Code: 9202577584

Stream Name: Stanley Creek (Bowen's Creek, Pete's Creek, Green's Creek)

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan River 1.75 km below the Cowichan Lake outlet and weir. Stanley Creek basin is steep, narrow and highly responsive to runoff. Its headwaters are high enough to receive a snowpack and the most robust flow peaks result from rain on snow events.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 1337 m and possibly beyond for less than 100 m. Ct to 1708 m. Bt to 1708 m. DV to 1708 m. St to 1708 m. Cm to 390 m.
Obstructions	A culvert with a vertical drop of 0.5 m is present at Cowichan Lake Road (390 m) and is passable at high flows for coho and trout. A weir was constructed 5m downstream on Oct. 9, 2002. It is about 1 m high and should backflood the culvert so that chums can pass. The Youbou Road culvert (860 m) appeared to limit coho migration. Few fish were observed above it. Outlet velocity averages 0.55m/sec. at moderate flow and its vertical drop is minor. It is 24 m long and 1.5 m in diameter. It is probable that few pass it because of lack of spawning habitat above it. Adjacent resident Jim Edwards constructed a small weir at the outlet of the culvert pool and backflooded the small drop that was present. The culvert is now easily passable for both adults and juveniles. An old water supply dam is located at 1337 m. It has a vertical drop at the end of its apron spillway of .6 m at low flows. The spillway lip is followed by a 3 m long apron with a 20% slope which is likely a velocity barrier. Fish might be able to pass around the east end of the dam at high flows. Little habitat is present above the dam but there is gravel backfilled behind the dam and it would be advantageous if coho could utilize it because spawning habitat is at a premium in Stnaley Creek, especially higher up where fry recruitment is most important. A series of impassable falls and cascades begins at 1708 m.
Max. Temp. (C)	13 (8/26/85) 18.1 8/1/98 (R4 at highway)
Min. Disch. (m^3)	0.00013 (8/26/85) 20 m above Youbou Road. 0.11 (8/31/85) Greendale Road. In most summers, Stanley Creek dewaters from 20 m below Youbou Rd. to the Cowichan R. however, in many years a little water remains, especially in Reach 1 below Greendale Rd. where water often stays in the culvert pool and in Reaches 2 and 3 where a little seepage flow remains from a seep that enters the creek 10 m above Old Lake Cowichan Road culvert.
Max. disch.	2.33 CMS (11/25/98)

STANLEY CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Area
Reach 1	6	2	1540	1.0	FC	L		229	458
Reach 2	3	1	136R	2.4	CON	N	0	146	146
Reach 3	6	1	1360	2.6	CON	N	0	15	15
Reach 4	5	0	1360	4.1	CON	N	.0004	459	0
Reach 5	5	2	1360	4.2	CON	N	.003	477	954
Reach 6	19	2	1450	1.5	UC	N	0	19	38
Reach 7	5	2	1270	15	CON	N		332	664
Reach 8	5	2	1171	20	CON	N		42	84
Reach 9	4	2	1152	28	CON-ENT	N			

B) FISH UTILIZATION AND LIMITING FACTORS

Stanley Creek supports small numbers of a diverse number of fish species including: coho and chum salmon, resident cutthroats, brown trout and occasional steelhead and Dolly Varden. High diversity but low numbers although the creek once supported healthy numbers of coho and there is an occasional year when 100 or more chums arrive.

Production is limited by low summer flows and drying (Reach 4, a 459 m reach between Youbou Rd. and Cowichan Lake Road, dries early with heavy coho fry loss in high escapement years) and high fall - winter discharge fluctuation. By late summer of many years, the entire creek below Youbou Road Culvert pool is dry except for a trickle below the seep 10 m above Cowichan Lake Road. Spawning habitat is sparse above 300 m. LWD is almost non-existent in Stanley Creek.

C) PRODUCTION OPPORTUNITIES

1. *FRY SALVAGE:* Fry salvage in the zone subject to drying **(Production Option # 207)**

Salvaged fry yield in 1986 and 1987 was:

	CO	Ct	Bt	Rb
1986	180	10	2	10
1987	584	50	20	46

2. *MAINTENANCE OF GREENDALE ROAD POOL:* Annual deepening and damming of the Greendale Road Pool will provide additional summer habitat, particularly in years of extreme drying **(Production Option # 208)**. Residents have volunteered to feed the fish in this pool.

3. ***SPAWNING PLATFORMS:*** Because spawning habitat is limited above 300 m, a boulder weir was installed in the summer of 1987 to attempt to trap gravel. It was successful and 5.5 cubic meters of gravel was captured and utilized by spawning coho. Two more spawning platforms were installed in the summer of 1988 . These structures washed out in the flood of 1990 but were surprisingly durable until then. It is possible that spawning platforms may last several normal winters and, with periodic maintenance, be a viable enhancement option. **(Production Option # 209)**,
Consideration should also be given to breaching the east side of the old water supply dam at 1337 m.

D) LAND USE FACTORS

Forestry

Advanced second growth. Second growth logging has begun (2000) on the Hill 60 side of the basin (TimberWest).

Residential

Minor subdivision along Neva and Greendale Roads. Townhouse development in 1992-93 at Neva. An old log box culvert was replaced by CSP which resulted in loss of habitat at the culvert site (a well covered pool was lost – the most habitable pool on the creek) and downstream scour and lateral erosion increased after the new pipe was installed. The culvert is open bottom arch and is 3.5 m in diameter. Its zone of influence extends downstream for 46 m. A similar situation is present at the Cowichan lake Road culvert, a 2.5 m structure (CSP arch).

Risk Potential

There are zones of steep, saturated soils adjacent to the stream above 1,500 m. Logging and road construction must be carefully planned along upper Stanley Creek. Impact would not only be expressed in the creek but more importantly, in the Cowichan River. A 1986 Village of Lake Cowichan proposal to log a small area adjacent to upper Stanley Creek generated so much local concern that it was dropped and the area has been protected under a conservation covenant (Nov. 1996) which only permits recreational uses. The Town floated another logging proposal in 2001 – 2002.

E) PROTECTION NEEDS

A top of slope setback should protect steep adjacent slopes above the 1,500 m point. These slopes are at least 140% in places and contain areas of seepage. Undeveloped lands in the Town of Lake Cowichan should be protected by a Greenway corridor of whatever green space remains Stanley Creek is a very high energy stream and future urban development should stay well away from it.

F) NOTES

Stanley Creek has been extensively modified over the years. It has been straightened and channeled from Greendale Road to somewhere above the present Highway 18. Pete Olson Senior channeled Reach 2 and poured concrete on the stream bottom and banks in 1947. Instead of the normal 6 m wide channel of this portion of the creek, the channel is only 3 m wide. Large portions of the concrete have now eroded away. Residents along Rockland Road on the west side of the creek have built structures and gardens right up to the stream bank which is now vertical in places and has to be almost constantly defended with rock or sand bags. Eunice and Bert Sheilds bank had to be sandbagged in the fall (10/22) of 2002 because it was at risk of beig washed away.
A gravel washing operation was located on the present Gord Neva property (1233 m) in the 50's and 60's.
Stanley Creek was once the primary water supply for the Village of Lake Cowichan
This stream has been known as Bowen's Creek, Pete's Creek and Green's Creek.

Escapement Records

	Co	Cm
2002	2	364

Stream Code: N/A

Stream Name: Birdcage Spring

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan

A) BIOPHYSICAL OVERVIEW: A short, inaccessible groundwater spring in the Town of Lake Cowichan. It enters the Cowichan River at the E + N trestle after originating in a spring behind Peter's Mall (1993) and crossing under Cowichan Lake Rd. The slope behind the spring once held some large cedar swamps according to Trevor Green.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	None although the spring pond is sometimes stocked with coho or cutthroat fry. Local people have been shocked to find trout living in this inaccessible pond that only measures 3 by 13 m and is only 25 cm deep.
Obstructions	A long steep culvert at 12 m.
Max. Temp. (C°)	13 (8/2/98)
Min. disch. (m^3)	0.00214 (8/5/98)

BIRDCAGE SPRING

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	1.0	0.5	2710	2.0	CON	N	12	6
Reach 2	1.0	0.5	0009	20.0	CULVERT	N	60	NIL
Reach 3	3.0	2.0	9100	.01	FC	N	35	70
Reach 4	1.0	0.5	2710	1.0	CON	N	15	7.5

B) FISH UTILIZATION AND LIMITING FACTORS

Contains no fish because the stream is inaccessible.

C) PRODUCTION OPPORTUNITIES

1. ***FRY STOCKING*:** Reach 3 is two ponds 15 to 40 cm deep and well covered with watercress and water parsley. Coho fry have been stocked with excellent results. They are fed by the property owners - Mr. and Mrs. Duke. Brown trout could also be planted. Recommended number of coho or browns: 700 fry if fed, 200 if not. Coho survival to smolts has been estimated at 70%. Coho smolt yield potential of 490 fish. Brown trout yearling yield potential 16 - 490 **(Production Option # 210)**.

2. *SUPPLEMENTAL INCUBATION*: There is room for a spawning platform in Reach 1 and incubation boxes in Reach 3 at the outlet of the ponds (Production Option # 211 and 212).

D) LAND USE FACTORS

This is a backyard spring almost in the centre of the town but residents value and protect it.

Risk Potential Low. A small mall was constructed in 1993; impact was minimal.

E) PROTECTION NEEDS

The Town of Lake Cowichan OCP recognizes Birdcage Spring as a watercourse protection area (DPA).

Stream Code: N/A

Stream Name: Atchison Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan

A) BIOPHYSICAL OVERVIEW: Enters the Cowichan River from the north between Beadnell Creek and Birdcage Spring. A backyard groundwater fed stream which is buried in a pipe above 35 m.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 35 m.
Obstructions	Buried in a pipe above 35 m.
Max. Temp. (C)	13 (8/31/98)
Min. disch. (m^3)	.0037 (8/31/98). The pipe under Cowichan Lake Road must continue up the east side of McDonald Road where seepage points can be seen on the surface in the winter as far up as Oak Lane. And all year along the north side of the driveway of the third house up McDonald on the east side.

ATCHISON CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	1.0	1.0	2430	2.5	CON	N	35	35

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are occasionally observed spawning in this creek. Production is limited by lack of quality gravel and small area. This stream is only 35 m long.

C) PRODUCTION OPPORTUNITIES

1. *SUPPLEMENTAL INCUBATION*: Incubation measures for coho, cutthroat or brown trout and creation of spawning platforms would be beneficial. Approximately 90% of coho eggs incubated in a plastic milk carton container survived to the fry stage in 1988-89 **(Production Option # 213)**.

D) LAND USE FACTORS

The stream is buried in a pipe above 35 m. so it receives no surface run-off. The lower 35 m. flows through a backyard. Residents care for the stream.

Risk Potential Low.

E) PROTECTION NEEDS

The Town of Lake Cowichan's OCP recognizes Atchison Creek as a protected watercourse DPA.

Stream Code: N/A

Stream Name: Beadnell Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the north 1,200 m below the Cowichan Lake weir. The upper basin of the main stem is steep and narrow but the portion below the 260 m contour is relatively broad. Summer flow is supplied by groundwater seepage. Winter flow fluctuation is minimal. The west branch parallels the base of the west end of Hill 60 picking up seepage.

Air Photos	BC 82007 137-138
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 1819 m but access is difficult after 94 m Cm to 94 m. Ct to 1819 m Bt to 1819 m.
Obstructions	25 m concrete section in Upper R1 which starts @ 75m. Migration period velocity in the lower 11 m of this section is about 2 MPS (most of this concrete was removed in 1999) Cowichan Lake Road culvert at 98 m (passable). Culvert is a 77 m long concrete box 3 m wide. It is just barely passable at times for adult coho, cutthroats and brown trout. It passes under Cowichan Lake Road and the west portion of Cowichan Esso (Romeo's). 500 m concrete flume with 3% slope (passable). Baffles added to aid fish passage 1994 –2002 (flume and culvert – Burns, 02) Sharply increasing gradient above 1819 m. Series of small drops on W.Fork in R2. Greatest vertical drop: .5 m. 1 m falls at 400 m on Neva Creek.
Max. Temp. (C)	12 9/19/87 R1 18.5 (R3 at highway 8/1/98) 15.2 West Fork R1 (9/12/98) 13.4 R5 (9/12/98)
Min Disch. (m^3) .	0025 (9/19/87) R1 R2 0 R3 0 R4 0 for the first100 m in very dry years R4 .00045 (8/26/85) R4 .0035 @ 50 m (9/12/98) R5 .0029 @ Hancock Logging Road (9/12/98) West Fork R1 .000032 (9/12/98)
Max. Disch.	5.4 CMS (11/25/98)

BEADNELL CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Mainstem								
Reach 1	4.0	1.0	145R	1.0	CON	N	98	98
Reach 2	3.0	0	R	3.0	ENT	N	500	0
Reach 3	5.0	0	2710	1.2	FC	M	310	0
Reach 4	3.0	1.0	1450	2.0	FC	L	755	755
Reach 5	1.0	1.0	1540	3.5	CON	N	160	160
Reach 6	1.0	1.0	1450	7.0	CON	N	1000	1000

West Branch (enters Beadnell at 1230 m)

Reach 1	2.0	1.0	1630	2.0	FC	L	72	72
Reach 2	1.0	1.0	1270	7.0	CON	N	35	35
Reach 3	2.0	1.0	1630	2.5	CON	N	500	500

East Branch (Neva Creek)

Reach 1	3.0	0	2610	2.0	FC	L	300	0
Reach 2	1.0	0.3	1540	4.0	ENT	N	350	105
Reach 3	1.0	0	1540	8.0	CON	N	900	0

1 One 30 m^2 pool at the highway culvert survived the 1987 drought. In more usual years, several to numerous small pools may persist through the summer.
Note: A spring enters the R2 flume 50 m above the top end of the Cowichan lake Road culvert It provides a trickle of water down the lower flume and through the culvert.

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, migrant cutthroats and brown trout utilize the lower 1819 m along with resident cutthroats. These fish also utilize the first 330 m of Neva Creek. Migrant cutthroats sometimes enter the stream as early as late October and have been observed spawning as early as late November and as late as late April. Peak of migration is late February – early March. 19 fish were observed opposite the hatchery on Feb. 28, 1998. On March 31, 2000, a pair of cutthroats spawned in the flume just 50 m above Oak Lane just opposite the back end of the CLSES hatchery. Gravel has accumulated in the flume pools since baffle installation.

Production is limited by summer drying in the 910 m section between the top of R1 and 100 m above the highway (100 m into R4). Note: drying does not occur every year and it is quite variable when it does occur. The 910 m of drying is in extreme years only. Loss of habitat in the flume section also reduces productivity. The flume is thought to have been constructed in 1954.

C) PRODUCTION OPPORTUNITIES

1) ***FLUME REMOVAL/CONTINUED FLUME IMPROVEMENT/COWICHAN LAKE ROAD CULVERT IMPROVEMENT AND UPPER R1 CONCRETE SECTION IMPROVEMENT*:** **Elimination of the flume could restore 1500 m^2 of stream (Production Option # 214)**. Flume access improvement began with the Fish and Wildlife Branch placing concrete bags at staggered points along the sides in the mid-seventies. CLSES began constructing baffles in 1994 and they were completed to the top of the flume by 1998. However, more baffles are required near the bottom of the flume (**Production Option # 215) and either baffles or large, flat-bottomed boulders should be placed in the Cowichan Lake Road culvert. The Cowichan Lake Road culvert is 77 m long and requires at least 20 offset baffles. There are 190 m of the flume above the culvert that need to be baffled. Baffles are set 3.5 m apart therefore some 54 baffles are needed. The concrete in Upper R1 should be removed and replaced with boulder weirs. Cowichan River swim-up fry need to be able to access as much of Beadnell as possible in hot summers when upper river temperatures stay in the 20-25 degree range for weeks. When the concrete stream section on the Nieser property is removed, work should begin on improving fry access through the Cowichan Lake Road culvert and up the flume.**

NOTE: Concrete was jack hammered out of the channel on Neiser property in the summer of 1999(7/6/99). A rock weir was constructed at the base of the pool below the formerly concreted section in the summer of 2000. Its purpose was to back flood the pool a short way up the section. Adult coho had trouble navigating the first part of the section in the late fall of 1999. 14 coho tried to navigate the first steep section but none were able to make it. One cutthroat was also thrown back and killed. The fish were trying to pass in very high water. A pair of coho navigated the pitch on the first high flows of 2000. They were spotted beside the hatchery on October 19.

NOTE: Much more work was done on the flume and culvert in the late summer and fall of 2002. 29 cedar baffles 4" high , 6" wide and about 8 ' long except for 5 offset shorter baffles were palced in the culvert. The culvert is composed of 3 sections: an 11 m long open portion at the bottom end, a 49 m mid sectionof relatively lower slope and a 7 m upper section that is somewhat steeper. 5 offset baffles were placed in the lower section, 15 were put in the mid section and 7 were added to the top section. The baffles were pre – drilled and placed in the desired locations. A hammer drill bored the culvert floor through the pre – drilled holes and 10 inch 5/16 rebar pins were driven into the floor of the culvert to hold the baffles. A smear of concrete was placed along the upstream face of the baffles to seal them. The baffles are designed to aid both adult and fry passage. A 2' deep, 6 " wide notch was placed in the center of the cross stream baffles. A large hole was eroding under the water line at Art Neiser's where the culvert empties into the top end of R1. The hole was filled with large boulders in November, 2002.

2. *NEVA CREEK BARRIER REMOVAL*: Removal of the 1 m falls on Neva Creek (backfilled root wad) would access another 100 m^2 of stream **(Production Option # 216)**.

***3. REFUGE POOL*: Excavation of a pool at Highway 18** provided 30 m^2 of wetted area in the summer of 1987. Fry salvaged downstream were placed in it and experienced good survival. This pool must be re-created every year **(Production Option # 217)**. June is the favoured month but the pool could be created as necessary. The Dept. of Highways used to do the work but private individuals or JJM (the local contractor for highways maintenance) would have to do the work post 1987. The pool has been hand created with sandbags and poly on two occasions since 1987 but results were not as good and the work took over a day instead of a couple of hours.

***4. LOWER NEVA RESTORATION*: Lower Neva Creek was damaged by a developer in 1993. A section of channel is in need of restoration (Production Option # 218)**.
Note: Channel section restored, 1996 however it needs better quality gravel. Developer (Gary Gunderson used angular gravel from Johel's Pit.

5. ***SELECTIVE EXCAVATION OF LOWER REACH 3*:** Excavation of Lower Reach 3 of Beadnell would expose groundwater and provide better channel confinement **(Production Option # 219)**. Valley Fish and Game Club worked on this section in the summer of 1994.

CLSES hatchery constructed in 1991-92.

6.***COVER IMPROVEMENT:*** LWD placement: there is a suitable site at the 262 m point of R4. A windfall log should be placed along a cut bank on a corner pool and anchored with two large rocks and tied to two old cedar logs on the bank which can be doubled up to provide the necessary ballast. LWD lack is not a strong limiting factor in Beadnell, which has a rather rich inventory of LWD, but there are sections that are somewhat deficient (Production Option # 220)

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth. Logging started again in the late 1980's.

A cedar mill (F. Doidge) is located in an old gravel pit at 1,100 m. it operates sporadically.

Residential

The lower 600 m flows through Lake Cowichan Town. Five hundred meters have been enclosed in a concrete flume adjacent to MacDonald Road.

Risk Potential

Moderate.

E) HISTORICAL NOTES

Neave (1949) reports Beadnell Creek produced an average of 6,000 coho smolts between 1939 and 1946. Mean egg survival was 27%. Fry production ranged from 22,971 to 173,360.

1987 fry salvage: CO 240
Ct 255
Bt 1005

Fishery Officer Narrative

E) PROTECTION NEEDS

Most of the portion of stream within the Town of Lake Cowichan is fully developed. The part that isn't is recognized by the Official Community Plan and protected . This section is very sensitive and requires a large buffer zone to conserve its riparian zone and prevent extensive lowdown, which has occurred in the past due to adjacent land clearing for future residential use. Above Youbou Road, Beadnell Creek enters an equally sensitive zone which consists of a narrow riparian flat and small ravine with steep, moist slopes. The top of the ravine is 30 to 60 m from the creek. Recent adjacent logging and land clearing did not invade the ravine but there has been considerable alder lowdown because of these activities.

Escapement History

Year	Co	Cm	Ct
1939	433		
1940	74		
1942	78		
1943	354		
2002	4	8	

Stream Code: 9202577600000

Stream Name: Oliver (Hatchery) Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

A) BIOPHYSICAL OVERVIEW: Oliver Creek enters the Cowichan River from the northwest 1,100 m below the Cowichan Lake weir draining a broad, low relief basin. Temperature and flow are relatively stable; groundwater is the primary flow source. The stream originates in wetland seeps near the Teleglobe Canada station.

Air Photos	BC 82007 137-138
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 960 m but sometimes to 4000 m. Ct to 4000 m. Bt to 4000 m. Rb to 4000 m. Cm occasional in R1 and lower R2 since 2001
Obstructions	Highway 18 culvert at 960 m, Potential obstructions in Cowichan Lake Road Culvert at 60 m (baffles added 1999), Darnell Road Culvert (1993) at 505 m (backflooded 1999) and an old dam at 582 m (section removed 1999). All these were juvenile barriers and the Darnell Rd. culvert may still be.
Max. Temp. (C)	15.5 (7/21/85) 18.1 R1 at Second Footbridge (8/3/98)
Min. Disch. (m^3)	0.018 (8/24/85) 0.0175 (8/3/98) Darnell Rd. 0.0115 (8/30/87) Darnell Rd. .00096 (8/30/87) West Fork below wetland confluence of West Fork and Krossa Creek at bridge.

OLIVER CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	4	2	1630	1.0	CON	N	.0115	65	132
Reach 2	4	2	2620	1.5	FC	L	.024	930	1860
Reach 3	3	2	2620	1.3	FC	L		1500	3000

WEST FORK

Reach 1	3	1	2710	1.2	CON	L		1500	1500

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, brown trout, resident cutthroats and a few rainbow and cutthroat spawners from Cowichan Lake/Upper Cowichan River utilize the stream. Oliver Creek is the main spawning stream for Cowichan River brown trout. A few chums were noted in 2001 and 2002.

The limiting factors are available rearing area and access. Oliver Creek provides ideal coastal stream habitat in terms of flow and temperature fluctuation and physical structure. The Highway 18 culvert limits coho, and possibly migratory rainbows and cutthroats to the lower 960 m (25%). Note: Coho can pass this barrier in some years. It is felt that when large numbers of fish accumulate below it, fish make it through. In addition, barriers to juvenile salmonid movement are present at Darnell Road Culvert (.25 m vertical drop at outfall and .22 m at the join point with a concrete box culvert 9.7 m upstream) and at an old backfilled dam that serviced the original Cowichan Hatchery. The dam's vertical drop is .8 m. Its located 53 m above Darnell Road. The most important potential obstruction is the Cowichan Lake Road Culvert some 60 m from the Cowichan River. It is a concrete box culvert with a series of utility pipes

suspended at various heights. Debris jams often form at these structures. When this happens, fish passage is extremely difficult because of the shallow water below the jams. At present (Sept./1997) there is a .65 m jam for the entire width of the culvert at the 8 m point It was felt that this might have been blocking passage for several years. Coho returns have been extremely low for the past few years. Only four were counted in 1996-97. However, Don Palmer, who owns the property on the east side of the creek at its confluence with the Cowichan (this is the property the sewage pipe services), removes any blockage that forms at the pipe and the blockage was not present during last year's coho migration. The barrier was removed by R. Nott's biology class this fall (1997).

Coho fry emergence is among the earliest in the province beginning as early as the first week in March. The third week in March is the usual time.

C) PRODUCTION OPPORTUNITIES

1. ***ADULT ACCESS*:** The Highway 18 culvert at 960 m is generally impassable to coho although there have been reports of them passing it. Coho smolt yield potential above it is 480 - 2,400. However, the B.C. Fish and Wildlife Branch would like to preserve the resident brown trout of this area from coho competition (Reid, pers. comm.). Brown trout fry are sometimes stocked above the culvert (Axford, pers. comm.). The culvert is 2 m in diameter and 49 m long. Average low flow velocity is 1.225 m/sec. but, during migration flows, it ranges between 2 and 3 m/sec. **Baffle placement could make it navigable (Production Option # 221)**. 1986 survey information reveals the presence of rainbow and cutthroat trout above the culvert but no coho. Brown trout were first captured above Youbou Rd. by the author on May 27, 1999.

2. ***JUVENILE ACCESS*:** The jam 8 m into the Cowichan Lake Road culvert should be removed immediately and strong consideration should be given to removing or modifying the pipe at this location (Don Palmer's sewer pipe). Small baffles should be placed in this 78 m long concrete box structure to aid fry passage. The other barriers at 50 m (cross log), Darnell Road (culvert at two places) and 53 m above Darnell Road should also be removed. (the Darnell Road culvert will require backflooding by downstream weirs). These are juvenile barriers. When Upper Cowichan water becomes warmer than about 21 degrees, juvenile trout and coho seek refuge in cooler water. Oliver Creek could play an important role **(Production Option # 222, 223, 224)**
   UPDATE: In Sept. 1999, 68 baffles were placed in the Cowichan Lake Road culvert by the Cowichan Lake Salmonid Enhancement Society; eleven were concrete and 57 were wood (cedar and Douglas fir). The baffles reduced mean flow velocity from .9 MPS to .36 MPS and increased average base flow depth from .5 cm or less to 8.2 cm. Two baffles were placed in the upper, concrete section of the Darnell Rd. culvert and the pool below the culvert was backflooded to reduce the drop at the culvert outfall from .4 m to 0. The old dam 55 m above Darnell Rd. was partially dismantled. Fry can now pass it. Full removal was not undertaken because there is considerable bedload backed up behind the dam. This dam formed a reservoir that once supplied the old Cowichan Hatchery with water via a wood stave pipeline. The reservoir had in-filled with gravel and fines over the years.

3. ***COVER IMPROVEMENT*:** LWD placement is possible at a number of locations. The most appropriate site is just above Darnell Road in the Darnell Road glide. A windfall log approximately 12 m long and .5 m in diameter would be tied into an existing LWD structure that is aging. Purpose: to provide cover for both adults and juveniles and help retain gravel at this important spawning site, especially for large browns. Two large browns (70 cm plus) spawned at this location Dec. 17 – 20, 1997 and were harassed unmercifully by local youths (**Production Option # 225)**.
   UPDATE: A 6.3 x .75 m windfall cedar log was installed 8 m above Darnell Rd. culvert in Sept. 1999 by CLSES. It is being utilized by coho juveniles.
   Funding for the 1999 projects was provided by Fisheries Renewal BC.

4. ***RIPARIAN RESTORATION:*** A 75 m section of upper R2 has been damaged by cattle (Doidge Property). The entire under story has been destroyed for distances of 15 m on the west and 25 m on the east. Top of slope fencing is required to protect this area which is part of the creek's FSZ and was an important spawning and rearing area prior to the loss of overhang **(Production Option # 226)**

D) LAND USE FACTORS

Forestry

Advanced second growth. A considerable portion of the basin has been logged since 1983. Deep, moist soils and small wetlands are common. They present considerable impact potential. Little has occurred to date however even though some of the areas were skidder yarded in the winter. There has been a noticeable change in bedload stability since 1990. Stability is less as more gravel moves downstream. No obvious sources are present.

Agricultural

Felix Doidge of 7250 Wilson Rd. Lake Cowichan has grazed a small herd of Black Angus cattle in his pasture between Highway 18 and Lower Beaver Rd. since the late 1980's. The animals have destroyed the under story vegetation along the pasture (75 m). The over story hasn't been cleared in the steam ravine but the cattle have more or less free range in it and have grazed or trampled away all streamside vegetation under story. Top of slope fencing is required to protect the FSZ in this area which is about 15 m on the west and 25 m on the east side of the stream. Note: Mr. Doidge died in 2000 and the cattle have been removed.

Residential

The lower 1,000 m flow through Lake Cowichan Town. Development pressure was light until 1992 when clearing began for what became me housing. In the summer of 1994, clearing progressed much closer to the creek and exposed two springs which ran over raw ground for some time.

Risk Potential

Low.

E) PROTECTION NEEDS

A riparian zone is present for most of the mainstem and the upper portion of the West Fork. It must be protected. A ravine is present on the mainstem from the upper portion of Reach 1 into lower reach 2, a distance of about 250 m. A similar situation is present on the West Fork for the lower 400 m.
The former School District 66 lands are in the process of being transferred to the Cowichan Land Trust but there has been considerable foot dragging on the part of the new school district (#79).
Friendship Park and Fisheries Trail were set aside by the village and School District 66 in 1989. The park protects approximately 380 m of stream.

F) HISTORICAL NOTES

A federal hatchery operated on this stream from 1910 to 1933. It was located on Stanley Road near the old R.C.M.P. building now known as Sturgess Place.

Escapement

Year	Coho
1938	330
1939	665
1940	481
1941	890
1942	307
1943	394
1944	258
1945	249
1989	528
1990	811
1991	97
1992	5
1993	330
1994	306
1995	95

1996	5
1997	14
1998	109
1999	106
2000	6
2001	34 and 2 Cm
2002	16 and 34 Cm
2003	
2004	

Note: 2 coho were seen above Youbou Road in 2001. There have been no confirmed reports of fish above the culvert but Felix Doidge had told me that he saw fish above the road on a few occasions and Kent Simpson said that PBS contractors had seen fish massed below the culvert one year. It was assumed that fish probably navigated the culvert in years of high escapement when there was pressure to move upstream as far as possible.

Stream Code: N/A

Stream Name: Tern Creek

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan , CVRD Area F

A) BIOPHYSICAL OVERVIEW: a very small groundwater fed stream that originates in a seepage zone near Beaver Road (Lake Cowichan) and enters the Cowichan River from the north 520 metres below the weir. The stream is highly urbanized. It enters the river between Ted Johnson's and Bert Brown's, flows 91 m to a 37 m long culvert between 46 and 50 Park St., then flows 61 m to the Park St., North Shore Rd. culvert which is 91 m long and is also under a driveway at 47 North Shore Road. At the end of the driveway is a 50 m^2 pond known as Olsen's Pond. From the pond it is just 20 m of ditched channel to Tern Rd. culvert which extends upslope for some distance.

Air Photos	BC 82007: 137-138
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 300 m. Ct to 300 m.
Obstructions	Steep culvert at 300 m. followed by a rapid increase in gradient and another steep culvert. Minor obstructions in R1 (backfilled roots etc).
Max. Temp. (C °)	15 18.1 R2 (8/3/98) 19.0 R1 (9/1/98)
Min. disch. (m^3)	Much of the stream dried in August of 1988. Usual minimum flow is about .5 LPS or less. Mean winter flow is only 20 LPS

TERN CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	2	.1	8110	.5	FC	N	.005	91	9.1
Reach 2	2	.5	2440	1.7	CON	N	0	61	30.5
Reach 3	1	.5	8200	.5	CON	N	0	20	10
Reach 4	Culvert								
Reach 5	1	.5	1270	20	CON	N		120	60
Reach 6	3	.5	1000	1.5	CON	N		60	30
Reach 7	3	.5	1000	.5	OV	M		120	60
Reach 8									

B) FISH UTILIZATION AND LIMITING FACTORS

Occasionally coho spawners are reported in very low numbers. Coho fry from the upper Cowichan migrate upstream in May in high numbers. A few resident cutthroat trout are present in a pond at the beginning of Reach 3. Cutthroat spawners from the Upper Cowichan have also been seen in December. Cutthroat fry emergence in Reach 3 began on May 8th in 1989.

Production is limited by a lack of quality spawning substrate (the bed in Reach 1 is almost totally mud and silt), low summer flow and small wetted area. Iron bacteria become a problem in most summers.

C) PRODUCTION OPPORTUNITIES

1. ***SPAWNING IMPROVEMENT*:** **Construction of gravel platforms in Reaches 1 and 2 (Production Option # 227). Leo Nelson constructed 3 platforms with an E team in the 1980's. The gravel used was too small. The platforms should be rebuilt with 2 – 5 cm washed gravel. Leo' platforms are located at 14 and 19 m of R2 and 61 m of R1.**

2. ***INSTREAM INCUBATION*: Incubators in Reach 2 (Production Option # 228)**

3. ***JUVENILE ACCESS:*** **Removal of fry barriers in Reach 1 (Production Option # 229)**

4. ***COHO COLONIZATION:*** 50 coho fry are normally stocked in Olsen's Pond at 47 North Shore Rd. (Production Option # 230)

Consideration should be given to removing the 37 m long culvert between the properties at 46 and 50 Park St.

D) LAND USE FACTORS

Most of the stream is located within the Town of Lake Cowichan. It appears that all the culverting and channel alteration necessary to accommodate property development has taken place.

Risk Potential

Moderate. Development of the headwater seepage zone must be monitored. A pasture on a small fork of Tern Creek has been cleared between the highway (Youbou Road) and Beaver Road and domestic animals are sometimes kept there (8360 Beaver Rd.) . A small barnyard is also very close to the creek on this property. The creek has been lightly ditched in the pasture which is moist and was largely riparian. No sedimentation has been noted from this potential source.

Fishery Officer Narrative

E) PROTECTION NEEDS

The Town of Lake Cowichan 's OCP recognizes Tern Creek as a watercourse protection DPA. The entire accessible portion aside from road rights of way is private property in people's backyards.

Stream Code: N/A

Stream Name: Maple Leaf Brook

Operational Management Unit: Lake Cowichan North

Municipal: Town of Lake Cowichan, CVRD Area F

A) BIOPHYSICAL OVERVIEW: A small, groundwater fed stream in the moist slope zone between the weir and Meade Creek Road entering Cowichan Lake 100 m. west of the weir. This stream originates in a series of seepage points about 170 m. above Cowichan Lake. The Cowichan Lake Salmonid Enhancement Society Hatchery was located on Reach 1.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	None, but returns from the hatchery occurred in 1989.
Obstructions	CN railway culvert located 100 m.
Max. Temp. (C)	14 (late summer) mean November to April temp = 5 C
Min. Disch. (m^3)	0.0005 (late summer) mean November to April discharge = .002 m^3/sec

MAPLE LEAF BROOK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2	1.0	9100	0.1	CON	N	70	70
Reach 2	1	0.5	2710	2.0	CON	N	50	25
Reach 3	0.5	0.5	1620	20.0	CON	N	50	25

EAST FORK OF MAPLE LEAF BROOK

Reach 1	1	0.5	1620	20.0	CON	N	60	30

B) FISH UTILIZATION AND LIMITING FACTORS

No fish utilization at present but returns (coho and cutthroat) will begin in 1989. These will be fish that escaped from the hatchery.

There is no accessible spawning habitat; some should be created to accommodate these fish and in order to sustain the runs.

Some steelhead trout, rainbow trout, brown trout, and Dolly Varden Char fry also escaped from the hatchery between 1985 and 1988.

C) PRODUCTION OPPORTUNITIES

Creation of spawning platforms in Reach 1. Present bed material is composed of mud and silts. Considerable effort will be required to maintain the gravel platforms due the low gradient of the stream and the potential for silting in of the platforms. There is room for approximately 8 m^2 of spawning gravel which could accommodate 4 coho females (8,000 eggs). At 10% survival 800 fry would migrate to Cowichan Lake resulting in the production of 160 smolts at 20% survival.

The hatchery has ceased operation but an incubation box at the present site and at the site of the flow collection box at 120 metres (Reach 2) will maintain this streams role as an egg incubator. Two incubation boxes at 5,000 eggs each would yield 8,000 fry at 80% survival and 1600 smolts at 20% survival in the lake. Most fry would rear in Cowichan Lake.

A 100 m^2 reservoir is present at the head of Reach 3. It could support 1000 fed coho fry and yield 500 smolts at 50 percent survival.

NOTE: STREAM WAS ELIMINATED BY UPLAND DEVELOPMENT IN 1990

D) LAND USE FACTORS

Upland slopes are covered by advanced maple-alder-cedar-fir-hemlock second growth. They are moist and unstable in places due to fine-grained soils with a high silt-sand-clay content. Logging and road building could have high impact.

Risk Potential

Stream was eliminated by upland development in 1990.

Fishery Officer Narrative

OPERATIONAL MANAGEMENT UNIT 8: COWICHAN LAKE

OVERVIEW

The Cowichan Lake OMU consists of the lake and its associated shore zone. The shore zone has been divided into 85 reaches based on biophysical characteristics. For the most part, the lake's shore zone is relatively narrow reflecting the mountainous character of the basin and the relatively exposed nature of the lake. Some 14 % of the lake's shore zone is considered Class 1 in terms of fish habitat quality. 37.7 % is considered Class 2.
Classification is based on the following factors: exposure to wave attack, substrate composition, beach slope and riparian and shoal development.
Industrial use of the lake has declined in the last two decades as the forest industry has slowed in the basin. At one time, there were numerous log storage areas on the lake but there are far fewer now in part due more of the logs being handled on land but mostly because of the general decline in the industry.
Residential use of the lake continues to increase, especially in the east portion of the lake basin in the Honeymoon Bay and Youbou areas. Considerable shore zone impact has resulted. Lakeshore residences now tend to be larger year round homes instead of the smaller summer cabins that were the historical pattern. Fortunately, a good part of the lake basin is still industrial forest in the Forest Land Reserve, not real estate in the normal sense of the word.

LIMITING FACTORS

Cowichan Lake fish production is limited by the small amount of littoral area that is productive and low nutrient levels primarily due to a high degree of flushing.

PRODUCTION OPTIONS

Four production options are available to mitigate these limits. Within Production Option # 231 there are numerous sites to carry out this option. The first complexing undertaking should be experimental with careful pre-treatment documentation of habitat conditions and fish utilization. Suggested locations for the study are Reaches 5, 5b or 9b. The options are outlined in Table 1.

Table 1: Production Options in the Cowichan Lake OMU

No.	Page	Location	Activity	Priority
231	320	Class 1 or 2 shores	Habitat complexing primarily with LWD	1
232	320	Throughout	fertilization	3
233	320	Throughout	Introduction of pisciverous rainbows	2
234	320	Lake outlet, south side	Spawning platform	1

Watershed Code: 9202577

COWICHAN LAKE

BIOPHYSICAL DESCRIPTION

A large, deep oligotrophic lake. Framed by steep mountains in a zone of high precipitation, the lake is not very productive (Carl, 1952). Its flushing rate is high and its shore zone is, for the most part, very narrow. Much of the shore zone is composed of rather exposed gravel which is not conducive to benthic community development and fish production. Cowichan Lake levels normally range from about 161.4 m to 162.4 m in the summer months (full storage level is 162.37 m) 163.9 m is the maximum average winter level and the highest recorded level was 165.388 on January 21, 1968.

Elevation (m)	Area (m^2)	Volume (m^3)	Mean Depth.	Max. Depth.	Perimeter
161-165	62,043,000	3,109,138,000	50.1	152 +	103,180 +

REACHES

Cowichan Lake's shore zone is composed of 85 reaches and sub-reaches. Reaches are designated on the basis of exposure to wave attack, slope, substrate character and width of the shoal zone and riparian zone (Table 1).

Table1 : Cowichan Lake Shore Zone Reach Characteristics

No.	Name	Class	Exp.	Slope	Subst.	Rip.	Shoal	Length	Com.	# Res	L	M	H
1	Beaver W/L	1	1	.01	1000	H	H	200					
2	Island Shake	2	1	1	9100	M	M	500	Cons. Fill	6	2	2	2
3	Pt.Ideal	1	1	.01	8110	H	H	450		1	1		
4	Lakeview	3	2	2	5320	L	L	260	Scalp				
4a	Cedar Spit	2	2	1	9100	L	M	40					
5	Lakeview W.	2	2	3	4321	L	L	9200		2	2		
5a	Old Dump	1	1.5	.5	9100	L	M	220	Old debris				
5b	Plantation Bight	1	1	.5	9100	M	M	150					
6	Forestry Pen.	3	3	1	5320	L	H	500					
7	South pen.	2	2	1	6310	L	M	900					
8	Bear L.	1	1	.01	9100	H	H	2300	FSZ Int.	10	7	3	
9	Ashburn	2	2	1	1720	M	M	1815	BH				
9a	Solmie	1	.5	.01	1000	M	M	200		1	1		
9b	Watson Folly	1	1	.5	1000	H	H	485	Fill				
9c	Sort/New Town	3	3	2	4510	L	L	1100	Fill	11	1	1	9
10	Honey E.	2	2	1	8200	L	M	400	Much mod.	14	2	5	7
11	Honey W.	1	1	.1	9100	M	M	400	Fill	6	1	4	1
12	Walton	3	3	2	4600	L	M	1700	BH, scalp	33	2	5	26
12a	Boatlaunch Wetand	1	2	.1	9100	H	M	40	Creek moved				
13	Gordon	2	1.5	1.5	8200	L	M	400	Imp. Beach				

14	Gordon O.	3	2	1.5	2521	L	M	400					
15	Narrows	5	4	80	0037	L	L	1100					
16	Narrows W.	4	4	2	2332	L	L	2400					
17	Copper	3	2	1.5	3322	L	L	2700					
17a	Lagoon	1	0	.01	1000	L	H	600					
18	Misery Fan	5	5	2	1630	L	L	700					
19	Misery W.	4	4	3	1243	L	L	3400					
20	Croft W.	3	3	2	3700	L	M	3800					
20a	Caycuse Sort	3	3	3	2620	L	L	400	Fill, BH				
21	Inner Caycuse	1	1	.1	9100	M	H	150					
22	Outer Caycuse	2	2	1.5	3700	M	M	1600	Scalp	15	3	4	8
22a	Rusty Bight	2	2	1	9100	L	M	200					
23	Nixon E.	1	2	.5	9100	H	H	600					
24	Outer Nixon	2	3	.5	2710	H	H	1000					
25	Inner Nixon	1	1	.1	1000	H	M	1300					
25a	Nixon Rec.	2	2.5	2	3700	L	M	150					
26	Rockcut	5	2.5	70	0082	N	N	1000					
27	Islands	1	1	1	9100	L	M	600					
28	W. Islands	2	1.5	.5	9100	L	M	700					
29	Hemm	1	1.5	.5	9100	L	M	1000					
30	Outer Hemm	3	2	40	0055	N	L	440					
30a	Little Hemm	3	3	2	1261	L	L	100					
30b	Outer Little Hemm	2	2	2	2800	L	L	60					
31	Long W.	2	2	1.5	2710	L	M	1850					
31a	CZ	3	2.5	3	2710	N	L	210	BH				
31b	Genoa Bay	1	1	2	3610	M	H	650					
32	Heather	3	3	2	2800	L	M	800					
33	Slide	4	3	30	1171	L	L	2000					
34	Little Shaw	2	2	1.5	2710	M	M	1400					
35	Shaw	3	3	6	1153	N	L	1200					
36	Shaw Bay	1	1	.5	1000	L	H	380					
37	Outer Shaw	2	2	2	2710	L	L	260					
38	Outer Shaw E.	3	2	1.5	2350	L	M	1500					
38a	Pocket	3	3	3	2800	L	L	100					
39	Hawes	3	2	2	2710	L	M	300					
40	Hawes Marsh	1	1	.5	1000	L	M	300					
41	Margaurite	4	3	2	2710	L	L	3000	BH				
41a	McKay Bight	2	2	1	3700	L	M	600					
42	McKay Fan	4	4	2.5	2530	L	M	880					
43	E. McKay	2	2	2.5	1540	L	M	880					
44	Wardroper	2	2	2	2620	L	M	2900	Scalp	36	12	20	4
45	Maple	2	2	1	4420	L	H	500					

	Grove E.												
46	Roberts	3	2.5	2	2800	L	M	500	Mod.	13	5	7	1
47	Cowan	1	.5	.2	9100	M	H	2000		18	9	8	1
48	Cott.W.	5	5	3	2620	L	L	1800					
49	Cott. E.	3	3	2	2620	L	L	1600					
50	Mill	2	2	3	2350	L	L	660					
51	Inner Mill Bay	2	1	1	7300	L	M	400					
52	Youbou W.	3	3	3	2710	L	L	2800	BH, scalp	67	10	26	31
52a	Inner Youbou W.	2	2	1.5	3610	L	M	100					
53	Saseenos	5	4	4	1522	L	L	700	Scalp, mod.	14	7	7	
54	Saseenos E.	2	2	1	2800	L	M	600	BH, scalp	14	7	6	1
55	Motel Bay	1	1	.01	1000	M	H	300	Marina	5	3	1	1
56	Youbou E.	2	2	3	3610	L	M	1600	BH, scalp, fill	91	39	39	13
57	Price-Miracle	2	2.5	3.5	2710	L	L	1500	Included in 56 for impact				
58	Miracle E.	2	1.5	1.5	2620	L	L	3000		6	2	3	1
59	Sunset	4	4	1.5	2800	L	M	700		19		1	18
60	Springs	2	2	1.5	3610	L	H	500		2		2	
61	Bald N.	4	2	2-20	1234	L	L	5400					
62	Outer Bald	5	5	80	0019	N	N	3200					
63	Bald Rec.	3	3	2	2710	L	L	400					
64	Bald E.	4	4	60	1153	N	L	1200					
65	Trans.	2	3	3	1630	N	L	400					
66	Trail	3	2	2	2620	L	M	2000					
67	Marble	1	.5	.01	9100	H	H	2400		12	6	4	2
68	Meade E.	2	2	2	2710	L	L	4000	BH, scalp	47	18	17	12
68a	IR	1	1	1	9100	M	M	50					
Tot.								103180		442	139	165	138
	Class 1							14775 (14.32)	Rank 4				
	Class 2							38115 (36.94 %)	Rank 1				
	Class 3							22810 (22.10 %)	Rank 2				
	Class 4							18980 (18.4%)	Rank 3				
	Class 5							8500 (8.24 %)	Rank 5				

Fish Utilization and Limiting Factors

Cowichan Lake is utilized by rainbow and cutthroat trout, Dolly Varden char and kokanee, coho and chinook salmon. A few chum salmon also rear a short time in the lake and an occasional shore spawning chum is reported. Very occasional coho shore spawning is also reported. Sturgeon are also reported very

occasionally as are Eastern Brook trout. Three – spine sticklebacks are very numerous in Class 1 and 2 shore zone habitat.
Cowichan Lake coho deserve some discussion. A percentage of the coho born in lake tributaries is morphologically designed for life in the lake (Swain and Holtby, 1989). These fish migrate to the lake in the first few weeks after emergence. Many Cowichan Lake tributaries dry for a large percentage of their accessible distance yet have consistent coho returns. Robertson Sidechannel is a good example. It has had some of the highest returns of any tributary in the Cowichan system yet dries almost completely in its accessible length.
Production is limited by low nutrients and the lack of quality shore zone fish habitat. Only 13.68% of the lake's shore zone is Class 1 habitat and most coho juveniles in deep coastal lakes like Cowichan remain relatively close to shore except for the warmer parts of summer. Mason 1974, found that Great Central Lake coho remained within 10 m of the shore. Cowichan Lake coho can be found up to 50 m or more from shore in the summer months. Nonetheless, the lake's shore zone is largely narrow, fairly exposed and lacking in cover/complexity. It is speculated that, with the large reduction in log storage, an important element of cover is lacking: log booms and associated elements like boomsticks protecting storage areas and the associated debris that accumulated in the shore zone as sunken and floating/semi-floating wood. It is apparent that coho production is highest in years when juveniles can remain in the shore zone for al or most of the summer. In very warm summers, the fish leave the shore zone sometime in July and do not return until about the second week in October. It is speculated that the fish move into deeper water near the thermocline where food is much less common and survival is probably lessened.
Enhancement Options

1.INCREASE SHORZONE COVER-COMPLEXITY: 38,765 m (37.57 %) of Cowichan Lake's shore zone is Class 2 habitat subject to improvement. It is probable that a good deal of this area could be upgraded to Class 1 with the addition of cover-complexity. This option should be explored on an experimental basis (**Production Option # 231)**. It is apparent that cover is limiting in Cowichan Lake and the lake (especially its shore zone) has been cleaned up considerably since the days of heavy log booming and towing. There seems to be a correlation between the decline in wood debris and the decline in lake coho stocks.

2.***IMPROVE FERTILITY:*** Fertilization is another option. Cowichan Lake has a large population of kokanee that mature at approximately 15cm (3 year olds). If these fish could grow 5 -10 cm larger, they could attract a sport fishery (**Production Option # 232)**. On December 8, 1982, I measured 135 kokanee at Sunset Beach at the head of Cowichan Lake's North Arm. Males averaged 159.85 cm and females averaged 154.71 mm (Burns, 1982)

3.***NEW SPECIES:*** Introduction of pisciverous rainbow trout such as Anderson Lake rainbow may also add an additional element of attraction to Cowichan Lake and help crop the kokanee somewhat. **(Production Option # 233).**

4. ***SPAWNING PLATFORM AT OUTLET:*** Both Chinook and coho spawn just above the south side of the weir where the river leaves the lake. As many as 40 chinook spawners were counted at this site on Oct. 18, 2000. Gravel is limited and there is indication that the fish are moving it downstream and exposing the weir base plate. The addition of 300 m^3 of 3 – 6 cm of washed gravel at this site would improve recruitment especially for chinooks. The site was snorkeled on September 16, 01. Most of the fish are spawning on a ridge of sand and fine gravel that runs from just NW of the tip of the fishway over to the upstream end of the island. The ridge is about 5 m wide. There is a suspicion that chinook utilization of the site has increased since the net pen program. The pens are located less than 200 m upstream in the lake (this program has been discontinued - 1997). Some of the coho spawners are Beaver Creek fish. Beaver enters right at the spawning site and it is sometimes too low for spawners to ascend **(Production Option # 234). This project should be undertaken with Norske – Skog. They did some work on the south side of the weir September 25 and 26, 01 and we hoped to have them add gravel at that time but there wasn't enough time to arrange the logistics such as procurement of a barge and agency approvals.**

NOTE: Another important production need was juvenile salmonid access into Cowichan Lake from the upper river. After the weir was constructed in 1957, juveniles were prevented from moving into the lake in the spring and summer months because head was created by storage and the only access point other than the boat lock on the north side of the weir (which fish do not appear to use much) was the adult fishway on the south side of the weir. The fishway was a velocity barrier with flows greater than 1 MPS for its entire length (21 m). Juvenile coho would be stacked up at the fishway outlet in the thousands. The problem was first observed by Dionys Deleuuw in the 1960's. It was first addressed in 1987 when Beaver Creek was re-routed

through Saywell Park to provide an alternative access route. Beaver Creek enters the lake at the top of the adult fishway. It was re-located through the park with the hope that fish would use it to access the lake. The Village of Lake Cowichan also felt that the re-located channel would enhance Saywell Park. Results were inconclusive and the village lost its zest for the project when Beaver Creek became almost stagnant in late summer. The channel was removed one year later. When Beaver Creek was re-located, it was also recognized that young salmonids were not even able to come close to the fishway at times early in the summer because a high velocity plume of current extended downstream from the fishway outlet to a point some 70 m downstream. In 1990, a bypass channel was constructed so fish could move around this barrier and a fry fishway was bolted onto the side of the adult fishway. The fry fishway contains a number of small baffles and has worked well since its installation.

Land Use Factors

Urban

Residential housing has increased along the lake in the last decade, especially in the east portion of the basin in the Honeymoon Bay and Youbou areas. Considerable shore zone impact has resulted from residential expansion. Lakeshore residences now tend to be year round homes instead of summer residences. Clearing and filling of riparian shore zones has been the major impact. Fill is often accompanied by retaining walls (bulkheads). A survey in August 2002 revealed that their were 442 developed properties around the lake. 31.4 % were judged to be of low impact, 37.3 were considered moderate and 31.3 were rated high impact.
Fortunately, much of the land around Cowichan Lake is managed forest in the FLR and this will help limit residential expansion into sensitive areas of shore zone. However, it is unknown how long the Forest Land reserve will survive. If a provincial govenment more sympathetic to land development than resource management comes to power, the FLR may be eliminated or reduced (NOTE: In May, 2001, a Liberal government replaced the NDP government that instituted the FLR.
Cowichan Lake's shore zone is private land, held by TimberWest and individuals which complicates management/protection.

Forestry

The volume of log handling in the lake is very small compared to two decades ago when numerous log dumps and booming areas were present around the lake. The majority of wood is handled at the TimberWest Honeymoon Bay Dryland Sort.

Protection Needs

The OCP's for CVRD electoral areas I and F are currently under review. In this process, lands suitable for residential development need to be sorted from resource lands and development directed toward appropriate land units. Class 1 and 2 shore zones must be zoned out of residential and industrial uses. Catherine Johnnie of CVRD says that a 15 m DPA has been applied to the entire lake perimeter. The CVRD planners wanted a 50 m DPA but the local area directors felt that was excessive.

OPERATIONAL MANAGEMENT AREA 9: LAKE COWICHAN – YOUBOU

OVERVIEW

This OMU stretches west from the west edge of the Town of Lake Cowichan to the western edge of Youbou but not including the mill. It ends at Youbou Creek. Adjacent uplands on Mt. Good and Mt. Holmes are included. In fact, the majority of the unit is upland. The only major lowland riparian area is on the Meade Creek fan – Marble Bay area which is more associated with the Cowichan Lake OMU than with Lake Cowichan – Youbou OMU.

Twelve salmonid streams are located in the OMU: Don Fern's, Castaway, Meade, Abernathy (Meade Creek Sidechannel), Bald Mountain, Miracle, Swordfern, Andy's, Price, Utility, Pond and Coonskin. Some of these streams are not regular producers. A large number of springs and small seepage areas are present in Youbou and many of these serve as local water supplies.

LIMITING FACTORS

Access, low summer flow and, in the case of Meade Creek, lack of stable lateral habitat, are important limiting factors.

PRODUCTION OPTIONS

A total of 20 production options are present in the OMU. They are outlined in Table 6. More detail is present in the streamfiles.

Table 6: Lake Cowichan –Youbou Production Options

No.	Location	Activity	Priority
235	Don Fern's Creek	Spawning platforms	3
236		Instream incubators	2
237	Castaway Creek	Spawning platforms	1
238		Fry stocking	1
239		Coho colonization	1
240		Barrier Improvement	1
241	Meade Creek	Fry salvage and colonization	1
242		Early run chinook colonization	2
243		Sidechannel development	1
244	Abernethy Creek	Fry salvage	1
245	Miracle	Instream incubation	2
246	Swordfern	Spawning platforms/and or incubators	1
247	Price	Spawning platforms	1
248		Arnold spring reconnection	1
249	Utility	Spawning platforms	1
250		Fry salvage	1
251, 252	Pond	Spawning platforms/incubators	2
253		Spring reconnection	1
254	Coonskin	Fry salvage	1

Stream Code: N/A

Stream Name: Don Fern's Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A small groundwater fed stream that originates from a seepage zone about 400 metres above Cowichan Lake. The stream enters Cowichan Lake in the South Arm 1000 metres west of the weir.

Air Photos	BC 82007 138-139
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 377 m. Bt to 377 m. Ct to 377 m.
Obstructions	None. The stream divides into three forks at 377 m. each too small to support salmonids.
Max. Temp. (C)	16 Mean November to April = 5
Min. Disch. (m^3)	Usually dry July-Oct. Mean November to April = .030 m^3/sec

DON FERNS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2	0	3610	1.5	FC	N	32	0
Reach 2	1	0	0009	1.5	CULVERT	N	36	0
Reach 3	2	0	1360	2.0	CON	N	42	0
Reach 4	2	0	2620	1.5	CON	N	267	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon, brown trout and cutthroat trout spawn in this stream. Most fry migrate to the lake by late May-early June. Production is limited by summer drying and lack of high quality spawning gravel.

C) PRODUCTION OPPORTUNITIES

1. *SPAWNING PLATFORMS:* Construction of spawning platforms in Reaches one, two and three (Production Option # 235).

2. ***INSTREAM INCUBATORS:*** Art Watson's incubators have been installed at Don Fern's (Reach 1 in Don's front yard) in the past with success. They need occasional maintenance from fine debris build up. Eyed eggs only. **(Production Option # 236)**

D) LAND USE FACTORS

50% of the basin was recently logged with no apparent impact. The remainder is advanced second growth except for a fringe of houses along the North Shore Road.

Risk Potential Low

E) PROTECTION NEEDS

The lower portion of the stream flows through Don Fern's. Above North Shore Road, the stream enters a small ravine/gully which comprises its FSZ.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Castaway (Manzini's or Encounter) Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A small low gradient system of three components: a short, narrow boulder dominated channel, a .42 Ha man-made pond and a largely seepage fed headwater system. Enters Cowichan Lake 1750 m. west of the weir.

Air Photos	BC 82007 137-138
Topographic Map	92 C/16, 92C.090
Salmonids	Co, Bt, Ct, Rb (introduced)
Obstructions	North Shore Road culvert (.8m) at 123 m, 2R6 concrete spillway at pond outlet (140 m), E & N culvert at 440 m. Remarkably, some fish get through the North Shore Road culvert but are stopped at the spillway of Vasko's Pond immediately upstream.
Max. Temp. (C)	18 (8/19/88)
Min. Disch. (m^3)	0.001 CMS (8/19/88) Dry to base of first spawning platform 10/02. Also dry above Green's 10/02.

CASTAWAY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2	1	1360	3.0	CON	N	123	123
Reach 2	30	30	9100	0.0	NA	N	140	4200
Reach 3	2	1	4500	1.0	PC	L	400	400
Reach 4	2	1	1450	1.5	CON	N	510	510
Reach 5	2	1	8200	.1	ENT	N	400	400

B) FISH UTILIZATION AND LIMITING FACTORS

Coho along with an occasional cutthroat and brown trout spawn in reach one.
Production is highly limited by lack of gravel and short accessible length.

Summer rearing does not occur due to very low flow and lack of pool - glide habitat. Fry migrate to Cowichan Lake soon after emerging. The lower 40 m of Reach 1 often dries in dry summers.
Bill Robertson Jr. cleared 52 m of the channel on his property in October, 02. Im asked him to line the bed and banks with gravel and swale the channel to give it some definition on October 11, 02. I checked it on October 24 and he had complied.

C) PRODUCTION OPPORTUNITIES

1.*SPAWNING PLATFORMS:* Creation of spawning platforms would increase spawning capability and egg survival (Production Option # 237). There is room for 6 platforms in Reach 1. CLSES constructed 3 with a total area of 18 m^2 in the summer of 1994. These have been used by coho but need periodic maintenance.

2. ***FRY STOCKING:*** **Stocking coho and cutthroat fry in the 4200 m^2 pond** could yield downstream migrants **(Production Option # 238).** At .15 coho fry/m^2, 50 coho smolts could result. The pond has been stocked with rainbow by the owner (Joe Vasko, 2963 Scott St., VICTORIA V8R 4J7: 598-6467). A spillway fence has been installed to prevent their escape. It must be removed. 100 rainbows were

stocked in 1989, few remain. Mr. Vasko saw six in 1994. Rises were noted on Feb. 7, 1995. There is a chance that these fish could spawn in the creek above the pond.

3. ***COHO COLONIZATION:* Fry could also be introduced to the upper reaches of the stream which include another small pond (2,000 m^2)**. Total habitable area is estimated to be 3310 m^2 which could yield 264 coho smolts at 1 fry/m^2 **(Production Option # 239).**

4. ***BARRIER IMPROVEMENT:*** If the culvert/spillway could be made passable, Options 2 and 3 would not be required. The trick to this obstruction is how to remove it without loosing the pond? **(Production Option # 240)**

D) LAND USE FACTORS

There is the possibility of suburban/industrial development in the upper watershed. A number of residences are present along North Shore Rd. Johel Brothers located their work yard on a headwater tributary in about 1988. The majority of runoff and drainage from their yard and pit drains west into the center of their pit. Bill Robertson Jr. lives on the south side of the creek just above the Green property which is adjacent to Clark Athison's. Bill cleared and grubbed a 52 m section of channel in the fall of 2002 and left the creek in a mess. I instructed him to swale out the channel to give it definition and cast clean gravel on the bottom and banks on 10/11/02. He did a commendable job of complying with my request.

Risk Potential: Moderate

E) PROTECTION NEEDS

Reach 1 of Castaway (Formerly called Encounter) is in the backyard of Manzini's and the former Castaway Property. A runoff pipe enters the creek from the Castaway Property but one of the owners assured me it was local runoff from roofs and driveway. It looked septic to me and I suspected it was a laundry room drain. Above North Shore Road, the creek enters Vasko's Pond then enters a moist ravine with a high degree of sensitivity. Clark Atchison owns much of this area and has recently constructed a house on the upland. Proceeding upstream, the suburban area along North Shore Rd. in the area of Meade Creek Rd. drains into Castaway. Then the creek splits and one branch drains the Johel Bros. Yard (most Johel Bros. Runoff enters their gravel pit to the west) where it has been filled along with a small wetland. The other fork is ditched up to the highway and drains an area that Highways has used to stockpile gravel. This area has been discussed as a possible industrial site. This would be a marginal choice because of high soil moisture levels. The Meade Creek industrial site is just across the road and is much better suited to development from a stream protection viewpoint.

Stream Code: 920 2577 652

Stream Name: Meade Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north. Drains a steep, narrow basin that is highly responsive to precipitation. Reach 1A is Meade Creek Sidechannel which is also known as Abernethy Creek. Abernethy has a file of its own. Prior to 1963, Abernethy Creek was the main flow carrier and Meade Creek channel below Abernethy was small. In 1963, a jam formed at the junction of the two channels and the majority of flow went down the small channel which then became the main channel. In the same flood, another jam formed at the CN bridge and water flowed along the berm to Sunset Beach undermining a house there (Bill Hughs).

Air Photos	BC 82007 104-106
Topographic Map	92 C/16, 92C.090, 0100
Salmonids	Co to 6633 m. St to 6633 m. Rb to 15,500 m. plus 2,500 m of tributary water DV to 6633 m. Ct to 6633 m. Cm an occasional individual or a few individuals use the sidechannel and lower Meade in some years Ch early run fish have been noted in the past and CLSES fry salvage crews occasionally pick up a few chinook fry
Obstructions	2 m falls at 8,000 m.
Max. Temp. (C)	15.5 (8/11/85) Harding Ponds 15 (9/8/98)
Min. Disch. (m^3)	0.28 (8/11/85) 0 below 1288 m

MEADE CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	25	0	1810	.3	FC	L		184	0
Reach 2	22	0	1360	2.2	FC	L		1104	0
Reach 3	18	7	1360	2.8	FC	M	.001	881	6167
Reach 4	12	10	1252	4	ENT	N		664	2500
Reach 5	17	7	1360	2.5	FC	L		1800	12600
Reach 6	12	8	1171	4	CON	N		2000	16000
Reach 7	14	7	1360	3	CON	N			

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 8,000 m including a 1,457 m flood channel (Abernethy Creek) which supports up to 100 coho spawners. Early run chinooks used Meade Creek but have not been reported since 1960 (Deleeuw, pers. comm.) although CLSES fry salvage crews occasionally pick up small numbers (< 100) of chinook fry. A resident population of small rainbows (<18 cm) is present in the upper 7,500 m. A few cutthroat trout and Dolly Varden Char from Cowichan Lake spawn in the creek but very little is known about these fish. Chum salmon fry have been salvaged from the sidechannel.

The lower 1,288 m of the mainstem usually dries between late June and early August. The 1,457 m flood channel carries water in high flows; parts of it dry in winter or early spring. Coho fry are trapped and must be salvaged to survive. The flood channel (known as Abernethy Creek locally) is a major coho spawning stream in its lower 700 m. Fish salvaged from the mainstem have been released above the barrier around the first bridge crossing. Some of the fish that were released as 40 mm fry in early May, 1986 were recaptured in early October as 65 mm parr. Sidechannel fish are released to Cowichan Lake at the mouth of the channel or at nearby Springs Beach.

Overall productivity is limited by high fall - winter discharge. Coho and Kokanee beach spawning occurs near the mouth of Abernethy Creek where ground water seepage and upwelling is present at Springs Beach.

C) PRODUCTION OPPORTUNITIES

1. *STEELHEAD – COHO FRY SALVAGE AND COLONIZATION* : **Best option is stocking steelhead and coho fry salvaged from the lower 1,500 m and the flood channel (Production Option # 241) to the 7,500 m reach above the falls and a 2,000 m tributary reach**. Slaney, et, al. have indicated that steelhead fry colonization is a viable option with an average survival of 32% from fry to Age 1 parr. If possible, salvaged coho should be separated into lake and stream type with lake fish going to Cowichan Lake at Springs Beach and stream type going above barrier to R4 with steelhead and the few Dolly Varden that may be in the mix.

2. *CHINOOK STOCKING :*It would also be worthwhile to introduce early run chinook fry to Reach 2 (Production Option # 242) to try to re-establish the population. Obtaining donor stock may be difficult.

Above barrier coho smolt yield potential:

Meade 1,500 smolts - 15,000 fry required.
Tributary 320 smolts - 1,600 fry required.

TOTAL 1,820 smolts - 16,600 fry required.

Above barrier chinook colonization is also possible. Smolt yield potential is 1500 and fry requirements are 15,000. Cutthroat and Dolly Varden colonization should be considered. Meade Creek is not quality cutthroat habitat, particularly above the falls, but is typical Dolly Varden habitat. Dolly Varden parr were more numerous in Meade Creek than in any other Cowichan Lake tributary in the summer of 1986.

3. ***GROUNDWATER CHANNEL DEVELOPMENT:*** **Groundwater sidechannel development potential exists in relic channel complexes adjacent to Reaches 1 and 3**. Reach 3 sites are under investigation by The Campbell Group (Hancock Timber), CLSES and DFO (1994) **(Production Option # 243)**. **A 147 m long sidechannel was constructed by the Campbell Group under the direction of Ted Harding in the summer of** 1995**. The channel contains three ponds with a total area of 350 m^2. Coho fry were using the channel in Nov. 1995. The channels were checked September23, 02. There was a slight flow between the ponds but no outflow from the Lower Pond to Meade Creek. Pond temperature was 14°. A riparian lobe known a Lace Flat is located 350 m below the ponds. It contains two large active channels and a smaller active channel. There is some potential to improve these channels by limiting winter flow. A promising relic channel is present at the 308 m point on the west side of Reach 3. It bears further investigation.**

Minnow Trapping Results, 9/8 to 9/10, 1996

	Co	Rb
Lower Pond	22	15
Middle Pond	5	12
Upper Pond	2	12

The Middle Pond fish were completely removed in September 1996 to accommodate deepening. Catch was 270 Co and 10 Rb.

D) LAND USE FACTORS

Forestry

Basin cover is mainly advanced second growth with large areas of early immature above the 500 m contour. Second growth logging is well underway in the Lower Basin (1994 - Campbell Group/Hancock). Difficult logging conditions are present in a 2,500 m canyon section of the main stem and a 2,000 m zone of a tributary due to steep slopes featuring cliffs, talus and thin soils. Log jams form in the upper and lower canyon. A 10 m high jam was discovered at the 283 m point of Reach 4 (Nid's Canyon) on October 10, 02. The canyon narrows to 8 m at that point. The jam is not a barrier but bears watching.

Residential

Considerable residential use of the delta; some residences located in flood prone areas. Dyke protection may be required. Habitat value is low in this area due to summer drying and bed instability.

Risk Potential

Moderate

E) PROTECTION NEEDS

Forestry

Careful logging will be required in the canyon section and other high slope areas of the basin. Large areas of the canyon should not be logged by any means because of the extreme slopes and high impact potential.

Urban

There is a need to restrict development on the Meade Creek Fan. Flood potential is high in areas close to the creek and its flood channel (Abernethy Creek).

Fishery Officer Narrative

Miscellaneous Counts

Year	Species	Number
1978	Co	300-400
1960	Ch	1 seen at CN Railway Bridge by Dionys DeLeeuw on July 1.
2002	Cm	30 carcasses in R1

Stream Code:

Stream Name: Abernethy Creek (Meade Creek Sidechannel)

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A 1457 m long flood channel that picks up groundwater in its lower 700 m. Above the 700 m point, the channel is very seasonal – almost ephemeral. It only flows during extended high runoff and is frequently dry even in the winter. In the winters of 1976 –77 and 2000-01, the upper 757 m of the channel were dry for most of the winter. However, when runoff is high, the channel carries a large flow volume and bedload movement is significant, especially in Reach 4. Reach 1 and the lower 600 m of Reach 2 are significant fish habitat. Prior to 1963, this channel was the main channel of Meade Creek.

Air Photos:	BC82007 104,105
Topographic Maps:	92C/16, 92C.090
Salmonids:	Co to 1457 m but mainly to 694 m Ct same ST same (steelhead are late spring run. Kelts are occasionally trapped by de – watering and salvaged by the CLSES fry salvage crew) Cm same but only occasional in years of high escapement
Obstructions:	None
Max. temp:	12 (R1 7/20/01)
Min. disch.	0 for upper 1363 m, 1 LPS lower 94 m (7/20/01)

ABERNETHY CREEK

	Channel width	Wetted width	Substrate	Slope	Channel confinement	Side Channel	LWD	Length	Wetted area
Reach 1	14	8	6400	.5	FC	L	.012	94	112
Reach 2	14	0	1720	1.0	FC	M	.0043	778	0
Reach 3	8	0	1360	1.9	CON	N	.0018	139	0
Reach 4	10	0	1630	1.0	OC	H	.0054	496	0

B) FISH UTILIZATION AND LIMITING FACTORS:

Coho, cutthroats and steelhead are present along with occasional chums in high escapement years. Although spawners can utilize the entire length of the channel, they usually do not go beyond the 694 m point. Fall – winter groundwater influence diminishes above this point and bedload instability increases.
Production is limited by early drying, especially above 694 m, and bed instability. The channel can dewater quickly above R1 except for 9 pools that usually persist into July in the lower 350 m of R2. Steelhead kelts are sometimes trapped in these pools along with many coho and trout fry and parr.

C) PRODUCTION OPTIONS

FRY SALVAGE: Between 5,000 and 15,000 coho and trout fry are salvaged annually in the lower 694 m and released at nearby Springs Beach in Cowichan Lake where cold seepage streams provide an ideal location to release fry even in warm weather or in Upper Meade Creek at the first bridge which is well above the barrier (Production Option # 244).

Note: Periodic selective bedload removal might benefit the channel and help protect surrounding lands but this option is problematical and is not an enhancement option.

D) LAND USE FACTORS

Forestry

Much of the channel is bounded by the Cowichan Lake Experimental Forest (BCFS) and advanced second growth.

Suburban

Jim Bowen owns property near south of the mouth and Ann Placema/ Marjorie Urquart have the property at the end of Nantree Road. Residential use of the area is light.

E) PROTECTION NEEDS

The channel has a high risk potential for flooding and floodwater does enter nearby forest in Reaches 1, 2 and 4. Residential development needs to give it a wide berth; fortunately this is the present situation. Removal of adjacent forest cover would increase flood potential and channel destabilization.

Miscellaneous Escapement Counts

2002	Cm	13 below Bowen's Bridge, 2 above. Lots of bear activiity

Stream Code: N/A

Stream Name: Bald Mountain Creek

Operational Management Unit: Lake Cowichan -Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A small, steep, unstable creek that drains a marrow basin on the north side of Bald Mountain; a granitic peninsular hill that separates the North and South arms of Cowichan Lake.

Air Photos	BC 82007 105-106
Topographic Map	92 C/16, 92C.090
Salmonids	A possibility of coho spawning in Reach 1 (85 m.).
Obstructions	A 4 metre falls over 10 metres at 155 metres upstream then rapidly increasing gradient.
Max. Temp. (C)	15^{o}
Min. Disch. (m^3)	0 for 155 m. then .0024 above (7/29/87)

BALD MOUNTAIN CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4.0	0	1360	3.0	CON	N	85	0
Reach 2	3.0	0	1360	4.0	CON	N	70	0
Reach 3	2.0	1	127R	10.0	CON	N	500	500

B) FISH UTILIZATION AND LIMITING FACTORS

There is a possibility that a few coho salmon spawn in reach one. Production is limited by substrate instability and dewatering.

C) PRODUCTION OPPORTUNITIES

None

D) LAND USE FACTORS

Advanced second growth.

Risk Potential

Moderate.

Stream Code:

Stream Name: Miracle Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: Enters Cowichan Lake from the north 2.5 km east of Youbou. Entirely groundwater fed by a complex seepage system that incorporates several small feeders between the rail road and Highway 18. The majority of the flow emanates from a rock fall seepage area of some 2.5 Ha located about 200 m above the highway.

Air Photos	BC 82007 105-106
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 250 m.
	Ct to 250 m.
Obstructions	Rapidly increasing gradient at 250 m (no habitat above this point).
Max. Temp. (C)	9 (8/25/86)
Min. Disch. (m^3)	0.1 (8/25/86)
	Mean winter disch. approx. .16 cms
	Mean winter temp. approx. 8.5

MIRACLE CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	2.5	2.0	1900	0.1	OC	L	250	500
Reach 2	2.5	1.0	127R	10.0	CON	N	200	200

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few resident cutthroats are present. Spawning conditions are optimal but habitable area is only 500 m^2. Rearing capacity is low due to shallow depth and lack of cover. This stream is best described as a coho spawning channel that supplies Cowichan Lake with fry. Miracle Creek has the highest density of coho spawners per area of spawning habitat I have encountered. 1985 - 1987 mean is .42 fish/m^2.

C) PRODUCTION OPPORTUNITIES

1) ***INSTREAM INCUBATORS:*** 1986 - 1987 winter temperature averaged 7 . Stable discharge of approximately 0.1 cms. Ideal conditions for incubation boxes or a small hatchery **(Production Option # 245)**. Because the entire accessible length of the stream is utilized by spawners, offset incubation will be required. Based on 100,000 eggs and egg to fry survival of 80%, 80,000 enhanced coho fry could be produced. Natural fry production is estimated to be 42,000 based on 103 females, 2,000 eggs per female and 20% egg to fry survival. Normal egg to fry survival is 15% but, due to the favourable incubation conditions in this stream, I have increased it 5%.
A spawning platform was added in the summer of 1997 by the UFAW crew of CLSES. It's located on the old CN grade which is utilized by B.C. Tel's fibre optic line. It was utilized by a pair of coho spawners in Nov.1997.

D) LAND USE FACTORS

Forestry

The basin is in the advanced second growth stage.

Risk Potential

Low.

Urban

MacMillan Bloedel Ltd. has developed a subdivision in the area (1988- 1994...). Clearing began in the fall of 1988 and by 1994, most of the lots were sold and developed. No measurable impact to the stream but substantial lake shoe zone clearing occurred in front of many of the properties despite restrictive covenants. Windfall along the creek has also increased due to increased exposure. The water table is high and many alders are very shallow rooted.

E) HISTORICAL NOTES

Escapement (CO): Miracle Creek is one of the few Cowichan Basin streams where the late run usually dominates

1985 300 (late)
1986 180
1987 150 (early 50, late 100)
1990 6 early, 100 late
1996 6 early, 16 late
1997 16 early
2001 24

Fishery Officer Narrative

F) PROTECTION NEEDS

A larger buffer zone with some upland forest component should have been retained in the subdivision development. The riparian area was protected but has suffered much blowdown due to wind exposure. The water table is high and the alders are shallow rooted. The area above the road should be developed very carefully if at all because of the complex drainage system there.

Stream Code:

Stream Name: Swordfern Creek

Operational Management Unit: Lake Cowichan -Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north 2.4 km east of Youbou; a groundwater stream. Most of it originates in a seepage zone of approximately 1 Ha which is located between the CN tracks and the highway. The rest comes from another seepage area located near the base of an old rockslide some 310 m above Youbou Road. The creek is summer dry between the upper and lower springs (Reaches 4 and 5). The upper seep is known as Split Rock Spring.

Air Photos	BC 82007 105-106
Topographic Map	92 C/16, 92C.090
Salmonids	Co to approximately 683 m Ct to about 683 m. 1 m vertical drop alder root at beginning of stream at Cowichan lakeshore – probably passable in most winters but is problematical and needs to be monitored closely.
Obstructions	1 m vertical drop culvert under Youbou Rd. @ 683m. However, it is doubtful that fish get this far because the channel divides below that point.
Max. Temp. (C)	9 (8/30/86) 11 (10/4/01)
Min. Disch. (m^3)	.03 (8/30/86) .0043 (10/4/01 – R1)

SWORDFERN CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length (m)	Wetted Area
Reach 1	3	1	3700	1	FC	N	.0576	81	81
Reach 2	3	1	9100	.1	OC	M		90	90
Reach 3	2	1	9100	.1	OC	M		278	278
Reach 4	5	2	9100	.01	UC	L	.011	34	68
Raech 5	2	2	9100	.1	OC	L		72	144
Reach 6	1.5	1.5	9100	.5	OC	L		53	78
Reach 7	1	0	8200	10	FC	L		75	0
Reach 8	1	0	2800	1.8	CON	N	0	105	0
Reach 9	1	0	1450	35	CON	N	0	190	0
Reach 10	1	.5	1450	32	FC	L	0	120	120

B) FISH UTILIZATION AND LIMITING FACTORS

Swordfern Creek supports coho and a few resident cutthroat trout. A few cutthroat spawners from Cowichan Lake also utilize the creek. Production is limited by its short length and lack of quality spawning habitat. The substrate is largely muck-detritus, sand-silt and fine gravel. A few spawning sites totaling 20 m^2 are present in Reach 1 but gravel quality is low. Approximately 40% of winter flow comes from the CN grade ditch which collects water from the west portion of the wet woodland area that contributes flow. Springs are located 175, 190, 205 and 220 m west of the mainstem. The lower 15 m of the ditch contribute a trickle of summer flow. Coho and trout occasionally spawn in the ditch. The catchment area below the highway is in regional park (CVRD Price Park). A spring from the west enters the creek 75 m above the old CN grade and a fork from the east (2 (2) OC .01 1000 70 m long) joins R5 at the 71 m point. This stream is also utilized by coho – cutthroat.

C) PRODUCTION OPPORTUNITIES

1) ***SPAWNING PLATFORMS AND/OR INSTREAM INCUBATORS:*** Additional gravel to improve coho fry recruitment to Cowichan Lake or utilization of incubators. Temperature - discharge

variation is minimal in this groundwater stream. The differences between summer and winter temperature means is only 2ºC (7 to 9 degrees). The difference between summer and winter discharge is .00454 m^3/sec. This is an ideal stream for incubation boxes. In previous years, Yount Elementary School students in Youbou have placed boxes in or near Coonskin Creek, a turbulent runoff stream. Future efforts should be in Swordfern. Probable fry yield based on 100,000 eggs at 80% survival is : 80,000 fry. **Spawning platforms should be constructed at 5, 10 and 46 m in Reach 1 (Production Option # 246). A spawning platform was constructed at 46 m in the summer of 1997 (CLSES).**

Another option would be deepening Reach 4 and adding a windfall log. Consideration should also be given to diverting the creek around an alder root that is a partial obstruction (perhaps a total obstruction in years when Cowichan Lake levels are low). The root complex is located at the mouth of the creek. It has a vertical drop of 1 m followed by a small pool below a cascade of .6 m over 2 m. The risk could be easily removed by constructing a 12 m long new channel just 2 m to the west of the present channel to bypass the problem. It appears that the lake level may only rise above the root mass a few times in a normal winter. Average winter lake level is just below the base of the drop.

D) LAND USE FACTORS

Risk Potential

MacMillian Bloedel has developed an 83 lot subdivision in Block 5 which encompasses the entire basin (1988). Careful planning has protected the stream and its water sources.

Historical Notes

Swordfern Creek was discovered in 1985.

Escapement (Co)
1985 4
1986 2
1987 4
1997 4

Fishery Officer Narrative

E) PROTECTION NEEDS

The wetlands and stream corridor have been zoned out of the development and CVRD has a park that comprises the corridor and the major wetland. Wet areas are present between the old CN grade and the highway and these are in the FSZ as are seepage zones above the highway. Highways diverted the channel some 100 m west in the ditch above Youbou Road.

Swordfern and Miracle Creeks are under the watchful eye of several people who live in the development or walk the trails in Price Park: Bill Gibson and Howie Smith usually report spawner numbers or any other important information.

Stream Code: N/A

Stream Name: Andy's Creek

Operational Management Unit: Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north near the east boundary of Youbou. Drains a short, steep basin.

Air Photos	BC 82007 105-106
Topographic Map	92 C/16, 92C.090
Salmonids	Co spawners to 50 m. but not a regular run
Obstructions	Rapidly increasing gradient above 50 m.
Max. Temp. (C)	N/A
Min. Disch. (m^3)	0

ANDY'S CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4.0	0.0	1450	1.5	CON	N	100	0
Reach 2	3.0	0.0	1360	3.5	CON	N	100	0
Reach 3	3.0	0.0	1270	4.0	CON	N	200	0
Reach 4	2.0	0.0	-	50.0	CON	N	800	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn in the first 50 m. Spawning conditions become very marginal above this point and the stream dries early. Fry rear in Cowichan Lake. 35 coho entered the stream in 1985/86. It is doubtful that all spawned successfully since there is only enough suitable gravel for approximately 10 redds. In January, 1988, Andy's Creek was dry for nine days. It is quite likely that this occurs in other winters with extended dry periods like 1976-77 and 2000-01

C) PRODUCTION OPPORTUNITIES

Creation of spawning platforms in Reach 1 would increase fry yield. However, it is likely that they would wash out soon. This measure is not recommended.

D) LAND USE FACTORS

Forestry

Advanced second growth. Logging in the general area began in 1996-97.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Price Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A very small groundwater stream from a seepage area at the east end of Youbou. Enters Cowichan Lake from the north.

Air Photos	BC 82007 105-106
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 65 m. Ct to 65 m.
Obstructions	CN railway culvert at 30 m.
Max. Temp. (C)	
Min. Disch. (m^3)	approximately 1 LPS

PRICE CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
				EAST BRANCH				
Reach 1	1.0	1.0	1910	1.0	FC	N	30	30
				WEST BRANCH				
Reach 1	1.0	0.5	8200	0.5	FC	L	35	17

B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn and cutthroat trout are present. As many as forty coho spawners have been reported in a total area of 65 m^2 (winter wetted width). Production is limited by a lack of suitable spawning sites in this tiny stream system.

C) PRODUCTION OPPORTUNITIES

1) ***SPAWNING PLATFORMS OR INSTREAM INCUBATORS:*** Spawning platforms and incubators should insure a high fry yield from this very stable stream. **Two spawning platforms and two 2000 egg incubators should yield 6000 - 7000 coho or cutthroat fry. Most fry rear in Cowichan Lake (Production Option # 247).**

2) *ARNOLD SPRING RECAPTURE:* Re-diversion of Arnold Spring (which is located some 50 m west of the end of the West Fork). Arnold Spring was originally part of West Price and made up the major part of its flow. It was diverted down Arnold Road ditch into Cowichan Lake in the early 1990's to avoid the possibility of it being contaminated by a septic tank field **(Production Option # 248)**.

D) LAND USE FACTORS

A protected backyard stream.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code: 920 2577 756

Stream Name: Utility Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This is a small, stable groundwater fed creek located within the Village of Youbou. It flows through backyards below Youbou Road which is located 208 m above Cowichan Lake. Utility Creek is tributary to Reach 55 (Motel Bay) of Cowichan Lake. R 55 is one of the lake's most productive shoezone reaches.

Air Photos	BC 82007 105 - 106
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 177 m. Ct to 177 m.
Obstructions	Man made weir with a drop of 1 m over 3 at 177 m, rapidly increasing gradient above this point.
Max. Temp. (C)	14 (8/26/85) Winter temperatures range from 5 – 9 degrees but are usually between 7 and 8.
Min. Disch. (m^3)	0 (8/26/85). Stream contained standing pools above 44 m but no apparent flow. The lower 44 m. were dry. Winter discharge is generally fairly steady at 90 to 100 LPS but flood flows can reach several times this level and the creek spills widely through backyards.

UTILITY CREEK

Reach	Channel Width	Wetted Width	Substrate	Slope	Channel Confinement	Sidechannel	LWD	Length	Wetted Area
1	2	0	2710	1.7	FC	L	.022	44	0
2	3	1	5500	.3	FC	L	0	26	26
3	1	1	2710	1.6	FC	L	.028	107	107
4	1	1	1630	15	CON	n			

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few resident cutthroats utilize the stream. Cowichan Lake cutthroats also spawn in the creek. A pair were seen on January 13, 2003. Lee Hutton of 10326 Youbou Rd. says that as many as 500 coho spawn in Utility Creek. Lee calls the stream Sarita Creek.

Production is limited by short habitable area. Reed Canary Grass and water parsley are invading portins of R3. Lee Hutton occasionally pulls plants when they become thick.

C) PRODUCTION OPPORTUNITIES

Stable flow and an average winter temperature of 5 favour various incubation strategies.

1) ***SPAWNING PLATFORMS:*** Additional gravel will increase recruitment. **Spawning platforms should be constructed at 35m in R1 and at 15, 22 and 35m in R2 (Production Option # 249)**.

2) ***FRY SALVAGE:*** Fry salvage is required in the lower 50 m **(Production Option # 250)**. Fish can be released in the lake at the creek mouth.

Removal of the 17 m long CN culvert at 44 m would increase the habitable length by 10%.

D) LAND USE FACTORS

Forestry

Advanced second growth covers the entire basin above Youbou Road.

Residential

The accessible portion of the stream stream passes through four properties. A backwater portion of the creek along the CN grade was partially removed when CN sold the right-of-way to adjacent residents. Property owners are genelly protective of the creek and pose little risk but a furnace oil tank on a property owned by Bev Kendall has leaked into the creek. The property is located at 10320 Youbou Rd. A tiny drainage channel leads from the tank to the creek.

E) PROTECTION NEEDS

A small buffer zone is needed in the residential portion of the creek. Willows/red osier should be planted beside the creek to protect it and discourage Reed Canary Grass and water parsley.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Pond Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: A very small groundwater fed system from the Youbou seepage zone. Enters Cowichan Lake from the north.

Air Photos	BC 82007 105-106
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 100 m. Ct to 100 m.
Obstructions	None. There is a .45 m leap onto a concrete apron at the CN culvert outlet at 10 m. but it is passable for adults.
Max. Temp. (C)	
Min. Disch. (m^3)	less than 1 LPS

POND CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	1.0	0.5	3700	1.0	FC	N	10	5
Reach 2	30.0	20.0	9100	0.0	UC	NA	20	500
Reach 3	1.0	1.0	2700	1.5	CON	N	70	70

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout are present. Some Cowichan Lake cutthroats are thought to spawn in this stream. Production is limited by lack of quality spawning gravel and small wetted area.

C) PRODUCTION OPPORTUNITIES

1) *SPAWNING PLATFORMS AND INCUBATORS:* Spawning platforms and incubators would increase fry yield. There are three good sites for platforms and at least two 2,000 egg incubators could be installed for a yield of 6,000 to 8,000 coho or cutthroat fry (Production Options # 251, 252).

2) *SPRING CAPTURE:* Re-diversion of some spring water to the east into Pond Creek. About 30% of the stream's flow has been diverted across the CN grade and is now wasted in a small ditch to Cowichan Lake at the Bigelow property **(Production Option # 253)**

D) LAND USE FACTORS

Pond Creek is a backyard stream. Modifications are likely to take place.

Risk Potential

Low.

Stream Code: 920 2577 768

Stream Name: Coonskin (Coon) Creek

Operational Management Unit: Lake Cowichan -Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north. The drainage area includes the steep, narrow south face of Mt. Holmes.

Air Photos	BC 82007 105 - 106
Topographic Map	92 C/16, 92C. 089
Salmonids	Co to 300 m. Ct to 300 m.
Obstructions	Rapidly increasing gradient and a series of falls beginning at 300 m and a 10 m dam at 350 m
Max. Temp. (C)	11 (8/26/85)
Min. Disch. (m^3)	0.004 (8/26/85) The lower 240 m dry.

COONSKIN CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	7.0	0.0	2710	1.0	CON	N	50	0
Reach 2	6.0	2.0	1360	5.0	CON	N	200	0
Reach 3	-	-	-	33.0	CON	N	1500	-
Reach 4	-	-	-	10.0	CON	N	1000	-
Reach 5	-	-	-	30.0	CON	N	500	-

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and resident cutthroats utilize the lower 300 m. 12 coho utilized the stream in 1979 and 75 in 1985/86. In some years, the creek doesn't get any coho spawners but fry swim up from Cowichan Lake in late spring or early summer.

Fish production is limited by the short accessible length and high gradient along with summer drying.

C) PRODUCTION OPPORTUNITIES

Spawning platform construction in Reach 2 could improve egg survival but this option is not recommended because durability/stability is low.

1) ***FRY SALVAGE:*** Fry Salvage is required in Reach 1 **(Production Option # 254). The stream dries to about the south edge of the Bolitho residence.**

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth. The upper portion was logged between 1981 and 1985. Considerable turbidity resulted but impact was minimal due to the low capability of the stream and its high flushing capacity.

Residential

The lower 250 m of Coonskin Creek flow past residences but impact is minor. Deane and Jean Bolitho live on the creek and have given permission to work on it (1999 – 2003).. They have the property on the left (west) bank just below the highway

Risk Potential

Moderate.

Stream Code: 920 24577 780

Stream Name: Youbou Creek

Operational Management Unit: Lake Cowichan - Youbou

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north near the west boundary of Youbou. The drainage area is confined to a steep, narrow basin.

Air Photos	82007 105 - 106
Topographic Map	92 C/16, 92C.089
Salmonids	Co spawners for 100 m in occasional years.
Obstructions	Rapidly increasing slope above 100 m. a 10 m dam at 200 m.
Max. Temp. (C)	N/A
Min. Disch. (m^3)	0

YOUBOU CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	6.0	0.0	1630	2.0	CON	M	50	0
Reach 2	5.0	0.0	1360	3.0	CON	N	50	0
Reach 3	-	0.0	-	40.0	CON	N	2500	0

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho spawn in the lower 50 m. Egg survival is usually low due to violent fall - winter discharge fluctuation. The entire stream dries in late spring or early summer.

C) PRODUCTION OPPORTUNITIES

Spawning platforms could be constructed in Reaches 1 and 2 but the possibility of washout is high.

D) LAND USE FACTORS

Forestry

Advanced second growth.

Residential

The lower 100 m bisects a residential area, however to date the impact has been nil.

Risk Potential

Low.

Fishery Officer Narrative

OPERATIONAL MANAGEMENT UNIT 10 : LAKE NORTH

OVERVIEW

Lake North OMU extends from Cottonwood – Widow Creek on the east to Hall Creek on the west. It includes all Cowichan Lake north shore tributaries west of Youbou.

For the most part, this OMU is composed of mountainous highlands with steep slopes adjacent to the streams and their networks of feeder tributaries which often flow in steep walled gullies and ravines. Riparian landscape units are generally narrow, often not much more than fringes adjacent to mainstems. Noteworthy exceptions are the Shaw – Little Shaw deltaic fan which features a much broader riparian unit that includes two small tributaries, along with several sidechannels and wetlands and the Hall Creek fan, another broad lowland riparian unit.

Human settlement in the OMU is minimal and is largely limited to seasonal residences clustered from just west of the Cottonwood Fan to just east of the Wardroper Fan. There are some year round residents in the Pine Point/ Roberts Road/Cowan Bay area and there has been some discussion of limited residential use of the Cottonwood Fan which is the only landscape feature in the OMU that has significant human settlement capability.

Land use is dominated by forestry. Most of the OMU was logged between the 1920'2 and 1950's although there are still scattered blocks of old growth at upper elevations. Second growth logging has been underway since the mid – 1980's.

LIMITING FACTORS

Primary production limits are access, low summer flows and high stream gradients.

PRODUCTION OPTIONS

There are 27 production options in the 11 anadromous trout and salmon streams in the OMU; they are outlines and prioritized in Table 1.

Table 1: Lake North OMU Production Options

No.	Location	Activity	Priority
255	Cottonwood Creek	Barrier improvements	2
256		Coho colonization	2
257		Small stream incubators in groundwater trib.	1
258	Pine Point One	Fry salvage	1
259		Spawning platforms	2
260	Cowan Brook	Spawning platforms	1
261		Small stream incubators	1
262	Wardroper Creek	Fry salvage	3
263	McKay Creek	Barrier improvement	3

264, 265, 266	McKay Cr. (cont.)	Coho, chinook or steelhead colonization	3
267	Shaw Creek	Barrier improvement	1
268, 269, 270		Juvenile stocking, colonization	2
271, 272, 273		Sidechannel development	1
274		Fry salvage	1
275,276 277	West Shaw	Juvenile colonization	2
278	East Shaw	Coho colonization	4
279,280	Little Shaw	Fry salvage/coho colonization	2
281	Hall Creek	Fry salvage	1
Total 27			

Stream Code: 9202577788

Stream Name: Cottonwood Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: Enters Cowichan Lake from the north 3 km west of Youbou. Drains the southern end of the Vancouver Island ranges - three alpine summits – melt water is a runoff factor especially between May and July. The basin is steep and narrow.

Air Photos	BC 82007 80-81, 106-107
Topographic Map	92 C/16, 92C.089. 099
Salmonids	Co 2,750 St 2,750 Rb 7,000 DV 7,000
Obstructions	Two 2 m falls at 2,750, two 1 m falls at 4,750.
Max. Temp. (C)	(8/14/85) R1 16, R2 13, R3 12.5
Min. Disch. (m^3)	(8/14/85) R1 .40, R2 .40, R3 at 1,500 m .30, R3 above Lomas 0.112, .2276 8/1/97

COTTONWOOD CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	14.0	8.0	1360	2.0	FC	M	1000	8000	
Reach 2	9.0	8.0	1234	3.0	ENT	N	1750	14000	
Reach 3	12.0	8.0	127R	3.5	CON	N	4250	34000	
Reach 4	10.0	5.0	1360	5.5	CON	N	2500	12500	
Reach 5	-	-	-	30.0	CON	N	1000	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Cottonwood Creek supports modest populations of coho and steelhead. There is a possibility of some rainbow and cutthroat spawners from Cowichan Lake in the lower 2,000 m. Kokanee spawning has been reported along the edge of the Cowichan Lake deltaic fan. Resident rainbow and Dolly Varden trout are present for 4,000 m. The resident rainbow population is supporting a light fishery, although no fish larger than 25 cm have been observed. In addition, there is a fall movement of Cowichan Lake rainbows into the creek along with a few Dolly Varden and a very occasional eastern brook trout up to 40 cm.

Production is limited by high fall - winter discharge, limited access for anadromous fish and high gradient..

C) PRODUCTION OPPORTUNITIES

1. *BARRIER REMOVAL:* Removal of falls at 2,750 m and 4,750 m could provide 34,000 m^2 of additional steelhead - coho habitat (Production Option # 255)

2. *COHO* *COLONIZATION*: Stocking **coho fry above these barriers could yield 1,360 to 13,600 smolts; fry required 17,000 (Production Option # 256)**.

Steelhead, cutthroat, Dolly Varden and chinook fry could also be stocked in this stream. Smolt yield potentials include: steelhead 544 smolts from 6800 fry and chinook 6120 smolts from 17,000 fry. Cottonwood Creek could support early run chinooks. Along with Shaw and McKay Creeks, it does not usually have a dry area on its delta in late summer or fall.

3.*SMALL STREAM INCUBATOR:* A groundwater tributary at 3750 m (Spring Bar Creek) could support incubators. This tributary is above the first falls and could supply a 2000 m section (16,000 m^2) with fry **(Production Option # 257)**.

D) LAND USE FACTORS

Forestry

Most accessible old growth has been cut. Second growth logging (mostly hardwoods on moist slopes below the 500 m contour) is well under way. There is a zone of steep, moist soils between 3,500 and 6,500 m. that will require special treatment to avoid impact to fisheries.

Risk Potential

Moderate.

E) PROTECTION NEEDS

Because the majority of basin slopes are very steep with considerable area of high soil moisture as evidenced by numerous springs and salmonberry – Devil's Club on 60 – 80% slopes and there is an abundance of steep gullies on the side hills, impact potential from physical disturbance - especially road building and ground yarding - is very high. TimberWest is beginning to use helicopters more frequently on high slope settings.
Riparian flats are uncommon and when they occur are typically very narrow and moist. They are also usually at the base of very steep slopes, they should not be disturbed.

Fishery Officer Narrative

Miscellaneous Counts

Date	Species	No.	Area
1/12/79	Co	368	Mouth to North Shore Rd.
11/23/80	Co	23	Above old camp

Stream Code: 9202577788254

Stream Name: Widow Creek (Tributary of Cottonwood)

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cottonwood Creek from the east approximately 2.8 km upstream from the mouth. The drainage area is a steep, narrow basin with substantial area of exposed bedrock – runoff is rapid.

Air Photos	BC 82007 106-107
Topographic Map	92 C/16, 92C.089, 92 C.090, 92C.099, 92C.100,
Salmonids	Rb to 3,500 m. DV to 3,500 m.
Obstructions	Chute - 1 m over 3 - at 50 m, 5 m falls over 15 at 3,500 m, 2 m falls at 4,100 m and 5 m falls at 4,700 m.
Max. Temp. (C)	10.5 (8/28/85)
Min. Disch. (m^3)	0.116 (8/28/85)

WIDOW CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	9.0	5.0	127R	3.0	CON	N	1200	6000	
Reach 2	6.0	3.0	127R	9.0	CON	N	2300	6900	
Reach 3	6.0	3.0	1279	10.0	CON	N	3000	9000	

B) FISH UTILIZATION AND LIMITING FACTORS

Resident rainbow and Dolly Varden are present for 3,500 m. There is the possibility of steelhead in the lower 1,200 m since they occasionally ascend Cottonwood Falls. The Dolly Varden Char may be the progeny of spawners from Cowichan Lake.

Gradient and high fall - winter discharge, limit production.

C) PRODUCTION OPPORTUNITIES

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Although there are 6,000 m^2 of habitat with 3 percent gradient in the lower 1,200 m which could be Colonized, this is not recommended.

D) LAND USE FACTORS

Forestry

Little accessible old growth remains; the basin is covered by a mixture of slash and early to mid stages of second growth. A severe fire occurred on the north side of the basin between 1,200 and 1,400 m (stream length); present regeneration is sparse.

Risk Potential

Low.

E) PROTECTION NEEDS

The steep and narrow nature of the basin makes it susceptible to slope damage from roads and yarding. The Widow Creek Road that linked Widow Creek with Coates Creek (Upper Chemainus tributary) has been washed out for several years. Heli logging is the most suitable harvesting method for most of the basin.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Pine Point One

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPYSICAL OVREVIEW: A small, seasonal stream with a primary flow source of runoff but somewhat buffered by near surface winter - spring seepage. The upper basin is steep and narrow. Enters Cowichan Lake in the extreme eastern portion of BCFS Pine Point Recreational Site. A similar stream known as Pine Point Two enters the lake some 250 m to the west in the western portion of the campsite. Very occasional coho spawners utilize Pine Point Two.

Air Photos	BC 82007 105 -106
Topographic Map	92C/16, 92C.089
Salmonids	Co
Obstructions	Rapidly increasing gradient above North Shore Road (530 m).
Max. Temp.(C)	N/A. Dries early.
Min. Disch.(m^3)	0

PINE POINT ONE

	Channel width (m)	Wetted width (m)	Substrate	Slope %	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^3)	
Reach 1	1.0	0.0	3700	1.5	CON	N	95	0	
Reach 2	1.0	0.0	4600	2.0	CON	N	60	0	
Reach 3	3.0	0.0	6400	0.5	OC	H	100	0	
Reach 4	1.0	0.0	2710	0.5	CON	N	250	0	
Reach 5	0.5	0.0	6400	10.0	CON	N	500	0	

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho spawn in reaches one and two. Production is limited by short accessible length, marginal gravel quality and sediment input from North Shore Road.

C) ENHANCEMENT OPPORTUNITIES

1. *FRY* *SALVAGE*: Fry **salvage is required (Production Option # 258).** The creek dries early but a few pools persist until late summer. Fish should be salvaged early and released in Cowichan Lake. If fish are caught after the lake warms, they can be released into the lake at Springs Beach.

2. ***SUBSTRATE IMPROVEMENT:*** At least three spawning platforms could be constructed in Reach 1 (Production Option # 259).

D) LAND USE FACTORS

Forestry

Reaches 1 through 3 are in Pine Point BCFS Recreation Area. The upper basin is advanced second growth. Some second growth logging has already occurred (mid - eighties). Part of the creek runs down the logging road for some 50 m.

Risk Potential

Low

E) PROTECTION NEEDS

The stream has a riparian component that must be protected along with the steep adjacent slopes in the reaches above North Shore Road. **NOTE: Pine Point 1 flows in the North Shore Road ditch for** 100 m.

Stream Code: N/A

Stream Name: Cowan Brook

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL DESCRIPTION: A very short groundwater stream tributary to Cowichan Lake. Cowan Brook receives virtually no overland runoff in its lower reach. Flow originates high on the mountain then goes underground for some 300 m before reappearing in Reach 1. The inland segment of this stream is a water supply for the Roberts Road subdivision.

Air Photos	BC 82007 106-107
Topographic Map	92 C/16, 92C.089
Salmonids	CO Spawning. Ct have been seen in the creek with coho but it is not known if they were spawners. They are usually seen with the coho spawners.
Max. Temp. (C)	11
Min. Disch. (m^3)	.02

COWAN BROOK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	1	1	1900	2.0	CON	N	45	45

Note: Above Reach 1 the stream is underground for about 500 m before it re-surfaces above North Shore Road.

B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn in Cowan Brook. As many as 12 have been reported. Cutthroats also enter the stream but they may not be spawners. They follow the coho.

Production is limited by short length and lack of spawning sites. The stream is totally composed of clean gravel of ideal size but, because of gradient and the narrow channel, there are only a few "flats" suitable for spawning. Summer rearing is also limited but, as is the case with most short, groundwater tributaries of Cowichan Lake, most fry rear in the lake.

C) PRODUCTION OPPORTUNITIES

1. ***SUBSTRATE IMPROVEMENT:*** **Creation of spawning platforms would aid recruitment (Production Option # 260)**.

2. ***SMALL STREAM INCUBATORS:*** The stream is ideal for incubation boxes or a small hatchery **(Production Options # 261)**. There is room for two (2,000 egg) incubators which would yield 6400 fry at 80% egg to fry survival.

D) LAND USE FACTORS

Cowan Brook is located in a small, long established rural subdivision at Roberts Road. Some residents draw their water from it and all value it highly.

Risk Potential

Low.

E) PROTECTION NEEDS

The stream and its riparian zone must remain undisturbed. Upper component of Cowan Brook supplies Roberts Road residents with water.

Fishery Officer Narrative

Stream Code: 9202577868000

Stream Name: Wardroper Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the north, approximately 7 km west of Youbou. The drainage basin is short and steep.

Air Photos	BC 82007 79-80
Topographic Map	92 C/16, 92C.099
Salmonids	Co to about 1120 m Ct to at least 1887 m Rb to at least 1887 m DV to at least 1887 m
Obstructions	Rapidly increasing gradient and periodic log jams above 1120m. 1.5 m bridge log @ 1179 m. Series of falls begin in canyon @ 1887 m
Max. Temp. (C)	13 (8/7/85)
Min. Disch. (m^3)	<0.03 (6/22/76) The lower 480 m. Dries early in the summer.

WARDROPER CREEK

	Channel width	Wetted width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	9	0	1360	3.2	FC	L	.00078	480	0
Reach 2	8	4	1360	8	FC	L		1304	5216
Reach 3	5	5	1144	25	CON – ENT	N		360	1800
Reach 4	7	5	127R	10	CON	N			
Reach 5									

B) FISH UTILIZATION AND LIMITING FACTORS

Very limited coho spawning occurs in the lower 1887 m. Egg survival is low due to bedload movement in freshets. Fry migrate to Cowichan Lake. Reach 1 dries surprisingly early.

Resident rainbow and cutthroat are present to at least 1887 m as are resident Dolly Varden. There is the possibility that some Dolly Varden from Cowichan Lake use this stream for spawning.

Production is limited by steep gradient and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SLAVAGE:*** Fry salvage is required in Reach 1 which dries surprisingly early in most springs. Yield is minimal because Wardroper Creek is a very marginal coho stream and cutthroats seldom emerge from Reach 1 before it dries if, in fact any spawn there. **(Production Option # 262)**.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. The logging road is very close to the stream and sections have been washed away.

Risk Potential

Moderate

Fishery Officer Narrative

E) PROTECTION NEEDS

For most of its length, Wardroper Creek is contained in a very steep ravine. Its slopes are largely stable with Salal – Swordfern but there are areas of higher slope moisture with salmonberry – Devil's Club that are sensitive to disturbance. The slopes are very steep – 70 to 120 percent or more for much of the valley. There a few narrow lenses of floodplain but these are highly riparian and generally contain sidechannels and are within the Fisheries Sensitive Zone as are the adjacent slopes. Boundaries were difficult to assign because the slopes are oversteep almost to the mountaintops for much of the valley. Amazingly, the old logging road parallels the creek for most of the valley and most of it still survives. On a stream walk of April 3, 01, a huge old growth Douglas fir log had slid from an upslope cut block all the way down to the creek at a point some 1960 m above Cowichan Lake. Weyerhaeuser operates in the Wardroper basin and active logging has resumed (2001).

Stream Code: 920 2478 867

Stream Name: McKay Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: McKay Creek enters Cowichan Lake from the north about 8.5 km west of Youbou. The drainage basin is steep and narrow. Alpine summits are present in the upper basin and melt water is a runoff factor.

Air Photos	BC 82007 79-80, 107-108
Topographic Map	92 C/16, 92C.099
Salmonids	Co to 1,000 m. St to 2,500 m. Rb to 5,000 m. DV to 1,000 to possibly 5,000 m.
Obstructions	A 3 m falls at 1000 m. A 5 m falls at 2,500 m. A 2.5 m falls at 5,000 m. A 5 m falls at 5,030 m. A 10 m falls at 6,500 m.
Max. Temp. (C)	14 (8/14/85)
Min. Disch. (m^3)	0.18 - 250 m above mouth, east fork 0.06, main stem 50 m above east fork - 0.12 (8/19/85).

McKAY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	150.0	0.0	2440	0.5	UC	H	50	0	
Reach 2	12.0	5.0	136R	2.0	CON	N	950	4750	
Reach 3	12.0	5.0	1252	3.5	CON	N	4030	20150	
Reach 4	13.0	4.0	1360	2.5	OC	L	1470	5880	
Reach 5	9.0	4.0	136R	5.0	CON	N	2245	8980	
Reach 6	6.0	3.0	-	20.0	CON	N	1255	3765	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho utilize the lower kilometre; steelhead are present for 2.5 kilometres. Resident rainbow occur in the first 5 kilometres.

Production is limited by short accessible length and high fall - winter discharge and relatively steep grades.

C) PRODUCTION OPPORTUNITIES

1. ***BARRIER IMPROVEMENT:*** **The falls at 1 and 2.5 kilometres could be improved for fish passage (Production Option # 263)**. Both feature wedged boulders as major obstructions. However, probability of recurrence is high and access is difficult.

2. ***ABOVE BARRIER COLONIZATION:*** Stocking coho or steelhead fry in the upper 8,000 m is a more appropriate strategy **(Production Options # 264 and # 265)**. Smolt yield potential:1,400 - 14,000: 17,500 fry required for coho.
McKay Creek is also a chinook colonization candidate. Chinook smolt yield from 17,500 fry is 6300 smolts **(Production Option # 266)**.

D) LAND USE FACTORS

Forestry

Old growth logging (TimberWest) is still in progress but in areas distant from the stream. Second growth logging began in 1996 in the lower valley and is located closer to the creek.
There are areas of steep, moist soils (salmonberry - swordfern ecotype) adjacent to the stream between 1 and 5 km. This zone is now advanced second growth.

Risk Potential

Moderate.

E) PROTECTION NEEDS

Because of the basin's structure, much of its slopes are susceptible to accelerated erosion from roads and yarding impacts. A number of rather large, very steep tributaries are present and these are especially vulnerable to road and yarding impacts. The mainstem FSZ accounts for steepness as well as high soil moisture in riparian zones some of which are not contiguous to the stream.

Fishery Officer Narrative

Stream Code: 920 2478 943

Stream Name: Shaw Creek (Mainstem & Middle Fork) including Shaw Lake

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: Shaw Creek enters Cowichan Lake from the north 15 km west of Youbou. This stream which has three main sub-basins: West, Middle and East Forks. It is the largest tributary to Cowichan Lake. Its basin is steep and only very lightly buffered. It drains extensive alpine uplands and melt water is an important runoff component.

Air Photos	BC 82007 78-79
Topographic Map	92 C/16, 92 F/1, 92 C. 098, 92C.099, 92F.008.
Salmonids	(CH) to 2699 m. Co to 2699 m but occasionally to at least 5499 m and into the Middle Fork and West Fork Rb to 5499 m in Mainstem and well beyond into the headwaters of the Middle and West Forks. Ct to 2699 m. DV to 2699 m (Cm) to about 2260 m ST to at least 2699 m and occasionally through Reaches 5 through 7 and into the Middle and West Forks
Obstructions	A 2.5 m falls at 2699 m. A 4 m over 10 cascade (Paintbrush Falls) with three components – 1.5R4, 1R3 and 1.5R4 - at 3000 m (passable via a sidechannel on the west side). Emerald Pool below falls sometimes holds steelhead. A series of chutes, cascades and small falls from in a narrow gorge (Reach 6) from 4100 to 4500 m (R6). A 4 m falls over 12 m at 4600 m. In the Middle Fork there is a 3 m over 4 falls at 700 m, a 1R falls @ 2600 and a 1R falls @2700. No further possible barriers are present until gradient increases rapidly in Reach 7 around the 8500 m point.
Max. Temp. (C)	1,800 m below North Shore Road: 15 (8/14/85). 1,700 m above falls:11 (8/13/85). 100 m below East Fork:14 (8/14/85).
Min. Disch. (m^3)	1,800 m below North Shore Road: 0.54 (8/14/85). 1,700 m above falls:0.50 (8/14/85) 150 m below East Fork:0.22 (8/14/85) 1,000 m above lake: 0.42 (10/23/86)

SHAW CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	50	0	1720	.3	FC	M		300	0
Reach 2	30	15	1540	1.5	FC	M		1200	18000
Reach 3	22	20	1450	1.7	CON	N	.00032	559	11180
Reach 4	12	12	1342	2.3	ENT	N	.00039	640	7680
Reach 5	25	15	1360	1.5	FC	L		600	9000
Reach 6	12	10	1243	2.5	ENT	N		1400	14000
Reach 7	25	15	1450	1.8	FC	L		800	12000

MIDDLE FORK

Reach 1	25.0	14.0	1540	1.5	FC	L	300	4200
Reach 2	20.0	15.0	1360	2.0	CON	N	300	4500
Reach 3	12.0	12.0	1252	3.5	CON	N	200	2400
Reach 4	20.0	14.0	136R	3.0	CON	N	1400	19600
Reach 4	12.0	10.0	136R	3.0	CON	N	5200	52000
Reach 6	8.0	8.0	127R	10.0	CON	N	1200	9600
Reach 7	4.0	4.0	127R	15.0	CON	N	2000	8000
Reach 8	-	-	-	56.0	CON	N	500	

SHAW LAKE FORK OF MIDDLE FORK

Reach 1	5.0	3.0	1252	40.0	CON	N	250	750
Reach 2	4.0	3.0	136R	2.5	CON	N	170	510
Reach 3	4.0	4.0	1450	0.5	FC	L	30	120

SHAW LAKE

Area (ha)	Elevation (m)	Approx. Volume(m^3)	Max. Depth (m)	Total Dissolved Solids (TDS) (mg/L)
10	821			

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead and a few chinooks, chums and Dolly Varden utilize the lower 2699 m. A few steelhead and very occasional coho pass the first falls in some years and migrate into the Middle and West Forks for considerable distance. Steelhead are thought to consist of both a spring run and a small summer run. Cowichan Lake. Summer or late spring fish have been observed above the falls in June (Steve Voller, pers. comm.) Rainbow and cutthroat trout also utilize the lower 2699 m for spawning. A few rainbows may be migrants from Cowichan Lake. Occasional chinooks and chums are reported. It is surmised that Shaw Creek was once an important spawning stream for the now nearly extinct spring – early summer chinook run. Art Watson reports that both native and white fishermen used to camp at the mouth of Shaw to spear, trap and angle for chinooks many years ago. October was the primary month.
Note: 8 coho were seen in the bridge over the Lower Middle Fork on Oct. 25, 01. Ideal flow conditions had permitted passage of the barriers at the tops of the two canyons and the fish were free to migrate well into the headwaters of the Middle and West Forks (D. Martel, pers. comm.)
Coho also utilize two tributaries that enter Reach 2 from the west. The first stream is known as Hidden Creek or Sluice Creek. Its potentially accessible for 340 m but a .65 m vertical drop culvert is present under the logging road (North Shore Road) at the confluence of Shaw and Hidden. It is probable that coho can make this leap and pass the culvert but beavers often plug its upper end and the fish cannot get through.
The next tributary is a combination stream/sidechannel that enters Shaw just upstream – it is known as Wren Creek. Accessible length is approximately 600 m. It is also wetted by a 160 m long flood channel from Shaw Creek when Shaw flows are greater than 10 CMS.

A sidechannel complex known as the Elk Garden Sidechannels is located adjacent to Reach 2 on the east side of the creek. The outer sidechannel is 270 m long and has limited improvement potential because it is very exposed to the mainstem. The inner sidechannel is 320 m long and is more protected from floods. Some improvement in flow duration is likely possible by excavating the lower 200 m. The outer channel is strictly a flood channel while the inner channel is wetted by flooding and the winter water table. It is the water table component of wetting that offers enhancement possibilities.

Production is limited by access, high fall - winter flow fluctuation and cool summer temperatures.

Shaw Lake rainbows spawn in several gravel patches in Reaches 2 and 3 of the outlet (Trib. to Upper Middle Fork) immediately below the lake.

C) PRODUCTION OPPORTUNITIES

1.*BARRIER IMPROVEMENT:* Falls at 2699 and 4,600 m could be improved (Production Option # 267). Cost may be high with some probability of recurrence due to boulder jamming. Removal of these barriers would open up 26 percent of above barrier stream habitat. Fry stocking may be a more appropriate alternative.

2. *JUVENILE STOCKING/COLONIZATION:* Chinook fry could be stocked in the lower four reaches of the mainstem and in Reach 1 of the Middle Fork (Production Option # 268). **Coho are more appropriate for 3,000 - 7,000 m (Production Option # 269)** and also for Shaw Lake although there is presently a population of rainbow stocked in Shaw Lake in 1960. Spawning platform construction in Reaches 2 and 3 of Shaw Lake Fork could improve rainbow fry recruitment to the lake. However, the lake's carrying capacity is low and the present level of recruitment appears to be sufficient at the low level of angling pressure. Fish as large as 40 cm are reported.
Steelhead colonization is possible for the entire above barrier portion of the system (Production Option # 270).

Smolt yield potential:	Coho	1,400 to 14,000 smolts from 17,500 fry
	Chinook	28,980 smolts from 80,500 fry
	Steelhead	700 smolts from 17,500 fry

3.*SIDECHANNEL DEVELOPMENT:* Development of the lower portion of Wren Creek could provide considerable benefit, especially to coho (Production Option # 271). This channel carries winter flow and is utilized by coho spawners but dries early in most years which places eggs and fry at risk. The channel is largely fed by the winter – spring water table. Present usable length adjacent to the road is 160 m. This could possibly be extended with excavation. Excavation, particularly an infiltration pool, might provide permanent wetting. A culvert could also be installed under the road to facilitate migration above the road (upper 370 m of creek).
The CSP culvert at the confluence of Hidden and Shaw Creeks should be replaced by a more passable structure such as a cedar log box culvert **(Production Option # 272).**
Excavation of the lower 200 m of Inner Elk Garden Sidechannel could prolong flow (Production Option # 273).

4. ***FRY SALVAGE:*** Fry salvage is required in Wren Creek, the Elk Garden Sidechannels and, on occasion, Reach 1 of the mainstem (Production Option # 274).

D) LAND USE FACTORS

Forestry

The majority of the basin is advanced second growth but extensive old growth remains above the 700 m contour. Approximately 200 HA of slash and early regeneration above 700 m (1987).

Risk Potential

Low.

Notes

Escapement

YEAR	COHO	CHUM	CHINOOKS	OTHERS AND COMMENTS
1990	1620			
1991	1161			
1992	591			
1993	573			
1994	1588			
1995	701			
1996	365			
1997	89			

1998	302			
1999	158			
2000	279			
2001	465	5	8	Few DV seen this year (2)
2002	252			2 Dv

Older Records

Date	Species	Number	Location
11/3/78	Co	300-500	Mouth to falls
	Ck	1	
12/1/79	Co	781	
12/6/84	Co	63	
12/10/85	Co	720	Between Hidden (Sluice) Creek and North Shore Rd.

E) PROTECTION NEEDS

There are substantial floodplain – riparian landscapes adjacent to Reaches 1 and 2, virtually the entire valley floor is taken up with lands subject to flooding and /or moist riparian landscape units. The FSZ is broad here. It narrows in upper Reach 3 and Reach 4 as upland and canyon lands are present. The FSZ widens somewhat in Reach 5 as some riparian landscape units are present. Reach 6 is largely canyon but there are some moist side hill areas on the west slope where a number of small seasonal creeks and perched wetlands and riparian units are present. Reach 7 is less contained with some significant riparian zones with a number of sidechannels.
The Middle Fork features steep and often moist adjacent slopes and a number of tributaries subject to torrenting. Very careful road construction and yarding techniques will be required. Heli logging should be favoured over mid-slope roads.

Stream Code: 920 2478 943 361

Stream Name: West Shaw

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: Enters Shaw Creek 6 km above Cowichan Lake. Valley floor is relatively broad for 5 km; very little floodplain however. It does feature some open meadows that are sometimes partly riparian. These are important elk habitat. Drains alpine sub-basins on Heather Mountain via Cable and Snowhole Creeks and the upper mainstem. Spring – early summer melt water is an important runoff factor.

Air Photos	BC 82007 78-79
Topographic Map	92 C/16 F/1, 92 C.98, 92C.99, 92F.008
Salmonids	Rb to 8800 m. Ct to 8800 m.
Obstructions	The Spout: series of 3 small falls and cascades at 5500 m: 2R3, 2R3 and 1R3. Technically this is not an obstruction because the population is non-migrating. However, there is a chance of steelhead and coho from fish that have surmounted the barriers in the mainstem. It's not likely this constriction would be barrier to them because the fish would have surmounted larger falls to get this far. 8R20 @ 7300 m.
Max. Temp. (C)	11 (8/14/85) 1,500 m.
Min. Disch. (m^3)	0.28 (8/14/85) 1,500 m. 0.05 (8/14/85) 6,200 m.

WEST SHAW

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	16.0	8.0	136R	1.5	FC	L	5000	40000	
Reach 2	10.0	5.0	1261	5.0	CON	N	700	3500	
Reach 3	12.0	5.0	1360	3.5	CON	N	1200	6000	
Reach 4	8.0	5.0	1261	8.0	CON	N	400	2000	
Reach 5	6.0	4.0	136R	5.0	CON	N	1500	6000	
Reach 6	3	1.0	1261	50.0	CON	N	1000	1000	

B) FISH UTILIZATION AND LIMITING FACTORS

Rainbow and cutthroat trout for 8800 m. maximum size: 25 cm. Possibility of steelhead and coho in some years.
Production limited by low (groundwater) summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. *JUVENILE COLONIZATION:* Coho colonization (Production Option # 275) smolt yield potential:4,000 - 24,000/50,000 fry required. **Chinook and steelhead are also colonization candidates** with the potential of 18,000 chinook smolts from stocking 50,000 fry **(Production Option # 276)** and 960 steelhead smolts from stocking 12,000 fry **(Production Option # 277)**. Colonization would not be required if falls on the mainstem were made passable. Note: A few steelhead and coho both pass the mainstem falls on occasion.

D) LAND USE FACTORS

Forestry

Most old growth has been logged. The basin is largely in advanced second growth. One block of recent logging in the upper basin (450 HA, 1978) and above the 700 m contour on the ridge separating West and Middle Shaw.

Risk Potential Low.

E) PROTECTION NEEDS

West Shaw's Valley is relatively broad in most areas. Steep adjacent slopes are uncommon until Reach 2. However, some of the tributaries are more subject to slope impacts; particularly Cable and Snowhole Creeks. It is hoped that heli logging will be employed in these and other areas susceptible to slope impacts from roads and yarding. There are several areas of steep, moist slopes adjacent to the mainstem in Reaches 2 – 5 especially middle Reach 3 which is also important elk habitat and features an interspersion of old growth timber and deciduous groves and semi-openings. Fred and Peter Olson contacted Dave Lindsay (TimberWest IRAS biologist about this area in 1999).

Stream Code: N/A

Stream Name: East Shaw

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: East Shaw Creek enters Middle Shaw 2 km above its confluence with West Shaw. The drainage basin is steep and narrow for 4,000 m then broadens at Gillespie Lake.

Air Photos	BC 82007 78-79
Topographic Map	92 C/16, 92C.099
Salmonids	Rb to 3,000 m and in Gillespie Lake
Obstructions	10 m over 15 falls at 3,000 m, high gradient and numerous falls above.
Max. Temp. (C)	15 (8/13/85)
Min. Disch. (m^3)	0.033 (8/13/85) 50 m above Middle Fork.

EAST SHAW

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	11.0	5.0	127R	3.5	CON	N	3000	5000	
Reach 2	10.0	4.0	127R	10.0	CON	N	800	3200	
Reach 3	-	-	-	20.0	CON	N	600	-	
Reach 4	-	-	-	22.0	CON	N	900	-	

GILLESPIE LAKE

Area (ha)	Elevation (m)	Approx. Volume(m^3)	Max. Depth (m)	Total Dissolved Solids (TDS) (mg/L)
10	820			

B) FISH UTILIZATION AND LIMITING FACTORS

Resident rainbows are present in the lower 3,000 m. Gillespie Lake is periodically stocked with rainbow trout; there is minor natural recruitment from outlet gravel patches. In moist summers, an inlet also provides some recruitment.

Stream production is limited by high fall - winter flows.

C) PRODUCTION OPPORTUNITIES

1. *COHO COLONIZATION:* Reach 1 coho colonization (Production Option # 278) smolt potential:400 - 4,000/5,000 fry required.

Gillespie Lake coho colonization smolt yield potential: 3,000 smolts from 15,000 fry required. Gillespie Lake sustains a small sport fishery. Rainbow trout were introduced in the 1930's by Ken Gillespie of Lake Cowichan. The Fish and Wildlife Branch stocked the lake in the 1960's and 70's. The present population maintains itself at a low level from outlet spawning and possibly some inlet spawning. Some very large rainbows were reported caught in Gillespie Lake prior to 1970. Stocking may have reduced the possibility of producing big fish.

D) LAND USE FACTORS

Forestry

Most of the basin has been logged in the last twenty years. Large areas of slash and early regeneration above the 400 m contour. A slope failure is present at 500 m (stream length). A large area of old growth is located on very steep slopes (65%) for 1,500 m adjacent to Reach 1.

Careful road construction and logging will be required here.

Risk Potential

Moderate.

Notes

E) PROTECTION NEEDS

Steep country borders much of the stream and adjacent slopes are often greater than 80%. Very careful road building and yarding will be required and significant leave zones may be required in some areas. Heli logging should be widely employed.

Stream Code: N/A

Stream Name: Little Shaw Creek

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: This tributary enters Cowichan Lake from the north 500 m east of the mouth of Shaw Creek. The drainage basin is a narrow and precipitous.

Air Photos	BC 82007 78-79
Topographic Map	92 C/16, 92 C.098
Salmonids	Co to 900 m. Rb to 900 m. No fish are present above the falls
Obstruction	A series of falls beginning at 900 m. 2 m vertical drops.
Max. Temp. (C)	9 (9/22/85) 100 m above North Shore Road.
Min. Disch. (m^3)	0 - 0.046

LITTLE SHAW CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	12.0	0.0	1450	0.5	OC	L	70	0	
Reach 2	12.0	3.0	1360	7.0	CON	N	830	2100	
Reach 3	9.0	4.0	0154	16.0	ENT	N	1700	6800	
Reach 4	6.0	2.0	1360	2.5	CON	N	1000	2000	
Reach 5	-	-	-	50.0	CON	N	400	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Little Shaw Creek supports small numbers of coho and resident rainbow. A few Cowichan Lake rainbow and cutthroat trout may spawn in the lower 70 m. Most coho fry migrate to Cowichan Lake prior to drying of the lower 70 m by mid-July. No fish are present above the falls. The canyon above the falls was extensively electro fished on May 18, 2000 with nil results.
Production is limited by accessibility, low summer flow and violent fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. *FRY SALVAGE/COHO COLONIZATION* Above barrier coho colonization (Reach 4) smolt yield potential:80 - 100/1,000 fry required **(Production Option # 279, 280)**. Fry salvage usually required in the lower 70 m.

D) LAND USE FACTORS

Forestry

Most of the basin above the 500 m contour was logged in the 1970's (Pacific) and is early stages of regeneration. Extensive cross-stream yarding caused bank damage and in-stream channel debris. A 5 m high log jam formed 50 to 150 m above North Shore Road. It was cleared in 1983 but some remnants still

remain at the location and at points in the canyon that extends almost up to the l972 cut blocks. Pacific Logging was charged and successfully prosecuted by the Fish and Wildlife Branch in 1973.

Risk Potential

Moderate.

E) PROTECTION NEEDS:

The majority of the basin is steep and vulnerable to slope and subsequent stream damage from road and yarding impacts. Roads will need to be carefully located and deactivated as soon as possible if in fact roads are the chosen method of access. Heli harvesting will be required in many locations in the Upper Basin.
Reach 1 is on a deltaic fan. Second growth logging in the lower basin resumed in 1999. A road was put in on the east side of the creek and one large cut block removed. In 1999 –2000, a very steep road was built on the west side of the creek and several cut blocks were harvested. A wide buffer was left on slopes adjacent to the creek which range from 60 to 90%. Examination of slopes in this area on both sides of the creek revealed that they are largely stable and dry with a Salal – Oregon Grape – Swordfern under story. There are several very small temporary/ephemeral tributaries on the west slope. Most are less than 1 m wide.

Stream Code:

Stream Name: Hall Creek (Lakehead North)

Operational Management Unit: Lake North

CVRD Electoral Area: I

A) BIOPHYSICAL OVERVIEW: One of several small streams tributary to the west end of Cowichan Lake. In the lower 200 m of the stream the basin is relatively broad with low relief. Above this point, it narrows and steepens.

Air Photos	BC 82007 78-79
Topographic Map	92 C/16, 92C.098
Salmonids	Co to 1,500 m.
Obstructions	1.8 m over 3 cascade at 1,300 m. An old cedar log culvert under the Nitinat Camp (Camp 3) Road at 1,100 m is in danger of collapsing (1985). This culvert was replaced in 1990.
Max. Temp. (C)	13 (7/30/86)
Min. Disch. (m^3)	Dries in summer for 260 m. 0.04 above dry zone (10/22/86) 0.029 @ 460 m (9/13/97)

LAKEHEAD NORTH (HALL) CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	3.0	0.0	3700	0.5	FC	L	260	0	
Reach 2	2.0	2.0	136R	1.5	CON	N	1040	2080	
Reach 3	-	0.0	-	8.0	CON	N	500	-	
Reach 4	-	0.0	-	40.0	CON	N	700	-	

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports coho and cutthroats including spawners from Cowichan Lake. Production is limited by low summer flow in the 1800 m^2 area of summer habitat. Mainly a spawning stream. Most fry rear in Cowichan Lake.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SALVAGE:*** Reach 1 fry salvage is required most years **(Production Option # 281)**. Reach 1 dries very early, often in April. A spawning platform was constructed in lower R1 in the summer of 1998 (CLSES).

D) LAND USE FACTORS

Forestry

Seventy percent of the basin is covered by advanced second growth. The remainder is slash and early regeneration.

Risk Potential

Low.

E) PROTECTION NEEDS

Reach 1 and lower Reach 2 are part of an extensive riparian area featuring some very large maples and very unstable stream channels and banks. The entire riparian zone is included in the FSZ. Progressing upstream, steep adjacent slopes are common and they are very moist in some areas. The stream splits into three forks just below Heather Mountain's Branch 1 Road and the stream becomes less subject to damage from adjacent activities because slope levels off somewhat until the ground becomes so steep that it prevents logging except for some small heli shows.

OPERATIONAL MANAGEMENT UNIT 11: LAKE SOUTH (SOUTH SHORE TRIBUTARIES – WEST)

OVERVIEW

Lake South OMU (South Shore Tributaries: West) extends from Lakehead (Junction) Creek on the west to Gordon Bay Creek on the east. For the most part, the OMU is mountainous upland with little human settlement. TimberWest's Caycuse Camp is the centre point of the area. It was established in 1927 when it was known as Camp 6 (Lake Logging). It was an active community and forest industrial site until the mid-1980's. Several hundred people lived and worked there at its height. Only a few families still reside at the old site and adjacent areas (Gilgan Rd., Couch Farm) and that's the extent of human settlement in the OMU. Forestry is the primary land use.

Most of the streams are small and drain steep mountain basins with little riparian lowland. The Fisheries Sensitive Zones of these streams are almost entirely slope related. However, there are several significant exceptions. Lakehead (Junction) Creek mainstem is an over mature, low gradient stream surrounded by a substantial riparian landscape unit. Caycuse 1, 2 and 3 Creeks also have significant riparian landscapes in their lowland reaches. Caycuse 3 originates from an *upland* riparian landscape unit. The Nixon Creek Corridor is highly riparian in Reaches 1 and 2.

LIMITING FACTORS

Primary limiting factors are access, lack of quality spawning habitat in some areas, lack of high quality winter habitat and low summer flows. As in other OMU's, quality LWD is also lacking. Precipitation is highest in this OMU but summer drought conditions still lower stream flows substantially and many streams are summer dry in their lower reaches.

PRODUCTION OPTIONS

A total of 33 production improvement opportunities are present in the Lake South OMU. They are outlined and prioritized in Table 1. More detail is provided in the stream files that follow.

Table 1: Lake South OMU Production Options

No.	Location	Activity	Priority
282	Lakehead Creek	Substrate improvement	1
283		Sediment control	1
284		Instream incubators	4
285		Stream diversion	3
286	Log Dump Creek	Fry salvage/coho col.	3
287	Mossy Creek	Fry salvage	2

288	Nixon Creek	Coho colonization	3
289		Chinook stocking	2
290		Fry salvage	1
291		Sidechannel development	1
292		Reach 1 channel excavation	2
293	Toms Creek	Fry salvage	1
294	Nixon West	Coho colonization	3
295		Barrier improvement (assess)	1
296	Nixon East	Coho colonization	4
297	Black Lagoon	Upwelling pool	1
298		Fry salvage	2
299	Caycuse 3	Restore original channel	3
300		Spawning platforms	1
301		LWD addition	1
302	Caycuse 2	Replace culvert	1
303		LWD addition	2
304	Caycuse 1	LWD addition	2
305	Helpful	Fry salvage	1
306	Dusty	Fry salvage	1
307	Cutthroat	Fry salvage	1
308	Misery	Fry salvage	1
309	Miserable	Fry salvage	2
310	Grassy Bay	Adult/juvenile barrier removal	2
311	Gordon Bay	Coho colonization	1
312		Headwater storage	1
313		Fry Salvage	1
314		Relocation of R1	1
		Total	33

Stream Code: N/A

Stream Name: Lakehead (Junction) Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This is a spring fed tributary to the west end of Cowichan Lake. The mainstem drainage basin is moist and of very low gradient. This small but productive stream has an over mature substrate and flows through a significant riparian landscape unit dominated by Salmonberry – Swordfern.

Air Photos	BC 82007 77-78
Topographic Maps	92 C/16, 92 C.098
Salmonids	Co and Ct
Obstructions	None
Max. Temp. (C)	9 R1 (9/22/85)
	15.5 R1 (7/12/01)
Min. Disch. (m^3)	0.04 R1 (9/22/85)

LAKEHEAD (Junction) CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5.0	3.0	5500	0.5	FC	M	450	1350	
Reach 2	150.0	30.0	1000	0.1	UC	H	320	9600	
Reach 3	3.0	2.0	2800	1.0	FC	M	990	1980	
Reach 4	1.0	1.0	2800	2.0	FC	L	300	300	

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports coho, resident cutthroat and Cowichan Lake cutthroat spawners.

Production is sub-optimum due to the high proportion of substrate fines, especially in Reach 1. This is an overmature stream with considerable beaver activity.

C) PRODUCTION OPPORTUNITIES

1. *SUBSTRATE IMPROVEMENT:* Periodic addition and maintenance of spawning gravel in Reach 1 (Production Option # 282) would be beneficial as would spawning platforms. Two sites were constructed in 1989 and have been heavily utilized since. The sites are located 150 and 180 m upstream of the logging road junction. A total of 6.4 cubic metres of 3-8 cm washed gravel was added to the two sites. The stream is very stable. Nearby lower Nixon Creek (7.5 km) is a suitable gravel source. It would be impossible to overproduce fry in Lakehead Creek because excess fish could move to Cowichan Lake. NOTE: The lower platform was replenished with 10 m^3 of washed 3 – 8 cm gravel from Butler's Glenora Pit. The material was dumped directly off a gravel truck on October 27, 01 then spread over the spawning bed to a depth of about 25 cm. (Burns, 2001)

2. ***SEDIMENT CONTROL:*** Some method of sediment control is required to prevent sediment runoff from the logging road (Nitinat Main) which is very close to the stream and two small tributaries (Production Option # 283) NOTE: TimberWest (Ron Wellman, HBO contact) installed eight sediment control structures at strategic points along the road in late October and early November, 2001. Five were NO POST concrete

barriers wrapped in filter cloth and three were weir and basin settling pond basins adjacent to the NO POST barriers (Burns, 2001)

3. ***INSTREAM INCUBATORS:* **A strong spring is located near the headwaters of this stream (1760 m). It is very accessible and has good potential for a small hatchery or other incubation measures (Production Option # 284).

4. ***STREAM DIVERSION:*** Steve Voller believes it would be both possible and beneficial to divert a small stream that presently flows to Vernon Creek into Lakehead (Production Option # 285)

D) LAND USE FACTORS

Forestry

The basin is in an advanced second growth stage; its lower portion is dominated by hardwoods. Conifers are unlikely to establish over much of it due to high soil moisture.
This stream receives considerable silt-laden runoff from the nearby logging road (see Sec. E below for updates).

Risk Potential

Moderate

E) PROTECTION NEEDS

Nearly the entire valley floor is very moist riparian habitat (Salmonberry-Swordfern-Lady Fern, Stink Currant, Devil's Club), Logging would cause a good deal of disturbance, the riparian zone should remain intact. Significant side hill spring zones are present adjacent to Reaches 3 and 4 and to a tributary from the south: Hammer Creek. These have also been included in the FSZ. There is also a need to deal with runoff from Nitinat Main. In periods of heavy rain or during thaws, considerable dirty road runoff enters the creek. Cessation of hauling during thaw periods and construction of several retention basins would mitigate the problem considerably. The possibility of re-sloping the portion of the road adjacent to R1 to direct runoff to the ditch side and thence to Cowichan Lake should also be considered along with placing a berm on the creek side or narrowing the road somewhat to allow a wider buffer. In places, the road is literally on the streambank. NOTE: See above Production Option # 283. Sediment control initiated in late fall 2001 by TimberWest HBO in conjunction with CLSES spawning habitat upgrade.
NOTE: 2002 – HBO re-established Br. 1 as main haul road out of Nitinat. Nitinat M/L is only open to light traffic and may be shut down altogether.

Stream Code: N/A

Stream Name: Log Dump Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the southwest 2 km southeast of Lakehead Creek where it drains a steep, narrow basin.

Air Photos	BC 82007 77-78
Topographic Map	92 C/16, 92C.088, 92C.098
Salmonids	Co to 145 m. Ct to 1,500 m.
Obstructions	Falls at 101 m: 2 m over 4,1 m culvert at 167 m, (culvert replaced with a bridge, summer of 1997), 1R2 @ 185 m, 1R3 @ 224 m, 1R3 @ 243 m, combination dam and falls @ 297 m 3DR8, 3R4 @ 1600 m then many falls and high gradient above that.
Max. Temp. (C)	9 (9/22/85)
Min. Disch. (m^3)	0.013 (9/22/85) The lower 50 m. is dry.

LOG DUMP CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	5	0	1540	1.6	CON	N	0	50	0
Reach 2	5	2	1261	1.9	CON	N	0	51	102
Reach 3	4	2	136R	2.2	CON	N	.010	142	284
Reach 4	3	3	1243	5	ENT	N	0	54	162
Reach 5	4	2	1540	1.9	FC	L	.023	878	1756
Reach 6	3	2	127R	9	CON	N	0	234	468
Reach 7	3	2	1152	25	CON	N	0	-	-

B) FISH UTILIZATION AND LIMITING FACTORS

Coho fry occur in the lower 101 m. Resident cutthroats are present for about1, 500 m. Possibility of a few Cowichan Lake cutthroats spawning in the lower 101 m.

Production is limited by access, low summer flow and high fall - winter discharge. The lower 50 meters is dry during the summer.

C) PRODUCTION OPPORTUNITIES

FRY SALVAGE – COHO COLONIZATION: Reach 5 could be stocked with fry salvaged from Reach 1. Reach 5 could carry about 1750 coho fry and it's likely that less than 100 would be available from Reach 1 (Production Option # 286)

D) LAND USE FACTORS

Forestry

The basin is in advanced stages of second growth. Logging resumed in the late 1980's, early 1990's and has proceeded upstream as far as lower Reach 7. The FSZ zone has been retained. There has been some windfall. It has added little functional LWD to the stream.

Risk Potential

Low.

E) PROTECTION NEEDS

The stream is contained in a small gully – ravine for most of Reaches 1 – 4. From the top of Reach 4 to the top of Reach 6, the stream flows though a small ravine which is steeper on the southeast side. There are several small riparian zones in Reach 5 (salmonberry – swordfern – alder) within the ravine. The ravine steepens above Reach 5. Logging should be set back from the edge of the gully and ravine and in fact has been to date.

Stream Code: N/A

Stream Name: Mossy Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the southwest 1.5 km west of the mouth of Nixon Creek. The drainage basin is short and steep.

Air Photos	BC 82007 108-109
Topographic Map	92 C/16, 92C.099
Salmonids	Co to 187 m. Ct to 387 m.
Obstructions	Increasing gradient and log jams at 187 m.
Max. Temp. (C)	11 (9/5/86) 15.1 (8/28/99)
Min. Disch. (m^3)	0 for 75 m then 0.0013 (9/5/86) 0 for 117 m then .0046 (8/28/99)

MOSSY CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	3	0	1360	3.3	CON	N	.0256	117	0
Reach 2	3	2	1270	3.1	CON	N	.018	70	140
Reach 3	3	2	1270	10	CON	N		200	400
Reach 4	2	1	1261						

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are present for 187 m; cutthroat for 387.

Production is limited by summer drying (the lower 75 m) and high fall - winter discharge.

C) PRODUCTION OPTIONS

1.*FRY SALVAGE:* Coho fry salvage is required in the lower 75 m (Production Option # 287). The few fish present should be transferred to Cowichan Lake if they can be captured early enough in the season. Otherwise they can go to Log Dump R5 (above the old dam).

D) LAND USE FACTORS

Forestry

The entire basin is covered by advanced second growth. Logging has resumed in the upper basin.

Risk Potential

Low.

E) PROTECTION NEEDS

The primary element of Mossy Creek's FSZ is steep adjacent slopes above R2. There is a narrow riparian zone adjacent to R2 which is fairly moist (Salmonberry – Devil's Club – Stink Currant).

Stream Code: 9202577919

Stream Name: Nixon Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Nixon Creek enters Cowichan Lake from the southwest, 2 km northwest of Caycuse Camp. This stream drains an area of relatively low mountains (<1,000 m). Relief is less than North Shore basins of Cowichan Lake tributaries. Even so, the Nixon basin is relatively steep and narrow and flow is essentially non-buffered. Nixon is subject to high fall –winter discharge and bedload movement.

Air Photos	BC 82007 108-109
Topographic Map	92 C/16, 92C.088, 089, 099
Salmonids	Ch reported in past years, a slight possibility remains that some may still be present. Chinook fry were captured by a fry salvage crew in R2 in May 1998 Co to 11,200 m. St to 11,200 m. Ct to 13,200 m. DV to 11,200 m. Rb to 11,200 m.
Obstructions	2R4 m falls at 11,000 m. A complex falls/cascade that features a possible bypass channel on the south and a possible passable slot along the north side of a bedrock island that separates the main channel form the high water channel.
Max. Temp. (C)	11 (9/22/85 - 2,000 m above South Shore Road – R2) 14.8 (8/7/98 R4)
Min. Disch. (m^3	0.225 (2,000 m. above South Shore Road - 9/22/85) 0.043 (200 m above falls - 9/26/85) 0.024 total of three tributaries between the falls and Raymond Creek -9/26/85. 0.088 total of two tributaries (Nixon E & W) between Raymond Creek and the point 2,000 m above South Shore Road on the main stem - 9/26/85. 0.12 Raymond Creek at Caycuse Main - 9/26/85 The lower 2,000 m. of Nixon Creek dries early and rapidly.

NIXON CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	60.0	0.0	2440	0.5	UC	L	2000	0	
Reach 2	40.0	20.0	1450	1.5	FC	H	5000	100000	
Reach 3	20.0	8.0	1360	1.5	FC	M	800	6400	
Reach 4	14.0	8.0	136R	2.0	CON	N	2400	12000	
Reach 5	11.0	9.0	1252	5.0	CON	N	1000	5000	
Reach 6	9.0	7.0	1261	4.0	CON	N	2000	14000	
Reach 7	8.0	6.0	1261	4.0	CON	N	2000	12000	
Reach 8	5.0	4.0	1261	15.0	CON	N	1000	4000	
Reach 9	4.0	2.0	0127	40.0	CON	N	800	1600	
Reach 10	3.0	1.0	1450	5.0	CON	N	300	300	
Reach 11				70.0	CON	N	500		

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead, rainbow, cutthroats and Dolly Varden are present for 11,000 m. Sporadic chinook spawning is reported. Chinook were last reported on November 26, 1973 when 400 were seen, a location was not provided.

Production is limited by summer drying (the lower 2,000 m) and high fall - winter discharge.

Fry production is highly variable in Nixon Creek. In 1987 late August fry densities (fish/m^2) for coho, rainbow-steelhead and cutthroat were .016, .0045 and .002 respectively. However, in 1951, it was estimated that 100,000 coho fry "perished in one small reach" (Burns et. al. 1987) and Reach I coho fry salvage has been as high as 23,150 or .38 fry/m^2. It is estimated that only 60 percent of Reach I coho fry can be salvaged.

C) PRODUCTION OPPORTUNITIES

1. *COHO COLONIZATION:* Above barrier coho colonization smolt yield potential:160 - 1,600/200 fry required **(Production Option # 288).**

2. *CHINOOK REINTRODUCTION:* Chinook fry stocking (Production Option # 289). Chinook could be stocked in Reaches 2 to 4. Only very occasional chinook fry have been found in Nixon Creek during fry salvage operations (1986 to 1998) and no chinooks have been reported in earlier salvages (Burns et. al., 1987). Nixon Creek does however have the capability for chinook rearing and spawners have been reported. Reach 1 is often dry during the fall chinook period. Spring run fish have the best chance of survival in Nixon Creek.

3. *FRY SALVAGE:* Fry salvage in Reach 1 and several sidechannels **(Production Option # 290)**.

4.***SIDECHANNEL DEVELOPMENT:*** An extensive network of complex sidechannels is adjacent to a 2600 m section of Reach 2 between Lush and Lagoon Creeks (these streams are across the creek from the sidechannel complex). These channels are an important component of Nixon Creek's coho production. They are a combination of active, flood and relic channels and some are strongly influenced by small tributaries and groundwater. These channels presently provide approximately 8500 m^2 of habitat. Unfortunately, a large portion of it is subject to both drying and peak flow inundation. If the at risk portion of Nixon's lateral habitat could provide safe summer rearing and overwintering, much more benefit would result **(Production Option # 291).** Fry salvage is carried out in parts of some of the channels. NOTE: In the summer of 1997, approximately 170 m of new channel was constructed by DFO (Habitat Restoration). Channel width is 3-5 m and it was excavated to a depth of 2-3 m. Minimum flow in the channel was .5 LPS 24 m below the inlet and 2.13 LPS 10 m below the outlet berm on 8/6/97. Temperature was 10.1. The channel was extended upstream in the summer of 1998. Coho spawners were reported in Dec. 1998. Temperature then was 9 degrees, 3 degrees warmer than the mainstem. The 1998 extension was 163 m plus a 100 m long spur channel. The main channel (known as Jenny Wren Channel) is 334 m long. Main channel flow was .0338 CMS at its lower end 6/1/99. Its temperature on that day was 7°. Spur channel flow was .0287 at the lower end and temperature was 7.5°
Temperatures since 6/1/99:
8/2/99 16.8

5. ***EXCAVATION:*** Reach 1 of Nixon dries in early summer resulting in huge fry and parr losses. Because of its remoteness and length of area requiring salvage (2000 m), salvage is difficult. Pools are deep for the most part, which also makes salvage difficult. When they begin to get shallow enough to salvage, drying is very rapid. Excavation of excess bedload might be a more suitable option. If summer drying could be prevented. approximately 120,000 m^2 of habitat would be returned to production. It is also possible that early run chinooks may spawn in Nixon again if water was available earlier in the fall. As many as 400 chinooks have been seen spawning in Nixon by E. Hall, former Fisheries Guardian. It is assumed they were early run fish. TimberWest has applied to FRBC for this project. Cost was estimated at $435,000 (Voller, pers. comm.) **(Production Option # 292)**

D) LAND USE FACTORS

Forestry

Ninety percent of the basin is covered by advanced second growth. A very rich hardwood community dominates the floodplain and many areas of lower slopes adjacent to it.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Reaches 1 and 2 are highly riparian and flood prone; they also contain significant lateral habitat such as sidechannels and the lower ends of groundwater tributaries. The Nixon Corridor is very broad here and extends up tributaries to the extent of their riparian or steep adjacent slope landscape units. Upland riparian landscape units are common in the Nixon Corridor. Moist soils with Salmonberry – Swordfern or even Salmonberry – Ladyfern - Equisetum are located on slopes as steep as 35 – 60 %. These are the most sensitive units in Nixon's FSZ. Above Reaches 1 and 2, the FSZ is primarily composed of oversteep slopes. There is a strong need to protect the floodplain – riparian zones and steep adjacent slopes.

Stream Code: N/A

Stream Name: Tom's Creek

Operational Management Unit: Lake South (South Shore Tributaries-West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Nixon Creek from the west 2.5 km upstream of Cowichan Lake and drains a steep, narrow basin after originating in a series of wetlands and small ponds at an elevation of about 740 m on a flat topped mountain. It dries early in Reach 1.

Air Photos	BC 82007 108-109
Topographic Map	92 C/16, 92C.088, 92C.089
Salmonids	Co to 1,200 m. Ct to 1,200 m.
Obstructions	Old box culvert with plank decking at Caycuse Main - passable but will likely need replacing within a few years. Series of falls at 1,200 m totaling 100 m over 200 m.
Max. Temp. (C)	12 (7/30/86) R2
Min. Disch. (m^3)	0.07 (7/30/86) R2 0 for 700 m from July – October or earlier.

TOM'S CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	10	0	1450	1.0	CON	L	700	0	
Reach 2	5	2	136R	2.5	CON	L	300	600	
Reach 3	5	2	1252	3.0	ENT	N	200	400	
Reach 4	3	1	1252	17.0	CON	N	2500	2500	

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 1200 m support coho and resident cutthroats, some of the cutthroats may be progeny of spawners from Cowichan Lake.

Production limited by high - fall winter discharge, summer drying (700 m) and cool temperatures.

C) PRODUCTION OPTIONS

1.*FRY SALVAGE :* Fry **salvage in Reach 1. R1 can dry rapidly and early (Production Option # 293)**.

D) LAND USE FACTORS

Old growth has been logged. Most of the basin is now covered by advanced second growth. Difficult areas along canyons (700 stream length). Most were not logged.

Risk Potential

Moderate

Fishery Officer Narrative

E) PROTECTION NEEDS

Much of Reach 1 is located in the Nixon Creek Corridor because of its riparian nature, Above R1; the FSZ is mainly composed of steep adjacent slopes including some precipitous tributary ravines with high impact potential if carelessly logged or roaded.

Stream Code: N/A

Stream Name: Nixon Creek (West)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Nixon Creek from the west 5 km above Cowichan Lake draining a narrow, steep basin.

Air Photos	BC 82007 108-109
Topographic Map	92 C/16. 92C.088
Salmonids	Co to 324 m. Ct to 1,000 m.
Obstructions	A culvert with a 0.6 m vertical drop at 110 m -passable but should be replaced; **NOTE:** This culvert was replaced about 1990. Falls: 1R1.6 @ 296 m - passable 1R @ 303 m – passable 1.8R3.9 @ 324 m – probably impassable. Falls was improved about 1990 by adding boulders to slot downstream to backflood but passage is still questionable.
Max. Temp. (C)	9 (9/26/85) R1 13 R1 (8/2/99)
Min. Disch. (m^3)	0.042 (9/26/85) R1 0.103 (8/2/99) R1

NIXON CREEK WEST

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	9	4	1360	2.2	FC	N	.0062	251	1004
Reach 2	7	4	1162	6	CON	N	.0084	85	340
Reach 3	8	4	127R	4	CON	N		2200	8800
Reach 4	-	-	-	8	-	-		500	

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 324 m support coho and resident cutthroats. Cutthroats are present above the falls.

Production is limited by access and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Above barrier coho colonization smolt yield potential:160 - 1,600/2,000 fry required **(Production Option # 294)**.

2.BARRIER IMPROVEMENT: TimberWest and MOE worked on the falls at 324 m in 1990. A follow - up assessment is required to determine if fish can now ascend the falls. This assessment should take place in the summer of 1999. Traps were set above the falls in August 1999 and no fish were captured however this was a very limited sample. Electro fishing should be employed. **(Production Option # 295)**

D) LAND USE FACTORS

Forestry

Most old growth (90%) has been cut. The basin is covered with advanced second growth except for a small area (<10%) on the ridge top to the north which has been recently logged.

Risk Potential

Low.

E) PROTECTION NEEDS

Some riparian habitat adjacent to R1. This is in the Nixon Creek Corridor (FSZ). Above R1, the FSZ is mainly steep adjacent slopes including some sensitive tributary ravines and gullies. A steep walled ravine (70 – 130%) is present beginning adjacent to upper R1. The sides are moist (salmonberry-swordfern-Devil's Club) and subject to failure if disturbed.

Stream Code: N/A

Stream Name: Nixon Creek (East)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Nixon Creek from the east 6 km upstream of Cowichan Lake draining a steep and narrow basin.

Air Photos	BC 82007
Topographic Map	92 C/16, 92C.088
Salmonids	Co to 50 m. Ct to 50 m.
Obstructions	A 2 m over 3 falls at 20 m. A culvert with a 2 m outlet drop at 250 m. Rapidly increasing gradient at 1,270 m.
Max. Temp. (C)	12 (7/7/85)
Min. Disch. (m^3)	0.046 (9/26/85)

NIXON CREEK EAST

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5.0	2.0	136R	3.0	CON	N	20	40	
Reach 2	5.0	2.0	136R	3.0	CON	N	230	460	
Reach 3	6.0	2.0	1360	3.0	CON	N	1000	2000	
Reach 4	-	-	-	30.0	CON	N	1260	-	

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and resident cutthroat fry utilize the lower 20 metres and may utilize up to 250 metres.

Production is limited by access and high fall - winter flows.

C) PRODUCTION OPPORTUNITIES

1.***COHO COLONIZATION:*** Potential above barrier coho colonization smolt yield: 80 - 800/1,000 fry required **(Production Option # 296)**.

D) LAND USE FACTORS

Forestry

Ninety-nine percent of old growth has been cut. The basin is covered by advanced second growth except for a very small patch of recent logging at its extreme upper end.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Some riparian is adjacent to R 1 but the main feature of the FSZ is steep adjacent slopes including those of tributary streams.

Stream Code: 9202577919559

Stream Name: Raymond (Lacey) Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Raymond Creek enters Nixon Creek from the west 6 km upstream from Cowichan Lake. The drainage basin is narrow but main stem gradient is relatively low.

Air Photos	BC 82007 109 - 110
Topographic Map	92 C/15, 92C/16. 92C.088
Salmonids	Co to 5,000 m.
	Ct to 5,000 m.
	St to 5,000 m.
	DV to 5,000 m.
Obstructions	Increasing gradient near headwaters, .
Max. Temp. (C)	10 (9/22/85), 17.5 (8/14/97)
Min. Disch. (m^3)	0.12 (9/22/85), .132 (8/14/97)

RAYMOND CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	20.0	5.0	1450	2.0	FC	L	85	425
Reach 2	11.0	8.0	136R	2.0	CON	L	5000	25000

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead, cutthroat and Dolly Varden are present for 5,000 m. It is possible that some of the cutthroat and Dolly Varden are spawners from Cowichan Lake.

Production is limited by high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

None apparent. This stream needs more study.

D) LAND USE FACTORS

Forestry

Ninety-five percent of the basin is covered by advanced second growth.

Risk Potential Low.

E) PROTECTION NEEDS

Although there is a fair amount of lowland riparian landscape in the corridor adjacent to the creek, the bulk of the FSZ is composed of steep adjacent slopes on both the mainstem and tributaries. A feature of the Raymond FSZ that is somewhat unique is the presence of what can be termed upland riparian landscapes. There are significant areas of moist riparian landscape units on slopes as high as 35% where extensive side hill seepage is present. These units are extremely sensitive to disturbance.

Stream Code:

Stream Name: Black Lagoon Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: For 80% of its length, Lagoon Creek is a steep, non-buffered runoff course. However, when the stream reaches the Nixon Creek floodplain, it intercepts groundwater from upwelling, sidechannels and the slope toe to form a productive stream/sidechannel complex. Which features a 60 m^2 upwelling lagoon.

Air Photos	BC 82007 108, 109
Topographic Maps	92C/16, 92C. 088, 089, 099
Salmonids	Co to 200 m
Obstructions	Rapidly increasing gradient with small backfilled jams above 200 m
Max. Temp.	10.0 (8/14/97)
Min. Disch.	R3 = 0 (6/27/96)

BLACK LAGOON CREEK

	Channel Width (m)	Wetted Width (m)	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	4	2	1810	1.0	FC	M	55	220	
Reach 2	3	1	2800	0.5	FC	M	95	285	
Reach 3	3	0	1720	1.0	FC	M	50	0	
Reach 4	2	0	1360	15.0	CON	N	80	0	
Reach 5	2	1	2530	5.0	CON	N	300	-	
Reach 6							400	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho fry densities very high on 6/27/96 in Reaches 1 and 2. Numerous redds were located in Reaches 2 and 3.
Production is limited by low summer flows. Reach 3 dries early.

C) PRODUCTION OPPORTUNITIES

1.***PROVIDE UPWELLING POND :*** **Excavation of an upwelling pond at the end of Reach 3** should provide more water downstream. Present flow is provided by an upwelling pond in Reach 2 and seepage through the floodplain **(Production Option # 297)**

2. *FRY SALVAGE:* Fry salvage is required in a **60 m section of creek water that flows along a Nixon Creek bar**. This could be considered Reach 1 but it belongs more to Nixon than Lagoon for most of the year **(Production Option # 298)**

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth coniferous except along the lower reaches where hardwoods dominate. The area was railroad logged many years ago.

Risk Potential

Moderate

E) PROTECTION NEEDS

Steep adjacent slopes, especially in Reaches 5 and 6, should not be disturbed. Of special importance is the slope break adjacent to Reach 4 between the floodplain and the upland. Reaches I-3 are riparian and are within the Nixon Creek Corridor.

Stream Code:

Stream Name: Lush Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Reach 2 of Nixon Creek 3.8 km from Cowichan Lake. Drains a short, steep non-buffered basin. Adjacent slopes are sensitive, especially in R1 due to steepness and moisture content.

Air Photos	BC 82007 108,109
Topographic Maps	92C/16, 92C.088, 089
	Co to 280 m
Salmonids	Ct to 280 m
Obstructions	2R3 at 50 m, passable. Partially backfilled log jam at 80 m, point of difficult passage. 40R60 impassable falls at 280 m.
Max.Temp.	
Min. Disch.	

LUSH CREEK

	Channel width (m)	Wetted width (m)	Substrate	Channel Confinement		Side Channel	Length (m)	Area (m^2)	
Reach 1	5	3	127R	CON		L	280	840	
Reach 2	3	3	1161	ENT		N	100	300	
Reach 3	4	2	127R	CON		N	600	1200	
Reach 4	3	2	127R	CON		N	600	1200	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout inhabit Reach 1. Production is limited by high gradient and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

None

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth

Risk Potential

Moderate due to steep adjacent slopes

E) PROTECTION NEEDS

Slopes adjacent to Reach 1 are very steep - 60 to 90 % - and relatively moist. The stream is named for the luxuriant cover along the tiny floodplain and adjacent lower slopes of Reach 1. Vegetation is dominated by a heavy understory of Swordfern, Ladyfern, Salmonberry and Devil's Club. The canopy is largely maple and alder. No logging should occur within 15 m of the top of the slopes adjacent to Reaches 1 and 2. Harvesting should be similarly set back from steeper portions of slopes adjacent to Reaches 3 and 4.

Stream Code: N/A

Stream Name: Third Creek (Caycuse 3)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: The western most of a group of three little streams that enter Cowichan Lake within 150 m of each other in a bay at Caycuse Camp. Drains a short, low gradient basin. Summer flow is and a large portion of winter flow is provided by groundwater seepage. A strong sidehill groundwater stream with a runoff component enters from the south at 645m. This stream is accessible for about 40 m. It delivers occasional gravel and gives the mainstem enough force to scour itself. The mainstem headwaters is a strong side hill spring at 1589 m. There is adjacent upland riparian landscape in this area.

Air Photos	BC 82007 108 - 109
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 645 m. Ct to 645 m.
Obstructions	Culvert and fishway at 35 m. The stream becomes too small to support salmonids above the 645 m point. **NOTE: FISHWAY HAS BEEN REPLACED WITH A CULVERT (1994)** **Decrease in size at 645 m.**
Max. Temp. (C)	13 (9/5/86)
Min. Disch. (m^3)	0.01 (9/5/86)

THIRD CREEK (Caycuse 3)

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	2	1	2710	1.0	FC	L	.028	35	35
Reach 2	2	1	6400	1.1	FC	L	.029	451	451
Reach 3	1.5	1	2710	1.3	FC	L	.071	139	139
Reach 4	1	1	8200	.7	FC	L	-	354	354

B) FISH UTILIZATION AND LIMITING FACTORS

At least coho 284 spawners have returned to this stream. Caycuse residents had to carry them across the road when a new culvert was installed on the low road that was impassable. Gord Mutch said that as many as 500-600 spawners were common in the 1940's. Cowichan Lake cutthroat spawning has been reported. Production is limited by small size and current lack of quality spawning habitat. Much of the substrate is sediment and the situation is further aggravated by silty runoff from the Caycuse Bypass Road. TimberWest has installed a collector box and pipe to catch dirty road water and carry it to a safe discharge site across the creek.

C) PRODUCTION OPPORTUNITIES

1. ***RESTORATION OF ORIGINAL CHANNEL:*** This stream was relocated in the 1940's. Restoring it to its original channel might increase its length by some 250 m **(Production Option # 299)**.

2. ***SPAWNING PLATFORMS:*** Addition pf at least three spawning platforms to R2 would greatly increase fry yield **(Production Option # 300).**

3. *LWD ADDITION:* This stream is very LWD deficient. Existing material is largely deciduous and of short duration. Addition of cedar or fir windfall logs to R2 would provide considerable benefit. LWD could be added in conjunction with spawning gravel (Production Option # 301)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Logging resumed in the lower basin in 1996.

Risk Potential

Low. Run-off from Caycuse Bypass Road has placed eggs at risk. The situation was at its worst in the winter of 1996-97. TinberWest has since (1997 summer) taken measures to improve the situation.

E) PROTECTION NEEDS

A significant amount of riparian landscape is adjacent to the entire length of the stream. The riparian zone is very moist and extents upslope in places where side hill springs are present. Average FSZ width is 40 to 50 m.

Stream Code: N/A

Stream Name: Second Creek (Caycuse 2)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This is the middle stream of three that enter Cowichan Lake in a bay at Caycuse Camp. Drains a short, steep basin.

Air Photos	BC 82007 108 - 109
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 120 m. Ct to 371m and 60 m in West Fork.
Obstructions	A culvert with .2 m drop at Caycuse bypass road. Structure is .8M CSP with an average migration flow velocity of 1.3 MPS. Its 19.3 m long. Increasing gradient above 371 m.
Max. Temp. (C)	12 (9/5/86) 11 (8/2/99 – R2)
Min. Disch. (m^3)	.008 (9/5/86)

SECOND CREEK (Caycuse 2)

	Channel width	Wetted width	Substrate	Slope	Confinement	Side Channel	Length	Wetted Area
Reach 1	1	1	1720	1.0	FC	N	37	37
Reach 2	2	1	1720	1.6	CON	N	83	83
Reach 3	2	1	2710	1.5	FC	L	169	169
Reach 4	2	1	1630	2.5	CON	N	82	82
Reach 5	1	1	1450	15.0	CON	N		

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and progeny of Cowichan cutthroats are present for 120 m. Resident cutthroats are present for 371 m and for 60 m in the West Fork.

Production is limited by size and access; lack of pools is also a problem.

C) PRODUCTION OPPORTUNITIES

1. ***BARRIER REMOVAL:*** Replacement of Caycuse Bypass Road culvert at 120 m would allow coho and cutthroat spawners from Cowichan Lake to utilize another 251 m plus 60 m in the West Fork (1 (I) FC .5 2710). Reach 3 is the most suitable spawning reach (Production Option # 302)

2. ***LWD PLACEMENT:*** Strategic placement of LWD in the form of scour logs would increase pool habitat in this shallow stream that lacks this element of habitat (Production Option # 303)

NOTE: The culvert on the lower road was removed in the summer of 1998 adding 17 m of habitat to R2.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Runoff from Caycuse Bypass Road was silting the creek badly at times in the winter of 1996-97. TimberWest took remedial measures in the summer of 1997.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Caycuse 2 has a small amount of riparian zone in R's1 – 4 and some steep adjacent slopes above. An extensive riparian zone is adjacent to the West Fork which enters R 4 at 70 m. Perhaps the stream's biggest threat is the Caycuse Bypass Road which has been a more or less chronic source of sediment since it was constructed. It is especially bad in periods of winter thaw. A potential settling pond is present between Caycuse 2 and 3. Road runoff should be diverted into it. This creek serves as the community water supply for Caycuse.

Stream Code: N/A

Stream Name: First Creek (Caycuse 1)

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: The eastern most of three streams that enter Cowichan Lake in a bay at Caycuse Camp (Camp 6). Drains a short, steep basin.

Air Photos	BC 82007 108 - 109
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 218 m. Ct to 218 m.
Obstructions	Increasing gradient at 218 m
Max. Temp. (C)	11 (9/5/86) 10.1 (8/2/99)
Min. Disch. (m^3)	.006 (9/5/86) .007 R3 – 8/2/99

FIRST CREEK (Caycuse 1)

	Channel width	Wetted width	Substrate	Slope %	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	1	1	1630	1.5	FC	L	.054	37	37
Reach 2	2	1	1540	1.8	CON	N	0	41	41
Reach 3	2	1	1540	3.5	FC	L	.092	140	140
Reach 4	2	1	1360	10	CON	N		200	200
Reach 5	1	1	1270	40	CON	N		500	500

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats utilize the lower 218 m. It is possible that these cutthroats could be progeny of Cowichan Lake spawners. Reach 2 is the cedar log box culvert under Caycuse Bypass/camp access rd.

Production is limited by size, access and lack of pools.

C) PRODUCTION OPPORTUNITIES

1. ***LWD PLACEMENT:*** Strategic placement of LWD in the form of digger logs would help create pools which this creek is lacking. The only places fish are present in any numbers is the few small pools that this creek contains (Production Option # 304)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Runoff from Caycuse Bypass Road was silting the stream in the winter of 1996-97. TimberWest took steps to remedy the problem in the summer of 1997.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

The FSZ includes the lakeshore zone in R! and a riparian corridor in R3 that varies in width. It's relatively narrow on the north (5-10 m) and quite wide on the south where it ranges up to 100m. Recent logging did a good job of protecting the FZS adjacent to R 3 and lower R4.

Stream Code: N/A

Stream Name: Helpful Creek

Operational Management Unit : Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake at the Caycuse Camp dry land sort. The stream drains a steep, narrow basin.

Air Photos	BC 82007 107 - 108
Topographic Map	92 C/16, 92C.089
Salmonids	Co and Ct to 200 m.
Obstructions	A 1 m culvert at 200 m, 1 m culvert at 300 m, increasing gradient above.
Max. Temp. (C)	13 (9/5/86)
Min. Disch. (m^3)	.01 (9/5/86) above 100 m.

HELPFUL CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5	0	1360	2.5	CON	N	100	0	
Reach 2	5	1	1360	2.5	CON	N	100	100	
Reach 3	4	1	1270	3.0	CON	N	100	100	
Reach 4	-	-	-	20.0	CON		1000	-	
Reach 5	-	-	-	11.0	CON		1250	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present for 200 m. It is possible that these cutthroats could be progeny of Cowichan Lake spawners.

Production is limited by accessible length, low summer flow and high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

1.***FRY SALVAGE***: Coho fry salvage in Reach 1 **(Production Option # 305)**. 300 were salvaged on July 7, 1986.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. This stream is located beside the Caycuse Dryland Sort.

Risk Potential

Low.

Stream Code: 9202577845

Stream Name: Croft Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream, draining a steep, narrow basin, enters Cowichan Lake from the south 3 km southeast of Helpful Creek. This stream is subject to early drying.

Air Photos	BC 82007 107 - 108
Topographic Map	92 C/16, 92C.089
Salmonids	Chance of coho spawning in the lower 150 m. No adults or fry have been seen. No trout are present.
Obstructions	Increasing gradient at 200 m, 2 m culverts at South Shore Road @ 280 m, 10 m falls at 750 m.
Max. Temp. (C)	11 (9/5/86)
Min. Disch. (m^3)	0 for 600 m, .001 for 100 m below falls

CROFT CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5	0	1450	1.0	CON	N	50	0	
Reach 2	4	0	1360	3.0	CON	N	150	0	
Reach 3	4	0	1270	6.0	CON	N	450	0	
Reach 4	4	1	127R	6.0	CON	N	100	100	
Reach 5	-	-	-	40.0	CON	N	1500	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Chance of coho spawning in lower 150 m, stream usually dries before fry emergence.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. TimberWest's Caycuse Campsite is located along lower Croft.

Risk Potential

Low.

Stream Code: N/A

Stream Name: Rowdy Creek

Operational Management Unit: Lake South (South Shore tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream, draining a steep narrow basin, enters Cowichan Lake from the south 1.3 km southeast of Croft Creek.

Air Photos	BC 82007 107 - 108
Topographic Map	92 C/16, 92C.089
Salmonids	Resident cutthroats with a strong rainbow influence are present in the summer habitable area - Reach 2 (300 m).
Obstructions	Series of falls beginning at 700 m - 40 m over 60 m.
Max. Temp. (C)	13 (9/5/86)
Min. Disch. (m^3)	0 for 250 m, then .007

ROWDY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5	0	1360	3.0	CON	N	250	0	
Reach 2	5	3	1360	3.5	CON	N	300	900	
Reach 3	-	-	-	30.0	CON	N	2250	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Resident cutthroat and rainbow in Reach 2. Slight chance of coho and Cowichan Lake cutthroat trout spawners in Reach 1.

Production limited by violent channel and substrate disturbance from high fall - winter discharge.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

Steep adjacent slopes are the primary aspect of Rowdy Creek's FSZ. Some residual slope damage from the first cut remains.

Stream Code: N/A

Stream Name: Dusty Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream, draining a steep, narrow basin, enters Cowichan Lake from the south 100 m southeast of Rowdy Creek.

Air Photos	BC 82007 107 - 108
Topographic Map	92 C/16, 92C.089
Salmonids	Ct to 1200 m.
Obstructions	A steep 12 m long box culvert with a .3 drop at 100 m. Passable but coho do not migrate more than 20 m above it because off increasing gradient and lack of spawning sites. 5 m falls at 1200 m.
Max. Temp. (C)	14 (9/6/86)
Min. Disch. (m^3)	0 for 500 m, then .05

DUSTY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	4	0	1360	2.0	CON	N	120	0	
Reach 2	3	2	1360	3.5	CON	N	380	0	
Reach 3	-	-	-	20.0	CON	N	2500	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are present for 120 m. Resident cutthroats to 25 cm utilize 1200 m. Production is limited by drying in the coho spawning zone and high fall - winter flows.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SALVAGE :*** Fry salvage in the lower 120 m **(Production Option # 306)**. 200 coho fry were salvaged in July, 1986.

D) LAND USE FACTORS

Forestry

Advanced second growth covers the entire basin.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Steep adjacent slopes are the main element of Dusty Creek's FSZ. Residual impacts from the first logging pass remain in the form of road related slope damage.

Stream Code: NA

Stream Name: Cutthroat (12Km) Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) Biophysical Description: A 1728 m long small tributary of the South Shore of Cowichan Lake. Drains a short, relatively steep, non-buffered basin just west of Misery Creek. Summer flow is provided by groundwater seepage. Subject to high fall-winter discharge and bedload movement. Bedload is particularly unstable below South Shore Road (400m). Subject to summer drying in this section.

Air Photos	BC 82007 107-108
Topographic Map	92C/16, 92C.089
Obstructions	Increasing gradient and small cascades at 730 m
Salmonids	Ct (resident and Cowichan Lake spawners)
Max. Temp.	14.9 (8/7/97- R2 30m upstream South Shore Road)
Min. Disch.	.00656 (8/7/97 R2 30 m upstream South Shore Road)

CUTTHROAT CREEK

	Channel Width	Wetted Width	Substrate	Slope(%)	Confinement	Sidechannel	Length	Area
Reach 1	3	3	1360	2.0	CON	N	356	0
Reach 2	3	1	1360	3.0	CON	N	207	207
Reach 3	2	1	1261	8.0	CON	N	60	60
Reach 4	3	1	1360	2.5	CON	N	105	105
Reach 5	2	1	1261	15.0	CON	N	1000	1000

B) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat trout fry and parr are present for 730 m. Fry density (1.5/m^2) strongly suggests that this is a spawning stream for Cowichan Lake cutthroats.
Production is limited by summer drying in the lower 356 m (Reach 1), unstable bedload and the small size of the creek.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SALVAGE:*** Fry salvage in the lower 356 m should yield approximately 500 fry for release to Cowichan Lake at the stream mouth. Salvage should occur before July 1 before lake temperatures become significantly higher than stream temperatures. Salvage will be difficult in the boulder-dominated channel (Production Option # 307)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Logging has resumed on the west side of the creek above South Shore Road. A leave zone that varies from15-50 m has been retained up to Reach 4.

Risk Potential

Moderate

E) PROTECTION NEEDS

A top of the bank leave strip needs to be retained to the headwaters and to the headwaters of the East Fork which enters at 730 m unless trees can be felled away from the creek on slopes less than 30%. However there should be considerable discretion left to the forest companies on site treatment.

Stream Code: N/A

Stream Name: Misery Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Misery Creek, a steep and narrow basin, enters Cowichan Lake from the south 2 km east of Dusty Creek.

Air Photos	BC 82007 107 - 108
Topographic Map	92 C/16, 92C.089
Salmonids	CO to 1200 m. Ct to 1200 m.
Obstructions	A culvert with a .8 m drop at 300 m, 2 m falls at 1200 m, 3 m falls at 1600 m, 2 m culvert at 1900 m.
Max. Temp. (C)	12 (9/7/86)
Min. Disch. (m^3)	0 for 500 m, then .07 (9/7/86)

MISERY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	7	0	1360	2.0	CON	N	800	0	
Reach 2	6	2	136R	5.0	CON	N	1000	2000	
Reach 3	-	-	-	25.0	CON	N	2000	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroat are present for 1200 m. It is possible that these cutthroats could be progeny of Cowichan Lake spawners.

Their numbers are sparse due to high fall - winter discharge and a shortage of spawning habitat.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SALVAGE:*** Fry salvage in the lower 800 m **(Production Option # 308)**. 100 coho fry and 7 cutthroat fry were salvaged in July, 1986.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

Misery Creek's FSZ is nearly 100% slope related. This is a steep, narrow valley with some very steep sideslopes that are moist and unstable in places. Some residual road related slope damage remains from the first cut, especially in the Upper Basin.

Stream Code: NA

Stream Name: Grossklegs's Creek

Operational Management Unit: Lake South (South Shore Tributaries – West)

CVRD Electoral Area: F

A) BIOPHYSICAL DESCRIPTION: This small, seasonal stream dries in its lower three reaches, It drains a steep, narrow basin and is non-buffered.

Air Photos	BC 82007 106-107
Topographic Maps	92C/16, 92C.090
Salmonids	Co 196 m
Obstructions	1 m culvert at South Shore Road, 1 m backfilled log jam at 567 m, combination falls/log jam at 747 m with total vertical drop of 5 m. Sharply increasing gradient upstream.
Max. Temp.	15 8/3/96
Min. Disch.	0 for 553 m then int. for 265 m then 3LPS 8/3/96

GROSSKLEGG'S CREEK

	Channel width(m)	Wetted width(m)	Substrate	Slope(%)	Channel Confinement	Side Channel	Length (m)	Wetted Area(m^2)	
Reach 1	4.0	0.0	1540	1.8	CON	N	196	0	
Reach 2	4.0	0.0	1630	2.0	CON	N	161	0	
Reach 3	4.0	0.0	1450	2.5	CON	N	196	0	
Reach 4	4.0	1.0	1360	3.0	CON	N	180	180	
Reach 5	3.0	1.0	1162	15.0	CON	N	1000	1000	
Reach 6	2.0	1.0	1162	35.0	CON	N	500	500	

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho spawners use the creek in years when Cowichan coho escapement is high.
Egg survival is questionable due to very early drying including the possibility of winter drying, mobile substrate and sedimentation from South Shore Road.
Production highly limited by the above factors and access.

C) PRODUCTION OPPORTUNITIES

The culvert at South Shore Rd. (196 m) could be removed but little gain would occur due to the low productivity of the stream above it and the relatively short distance to the next barrier (371 m).
This creek should be checked for coho fry below South Shore Road; it dries early but doesn't get spawners every year.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth (approx. 60 - 70 years old). Recent logging in the west part of the lower basin (1996).

Risk Potential

Low

E) PROTECTION NEEDS

Portions of the stream are contained in steep walled ravines with unstable slopes, these areas should be avoided. Road building should be highly curtailed in the high slope portion of the upper basin. Reach 1 receives a good deal of sediment-laden runoff from South Shore Road. Attempts have been made to divert the water down the road to the old Misery Creek Log Dump and these have been successful. This measure needs to be repeated on at least annual basis. Reach I gravel becomes highly sedimented in a short time if dirty water is allowed to run down the creek.

Stream Code: N/A

Stream Name: Miserable Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream drains a steep, narrow basin and enters Cowichan Lake from the south 6 km northwest of Honeymoon Bay.

Air Photos	BC 82007 106 - 107
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 1,300 m. Ct to 1,300 m.
Obstructions	A 4 m falls at 1,300 m.
Max. Temp. (C)	8 (9/22/85)
Min. Disch. (m^3)	0 for 292 m then .0135 (8/3/96)

MISERABLE CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	4.0	0.0	1540	2.2	CON	N	292	0	
Reach 2	3.0	1.0	136R	3.5	CON	N	800	800	
Reach 3	2.0	1.0	1135	25.0	CON	N	2000	2000	

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho and resident cutthroat utilize the lower 1,300 m. It is possible that some of these cutthroats could be progeny of Cowichan Lake spawners.

Production is limited by access, gradient, low summer flows (the lower 292 m dry) and high fall -winter discharge.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SALVAGE:***. Fry salvage could be undertaken in the lower 292 m. Fish could be released in Cowichan Lake if they can be caught early enough **(Production Option # 309)**

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. 1,500 m of stream is affected by South Shore Road (Grosskleg's Hill) runoff which carries considerable sediment.

Risk Potential

Low.

E) PROTECTION NEEDS

Steep adjacent slopes are present above R2. Some are very moist – upland riparian – units. Some residual slope damage remains in the upper reaches.

Stream Code: NA

Stream Name: Grassy Bay Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Cowichan Lake from the south some 300 m west of a small island and just west of Logger Bill's Lagoon. Drains a short, steep basin. Flow partially buffered by a groundwater tributary that enters from the east at 285 m.

Air Photos	BC 87024 043, 044
Topographic Maps	92C/16, 92C. 089
Salmonids	Co to 180 m, possibly to 390 m at times
Obstructions	2 m backfilled logjam at 180 m, 10R20 falls at 390 m
Max. Temp.	
Min. Disch.	

GRASSY BAY CREEK

	Channel Width (m)	Wetted width (m)	Substrate	Slope(%)	Channel Confinement		Side Channel	Length (m)	Wetted area (m^2)	
Reach 1	2	0	2710	0.5	FC		L	55	0	
Reach 2	2	1	1720	2.0	CON		N	335	335	
Reach 3	2	1	1243	30.0	CON		N	400	400	

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho utilize the lower 180 m. Some may navigate the log jam and proceed to the base of the falls at 390 m. Production is limited by stream size, low summer flows and high fall - winter discharge. On June 24, 1996 - a very damp spring - the lower 35 m were dry. The upper 15 m of this zone had just dried. Flow above this point was 3 LPS.

C) PRODUCTION OPPORTUNITES

1. ***LOG JAM REMOVAL:*** Removal of the log jam at 180 m **(Production Option # 310)**.

D) LAND USE FACTORS

Forestry

Most of the basin is in advanced second growth. A small amount of logging occurred adjacent to mid-Reach 3 in the early 1990's. A new road (TimberWest) was constructed from Chicken Joe's to Grossklegg's Creek in 1991. The road contributes small amounts of sediment to the creek.

E) PROTECTION NEEDS

The creek's small deltaic fan should not be disturbed - the creek sometimes spills across it. About .5 Ha is involved. Steep slopes adjacent to Reach 3 and to the groundwater tributary need to be retained in buffer zones.

Stream Code: NA

Stream Name: Gordon Bay Creek

Operational Management Unit: Lake South (South Shore Tributaries: West)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A small, temporary stream that originates near the old Cowichan Copper Mine and enters Cowichan Lake at Gordon Bay. Also fed by a number of smaller tribs. to the east that cross South Shore Road on the cut climbing up from the old road. These feeders form a South Fork of Gordon Bay Creek which only flows on the valley bottom in periods of extended high runoff.

Air Photos	BC 82007 106 - 107
Topographic Map	92 C/16. 92C.089. 090
Salmonids	Co Cm: two chum carcasses were found at the mouth of the creek in December 2001. It is possible they could have spawned on the beach but they likely spawned in Gordon Bay Creek. 5 carcasses were found at the mout in Nov. 2002, a very heavy Cm esapement year. Chums were common in all larger Cowichan Lake tribs in 02.
Obstructions	A culvert with a 1 m drop at 100 m (passable at high flows), increasing gradient and a number of small falls at 400 m, 2 m falls at 960 m.
Max. Temp. (C)	N/A
Min. Disch. (m^3)	0

GORDON BAY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5	0	1360	1.0	CON	Nil	100	0	
Reach 2	2	0	1810	1.0	CON	Nil	200	0	
Reach 3	1.5	0	136R	8.0	CON	Nil	970	0	

B) FISH UTILIZATION AND LIMITING FACTORS

Gordon Bay Creek dries early each year. Reach 1 sometimes dewaters during winter dry spells. Nonetheless, coho spawned in the fall/winter of 1995-96 and approximately 1000 fry were salvaged.

C) PRODUCTION OPPORTUNITIES

1.***COHO COLONIZATION:*** A 5040 m^2 impoundment at 970 m could be colonized with coho fry **(Production Option # 311)**.
Carrying capacity: CO ~ 750

The impoundment was created by Cowichan Copper. It's the lowermost of five. Those above it have filled with tailings. The mine closed in 1962 and, although the pond still has a blue green tinge, it supports plankton, vegetation and frogs. There is a 2 m^2 patch of silty gravel in the accessible portion of the inlet that could be improved to sustain an early spawning resident cutthroat population.

2.*HEADWATER STORAGE:* In order to insure coho smolt migration, the impoundment should be raised 20 cm. (Production Option # 312). The stream often dries before June 1. On February 26, 1988, the lower 100 m was dry except for its first 10 m and the rest was discharging .02 cms. Depth over the pond's outlet sill was only 2 cm.

3.***FRY SALVAGE:*** Although it is uncertain whether Gordon Bay receives regular escapement, it should be checked every spring between early April and mid-May for coho fry. If they can be caught early enough, they can be released in Cowichan Lake or Gordon Bay Pond which has a carrying capacity of 750. If fish are released in the pond, their survival should be monitored by summer temperature and oxygen measurements, minnow traps and, if it's clear that some have survived, a smolt trap the following spring (Production Option # 313)

4) *RELOCATION OF REACH 1:* Reach 1 used to continue to flow east from where the culvert at the head of R1 is located to enter Cowichan Lake in a productive riparian area (Cowichan Lake Reach 12A which has been termed Boat Launch Wetland). It should be relocated to its original location because this is a much more productive condition than its present location which is an eroded trench. The re-located reach would be approximately 340 m long as opposed to the present R1 length of 100 m. 180 m would be between the top of present R1 and the top end of Boat Launch Wetland and 160 m would be within the wetland. Overall, 140 m of additional channel would be gained (Production Option # 314).

D) LAND USE FACTORS

Forestry

The basin is mixed second growth (20 - 40 years).

Mining

Cowichan Copper ceased operation in 1962. The mine was known as the Blue Grouse.

Risk Potential

Low.

Fishery Officer Narrative

E) PROTECTION NEEDS

Gordon Bay Creek flows through a small valley with both riparian and slope components to its FSZ. There are areas of high sensitivity above R2. South Shore Road crosses several forks of Gordon Bay Creek and sediment runoff from its surface is common during rainy periods. The road is especially problematical during periods of thawing combined with rainfall.

OPERATIONAL MANAGEMENT UNIT 12: LAKE SOUTHEAST

OVERVIEW

Lake Southeast OMU extends from Sutton Creek – Gordon Bay on the west to Halfway Creek and the west boundary of the Town of Lake Cowichan on the east. The OMU has also been termed South Shore Tributaries – East.
Urban development is light consisting of two small communities: Mesachie Lake and Honeymoon Bay. Agricultural use is very light with activity on the March farm on the Sutton Creek Delta and even less activity on the Robertson River Delta. Forestry dominates land use in the OMU. Almost no old growth remains but second growth is advanced and logging is well underway.
The OMU is rich in streams and there are a substantial number of significant riparian landscape units in their Fisheries Sensitive Zones: The Maple Flat area of Lower Sutton Creek, Golf Course Creek above the logging road, Patricia Creek's lower and middle reaches, the Robertson River Corridor especially from Coho Heaven to Roach's Bridge, Mesachie Creek Wetland and the Mesachie Sponge Zone of Halfway Creek and the Upper Halfway Wetlands including Fairservice(Cook's) Lake.

LIMITING FACTORS

Production is limited by low summer flows, lack of quality winter habitat and, in some cases, low habitat diversity/complexity.

PRODUCTION OPTIONS

Fortunately, there are numerous opportunities (66) to mitigate production limits in OMU 12. They are outlined and prioritized in Table 1 and discussed in more detail in the stream files.

Table 1: Production Options in OMU 12 (Lake Southeast)

No.	Location	Activity	Priority
315	Sutton Creek	Sidechannel development	1
316, 317		Coho or chinook colonization	3
318		Fry salvage	1
320	Millar Creek	LWD complexing	3
321	Five Culverts Creek	Coho Colonization	4
322		LWD complexing	2
323	South Sutton Creek	Coho colonization	3
324	Slippery Creek	Coho colonization	3
325, 326	Maple Flat Creek	Sidechannel development	2
327		Barrier removal	1
328		Spawning platform	3
329		Headwater storage/coho col.	2
330	Golf Course Creek	Headwater storage, sp.pl.	2
331		Culvert removal	2
332, 333		Fry salvage, coho col.	1
334	Golf Course Cr.	Barrier removal	1

335, 336		Structural improvement	2
337	Ashburnham Creek	Coho colonization	2
338		Fry salvage	2
339		LWD addition	3
340		Groundwater channel	1
341	Robertson River	Fry salvage	1
342		Gravel removal	3
343,344,345		Sidechannel development	1
346	Patricia Creek	Headwater storage	3
347	Nineteen Creek	Fry salvage	2
348		LWD addition	2
349		Fertilization	1
350	Easy Creek	Fry salvage	1
351		Juvenile barrier removal	1
352	Benny's Creek	Excavation	1
353	Sixteen Creek	Barrier removal	3
354		Sidechannel development	2
355	Steve's Creek	Channel protection	1
356	Swampwater Creek	Barrier removal	1
357		Headwater storage	2
358		Substrate improvement	2
359	East Robertson	Coho colonization	2
360		Fry salvage incl. Roach's S.C.	1
361	March Creek	Fry salvage	1
362		LWD addition	1
363	Robertson Sidechannel	Fry salvage	1
364		Excavation	1
365		Gravel management	1
366		LWD and boulder addition	2
367	Blind Channel	Riparian planting	2
368		LWD addition	1
369		Fry salvage	1
370	Mesachie	Mesachie L. storage	1
371		Mesachie L. fry stocking	1
372, 373	Plantation Creek	Headwater storage	1
374		Spawning platforms	2
375		Fry salvage	1
376		LWD addition	
377	Halfway Creek	Fry salvage	2
378		Headwater storage	1
379		Excavation	3
380		Barrier improvement	

Stream Code: 9202577701

Stream Name: Sutton Creek

Operational Management Unit: South Shore Tributaries: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Cowichan Lake 1.5 km west of Honeymoon Bay townsite. Drains a relatively broad basin of comparatively low relief. A complex stream system with a number of important tributaries. Relatively lightly buffered and subject to high fall – winter discharge fluctuation.

Air Photos	BC 82007 135 - 136
Topographic Map	92 C/16,92C.079, 92C.089, 92C.090
Salmonids	Co to 10,500 m. St to 10,500 m. Rb to 10,500 m. Ct to 10,500 m. DV to 10,500 m. Occ. Cm lower reaches Early Ch have been reported
Obstructions	Steep gradient and falls beginning at 10,500 m.
Max. Temp. (C)	18.5 (7/26/96) Reach 3 18.2 (7/28/98) R 3
Min. Disch. (m^3)	0.16 (Reach 3) 250 m above the mouth of Millar Creek (8/26/96) 0.061 (Reach 4) 50 m above South Sutton (8/26/85)

SUTTON CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1		30.0	0.0	3610	0.1	CON	N	365	0
Reach 2		16.0	0.0	1540	1.0	FC	L	1000	0
Reach 3		25.0	6.0	1450	1.0	FC	M	2500	5000
Reach 4		10.0	6.0	1270	2.0	ENT	N	300	1500
Reach 5		14.0	6.0	1450	1.7	FC	L	4000	16000
Reach 6		8.0	4.0	1270	4.0	CON	N	2700	10000
Reach 7		4.0	2.0	1144	16.0	CON	N	2500	5000
Reach 8		-	-	-	8.0	CON	N	1500	-

B) FISH UTILIZATION AND LIMITING FACTORS

Sutton Creek supports populations of coho, steelhead, resident rainbow and resident cutthroat trout and Dolly Varden Char. A few chum salmon are also present on an intermittent basis and early run chinook salmon are occasionally reported. Three were seen in early May 1985. 75 chinooks (presumably fall run) were reported in Reach 2 on November 26, 1973 .The large Cowichan Lake cutthroat trout spawn in Sutton Creek but their numbers are extremely low. and spawning locations are unknown. The creek was also known as an important spawning stream for Cowichan Lake Dolly Varden which are also scarce. Individuals as large as 6 kg. were reported prior to the 1950's. There haven't been many recent observations but Steve Voller saw a pair in October, 2000. On Nov. 26, 2002, there were 5 dead and 22 live chums between South Shore Road and Golf Course Creek, a distance of 275 m.

Production is limited by high fall - winter discharge and low summer flow. The lower 1,365 m dry. Gordon Main logging road contributes a good deal of sediment for much of the fall -winter.

C) PRODUCTION OPPORTUNITIES

1. *SIDECHANNEL DEVELOPMENT:* There is sidechannel development potential in Reaches 3 and 5, it is especially high in the Maple Flat/Big Split area of Reach 3 (Production Option # 315).

Cold Spring, a 185 m relic-active channel on the west side of Maple Flat, was selectively excavated in 1996 to increase depth and area and draw groundwater. Base flow ranges from .69 LPS at the beginning of the channel to 15.16 LPS at the confluence with a Sutton Creek sidechannel (8/24/98). Temperatures ranged from 9.9 at the start to 11.9 at the end (8/21/98). The inlet end of this channel requires some defense. Other options are present in this riparian complex. The east side of Maple Flat has a number of possibilities in the area above Maple Flat Creek. The Cold Spring Channel has further development opportunity in the form of complexing and creating lateral ponding. This channel was developed by Hancock Timber/Campbell Group and Ted Harding/CLSES.

Another channel was constructed on the next floodplain lobe on the east above Maple Flat mainly in 1999; I term this lobe Upper Maple Flat. The channel has been termed Meadow Channel or Meadow Ponds. It is 244 m long with 10 pools. June 28, 00 temperature ranged from 8 near the top end to 11 at the bottom end while nearby Sutton Creek was 14. Flows on June 28, 00 ranged form about 1 LPS at the top to 15 LPS at the bottom. On Sept. 29, 02 flow was .42 LPS throughout the channel. Temperature was 11. Coho spawners and overwinter migrants use this channel along with oeriodic in – migrants form Sutton Creek. The channel blends into the mainstem and a large sidechannel that is 254 m long. In the late summer, most Meadow Pond flow enters the sidechannel. This is another Hancock-Harding channel.

Yet another channel has been proposed by Hancock – Harding in the Lower Maple Flat Complex. It was scheduled to undergo construction in the summer of 2001 and would be known as Art's Channel (after Art Watson, president of CLSES). The channel is located on the west side of Sutton Creek below Cold Spring and will be approximately 155 m long and about 5 m wide. This channel was constructed in the late summer of 2002.

2. *COHO AND CHINOOK COLONIZATION:* Coho and chinook fry stocking in the headwaters (Production Options # 316 and # 317). In some years, coho escapement and subsequent fry density is generally so low that the creek can be considered a colonization candidate in Reaches 6 and 7. Chinooks could be stocked in Reaches 3 - 7.

3. *FRY* *SALVAGE*: Fry **salvage is required in the lower 1365 m (Production Option # 318)**. Yield is usually 10 - 20,000. Salvage is also necessary in the flood channel below Coldspring. Yield is generally around 3000 fry and perhaps 50 coho smolts.

D) LAND USE FACTORS

Forestry

Eighty percent of the basin is covered by advanced second growth. The remainder is early regeneration. Considerable second growth logging has occurred in the late 1980's and 1990's.

Residential/Golf Course

There is considerable development along South Shore Road including March Meadows Golf Course. Some of the housing and part of the golf course is within the riparian/floodplain zone of Sutton Creek and at risk from flooding. The RV park at the creek mouth is partly within the creek's FSZ and partly within the FSZ of Cowichan Lake. Some of the sites near the lake are flooded in high water periods. Aside from the loss of part of the riparian zone, there is intermittent pressure to channel and dredge the creek. When a large flood and property damage occurs, this will increase.

Risk Potential

Low to moderate.

Fishery Officer Narrative

E) PROTECTION NEEDS

No further urban invasion of Sutton Creek's riparian lands should occur. This not only applies to Reaches 1 – 2 but to upstream reaches as well. Significant riparian areas are located adjacent to Reach 3 particularly in The Maple Flat/Big Split Area and lesser areas are located along Reach 5 and lower Reach 6. Reach 2 riparian landscapes include the maple meadow type which is rather rare and largely confined to south central Vancouver Island in the Upper Cowichan and Upper Nitinat Valleys. Some of these landscape units are deserving of Ecological Reserve status. Beginning at Reach 6, Sutton Creek adjacent slopes steepen and there are a number of seepage points along these slopes which need to be avoided. Most of the

tributaries also have this feature especially the pair at Mile 11 which feature very steep and moist slopes with salmonberry – Devil's Club landscape units on ravine walls.

Stream Code: 9202577701113

Stream Name: Millar Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Millar Creek enters Sutton Creek 1.5 km above Cowichan Lake. Summer flow is provided by groundwater seepage.

Air Photos	BC 82007 106 to 107
Topographic Map	92 C/16, 92C.089, 92C.090
Salmonids	Co to 3,000 m. Ct to 3,000 m.
Obstructions	A huge log jam at 2,500 m. The stream dries above this point. Old debris is present below this jam which periodically also forms barriers.
Max. Temp. (C)	17.5 (8/26/96)
Min. Disch. (m^3)	0.010 (8/26/96 – R1)

MILLAR CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	6.0	2.0	1450	1.5	OC	L	3000	6000	
Reach 2	4.0	0.0	127R	30.0	CON	N	1500	0	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroat trout are present for 2.5 km. A few Cowichan Lake cutthroats may spawn in this creek.

Access is occasionally blocked by log jams.

C) PRODUCTION OPPORTUNITIES

1. ***LWD COMPLEXING:*** Lower Reach 1 could be improved by adding LWD. Upper portions of the Reach are rich in large woody material (although much of it is very old) and there is no lack overall but Lower Reach 1 is lacking and is very accessible above and below Gordon Main. At least two test sites should be established immediately above and just below the road and monitored for before and after utilization and post installation changes (Production Option # 319).

D) LAND USE FACTORS

Forestry

The watershed is covered by advanced second growth. Steep moist slopes (salmonberry -swordfern -alder) adjacent to the stream from 500 - 2,300 m. Seepage points are present throughout this reach.

Risk Potential

Moderate.

Fishery Officer Narrative

E) PROTECTION NEEDS

Millar Creek is located in a ravine for much of its length. The walls are steep and moist in most areas. The ravine and lower delta comprise the FSZ.

Stream Code: NA

Stream Name: Five Culverts Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Sutton Creek 5,000 m above Cowichan Lake; drains two steep, narrow basins. Creek is named for the five culverts under Gordon Main at the 56 m point. The CSP culverts are .76 m in diameter and 12 m long.

Air Photos	BC 82007 135-136
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 120 m. Ct to 120 m.
Obstructions	5 m over 30 cascade at 120 m. The namesake 5 culverts are located under Gordon Main @ 56 m. They are .76 m in diameter and 12 m long. There is a 10 cm vertical drop at their outfall which could pose a barrier to juvenile coho swim – ups. Swim –ups have not been needed in this stream in the years I have been observing it because escapement is usually more than strong enough to seed the creek with fry. In some years it's been so strong that a CLSES member took some brood stock. The main spawning area is in Lower R2 between Gordon Main and the falls.
Max. Temp. (C)	15.0 R! – 8/24/98
Min. Disch. (m^3)	West Fork 0.021 (9/26/85) East Fork 0.002 (9/26/85) Mainstem 0.023 (9/26/85) Mainstem 0.0108 (8/24/98 R1)

FIVE CULVERTS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	5.0	2.5	1360	2.3	FC	L	56	140	
Reach 2	9.0	2.5	1720	2.0	FC	L	64	160	
WEST FORK									
Reach 1	5.0	2.5	1360	2.5	FC	L	500	1000	
Reach 2	4.0	2.0	1360	8.0	CON	N	500	1000	
Reach 3	5.0	2.5	136R	2.5	CON	N	500	1250	
Reach 4	4.0	2.0	127R	40.0	CON	N	1000	2000	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroat utilize the lower 120 m. There is a possibility that some of the cutthroats in this stream are progeny of cutthroat from Cowichan Lake. Coho numbers are surprisingly high in some years and brood fish have been taken from this creek. Main spawning area 10m upstream of Gordon Main. Gravel is quite compacted (1994).

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION*** : Potential above barrier smolt yield:100 - 1,000/1,250 fry required **(Production Option # 320)**. This stream should be considered as a brood stock source and, if warranted by escapement numbers, at least two females could be taken for fry out plants in the Sutton drainage.

2. ***LWD COMPLEXING***: Reach 2 is sparse in LWD and is very accessible. Two good sites for single or double windfall logs are present above Gordon Main. The installations need to be monitored because they could jam the culverts under Gordon Main that give this creek its name (Production Option # 321).

Consideration should be given to removing these culverts but they have trapped gravel upstream which provides excellent spawning habitat.

D) LAND USE FACTORS

Forestry

Ninety five percent of the basin is covered by advanced second growth. The rest is early immature and new regeneration.

Steep, moist slopes (70 percent) are present adjacent to both forks for 2,000 m.

Risk Potential

Moderate.

E) PROTECTION NEEDS

Large portions of the stream above the falls where it forks into two branches are contained in steep, moist ravine landscape units. Logging should be well set back from ravine edges. There is some moist riparian landscape adjacent to Reach 1, especially to the south near Gordon Main.

Miscellaneous Counts

2001
2002 Co 6

Stream Code: 9202577701418

Stream Name: South Sutton Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This moderate sized stream enters Sutton Creek from the south 6 km above Cowichan Lake. Drains two steep, narrow basins.

Air Photos	BC 82007 135 - 136
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 1000 m. St to 1000 m. Ct to 1000 m. DV to 1000 m.
Obstructions	3 m falls at 1,000 m.
Max. Temp. (C)	9 (9/17/85)
Min. Disch. (m^3)	0.11 (9/17/85) West Fork:0.065 East Fork:0.045

SOUTH SUTTON CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	14.0	4.0	1540	1.5	FC	L	700	2800	
Reach 2	9.0	6.0	136R	2.5	CON	N	300	1800	
Reach 3	5.0	2.0	1360	4.5	CON	L	1500	3000	
Reach 4	-	-	-	20.0	CON	N	1500	-	

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 1,000 m are utilized by coho, steelhead, cutthroats and Dolly Varden.

Production is limited by high fall - winter flows and cool summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. *COHO COLONIZATION* : **Above barrier coho colonization smolt yield potential** (West Fork):120 - 1,200/1500 fry required **(Production Option # 322)**.

D) LAND USE FACTORS

Forestry

Fifty percent of the basin is in advanced second growth. The rest is early regeneration and early immature. The north slope of the East Fork is extremely sensitive to logging and road building. 50 stream courses are present on unstable soils on 70% slopes for 3,500 m - nearly the entire length of the stream.

Risk Potential

High.

E) PROTECTION NEEDS

There are large areas of stream adjacent ravine lands in this basin and many small tributaries that enter both forks through this landscape type. This is especially true of the north slope of the East Fork where many little tributaries enter over slopes that are greater than 70 % in many areas. Logging will have to be very carefully conducted here (likely summer only) and road building should be avoided in favour of heli – logging in the steeper parts of the basin.

Stream Code

Stream Name: Stink Currant Creek

Operational Management Unit: South Shore Tributatries East (13)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A very small stream that enters Reach 5 of Sutton Creek from the east. This stream is primarily a runoff creek that drains a steep narrow basin. However there are groundwater contributions that help provide summer flow and stabilize winter flow in non-runoff periods.

Air Photos	BC 82007 135-136
Topographic Maps	92C/16, 92C.089
Salmonids	Co to approximately 553 m but mostly in lower 80 m Ct to approximately 553 m
Obstructions	There are no obvious barriers until gradient begins to increase rapidly at the start of R4 at about 553 m but periodic debris jams in upper R3 could limit access from time to time. Trout and coho are usually sparse above 80 m.
Max. temp.	11 (10/3/01 R2)
Min. disch.	.0162 CMS 10/3/01 R2)

STINK CURRANT CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	9	4	1720	.7	FC	L	.0083	80	320
Reach 2	3	2	1810	2.7	FC	L	.027	37	74
Reach 3	3	2	1450	5	FC	L		436	872
Reach 4	2	2	1270	21	CON	N		800	1600

B) FISH UTILIZATION AND LIMITING FACTORS

Stink Currant Creek supports coho salmon and cutthroat trout. Numbers are sparse above Reach 1 which is a Sutton Creek sidechannel (floodchannel) that has captured Stink Currant. Above R1 production is limited by size, gradient and structural limitations (lack of pools).

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Second growth harvest is underway in the Sutton Creek watershed and it may not be long before cut blocks appear on this creek. TimberWest has two site sample stations on the creek. One is 00106103.

E) PROTECTION NEEDS

The creek is located in a ravine for almost its entire length. In many places its slopes are greater than 100%. Logging should be set back a reasonable distance from the ravine edge.

Stream Code:

Stream Name: Elk Wallow Creek

Operational Mangement Unit: South Shore Tributaries East (13)

CVRD Electoral Area: F

A) BIOPYHSICAL OVERVIEW: A very small but very complex seepage stream that enters Reach 5 of Sutton Creek from the east. The stream is almost entirely fed by groundwater seepage that surfaces in numerous locations along the stream. Sections of the stream are wetlands produced by upwelling groundwater. The Sutton Creek elk herd makes good use of the muckier sections of the creek for wallows.

Air Photos:	BC 82007 135-136
Topographic Maps	92C/16, 92C.089
Salmonids	Co – Ct to at least 211 m but mainly in lower 31 m which is also a Sutton Creek sidechannel
Obstructions	No obvious barriers. The possible barrier has been placed at the 211 m point because this point is the beginning of a transitional reach between the Sutton Creek floodplain and upstream reaches. Fish were not found above 40 m but this survey was conducted after most fish had moved to their winter habitat.
Max. Temp.	12 (10/3/01 Reach 3)
Min. Disch.	.0053 CMS (10/3/01 Reach 3)

ELK WALLOW MAINSTEM

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	3	2	1810	.8	FC	L	.0107	32	62
Reach 2	2	1	3610	.5	FC	L	.027	180	180
Reach 3	2	1	2620	8	CON	N	.064	31	31
Reach 4	2	1	1000	.5	OC	M		80	80

SOUTH FORK (enters R2 of Mainstem @ 160 m)

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	2	1	1000	.3	OC	M	0	56	56
Reach 2	2	1	2350	5	CON	N	.0106	47	47
Reach 3	2	1	1000	.8	OC	M	.003	140	140
Reach 4	3	1	1450	6	FC	L	.021	230	230
Reach 5	1	1	2710	5	FC	L		58	58

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout are numerous in Reach 1 which is also a Sutton Creek floodchannel then sparse. They are likely present in R2 of the mainstem and R1 of the South Fork and could be present for considerably further but this is unlikely.
Production is limited by the very small size of the stream and the lack of pools.

C) ENHANCEMENT OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth and logging is resuming in the Sutton Creek Valley. Cut blocks could soon appear near Elk Wallow Creek.

E) PROTECTION NEEDS

This little stream system has a high degree of inherent sensitivity. Its fish values are not particularly high (its possible that they could be higher than they appear because Sutton Creek juveniles could and likely do move into at least the lower 2 reaches of the mainstem and Reach 1 of the South Fork to overwinter) but the amount of adjacent seepage water and associated muddy ground make this stream very susceptible to physical disturbances like those associated with logging. Reach 4 of the South Fork is located in a ravine with at least 150 m of slopes of 40 to 70%. Small seepage streams, springs and moist soils with salmonberry- ladyfern are present in this zone. Logging should be set back a cautious distance from the edge of these slopes and the wetland portions of the system.

Stream Code: 9202577701277

Stream Name: Slippery Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream drains a steep and narrow basin, enters Sutton Creek from the southeast 4,000 m above Cowichan Lake.

Air Photos	BC 82007 135 - 136
Topographic Map	92 C/16, 92C.089
Salmonids	Co to 100 m. Ct to 850 m.
Obstructions	3 m over 5 falls at 100 m. 7 m falls at 850 m.
Max. Temp. (C)	9 (9/17/85)
Min. Disch. (m^3)	0.09 (9/17/85)

SLIPPERY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	7.0	2.0	136R		1.5	OC	L	100	200
Reach 2	4.0	2.0	127R		3.0	CON	N	750	1500
Reach 3	-	-	-		25.0	CON	N	2500	-

B) FISH UTILIZATION AND LIMITING FACTORS

The stream supports coho and resident cutthroat in its lower 100 m and resident cutthroat for another 750 m.

Production is limited by access, high fall - winter discharge and cool summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. *COHO* *COLONIZATION*: Above **barrier coho colonization smolt yield potential of 60 smolts based on 1,500 m^2 of upstream habitat at 0.5 fry/m^2: fry required 750 (Production Option # 323)**.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth.

Risk Potential

Low.

E) PROTECTION NEEDS

Reach 1 is on the Sutton Creek floodplain and is thus in the Sutton Creek FSZ. Portions of the upstream reaches are bordered by steep slopes where seepage is occasionally present. Logging should be set back from the edges of ravine portions of the valley, especially those where high soil moisture is present.

Stream Code: NA

Stream Name: Maple Flat Creek

Operational Mgnt. Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL DESCRIPTION: Steam consists of two components: a lower section that's part of a sidechannel complex on the Sutton Creek floodplain and an upland segment that is groundwater fed from a strong sidehill spring.

Air Photos	BC 87024 42,43,44
Topographic Map	92 C/16, 92 C.089
Salmonids	Co 327 Ct 327
Obstructions	1 m backfilled log @ 360 m, appears to be passable at high flows.
Max. Temp. (C)	17.6 (8/25/96)
Min. Disch. (m^3)	.0009 (R1 8/25/96) Flow drops to .0005 in Lower R2 then stream is intermittent for 112 m before flow increases to .003 CMS in Upper R2 where temperature decreases to 15

MAPLE FLAT CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m^2)	
Reach 1	12	3	1540	.5	OC	M	70	0	
Reach 2	3	2	2120	1.0	FC	L	257	514	
Reach 3	3	1	2810	4.0	CON	N	70	70	
Reach 4	5	1	3700	.5	FC	L	175	175	
Reach 5	20	1	9100	.001	UC	M	50	50	
Reach 6	15	1	2800	3.0	UC	M	30	30	
Reach 7	2	1	1270	10.0	CON	N	500	500	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present for at least 360 m. Their numbers are limited by critical period drying - the lower portion of the floodplain dries and, to a much lesser degree by access.

C) PRODUCTION OPTIONS

1. ***SIDECHANNEL*** *DEVELOPMENT* : It **should be possible to provide more summer flow to Reach 1 and lower Reach 2 by excavation of a relic channel at 166 m. The lower 50 m of this 95 m long channel could be excavated with an infiltration pool at the 50m point. This channel is summer wet in most years but does not provide any flow. Similarly, excavation of a small channel at the base of the escarpment (327 m) could provide extra critical period water to the stream below this point (Production Options # 324, 325)**

2.*BARRIER REMOVAL:* Removal of a barrier log at 360 m would provide access to an additional 257 m of habitable water which includes some spawning habitat which could be improved (Production Option # 326).

3. *SUBSTRATE IMPROVEMENT:* The addition of at least two spawning pads to Reach 3 would extend recruitment upstream (Production Options # 327).

4. ***IMPOUNDMENT AND COHO COLONIZATION:*** **Reach 5 could be impounded to store approximately 2000 m3 and serve as additional rearing space. Stock with fry salvaged from Lower Sutton or Golf Course Creek (Production Options # 328, 329)**.

D) LAND USE FACTORS

Forestry

Area second growth is being logged.

Risk Potential

Low

E) PROTECTION NEEDS

Reaches 1 and 2 are on the combined Maple Flat – Sutton Creek floodplain which is a rather unique riparian landscape unit featuring large old growth maples as the dominant tree. This unit is highly utilized by the Sutton Creek elk herd and is deserving of special management status. Hancock Timber (the landowners) have, to their credit, logged around it on adjacent uplands but have not come close to this landscape unit Above the floodplain, the creek enters a short ravine then another riparian reach before it climbs toward its headwaters. The ravine and upper riparian areas (Reaches 3, 4, and 5) are within the FSZ. The upper reaches are more stable and less sensitive.

STREAM CODE: NA

STREAM NAME: Golf Course Creek

OPERATIONAL MGNT. UNIT: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A small lower Sutton Creek tributary that drains the lower slopes of the Seymour Range. Enters Sutton in Reach 1 at 500 M. near the North Boundary of March Meadows Golf Course.

Air Photos	BC 87024 42,43,44
Topographic Map	92 C/16, 92 C.090
Salmonids	Co 1000 m.
	Ct 1000 m.
	Cm occasional individuals to 730 m.
Obstructions	1 m over 2 cascade at 730 m (usually passable for adults but a juvenile barrier).
	1.4 m backfilled log at 795 m. - passable
Max. Temp. (C)	15 but 22 in East Fork lower pond (7/26/96)
Min. Disch. (m^3)	.0005 7/26/96 lower 830 m dries.
	.0003 East Fork
	.0002 West Fork

GOLF COURSE (MANY FORKS CREEK)

	Channel width	Wetted width	Substrate	Slope %	Confinement	Sidechannel	Length	Area
Reach 1	3	0	1720	1.3	CON	N	100	0
Reach 2	8	0	8200	.2	FC	L	240	0
Reach 3	3	0	2710	1.0	FC	L	490	0
Reach 4	4	1	2710	1.5	FC	L	285	285
EAST FORK								
Reach 1	8	2	9100	.5	OC	L	70	140
Reach 2	15	15	1000	0	UC	N	50	750
Reach 3	2	1	9100	1.0	FC	N	185	185
Reach 4	30	30	1000	0	UC	N	80	2400
Reach 5	30	0	1000	.01	UC	M	50	0
Reach 6	1	0	1360	8.0	CON	N	1000	0
WEST FORK								
Reach 1	2	.5	5500	1.0	OC	M	280	140

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats for at least 1000 m. Production limited by nil summer flow in the lower 830 m and very low to nil flow above this point.
The lower 20 m of Reach 1, all of Reach 2 and the lower 240 m of Reach 3 are subject to winter drying and egg mortality.

C) ENHANCEMENT OPPORTUNITIES

1.*HEADWATER STORAGE, SPAWNING PLATFORMS*: Two impoundments on the East Fork (Reaches 2 & 4) store 2295 cubic meters of water for summer release and headwater stocking of coho fry. They were constructed in the summer of 1994 by the Campbell Group (Ted

Harding). Two more pools with spawning pads can be created at 35 and 56 m on the West Fork (Production Option # 330)

2. *GULVERT REMOVAL:* Culvert removal is also required at the 235 m. point on the West Fork (Production Option # 331). Coho fry were present in The East Fork Ponds on July 26, 1996 despite a surface temp. of 22. Fish were active.

2.*FRY SALVAGE/ COHO COLONIZATION:* Fry salvage **required in the lower 830 m. 1996 was the first year it was undertaken. Yield was 6000. Stream is subject to very early and rapid drying. Portions of it have even dried in the winter months. Stock fry in East Fork headwater ponds if none have entered on their own (Production Options # 332, 333)**.

3. ***OBSTRUCTION REMOVAL*: the cascade at 730 m can be improved by backflooding a pool at its base and creating a purchase point on its north edge. It appears to be passable at peak flows which approximate 1.5 cms (Production Option # 334)**. Juveniles cannot pass and have been observed leaping at the barrier. Downstream drying apparently forces fish to move upstream as far as they can.

4. ***STRUCTURAL IMPROVEMENT:*** If Golf Course Creek coho runs improve to the point where many spawners are ascending the falls, it will be prudent to improve the West Fork's carrying capacity/recruitment potential by complexing habitat via the addition of LWD and adding several spawning platforms in this gravel deficient reach. An old grade leads into the basin from Gordon Main and should be improved as a hiking trail/Streamkeepers access route (Production Options # 335, 336).

D) LAND USE FACTORS

FORESTRY

Most of the basin is covered by advanced second growth. Logging has resumed along much of the creek.

GOLF COURSE

The lower 360 m is located on March Meadows Course where portions have been cleared to the banks.

RISK POTENTIAL

Low

E) PROTECTION NEEDS

The majority of Reach 1 is on March Meadows Golf Course. This portion of the stream is very unproductive and subject to rapid drying *even in the winter*. Above Gordon Main, there is extensive riparian zone adjacent to the creek as well as a small ravine before the stream splits into its two forks. Most of the riparian zone and the ravine are in the FSZ as is riparian habitat above the forks. There is extensive moist riparian area adjacent to the West Fork. This area is utilized by the Sutton Creek elk herd and is within the FSZ.

Miscellaneous Spawner Counts

2001
2002 Co 2

Stream Code: 9202577699

Stream Name: Ashburnham (McPherson) Creek

Operational Management Unit: South Shore Tribs – East (Lake Southeast): OMU 12

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters Cowichan Lake from the south at Honeymoon Bay. It drains a steep, narrow, non-buffered basin and is highly responsive to runoff. According to Wayne Robertson and other long time local residents, Ashburnham used to enter Cowichan Lake somewhere in the present TimberWest dry land sort area after flowing through what is now Honeymoon Bay town site.

Air Photos	BC 82007 135 - 136
Topographic Map	92 C/16, 92C.090, 079, 080
Salmonids	Co to 1,830 m or 1936 m. Ct to 3,000 m. Rb to 3,000 m. DV to 3000 m. Cm very occasional in years of heavy escapement
Obstructions	2m over 7m (2R7) cascade @ 1830 m. Usually passable but no spawning habitat above it to the dam 106 m upstream 5 m dam at 1,906 m. 2 m high 3 m long falls at 2096 m. 12 m falls at 3,000 m.
Max. Temp. (C)	8 (9/26/85), 14 (9/1/97) Summer temperatures are higher in years when there is more flow and groundwater makes up a smaller portion of the flow. 15.1 (7/28/98 R3) 14.2 (8/26/00 R4)
Min. Disch. (m^3)	0 (9/26/85) R1 (R1 is generally dry from mid-July to October) 0.043 (9/26/85) R8 20 m above the reservoir 0.007 (9/26/85) R8 50 m above the falls 0 (8/26/00 R3)

ASHBURNHAM CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Sidechannel	LWD	Length	Wetted Area
Reach 1	11	0	1360	1.6	FC	L	.0069	1054	0
Reach 2	9	4	1360	2.2	FC	L	.0068	292	1168
Reach 3	9	0	1360	2.5	CON	N	.0018	122	0
Reach 4	10	4	1180	3.1	CON	N	.0004	212	848
Reach 5	6	5	1171	4.9	CON	N	.0077	150	750
Reach 6	8	3	1171	3.2	CON	N	.0047	106	318
Reach 7	23	23	1630	.0001	UC	L	Res.	90	2070
Reach 8	7	3	1252	5.0	CON	N		1500	4500
Reach 9	6	2	127R	8.0	CON	N		1500	3000
Reach 10				40	CON	N		1000	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident rainbow and cutthroat utilize the lower 1,936 m. Resident trout are also present in the water supply reservoir and for 1,500 m above it. During the 2000 reservoir clean out, a total of 60 cutthroat fry, parr and adults were salvaged form the reservoir. The adults were as large as 34 cm. It appeared that the adults were living in the reservoir and spawning in the portion of the creek that fans over the accumulated bedload. Most of the adults were kelts and 26 fry were captured in the " creek portion" of the reservoir. The next obstruction is just 70 m upstream from the south end of the reservoir. Dolly Varden are also present in the lower 1936 m and may be progeny of Cowichan Lake spawners. Cowichan Lake cutthroat spawners have been reported. An occasional steelhead may also utilize the stream.

Production is limited by low summer flows (the lower 1,054 m dry along with R3, a 122 m section above the logging road and Colin Wall's work yard), access, high fall - winter discharge and cold groundwater summer temperatures in years when flow is largely provided by groundwater seepage. Maximum temperature in most summers is about 14 but in very dry years it can be lower.

C) PRODUCTION OPPORTUNITIES

1. *COHO COLONIZATION:* Above barrier coho colonization smolt yield potential: 224 - 1,120/2,800 fry required (Production **Option # 337)**.

2. *FRY SALVAGE:* Fry salvage in Reaches 1 and 3 (Production Option # 338). Fry salvage access is good. Lower R1 is reached from Beach Dr., Upper R1 is well serviced by Woodland Trails off the end of First St. and R3 can be reached via a path from the reservoir access road. Contact Colin Wall (749-3580) if the gate is locked. 5,000 to 10,000 fry are usually salvaged and either released in the lake at Lily Beach or upstream in R8 which is reached via the logging road. The logging road is accessed from 19 Creek Road (the back road from Hillcrest M/L to Honeymoon Bay.

3.***STRUCTURAL IMPROVEMENT:*** Addition of LWD to debris starved Reach 3 would improve its capability for coho and trout rearing. Reach 3 is the only accessible (to anadromous fish) Reach that isn't summer dry (Production Option # 339).

4. *GROUNDWATER CHANNEL DEVELOPMENT:* A riparian floodplain lobe adjacent to R4 that I call Devil's Club Flat has a network of scour relic channels that could be excavated to produce a groundwater channel that could provide winter habitat in a reach that has none. The channel could also provide safe spawning habitat Channel length would be about 100 m. A potential alignment was flagged 9/15/00. The channel is on Hancock Timber property (Production Option # 340)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Most logging scars from the first cut have healed although a few slope failures remain that could receive some remedial work. Hancock Timber is on the west side of the creek above the Colin Wall block and TimberWest is on the east side.

Urban

The 90's have seen some houses appear in the middle of nowhere along Reaches 1 and 2 of Ashburnham. They are well beyond the limits of Honeymoon Bay town site or other recent development on the old WFI mill site. Hopefully this is not a trend. Colin Wall cleared a large area on the west side of the creek adjacent to R1 between the logging road and South Shore Road in anticipation of residential development.

Water Supply

Ashburnham Creek is Honeymoon Bay's water supply. A reservoir located at the 1,936 m point services the community via a pipeline. The system was constructed by the mill in the 1950's. WFI installed a generator in the dam that powered the mill in the winter months. The pipeline was recently replaced. The reservoir fills with gravel and sediment every 2 - 5 years and cleaning is required. Usual volume of material is about 4000 m^3. The reservoir may be having some impact on downstream bedload transport. The stream was walked from Cowichan Lake to the dam on August 26 00. The creek appeared to be degrading slightly. There are six sections of scour banks totaling 175 m in length. The present approach to mitigating erosion is to move some of the material over the dam during the removal process. About 200 m^3 have been dumped over the dam in recent clean – outs. This amount should be increased to 40 truck loads (400 – 480 metres).

Risk Potential

Low.

E) PROTECTIVE NEEDS

Portions of the mid and upper basin are very steep. These areas will require leave zones where they are adjacent to the creek and very careful road building and yarding. They are included in the FSZ along with areas in the lower basin that are enclosed by steep ground or at risk from erosion with streamside vegetation removal. A riparian floodplain is present adjacent to R,s 2, 3 and 4 on the west side of the stream. It ranges from about 40 to 60 m in width. It is separated form the upland by a 40-60% slope of 30 to 40 m long. Logging and land development should be set back at least 10 m from the slope edge unless wind throw is judged to be a potential problem. In this case, logging could proceed down slope somewhat. The floodplain contains a network of relic channels and a small flood channel. There is occasional spill into at least one channel near the creek.

Miscellaneous Sapwner Counts

2002 Cm 9 dead and 3 live between lake and South Shore Road on Nov. 26 with 1 live Co

Stream Code: 9202577685

Stream Name: Robertson River

Habitat Mgmt. Unit: South Shore Tributaries: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Bear Lake (a Cowichan Lake backwater) near Mesachie Lake Village. Drains a relatively low relief basin which is comparatively broad in its lower end. A high energy stream with considerable bedload movement and flood potential.

Air Photos	BC 82007 136 - 137
Topographic Map	92 C/9, C/16
Salmonids	Co 10,694 m.
	St 10,694 m.
	CM 5,000 m.
	Ch 5,000 m.
	Rb 15,000 m.
	Ct 15,000 m.
	Or 10,694 m.
Obstructions	Falls: 7 m over 10 at 10,694 m. (Surprise Falls)
Max. Temp. (C)	13 (8/25/85)
	16 (8/10/02 R1)
Min. Disch. (m^3)	0.0 for 6038 m.
	0.28 at 6,000 m. (8/24,25/85)
	0.084 at 10,500 m. (8/24,25/85)
	0.075 at 14,000 m. (8/24/85)

ROBERTSON RIVER

	Channel width (m)	Wetted Width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m^2)	
Reach 1		30.0	0.0	1720	0.5	FC	M	1700	0
Reach 2		170	0.0	1720	0.8	FC	M	576	0
Reach 3		80.0	0.0	1450	1.2	FC	M	1682	0
Reach 4		22.0	0.0	1450	1.4	FC	M	2080	0
Reach 5		21.0	7.0	1450	1.7	FC	M	689	4823
Reach 6		18	12.0	136R	1.9	CON	N	567	6804
Reach 7		18	12.0	1450	1.6	FC	L	2900	33600
Reach 8		8.0	8.0	1351	2.0	ENT	N	500	4000
Reach 9		15.0	6.0	1540	1.5	CON	N	4000	24000
Reach 10		10.0	6.0	136R	2.5	FC	L	5000	30000
Reach 11		8.0	2.0	1243	10.0	CON	N	1500	3000
Reach 12		4.0	1.0	1243	0.5	FC	L	1000	1000

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 10,694 m. Occasional chinooks (250 - 300 were noted on Nov. 26. 1973) have been reported in the lower 5,000 m. Resident rainbow and cutthroat are present for 15,000 m. Spawning runs of rainbow, cutthroat and Dolly Varden from Cowichan Lake are also present. Robertson River is thought to be the main spawning stream for the large race of Cowichan Lake cutthroats but their numbers are very low (<50). Spawners of the large race enter the river about mid - February and spawn in March and April.

Production is limited by low summer flows (the lower 6038 m. and about 1000 m. of sidechannel dry in most summers) and high fall - winter discharge and accompanying bedload movement. 120,000 square metres of

main channel and 7,500 square metres of sidechannel habitat are estimated lost to drying. Low complexity in the lower 5,000 m. limits steelhead production. General instability is also limiting in the lower 5,000 m., particularly in Reaches 2, 3 and 4.

C) ENHANCEMENT OPPORTUNITIES

1. ***FRY SALVAGE- COHO COLONIZATION – HEADWATER STORAGE:*** **Potential above barrier colonization coho smolt yield: 8,000 - 12,000/15,000 fry required. Yield could increase. Fry salvage is required in the lower 5 km. Robertson River salvage yields are very high; often highest in the Cowichan watershed and in the order of 50,000 to 150,000.** Possibly the most productive colonization site in the Robertson system is its Headwater Marsh. This 11.5 ha marsh contains no fish and appears to have high capability to support coho in the October through May period at least. The wetted area and depth of the marsh could be increased with impoundment – a good site has been located. This could also extend the wetted period of the Lower Robertson and, in moist summers, be a significant factor in carrying capacity for the lower 5 km of stream. Summer temperature and oxygen profiles in the marsh are necessary to determine suitability for spring – summer rearing. It is assumed that fall – winter conditions are suitable. The coho fry carrying capacity for a non-impounded Headwater Marsh should be 6000 which would yield 900 smolts at 15 % survival.

The South Shore Bridge Pool was salvaged in September, 02. It had dewatered to 980 m^2 by this time in a very dry summer and only held water because of Patricia Creek inflow. 3506 coho juveniles ranging from 41 to 97 mm were captured ffor a density of 3.57 fry/m^2. Also caught were 391 sculpins (*Cottus aleuticus)*, 24 cutthroat trout, 3 rainbows and two Dolly Varden. **(Production Options # 341)**.

2. ***GRAVEL REMOVAL/ FLOODWAY MANAGEMENT:*** **Removal of gravel in the lower 6000 m could expose flow (there is approximately 1-3 m of overburden). There has been periodic gravel removal for years by the Robertson's and Pacific/TimberWest. It needs to be coordinated into a plan for long-term improvement of both fish production and flood protection (Production Option # 342)**. The present overburdened channel is unstable and is undergoing considerable lateral erosion which could be stemmed somewhat by thalweg maintenance. The situation is most critical in Reach 2 which is commonly known as Robertson Hook. The stream makes a sharp bend at the lower end of this reach and bedload has a difficult time working its way around it causing the river to erode laterally when it backs up. The channel is 170 wide in this reach and threatens to break out when bedload accumulates to a high degree. It is critical that bedload does not jam in this reach. Breakout to the east would imperil Robertson Sidechannel and the western portion of the Measachie Lake community (Auriol Robertson, Jim Eddy, Bergstrom's) while breakout on the east would threaten Patricia Creek and adjacent wetlands and the Robertson Farm. There is another break out zone on the east bank below 19 Creek that could also threaten the same targets along with considerable TimberWest land and Bill Robertson's industrial site.

3. ***SIDECHANNEL DEVELOPMENT:*** **Sidechannel development on the west side of the river adjacent to Reaches 2 and 3 is feasible. The Coho Heaven Complex in upper R3 has considerable promise. (Production Option # 343)**.
A 358 m long groundwater channel now known as Blind Channel was excavated on the east side of Reach 2 in the summer of 1994. Further refinement will be undertaken to hold brood stock and provide spawning, rearing and overwintering (Production Option # 344).
A number of groundwater sidechannel development opportunities are present on the deltaic fan where the river enters Bear Lake. Several other relic channels are present to the west on the McKenzie Bay portion of the fan. These channels extend upstream to the middle section of Reach 1 and include a portion of river channel that was filled in the 1950's **(Production Option # 345)**.
Relic channels are also present adjacent to Reaches 5, 6, and 8.

D) LAND USE FACTORS

Forestry

Most of the watershed is advanced second growth - early immature above 500 m. Logging has resumed in many lowland areas.

Flood Control

The lower 2000 m are partially dyked. More work is anticipated as bed elevation is increasing. The South Shore Bridge was undermined in the Jan. 1986 freshet and again in March of 1997. There is low intensity residential-agricultural- industrial use of the floodplain but it is at risk from flooding. So is Robertson Sidechannel, an important relic-active channel to the east.

Risk Potential

Moderate. A comprehensive flood control program could benefit fish production.

Notes

E) PROTECTION NEEDS

Robertson River has a very extensive floodplain adjacent to Reaches 1 through 4. It starts at the base of Surprise Canyon at the upstream end and continues downstream in varying widths and levels of stability, Areas of special concern are the Sixteen Creek Fan and Reach 1 of Sixteen Creek, Roach's Sidechannel and the East Robertson Fan which includes Reach 1 of East Robertson River, Choke Rope Sidechannel – Coho Heaven, Thistle Hell, the Nineteen Creek Confluence area and several areas downstream including the lobe of floodplain on the east side of the river between Nineteen Creek confluence and the Blind Channel, the Patricia Creek confluence area, the residential area along South Shore Road including the bridge bottleneck and Lower Reach 1 including the river delta particularly on the east side. There is a need for very careful logging and residential setbacks on the Robertson Floodplain because of the danger of major flooding and river breakout and because productive fish habitat is present.
Above the floodplain, there are areas of steep, moist slopes where road construction and harvesting will have to allow for slope and soil moisture considerations. These areas are too numerous to mention in any detail but they are included in the FSZ or Robertson River Corridor as are the floodplain – riparian components.

ESCAPEMENT COUNTS

YEAR	COHO	CHUM	CUTTHROAT	CHINOOK	OTHERS
1973				250-300	
1974	10,000 plus				
2000	909				
2001	2426	18	20 following salmon. These were not spawners.	11	
2002	964	36	63 most were 40-50 cm but some were large race. Ct were seen in mid – Dec. Tge earliest the large fish usually arrive is Mid –Feb.		1 DV

Post 1999 sections are counted by snorkeling.

Stream Code: 9202577685102

Stream Name: Pastuch (Patricia) Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) Biophysical Overview: Enters Robertson River from the west 1,500 m above Bear Lake. Drains a broad, low relief basin for 60% of its length; the upper 40% is steep and narrow. The Lower Basin is broad and moist. The stream divides into two forks at the 700 m point. The North Fork is very broad and unconfined with a wide riparian zone that holds its water well below a large beaver dam but is either dry or very close to it above the dam. North Fork flow is mostly water table water. There is only a small upland runoff component. Although both forks are relatively stable, the North Fork is remarkably so. The South Fork originates in a steep basin and is subject to summer drying in its middle reaches which are rather unstable

Air Photos	BC 82007 136-137
Topographic Map	92 C/16, 92C 080, 090
Salmonids	Co 3000 m
	St/Rb occasional individuals
	CT 3000 m
	Ch reported in 2001
	Cm occasional
Obstructions	4 m falls at 3000 m
	Two 2 metre vertical drops with no resting pool between
Max. Temp.	17 (8/26/85)
	16.5 (9/1/02) R1
Min.Disch.	0.024 100 m above Robertson (8/26/85)
	0.104 - .017 15 m above the Robertson 9/1/02

PASTUCH (PATRICIA) CREEK

	Channel width(m)	Wetted width(m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m^2)	
Reach 1	8.0	3.0	2800	1.0	FC	L	236	708	
Reach 2	60.0	4.0	1000	.01	UC	H	464	1856	
				NORTH FORK					
Reach 1	70	70	1000	.01	UC	H	1100	77000	
Reach 2	60	3	1000	.01	UC	H	500	1500	
				SOUTH FORK					
Reach 1	60	3	1000	.01	UC	H	1400	4200	
Reach 2	20	0	2710	.5	OC	H			
Reach 3	6	2	1540	2.0	FC	L			

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present for 3000 m. Some of the large race of Cowichan Lake cutthroats use this stream along with residents and the smaller race of lake fish.

Production is limited by low summer flows but not to the extent of other area streams.

C) ENHANCEMENT OPPORTUNITIES

1. *HEADWATER STORAGE:* Headwater wetlands offer storage and ponding for low flow improvement and possible increased rearing space. Five HA are available and could provide 0.0007 cms for 180 days (Production Option # 346).

Consideration should also be given to excavation of Reach 2 of the South Fork. This reach dries early and is poorly defined.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth.

Agriculture

Pasture adjacent to the lower 1000 m.

Notes

DFO operated smolt traps on Lower Pastuch in 1975 and 1976. Coho smolt catches were 4305 and 3996.

Coho Escapement

YEAR	NUMBER
1977	816
1989	1106
1990	1320
1991	550
1992	274
1993	320
1994	715
1995	366
1996	78
1997	79
1998	627
1999	192
2000	238
2001	601 plus 5 Ch and 6 Cm
2002	291 plus 7 Cm. An immature female Co about 30 cm FL was found

Risk Potential

Low

E) PROTECTION NEEDS

The lowland portions of Patricia Creek are very moist in places and the stream is very poorly confined, especially the South Branch which wanders through a swamp forest of willow – red osier that is next to impenetrable in places. The mid area of the Robertson Farm is very representative of soil moisture levels. This portion of the farm is more marsh than pasture. The broad riparian zone in the lowland portion of the system is included in the FSZ along with portions of steep ravine lands in the upland portion of the system.

Stream Code: 9202577685230

Stream Name: Nineteen Creek

Operational Management Unit: South Shore Tribs: East (Lake Southeast – OMU 12)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Robertson River from the west 3,500 m upstream. Drains a steep , narrow basin with a generally northeast aspect.

Air Photos	BC 82007 136-137
Topographic Map	92 C/16, 92C.080
Salmonids	Co 8700 m
	St 8700 m
	Ct 8700 m
	DV 8700 m
Obstructions	Rapidly steepening gradient above 8700 m
Max. Temp.	10.5 (8/30/85)
Min. Disch.	0.212 (8/30/85)
	0 for 362 m (10/10/02)

NINETEEN CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope	Channel Confinement	Side Channel	Length (m)	Area (m^2)	
Reach 1	18.0	0	1450	1.0	FC	L	362	0	
Reach 2	11.0	5.0	1360	1.5	FC	L	1200	6000	
Reach 3	10.0	5.0	136R	2.5	CON	N	5500	27500	
Reach 4	7.5	5.0	127R	8.0	CON	N	2000	10000	
Reach 5	-	-	-	22.0	CON	N	1000	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead and resident rainbows, cutthroats and Dolly Varden are present for 8700 m. Resident cutthroats are also present in the lower reaches of at least three small tributaries. Cowichan Lake cutthroats and Dolly Varden spawn in this creek. In some years, steelhead and migrant cutthroats become landlocked above the 100 m section that dries on the fan
Creek Nineteen as many locals call it, holds its base flow quite well and is not as susceptible to CPD deficiencies as other streams in the system such as the mainstem Robertson. Gravel bedload has not accreted substantially despite considerable input from upslope logging disturbances.

C) ENHANCEMENT OPPORTUNITIES

1. ***FRY SALVAGE:*** **Reach 1 fry salvage in dry years (Production Option # 347)**.

2. ***LWD ADDITION:*** Nineteen Creek is LWD starved but peak flows may be too high to sustain LWD. A test addition at the tote road crossing below Ashburnham Main Bridge is recommended. If successful for more than two winters, several more complexes can be added in Reach 2 (Production Option # 348)

3. ***FERTILIZATION:*** Nineteen Creek is a good candidate for fertilization because of its very low productivity (the creek is essentially non-buffered and faces north east) and ease of segmentation for comparative purposes (**Production Option # 349)**

D) LAND USE FACTORS

Forestry

Most of the basin is covered by advanced second growth. Logging resumed on lowland sites in 1983. There are several problem areas on the south slope of Nineteen Creek that resulted from the old road – rail system. At least two streams were sluiced out by debris avalanches originating from old road crossings that were left intact.
Some clay - compact basal till on steep slopes (40 -80%) adjacent to the stream; poorly drained and subject to mass movement. An especially sensitive area is present on the north side of the creek at 3100 m. The old north side road cut through it and a slope failure resulted.

Risk Potential

Moderate

Notes

E) PROTECTION NEEDS

Nineteen Creek is relatively stable for most of its length in terms of both channel and bank integrity. However there are some areas of steep, moist slopes adjacent to the creek beginning in Reach 2 and persisting to various degrees well into the headwaters. There are some deeply incised tributaries in these areas that have ravines of their own with sidewalls over 100% in places. Careful road location and construction will be necessary to avoid problem areas. Some very sensitive zones will possibly require heli – logging or no logging.

Stream Code: 9202577685291

Stream Name: Easy Creek

Operational Management Unit: South Shore Tribs: East (Lake Southeast – OMU 12)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Robertson River from the southwest 4,100 above Bear Lake. Drains a short, steep and narrow basin. Highly responsive to runoff. The lower portion of the stream traverses the Robertson Flats where it dewaters in early summer.

Air Photos	BC 82007 136-137
Topographic Maps	92 C/16, 92C 080
Salmonids	Co 1,500 Ct 1,500
Obstructions	3 m falls at 1,585 m .5 m vertical drop at Hillcrest Main culvert outfall (455 m) at mean winter - spring flows (.5 CMS): juvenile barrier
Max. Temp.	11.5 (8/25/85), 14.9 (9/4/97)
Min. Disch	0 for 585 m 0.0023 at 600 m (8/25/85) 0.0133 at 585 m (9/4/97)

EASY CREEK

	Channel Width(m)	Wetted width(m)	Substrate	Slope%	Channel Confinement	Side Channel	LOD%	STR	Length (m)	Area (m^2)
Reach 1	7.0	0.0	2710	1.0	FC	L	1	6	110	0
Reach 2	5.0	0.0	1450	1.5	CON	N	0	6	475	0
Reach 3	5.0	1.0	127R	3.5	CON	N	1	4	1000	1000
Reach 4	4.0	1.0	127R	40.0	CON	N	1	6	1500	1500

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats utilize the lower 1,585 m, Cowichan Lake cutthroats spawn in this stream.

Production is limited by nil to low summer flows and high fall-winter discharge. The bottom and banks are very unstable, especially in reach 1.

C) ENHANCEMENT OPPORTUNITIES

1.*FRY SALVAGE:* Fry salvage is required in Reach 1 and yield can be surprisingly high. The culvert pool at Hillcrest Main has produced up to 10,000 coho fry and over 100 smolts along with 30 trout parr and a cutthroat kelt (Cowichan Lake spawner) (Production Option # 350).

Reach 1 dries very abruptly sometime in June in most years.

2. ***JUVENILE BARRIER IMPROVEMENT:*** Backflooding or replacement of the Hillcrest Main culvert would allow juvenile trout and coho from the lower creek to move upstream into summer wetted habitat. Most of the spawning habitat is located below the culvert while the only permanent rearing habitat is above it. There is also a movement of Robertson River coho fry into Lower Easy Creek in some years and it would be beneficial if some of these fish could move through the culvert rather than becoming trapped by drying and either being salvaged or perishing. The culvert was set flush with the substrate when it was installed but scour has lowered the streambed. Production Option # 351)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth except on steep, rocky slopes above 600 m. Difficult road building conditions in the Upper Basin.

Risk Potential

Low

Notes

Reach 2 has been ditched. The consequences are slight because of rapid drying and low overall habitat value in Lower Easy.

E) PROTECTION NEEDS

Steep terrain in the Upper Basin calls for very careful road building and fast de-activation and some heli-logging. A 15 m leave zone adjacent to reaches 1, 2 and lower reach 3 should suffice except for that portion of Reach 1 which is in the Robertson River Corridor.

Notes:

Went up to the North Fork on September 17: Point sample some 200 m above confluence with mainstem: 3.6 (1) CON 15 1540. Flow was a bare trickle. The stream was almost int. No fish. Advaced fri- hemlock second growth over Salal – Swordfern on N and Salmonberry- Swodfern on S. Creek is in a deep ravine. North slope is 85% and the south is 100%. North slope is stable but the south slope could be de – stabilized by logging.

Stream Code: NA

Stream Name: Benny's Creek

Operational Management Area: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A very small groundwater stream wetted by the winter water table. The stream was partly created by excavation to build the original Robertson River Valley railroad grade. Drains a moist riparian flat adjacent to Lower Reach 4 of the Robertson near One Log Bridge Pool and Truck Road 2.

Air Photos:	BC82007 156, 157
Topographic Maps:	92C/16, 92C.080
Salmonids:	Co to 290 m
	Ct to 290 m
Obstructions:	None
Max. temp.	NA
Mean Nov. – March temp:	7
Min. Disch:	0 May to October
Mean Nov. March Disch:	.100 CMS (R!), .0114 (R3), .012 North Fork

BENNY'S CREEK

	Channel Width	Wetted Width	Substrate	Slope	Confinement		Side Channel	Length	Area
Reach1	1	0		9100	1.5	CON	N	28	0
Reach 2	8	0		1000	.1	OC	M	104	0
Reach 3	2	0		2710	1.0	CON	N	26	0
Raech 4	4	0		1000	.5	CON	N	132	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho spawn and overwinter in the stream. Two redds were found at o and 12 m of R3 on Feb. 21, 1999. Cutthroat parr also winter in the channel. This stream is summer dry.

C) PRODUCTION OPTIONS

1) ***EXCAVATION:*** Excavation beginning at the upper end of R3 could provide more flow (**Production Option # 352). The stream will be assessed in the late summer of 1999 to determine if it carries water then. A test dig can occur at that time.**

D) LAND USE

Forestry

Within TimberWest/Pacific Cowichan Woodlands Division – advanced second growth. The surrounding timber is being logged.

D) PROTECTION NEEDS

Within the Robertson River FSZ Corridor. Although there is a small amount of upland between Benny's Creek and the Robertson, the entire unit form about 100 m west of Hillcrest Main to the Robertson should be retained. It is highly riparian and mostly deciduous.

Stream Code: 9202577685500

Stream Name: Sixteen Creek

Operational Management Unit: South Shore Tribs.East (Lake Southeast – OMU 12)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Robertson River from the northwest 7,500 M. above Bear lake. Drains a steep, narrow basin.

Air Photos	BC 82007 136 - 137
Topographic Map	92 C/9, C/16, 92C.080
Salmonids	Co 4,500 m. St 4,500 m. Ct 6,000 m. Rb 6,000 m.
Obstructions	2 m over 6 combination falls - log jam at 3,000 m. Cascades at 6,000 m. Rapidly increasing gradient above.
Max. Temp. (C)	11 (8/25/85 – R4) 15.1 (8/24/98 – R2)
Min. Disch. (m^3)	0 for 232 m July – early Oct. – R1 .0066 50 m point – R2 (8/24/98) 0.528 R4 (8/25/85)

SIXTEEN CREEK

	Channel width	Wetted Width(m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m2)	
Reach 1	16.0	0	1450	2.0	OC	H	232	0	
Reach 2	15.0	3.0	1360	2.5	FC	M	672	2016	
Reach 3	9.0	8.0	1252	2.5	CON	N	140	1120	
Reach 3	13.0	3.0	127R	2.5	FC	L	3500	10500	
Reach 4	10.0	3.0	127R	3.0	CON	N	1500	4500	
Reach 5	6.0	2.0	127R	10.0	CON	N	1500	3000	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead and resident rainbow and cutthroat are present for 4,500 m.

Production is limited by low summer flows, high fall - winter discharge and cool summer temperatures. The lower 232 m dry.

C) ENHANCEMENT OPPORTUNITIES

1.***BARRIER REMOVAL:*** Removal of the combination falls - log jam at 4,500 m. would provide another 4,500 square meters of accessible habitat. Coho fry colonization annually could be undertaken in lieu of this. Access to the site is difficult for heavy equipment (Production Option # 353)

2. ***SIDECHANNEL DEVELOPMENT:*** Steve's Creek, a 532 m long stream fed by a series of six springs and occasionally by spill from Sixteen Creek via a flood channel that enters at the 300 m point, an enhancement candidate. It provides stable winter habitat for Sixteen Creek and Robertson River. It also provides spawning. Productivity could be improved by berming off the flood channel and deepening the upper end of the stream at its headwater spring. It may also be worthwhile to extend the stream somewhat. There is a 192 m relic portion above the headwater spring and some of that could be excavated. More study at low flows is necessary to determine best treatment. This stream has not been viewed in the summer months. It was discovered by Steve Voller on April 4, 1999 **(Production Option # 354).**

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth except for some steep slopes and mountaintops above the 600 m contour. The west slope of the mountain that parallels the stream above the 5000 m point is very sensitive to logging and road construction. Twenty-two small creeks are present in a 2500 m section of this slope which is characterized by highly erodible surficial materials.

Risk Potential

Moderate

E) PROTECTION NEEDS

Steep adjacent slopes and those of several tributaries require leave zones, as do floodplain segments adjacent to Reach 1 and lower Reach 2. The FSZ is over 100 m wide in places on the south side of the creek in R1 and R2. Steve's Creek, a groundwater fed sidechannel, is present here as are a number of springs and flood channels. This area could be destabilized by clear cutting and roads. Road re-construction in the Upper Basin must be very carefully considered. A good deal of fines entered the creek from the first pass and subsequent erosion of roads left to themselves.

Stream Code:

Stream Name: Steve's Creek

Operational Management Unit: Lake Southeast - 12

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A 532 m long stream on the Lower Sixteen Creek floodplain that is largely groundwater fed. It enters the Robertson River on the Sixteen Creek fan some 100 m above the Robertson – Sixteen Creek confluence. Reach 1 receives flood spill and bedload input from Sixteen Creek in the winter months and is therefore subject to periodic instability. Spring and summer conditions are highly stable; the entire flow is provided by groundwater during this period. Above the influence of Sixteen Creek, the stream splits into two small ground water channels termed Reach 2a and Reach 2b.

Air Photos	BC 82007: 136, 137
Topographic Map	92C/9, 92C/16, 92C.080
Salmonids	Co 365 m
	Ct 365 m
Obstructions	None
Max. temp. (C°)	13 (R1 – 8/20/99)
Min. Disch. (m^3)	.006 (R1 – 8/20/99)
Spring temp.	6 (R1-4/9/99)
Spring disch.	.056 (R1 – 4/9/99)

STEVE'S CREEK

	Channel width	Wetted width	Substrate	Slope (%)	Confinement	Side Channel	LWD	Length	Area
Reach 1	4	3	1540	1.0	FC	L		300	1200
Reach 2a	2	1	7210	.5	FC	L		65	65
Reach 2b	2	1	7210	.5	FC	L		65	65
Reach 3	2	0	7210	.5	CON	N		40	0
Reach 4	2	0	5410	1.0	CON	N		192	0

B) FISH UTILIZATION AND LIMITING FACTORS

Steve's Creek supports coho salmon and cutthroat trout spawning, rearing and overwintering for 300 m and coho and cutthroat rearing and overwintering for another 130 m and in terms of overwintering, perhaps another 40 m in Reach 2b.
Production is limited by periodic winter instability in Reach 1 due to breakout from Sixteen Creek. However, it's probable that Sixteen Creek does not spill every winter. In relatively stable winters like that of 1998, 1999 when there were only two relatively minor warm storms from the southwest, its quite likely that Steve's Creek is productive all winter.

C) PRODUCTION OPPORTUNITIES

1. ***SIXTEEN CREEK SPILL PROTECTION:*** A berm could be constructed along the Sixteen Creek breakout zone to prevent flood flows form entering Steve's Creek in force (**Production Option # 355)**

D) LAND USE FACTORS

Forestry

The area is covered by advanced second growth. Logging is imminent but the area around the creek is largely riparian and the falling boundary should be well away from the riparian lowland.

E) PROTECTION NEEDS

Steve's Creek is located entirely on the riparian floodplain of Reaches 1 and 2 of Sixteen Creek. The FSZ is over 120 m wide in places and includes Sixteen Creek and its flood channels. The area is largely deciduous with alder – maple over story and salmonberry – swordfern – Devil's Club under story. Logging should be set back at least 15 m from the edge of the scarp on the south. No logging should occur on the north. The original forest contained many very large cedars as evidenced by a number of massive stumps. Steve's Creek is within TimberWest's Honeymoon Bay operating area.

Stream Code: NA

Stream Name: Swampwater Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Sixteen Creek from the south 1,400 m. above Robertson River. Drains a broad, low relief basin containing two wetlands of significant size. This creek has some of the highest coho fry densities in the Cowichan watershed. There were sites with more than 20 fry/m^2 in the summer of 2001.

Air Photos	BC 82007 136 -137
Topographic Maps	92 C/9, 92.080
Salmonids	Co 174 m but usually to 1118 m and beyond White Pine Wetland Ct 1118 m Ebt According to Art Watson, Upper Lens Creek occasionally back floods into the headwater wetland bringing brook trout. Whether they became permanent residents or not is difficult to say. Only Ct and Co have been captured since 1985 but sampling has been very limited.
Obstructions	Two 23 m long culverts at 174 m. They are velocity barriers at times
Max. Temp. (C)	12 (8/25/85) 16.8 (8/15/01)
Min. Disch. (m3)	0.0017 (8/25/85)

SWAMPWATER CREEK

	Channel Width	Wetted Width	Substrate	Slope%	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	5	2	0019	5	CON	N	0	33	66
Reach 2	5	2	1360	2.8	FC	L	.003	141	282
Reach 3	4	3	1630	1.2	CON	N	.01	50	150
Reach 4	4	2	1360	2.5	FC	L	.009	602	1204
Reach 5	6	4	5410	.5	FC	M		292	1168

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present throughout. Coho utilization occasionally limited by a pair of culverts at 174 m.
Cowichan Lake cutthroats spawn in this stream.

Production is limited due to culvert access and low summer flows. A section between 174 and 254 m dries on occasion.

C) ENHANCEMENT OPPORTUNITIES

1 *BARRIER REMOVAL:* Removal of the culverts from an unused section of logging road would provide 4,580 square meters of additional coho habitat **that would be accessible in all conditions and to juveniles (Production Option # 356)**.

2. *HEADWATER STORAGE:* Headwater storage would increase minimum summer flow from 0.0017 cms to 0.0021 cms and might provide continuous flow throughout the lower reach. Drying is at least partly caused by bedload damming behind culverts. Beavers occasionally further complicate the situation by building dams at the culvert inlets **(Production Option # 357)**.

3. ***SUBSTRATE IMPROVEMENT:* Quality gravel is limited; addition at selected sites would improve egg survival and spawning potential. A 2.31 m3 spawning platform was constructed in the summer of 1989 (Reach 5). Upgrading this platform and the addition of two more would provide considerable benefit (Production Option # 358)**.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. A lower portion of the creek was logged in 1996.

Risk Potential

Low

E) PROTECTION NEEDS

The most important protection needs for Swampwater is protection of the riparian lands and small seasonal feeder streams that surround its headwater wetlands and maintenance of the canopy/streamside vegetation. Both Lens Main and Hillcrest Main are close to Reach 4 and sometimes contribute sediment during rain or melt especially when hauling is in progress.

Stream Code: 9202577685437

Stream Name: East Robertson River

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Robertson River from the east 6,500 m. above Bear Lake. Drains a steep, narrow basin which broadens and becomes less steep above the 600 m. contour.

Air Photos	BC 82007 136 - 137
Topographic Map	92 C/16, 92C.080
Salmonids	Co 1,350 m
	St 1,350 m
Obstructions	1 m over 6 m cascade at 400 m; passable
	1.5 m falls at 1,200 m; passable
	40 m falls at 1,350 m
Max.Temp.	15 (8/24/85)
Min. Disch.	0 first 50 m
	0.073 at 1,500 m (8/24/85)

EAST ROBERTSON RIVER

	Channel width	Wetted width	Substrate	Slope	Channel Confinement	Side Channel	Length (m)	Area (m^2)	
Reach 1	15.0	0	1450	1.8	FC	M	50	0	
Reach 2	15.0	8.0	1360	2.0	FC	M	300	2400	
Reach 3	12.0	10.0	1261	2.5	CON	N	950	9500	
Reach 4	18.0	8.0	127R	2.0	CON	N	1000	8000	
Reach 5	16.0	8.0	127R	2.5	CON	N	1000	8000	
Reach 6	15.0	8.0	127R	8.0	CON	N	2500	20000	
Reach 7	8.0	3.0	136R	3.0	CON	N	1700	5100	
Reach 8	7.0	3.0	127R	5.5	CON	N	400	1200	
Reach 9	6.0	2.0	1342	4.5	CON	N	1750	3500	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 1350 m. One brown trout fry was captured in Reach 1 in 1982.

Production is limited by high fall-winter discharge and low summer flows

C) ENHANCEMENT OPPORTUNITIES

1. ***COHO COLONIZATION:*** **Above barrier coho smolt yield potential: 984 - 6640 to 9750 fry required (Production Option # 359)**.

2.***FRY SALVAGE: REACH 1 AND ROACHE'S SIDECHANNEL:*** **Fry salvage** is required in Reach 1 which is associated with a sidechannel complex of the Robertson (Roach's Sidechannel, a 340 m long sidechannel complex that generally dries by June or July. However, in wet summers it is sometimes flowing in its lower 140 m). Yield is generally less than 1,000 fry **(Production Option # 360)**.

D) LAND USE FACTORS

Forestry

Most old growth has been harvested or burned in wild fires. Regen has been spotty on slopes between 2,500 and 4,500 m (stream length) due to a combination of fire history and low site productivity. 2000 – logging lower basin beginning to advance rapidly. 2002 – logging heavy around falls. No problems however.

Risk Potential

Low

E) PROTECTION NEEDS

The deltaic fan (Reaches 1 and 2) is unstable and contains a number of flood channels along with Roach's Channel; its part of the Robertson River FSZ. Above Reach 2 the river enters a canyon then is bordered by steep lands well into the headwaters.

Stream Code: 9202577685268

Stream Name: March Creek

Operational Management Unit: South Shore Tribs: East (Lake Southeast OMU 12)

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: Enters Robertson River from the southeast 4,000 m above Bear Lake. Drains a steep, narrow basin – non – buffered and subject to high fall – winter discharge fluctuation.

Air Photos	BC 82007 136 - 137
Topographic Map	92 C/16, 92C.080
Salmonids	Co 533 m and occasionally to 661 m Ct. 1167 m but majority below 661 m
Obstructions	Culvert with a 1 metre over 2 m drop at its outfall – 533 m. Only one coho fry was found above this point on Aug. 28, 1999. The culvert rests on a stump and the drop would be greater and more vertical if this structure washes away. 661 m massive backfilled log jam – a few cutthroats are present above it 733 m another big jam – only two small cutthroat fry were seen above it (8/28/99). They were likely progeny of resident spawners. Series of high natural falls begins at 1167 m
Max. Temp. (C)	15 (8/24/85) 15.8 (R2 8/28/99)
Min. Disch. (m^3)	0.0056 (8/24/85) .00392 (R2 8/28/99)

MARCH CREEK

	Channel width	Wetted width	Substrate	Slope	Confinement	Side Channel	LWD	Length	Wetted area
Reach 1	9	0	1540	1.8	FC	L	.032	38	0
Reach 2	6	2	1360	2.9	FC	L	.0163	513	1026
Reach 3	6	3	1261	7.0	CON	N	.011	551	1653
Reach 4	4	3	1261	18.0	CON	N	.16	79	237
Reach 5	4	3	1153	30	CON - ENT	N	-	1900	5700

B) FISH UTILIZATION AND LIMITING FACTORS

Coho are present for 533 m with a few to 661 m. Cutthroats, both residents and progeny of spawners from Cowichan Lake, are present for 661 m. A few cutthroats are present to 733 m and even to 1167 m at times but the majority are present below 661 m. Cutthroat densities increase after mid- Reach 2 while coho densities decline. The portion of the stream above Trace's Main was inaccessible to coho for an unknown period prior to 1987 due to an impassable culvert at 100 m . The culvert under Trace's Main is (a combination twin 1.3 m CSP and cedar log box culvert) is still subject to plugging. When this happens, flow sometimes diverts into a 1987 spill channel that runs south for 70 m before going under the road and into Robertson River.

Production is limited by low summer flow and high fall - winter discharge.

C) ENHANCEMENT OPPORTUNITIES

1. ***FRY SALVAGE:*** A few coho fry are often available for salvage in Reach 1 and are picked up by the Robertson River crew to be stocked in Upper Robertson River (Production Option # 361).

2. ***LWD ADDITION:*** Very little LWD remains in March Creek. It is recommended that a windfall log complex be added to Reach 2 at a point just upstream of TimberWest's stream sample station 981220201 which is located 138 m above Trace's Main and 244 m above Robertson River. If the material persists more than one winter, more complexing can occur (Production Option # 362).

The culvert at 533 m could be replaced but little gain would result because more obstructions are close at hand upstream.

D) LAND USE FACTORS

Forestry

Thirty percent of the basin is covered by advanced second growth, logging resumed in 1987. The remainder is in early stages of regeneration on thin soils and rock. There is a scattering of upper elevation old growth Douglas fir.

Risk Potential

Moderate.

E) PROTECTION NEEDS

March Creek's main protection needs are related to steep adjacent slopes that begin in mid to upper Reach 2 and extend well upstream into headwater tributaries. There is a talus slope adjacent to upper R3. The present new road extends very close to the beginning of the talus zone which is located in a steep ravine. Careful planning will be required for road alignment in the mid and upper basin.

Stream Code:

Stream Name: Robertson Sidechannel - Mayo Creek

Operational Management Unit: South Shore Tribs: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A complex system with two major components: a steep mountain stream known as Mayo Creek and a floodplain component termed Robertson Sidechannel. The upland component flows all year above a point beginning 167 m above Hillcrest Main. It is a runoff stream in the fall and winter months. The floodplain component is summer dry but the bulk of its winter – spring flow is supplied by the winter water table so discharge during this period is usually very stable. Since the late 1980's, excess gravel in the sidechannel portion has limited productivity and prevented the winter water table from reaching the channel surface on a regular basis.

Air Photos	BC 82007 136-137
Topographic Map	92 C/16, 92C.080, 090
Salmonids	Co 2090 m Ct 2281 m Cm 1570 m
Obstructions	Log jam @ 2090 stops Co and most Ct. Another blocking jam is present at 2281 m. This jam has at least 500 m^3 of gravel backfilled behind it. Falls begin @ 2513 m.
Max. Temp. (C)	13 (8/15/86) in permanent section above 2000 m. 16.4 (8/28/99) temperature in permanent section above Hillcrest Main Since excavation in 2000, there has been some summer flow in the lower reaches. Because it is groundwater, temperature has not exceeded 12° and usually peaks between 9 and 11°.
Min. Disch. (m^3)	0 for 2000 m then .008 (8/15/86) .0025 (8/28/99)

ROBERTSON SIDECHANNEL - MAYO CREEK

	Cannel width	Wetted width	Substrate	Slope %	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	4	0	4510	.2	CON	N	0	131	0
Reach 2	8	0	1720	.8	FC	L	.0016	1339	0
Reach 3	6	0	1450	1.7	CON	N	.0073	363	0
Reach 4	6	0	1360	2.2	CON	N	.0129	167	0
Reach 5	6	2	1360	3.5	CON	N	.009	250	500
Reach 6	4	2	1270	6.5	CON	N	.012	262	524
Reach 7	4	2	1152	40	CON - ENT	N		415	830
Reach 8	3	2	1261	25	CON - ENT	N		2200	4400

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present for 2332 m. Coho far outnumber cutthroats which are only common in the upper 500 m of accessible habitat. Possible reason: the lower 1700 m dry before cutthroat fry emergence. A few chums also spawn in the sidechannel in some years. Portions of the lower 1700 m dry before full coho fry emergence. In most years, many eggs and alevins are lost for this reason. Portions of Reach 2 now commonly dry in winter and the entire reach usually dries before April or May. Very large numbers of fry are trapped. In the winter of 1997 – 98, the channel hardly flowed at all. The channel is excellent spawning habitat. Isolated from the extreme flows and temperatures of winter and nearly ideal substrate composition, it formerly hosted more than 1000 coho spawners on many occasions.

Extreme early drying is relatively recent (last 10 years). Prior to the 1960's, the sidechannel usually flowed until sometime in July.

C) ENHANCEMENT OPTIONS

1. *FRY SALVAGE (PRODUCTION OPTION # 363)*

10,000-70,000 coho fry are trapped by diminishing flows. Most can be salvaged. Salvage conditions are very good but the channel dries early and fast. Careful monitoring is required between late March and May. Fry numbers are dropping fast as the number of spawners diminishes because flows are sometimes not present in spawning time. Note: excess bedload condition remedied in 2000 – 2001 but salvage is still required later in the summer.

2*. PROLONGED FLOW VIA EXCAVATION (PRODUCTION OPTION # 364)*

It should be possible to prolong flow in Robertson Sidechannel by gravel removal to access the winter - spring water table. At least 1M of material will have to be removed. A side pit (trap) should be excavated above the removal area to catch annual accretion and prevent recurrence of the bedload build-up. The trap should be installed just below the upper access road by the dry land sort. Angled windfall logs could be installed in the excavated section to create scour and hydraulic cover. Flow could also be extended by linking a relic portion of the sidechannel which is sometimes called the West Fork to a new channel (Blind Channel) that was excavated in 1994. This 320 m long channel accesses the winter water table and discharges to the Robertson River. The connector channel would be 325 m long. Another option is to connect the sidechannel to the river via a 500 m long relic channel. The basic problem with the sidechannel is that the winter water table no longer serves it and flow is only provided by Mayo Creek. The creek's flows are far too low to supply the sidechannel except in periods of high runoff. **Note:** It may be necessary to return a portion of the excavated gravel to the channel if underlying materials are mostly fines.
UPDATE NOTE: The Cowichan Lake Salmonid Enhancement Society in cooperation with the Robertson Family, excavated the channel down 1.5 to about 2 m for a distance of 1440 m in the summers of 2000 and 2001. Flow persisted in the treated section from the onset of fall rains on October 19, 2000 to July 18, 2001. Fisheries Renewal BC provided the funding (Burns and Robertson, 2001a, 2001b). Channel maintenance will be required to insure that bedload does not rebuild.

3*. GRAVEL MANAGEMENT (PRODUCTION OPTION # 365*)

Improvement in gravel quality is necessary in Reach 1 where recent channeling has removed surface gravel and exposed fines. Several spawning pads should be constructed here.

A large gravel bar frequently forms at the confluence of the sidechannel and the river. Fry have a difficult time navigating it and it exposes them to heavy predation. It must be removed periodically. The landowner has done this on his own in recent years.

4. LWD AND BOULDER ADDITION (PRODUCTION OPTION # 366)

Although permanent rearing does not occur in Robertson Sidechannel, there is virtually no cover in it. Spawners and fry are at risk of predation. The addition of several windfall logs and large boulders would improve conditions.

D) LAND USE FACTORS

Forestry and Fire

The lower half of the basin is covered by advanced second growth. However, the upper half is in early stage of regeneration from logging, fire and a slope failure. Extensive areas of bedrock have been exposed by fire and erosion. Reach 3 is owned by TimberWest. Reaches 4 through 8 are on Hancock land.

Risk Potential

Moderate but decreasing.

E) PROTECTION NEEDS

The riparian zone (approximately 20 Ha adjacent to the Lower Channel and Lower Robertson River) should be left intact and logging and road construction in the steep upper basin should be highly limited.

Notes:

Coho Escapement

YEAR	NUMBER
1974	5000 plus
1977	1575
1978	1220 plus 400-600 holding at mouth on count day
1986	366
1987	393
1988	285
1989	475
1990	621
1991	197
1992	30
1993	217
1994	57
1995	83
1996	22
1997	0
1998	3
1999	20
2000	116
2001	294 and 144 chums
2002	39 and 364 chums. A female Ct kelt mort of 39 cm FL was found at the base of the Newbury Weir on Jan. 15

Stream Code:

Stream Name: Blind Channel (Fish Ditch)

Operational Management Unit: Lake Southeast

Municipal: CVRD Area F

A) BIOPYSICAL OVERVIEW: An excavated groundwater channel constructed by DFO/Colin Wall in the summer of 1994 to provide an element of stability in the Lower Robertson River (R2). This channel provides overwinter habitat, safe spawning and summer rearing. Although it is located immediately adjacent to a part of the Robertson River that dries early, it usually maintains a substantial summer flow. However, in very warm dry summers like 1998, it can become intermittent.

Air Photos	BC 82007 136,137
Topographic Maps	92C/16, 92C.080, 090
Salmonids	Co to 358 m Cm to 358 m CT to 358 m ST to 358 m DV to 358 m
Obstructions	None, channel simply ends
Max. Temp.	11.5 R2 @60 m 10/18/99 15.0 8/31/99 R1 standing pools 15.0 8/30/02 18.0 (9/24/02 R1 lower pool)
Min. Disch.	.185 R2 @ 60 m 10/18/99 0 Aug. 31, 1998 (intermittent pools) .003 10/1/00 0 August 20, 2002 to October. Only 5 pools remained in the channel and there was no flow between them. Oxygen in the lowest pool dipped to 5 mg/L. Temperature was 18. Only one pool was located in R2 above the culvert.

BLIND CHANNEL

	Channel Width	Wetted Width	Substrate	Slope %	Confinement	Sidechannel	LWD	Length	Wetted Area
Reach 1	12	10	3610	.001	CON	N	.011	220	2220
Reach 2	6	5	2710	.01	CON	N	.012	138	690

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and chum salmon utilize the channel. Chum for spawning only but coho spawn, overwinter and summer rear. Only the upper 17 m of R1 is utilized for spawning but nearly all of R2 is used. 25 coho fry were sampled for length on October 3, 2000. Mean length was 71.8 mm and range was 65-83 mm.
Production is limited by lack of cover – complexity.
Steelhead spawners were reported in April 2001.
Cutthroat trout and Dolly Varden are also present. Large numbers of juveniles of both species were captured in a minnow trap salvage operation in the late summer of 2001 prior to complexing.

C) PRODUCTION OPPORTUNITIES

1 . ***ESTABLISHMENT OF A RIPARIAN BAND:*** The channel was excavated in a gravel environment that is very dry. Less than 10% of the channel edges have developed a band of riparian vegetation. There is a need to plant the rest of the area (some 640 lineal metres) with willow-alder-cottonwood and remove the broom which has colonized much of the channel's upper slopes. Planting should be done in the spring or fall with dormant seedlings and cuttings (Production Option # 367). Note: Planting is well underway. FsRBC contracts in 2000 and 2001 made considerable progress in both planting and broom removal.

2. ***ADDITION OF LWD:*** Some of the channel has been complexed and 3 shelters were constructed in R2. However, instream cover is still limiting and there is a need for more windfall logs – especially those that angle from the surface to the bottom (Production Option # 368) **Note: LWD added in Sept. 2001 FsRBC contract. 6 key logs and 90 pieces were added to the existing LWD base of 39 pieces. Key logs were excavated into the channel banks at selected locations in R1 and additional material was tied to them and existing material. The channel is now complexed to an appropriate degree (Burns, et. al. 2002).**

3. *FRY SALVAGE:* In dry summers like 1998, this channel can become intermittent and fry salvage is required . 10,000 were captured in the August 31.1998 salvage; 7,000 from one pool. Overall fry density was 3.49/ m^2. Fish can be stocked in R6 of the Robertson (Nine Mile Bridge) or, if R6 is fully stocked, Lucky Creek can be stocked at the 6 Km. Crossing (Upper Roach's Road). Lucky Creek enters R6 of the Robertson but is not accessible to coho juveniles stocked in R6 due to a barrier very close to the confluence of the two. Lucky Creek has a coho carrying capacity of 3000 (Production Option # 369)

Note: Replacement of the culvert at 220 m with a bridge should also be considered (this culvert is susceptible to plugging) and the small culvert under the road just east of the crossing should also be replaced. It isn't large enough to handle peak flows that pass through in large runoff events. The surface flow is a result of a high water table and breakout from the Robertson well upstream.

D) LAND USE FACTORS

The surrounding area is private land (Bill Robertson) and is an industrial site centered on forestry activities such as specialty milling and firewood cutting. It is also a bone yard for old logging equipment and general junk.

E) PROTECTION NEEDS

A small buffer zone is all that is required to protect the channel because runoff is not a factor except on a very local basis. Once revegetation strengthens, a buffer zone will be defined and marked. NOTE; This channel can spill in a prolonged heavy runoff event. Spill is generally gentle however serious erosion and deposition occurred in the winter of 2001 –2002 when runoff was so high that a small culvert under the access road was unable to handle it and material washed into the channel plugging the upper culvert and casting a blanket of silt over the spawning bed below the culvert Beavers also plug this culvert on occasion (they plugged it frequently in the fall of 2001) and it needs to be monitored. There is also a danger of them plugging the lower culvert to the Robertson River.

F) HISTORICAL NOTES

A railroad grade once ran where the present road is. It led to a trestle that provided access to the west side of the Robertson and Nineteen and Patricia Creeks.
The channel of the Robertson River was approximately where Blind Channel is now prior to 1974.

ESCAPEMENT COUNTS

YEAR	COHO	CHUMS	OTHERS
1994			
1995			
1996			
1997			
1998			
1999			
2000	135		I steelhead seen in early April by a passing worker
2001	198	2	
2002	116	6	

Stream Code: 9202577685023

Stream Name : Mesachie (Bear) Creek and Lake

Operational Management Unit: South Shore Tributaries: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW

A small, low gradient stream well buffered by Mesachie Lake. The original stream course meandered through an extensive wetland between Mesachie and Bear Lakes. The present channel is relatively straight and much shorter. The new channel is likely an improvement in terms of recruitment potential because it has considerable gravel and some gradient. The old streambed was largely muck-detritus.

Air Photos	BC82007 136-137
Topographic Map	92 C/16, 92C.090
Salmonids	Co, Ct, Rb, Ko
Obstructions	None
Max. Temp.	22 (7/20/88)
Min. Disch.	0 (generally from mid- July to the onset of fall rain although a few pools sometimes remain)

MESACHIE CREEK

	Channel width	Wetted width	Substrate	Slope%	Channel confinement	Sidechannel	Length (m)	Area (m^2)	
SC Reach 1	8	0	9100	.001	FC	H	30	0
SC Reach 2	3	0	2800	1.0	FC	H	75	0
Old Channel	5	0	3700	.01	FC	N	115	0
Mainstem	6	0	2800	0.5	FC	N	375	0
SC 2	5	0	2800	0.2	CON	H	94	0
Trib. Channel	5	0	9100	.01	FC	H	157	0

GUNDERSON'S POND

Area	Elev.	Max. Depth	Perimeter
.25 HA	167	6m	228m

MESACHIE LAKE

Area	Elev.	Max. Depth	Perimeter	Volume
59.3	168	32m	4050m	11,450,000

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, kokanee and a few rainbows and cutthroats spawn in Mesachie Creek. The fry rear until the onset of drying. Coho spawning is heavy in years of high escapement. Incubation and early rearing conditions are very good but fry must leave the creek by early July thus limiting stream production. A survey on June 18, 1988 revealed that only 526 fry remained in the creek (514 coho and 12 cutthroat) - average of .16 per square meter; about 16% of carrying capacity at full wetted area.

Lampreys, sculpins and sticklebacks also utilize the creek. Large numbers of lampreys are present in Mesachie Lake. A significant percentage of coho smolts leaving the lake are scarred by lampreys. In 1990, 29.1 % of smolts sampled at the Mesachie Creek counting fence were marked. Some fish had up to four lamprey scars (Burns and Anderson, 1990). The lampreys in Mesachie, Bear and Cowichan Lakes are considered to be non-anadromous and have been termed *Lampetra macrostoma* (Beamish, 1982).

Four Mesachie Lake cutthroats (40-55 cm) spawned in Mesachie Creek between April 16 and May 5, 1989. Fry emergence began May 22. Kokanee from both Cowichan and Mesachie Lakes spawn in the creek. Mesachie fish are somewhat larger (20-28 cm as opposed to 15-18 cm). Spawning peaks in late Nov. In 1989, 750 spawners from Mesachie Lake spawned in the top 200m. Kokanee are also reported to spawn on the Halfway Creek deltaic fan at the east end of Mesachie Lake. Occasionally rainbow spawners from both lakes utilize the creek and, on very rare occasions, steelhead are reported. These are likely returnees to the nearby net pens. A very occasional brown trout is also reported.

C) ENHANCEMENT OPPORTUNITIES

1. *MESACHIE LAKE STORAGE* (Production Option # 370)

One meter of storage in Mesachie Lake would yield .016 cms for Mesachie's Creek average dry period of 130 days. If evaporation loss is 30%, flow would be reduced to .0112 cm. Ideal Mesachie Creek flow is .100 cms. This is not achievable without much greater storage. More than 10m of storage would be necessary to maintain this flow. Fairservice (Cook's Lake) a wetland at the head of Halfway Creek) storage of 2m would add another .002 cms for a total of .0132, only 13% of ideal. Nevertheless, a survey on July 20, 1988 when Mesachie Creek was flowing at .002 cm, revealed significant numbers of coho and trout fry (258 and 100). Mesachie Creek's theoretical smolt yield is 263.

2. ***MESACHIE LAKE FRY STOCKING*** **(Production Option # 371)**

In 1976, Mesachie Lake produced 45,489 coho smolts (Argue, et.al. 1979). A decade later, yields have been about 13% of that figure. It was thought that salvaged fry stocked in Mesachie Lake may have helped account for high yields but, according to the records, Mesachie Lake has only been stocked once: 40,000 in 1985. However, Bear Lake was stocked in 1975, 1977 and 1978 (Burns et.al.1987) and some fish could have moved up to Mesachie.

Bear Lake Coho Fry Stocking:

YEAR	NO.	SOURCES
1975	6,850	Robertson River, & Sidechannel
1977	41,290	Robertson River, & Sidechannel, Meade Creek, Sutton Creek
1978	15,126	Robertson River, & Sidechannel, Sutton Creek

Even so, these fish could not have added significantly to 1976 smolt production.

1975 was a high escapement year in the Cowichan System (40,000 spawners) and Mesachie Lake draws fish from other sources. Robertson River is probably a major source. The lower 500 m of the mainstem and 300 m of Robertson Sidechannel are vacated by coho fry in most years. Similarly, many coho fry leave Halfway Creek by June. There is also a fall movement of juvenile coho into Mesachie Lake.

If Mesachie Lake's productive capacity is 45,489 smolts, then 569,862 fry are required. It is highly unlikely that escapement is capable of supplying these fish. It is recommended that salvaged fry from Robertson River supplemented by hatchery fry be utilized to stock Mesachie Lake. Coho fry utilize the margin of Mesachie Lake in the spring and early summer. Minnow trap catches provide a rough estimate of numbers. In June 1988, minnow trap catch indicated a fry population of $7/m^2$ of shoreline (4,050m) - 28,350 fry; a shortfall of 541,512. Annual surveys should be carried out to determine fry stocking requirements.

D) LAND USE FACTORS

Urban intrusion and second growth logging are threats. Risk potential is considered to be moderate. There has already been some loss of wetland near the creek and in Bear Lake's shore zone. The developer has also modified portions of the creek. Mesachie Lake is owned by Camp Imadene, a private religious group that desires to keep the lake as pristine as possible. The creek and its riparian zone along with the associated section of Bear Lake's shore zone are the property of Gary Gunderson.

E) PROTECTION NEEDS

All land use activities must be excluded from the riparian zone of Mesachie Creek which is known as the Mesachie Wetland and the riparian shore zones of Bear and Mesachie Lakes.

ESCAPEMENT DATA (COHO)

YEAR	NUMBER
1942	999
1943	1826
1944	3292
1977	1697
1984	1153
1986	291
1987	431
1988	170
1989	156
1990	574
1991	77
1992	13
1993	41
1994	133
1995	373
1996	26
1997	47
1998	602
1999	107
2000	234
2001	559
2002	346

Coho Smolt Output

Year	Number
1976	45,489
1987	5511
1988	6864
1989	2216
1990	4155
1991	21189
1992	6668

1991 and 1992 results were influenced by flooding when a large in – migration of fry from elsewhere in the system were pushed upstream and trapped behind the fence.

Stream Code: N/A

Stream Name: Plantation Creek

Operational Management Unit: Lake South: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A small, temporary stream draining the B.C. Forest Service Research area near Mesachie Lake. Parts of the stream have been channeled many years ago.

Air Photos	BC 82007 136 - 137
Topographic Map	92 C/16, 92C.090
Salmonids	Co
Obstructions	None.
Max. Temp. (C)	N/A
Min. Disch. (m^3)	0

PLANTATION CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Sidechannel	LWD	Length	Wetted Area
Reach 1	3	0	1810	.5	FC	N	0	35	0
Reach 2	2	0	1720	1.8	CON	N	.0076	330	0
Reach 3	3	0	2710	.5	CON	N	0	263	0
Reach 4	100	0	1000	.001	UC	N	NA	390	0
Reach 5	2	0	4420	.8	FC	N	0	160	0
Reach 6	50	0	1000	.001	UC	N	NA	420	0

B) FISH UTILIZATION AND LIMITING FACTORS

A total of 645 coho fry and 1 smolt were seined from Reaches 1 and 2 on April 26, 1988. Emergence was not complete so it's probable that more fry could be produced. But spawning sites are very limited and the total is unlikely to exceed 1,000.

The creek dries by July but most coho fry rear in Cowichan Lake.

C) PRODUCTION OPPORTUNITIES

1. *HEADWATER STORAGE:* It may be possible to maintain permanent flow by storing water (Production Option # 372) in two wetland basins which have a combined surface area of 6.5 Ha and a theoretical storage capacity of 19.5 m could yield .0026 cm for 180 days and support 10,500 coho fry (Production Option # 373)

2.SUBSTRATE IMPROVEMENT: **Spawning platforms in Reach 2 (Production Option # 374)** would improve fry yield in this very stable stream. However, it's unlikely that numbers would satisfy the carrying capacity of the wetlands so stocking will be required if the wetlands are impounded.

3.FRY SALVAGE: Fry salvage is required in Reaches 1 – 3 (Production Option # 375)

4.***LWD ADDITION:*** The stream is starved for LWD. Very little is present in R2 and R's 1 , 3 and 5 have none. Reaches 4 and 6 are wetlands. There are some excellent sites (good access and available material close by) in Reaches 2 and 3. An especially favourable site is located at the 52 m point of R3 (Production Option # 376)

D) RISK POTENTIAL

Low. Most of the watershed is provincial research forest.

E) PROTECTION NEEDS

Plantation Creek is almost entirely within the BCFS Research Station Area. Several small wetlands are present and they require protection. There has been a tendency on the part of BCFS personnel to manicure this creek.

Stream Code:

Stream Name: Pawlik's (Mill) Creek

Operational Management Unit: Lake Southeast (OMU 12)

CVRD Electoral Area: F

A) BIOPHYSICAL DESCRIPTION: A small run-off stream that dries very early in its lower reaches. Tributary to Mesachie Lake at Pawlik's Bay. Was formerly located on the Hillcrest Mill Site which is now occupied by Camp Imadene.

Air Photos	BC 82007 137-138
Topographic Map	92 C/16, 92C.090
Salmonids	Co, Ct have been reported in the past Ko occ. Spawners in R1
Obstructions	Increasing gradient and small debris jams above 860 m.
Max. Temp. (C)	13 (9/21/00 R5)
Min. Disch.	0 in Reaches 1 – 3 .064 LPS R5 9/21/00

PAWLIK'S CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel confinement	Side Channel	Length (m)	Area (m2)	
Reach 1	1.5	0	4600	1.0	FC	N	98	0	
Reach 2	1.5	0	3610	.1	CON	N	280	0	
Reach 3	4	0	2710	1.5	FC	N	190	0	
Reach 4	2	1	1360	5.0	CON	N	300	300	
Reach 5	2	1	2620	3.5	CON	N	35	35	
Reach 5	2	1	1270	25	CON	N	700	700	

B) FISH UTILIZATION AND LIMITING FACTORS

An occasional coho may spawn in Reaches 1-3 in years of high escapement and high flow. Kokanee spawners are sometimes seen in R1. A few resident cutthroats are said to be present in Reach 4. Surveys in 2000 and 2001 didn't reveal any. Some 300 m of Reaches 3 and 4 were surveyed on September 21, 2000 including minnow trapping – no fish were seen or captured. On May 22, 2001 200 m of R3 was checked. Flow was 9 LPS and a number of pools were present. No fish were seen or seined. A nearby resident reports that "an old guy in a van comes every year to salvage fish".
Production is highly limited by water availability. In many years, the stream is dry in Reaches 1-3 at spawning time.
In the 1940's, coho were commonly reported in this creek. The last time spawners have been verified is 1977. Susan Anderson reported that coho spawned in R2 (which is a ditch on the upstream side of South Shore Road) that year.
The creek has been relocated over the years to serve the needs of the Hillcrest Mill and South Shore Road.

C) ENHANCEMENT OPPORTUNITIES

Creation of spawning platforms in the lower part of Reach 4 might provide some benefit if coho spawned there. They could also be constructed in Reach 1 which also holds water better than Reach 2. However, this is not recommended because Pawlik's Creek is now very marginal fish habitat. If the creek were restored to its old position on the mill site (now a church camp called Camp Imadene), benefits might result. Note: Valley Fish and Game Club installed some spawning gravel in R1 in 2002.

D) LAND USE FACTORS

Forestry

The entire basin is advanced second growth TimberWest is the main owner. Camp Imadene has the lower portion and has recently logged a small area.

Water Supply

A water tank is present adjacent to an old reservoir basin on the upper portion of the creek (R5). Water is pumped up from Cowichan Lake then gravity fed back down to Mesachie Lake. CVRD Engineering looks after the system.

E) RISK POTENTIAL

Low.

F) PROTECTION NEEDS

Pawlik's Creek flows in a small ravine for much of its upper length. Roads and landings should be set back from the edge of the ravine.

HISTORICAL NOTES

ESCAPEMENT DATA

Year	Coho	Kokanee
2001	2	3
2002		4

Stream Code:

Stream Name: Halfway Creek

Operational Management Unit: South Shore Tributaries: East

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW

A highly complex stream system subject to high fall-winter discharge fluctuation and extensive summer drying. Summer flow provided by three small tributaries where groundwater surfaces in their lower reaches.

Air Photos	BC 82007 136-137
Topographic maps	92 C/16, 92C.090
Salmonids	Co,Ct,Rb,DV,Ko None. South Shore Road culvert at 2,150 m is a velocity barrier at high flows.
Max. temp. (C)	15 (8/20/87)
Min. discharge (m^3)	0 (July – mid – Oct. except in wet summers when it may flow to early or mid- Sept.). Water is present in Reach 2 and the lower sections of the groundwater tributaries.

MAINSTEM

	Channel Width	Wetted Width	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m2)	
Reach 1	5	0	3700	0.001	CON	N	30	0	
Reach 2	9	0.534	2800	1.0	FC	L	600	267	
Reach 3	30	0	7300	0.01	UC	H	720	0	
Reach 4	8	0	2800	1.5	ENT	N	800	0	
Reach 5	4	0	1450	1.5	CON	N	155	0	
Reach 6	3	0	1450	2.1	CON	N	362	0	
Reach 7	4	0	8200	.5	FC	N	50	0	
Reach 8	12	0	1000	.1	OC	M	448	0	

GROUNDWATER TRIBUTARY 1 (T 1)

Salmonids	Co, Ct, DV 495 m
Obstructions	2 m over 4 falls at 595 m
Min. disch.	.0007 @ 50 m (9/23/87)

	Channel Width	Wetted Width	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m2)	
Reach 1	7	2	2800	1.0	CON	L	40	80	
Reach 2	6	2	2620	1.5	CON	N	280	560	
Reach 3	5	1	4600	.5	UC	M	105	105	
Reach 4	30	0	1810	.5	UC	H	75	0	
Reach 5	5	0	1630	1.0	CON	N	75	0	
Reach 6	2	0	136R	2.5	ENT	N	140	0	
Reach 7	1.5	0	136R	20.0	ENT	N	500	0	

GROUNDWATER TRIBUTARY 1 EAST BRANCH (T1B1)

Salmonids	Co,Ct 250 m
Obstructions	None. Gradient increases sharply above 600 m. Very doubtful that fish would migrate this far. Stream is subject to winter drying above 400 m.

Min. Disch. .0001 (8/24/96.)

	Channel Width	Wetted Width	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m2)	
Reach 1	4	1	2710	.5	FC	L	200	200	
Reach 2	8	1	9100	.5	UC	H	100	100	
Reach 3	3	1	2710	.5	FC	L	100	100	
Reach 4	3	0	2710	.5	FC	L	100	0	
Reach 5	3	0	1540	3.0	CON	N	200	0	

TRIBUTARY 2 (T2)

Salmonids Co,Ct, DV

Obstructions South Shore Road culvert at 1000 m - a velocity barrier in high flows. Increasing gradient at 1800 m.

Min. disch. .0003 lower 435 m (9/23/87)

	Channel Width	Wetted Width	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Area (m2)	
Reach 1	4	2	2710	1.0	UC	M	435	870	
Reach 2	8	0	6400	1.0	FC	L	100	0	
Reach 3	10	0	7300	.1	UC	M	600	0	
Reach 4	3	0	3700	1.5	CON	N	400	0	
Reach 5	2	INT	1630	3.0	CON	N	300	0	
Reach 6	1.5	INT	1270	15.0	ENT	N	500	M	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and resident cutthroat trout are present. Migrant spawning cutthroat, Dolly Varden and Kokanee from Mesachie (and possibly Bear and Cowichan Lakes) also use the stream.

Production is highly limited by summer drying. In 1987, only 2022 square meters of wetted area remained in the system; 267 in the mainstem, 885 in trib. 1 and 870 in trib. 2. Some water was also likely present in Groundwater Trib. 1 East Branch (more often known as T1 – B1 but it was not inventoried until 1996, not a particularly dry summer. 400 square metres of wetted habitat were present then.

C) ENHANCEMENT OPPORTUNITIES

1. *FRY SALVAGE:* : It is estimated that approximately 2000 fry could be salvaged in most years and utilized to stock Mesachie Lake **(Production Option # 377)**.

2***. HEADWATER STORAGE*** **(Production Option # 378)**

Storage and flow release from Fairservice (Cook's) Lake could yield .0023 cms for Halfway Creek's approximately 150-day dry period. Fairservice Lake is a 2.1 ha marsh (Carex - Spirea - a headwater wetland basin of the mainstem) that usually dries by late spring. Storage required: 2 m. Some minor modification of the west inlet will also be required to prevent some inflow from being lost to Halfway Creek below the dam site. Inflow is critical. There are 9 inlets but 7 only flow during heavy runoff periods (ephemeral) and the remaining two are small and seasonal. They generally only flow until mid-spring and even then they often go sub-surface before they reach the lake. Columbine Creek, the largest inlet which drains a large percentage of the north face of Mayo Mtn. goes underground 440 m above Fairservice Lake except during periods of high runoff. Above this point Columbine Creek flows well into the summer. It is not known whether 2.3 LPS will be enough flow to wet Upper Halfway significantly. This water may simply go underground as well. Note: Fairservice lake is also known as Cook's Lake. There was a dam/Pelton Wheel at the outlet from the 1920's to the 1930's. It was constructed by Stanley Gordon to power his store in Lake Cowichan and it later powered the village for a while

3. ***CHANNEL IMPROVEMENT*** **(Production Option # 379)**

Reaches 4 & 5 of Groundwater tributary 1 and Reach 2 of its East Branch and Reach 3 of tributary 2 could be deepened and channeled to expose groundwater and concentrate flow. Channel organization is poor and summer flow is highly diffused in the gravel - sediment - detritus overburden. The same treatment could also be applied to R4 of T1B1.

4. BARRIER IMPROVEMENT (Production Option # 380)

The South Shore Road culvert at 2150 m is a migration barrier. This two sided concrete box culvert has a 1 m vertical drop at its outfall at low water and the culvert itself is thought to be a velocity barrier at peak flows. It's possible that adult fish could navigate the culvert in moderate flows but no fry or adults have been observed above it for many years. Fish were observed above the culvert in 2001 but species was not specified. It should be possible to back flood the plunge pool to a point where the culvert could be passable by constructing a boulder weir at the pool outlet when the creek is dry in July – September. The culvert is impassable mainly because its outfall has scoured a plunge holw below it. This hole could also be partially filled in with large rock to reduce the vertical drop.
NOTE: The culvert was ramped on 10/9/02. Sean Wong of DOTH contributed funding and the plunge pool was built up then the channel was ramped down to grade by adding shot rock for 12 m downstream – ramp slope is 6%. It may still be necessary to add baffles inside the culvert. Velocity at mean winter flow was measured on Jan. 15, 02. It was .835 MPS in the 16 m long east box which is somewhat deeper (d = 6CM) than the west box and the most likely avenue for fish passage. It is probable that coho and trout migrants can navigate this velocity but the addition of baffles would garuntee it. Two cedar cant baffles 20 cm high and 1.5 m wide could be installed in August 03.
The old wooden culvert on T 1 at the railroad grade should also be removed when the next logging setting is in the area. Steve Voller is aware of this (9/00)

D) LAND USE FACTORS

FORESTRY

The basin is covered by advanced second growth; some of which is being logged. An extensive thinning program began in 1994.

SUBURBIA

A large subdivision was proposed (1988) for the ridge between Halfway Creek and Cowichan Lake. A good deal of groundwater seeps out of this area and it forms a significant percentage of the creek's catchment area. Fran Heald built a house near the creek in the early 1990's. Bank protection measures were carried out in the late summer of 2002.

RISK POTENTIAL

Moderate

E) PROTECTION NEEDS

Much of the lowland portion of the Halfway Creek Basin is part of the old bed of Mesachie Lake. This area is poorly drained with areas of moist organic soils and small wetlands. Nearly the entire area is salmonberry - swordfern or salmonberry - ladyfern - arum. Alder is the dominant overstory. I call this broad riparian area the " Mesachie Sponge" and consider it to be one of the most important Fisheries Sensitive Zones in the region. All land use activities except perhaps highly selective seasonal logging should be excluded.
Portions of the upper reaches of some of the tributaries are very steep and deeply incised. They should be avoided by road construction and yarding.

Escapement Counts – Coho

Year	Number

2001	19

OPERATIONAL MANAGEMENT UNIT 13: LAKE COWICHAN SOUTH

OVERVIEW

Lake Cowichan South OMU includes all lands in the south portion of the Town of Lake Cowichan and adjacent uplands to the south up to the height of land on Big Mesachie and Mayo Mountains. It also takes in some areas outside the town on both its east and west fringes: Upper Beaver Creek on the west and Hudgrove Road – Fairservice Creek Area on the east.
There are significant riparian and wetland landscape units within the OMU: Money's Wetland and Beaver Creek Deltaic Wetland (also in the Cowichan Lake OMU) are two large riparian/wetland units within the town and there are a number of large wetlands to the south which principally drain into the South Fork of Moneys Creek and Fairservice Creek. A small part of the wetland complex drains to Beaver Creek.
This OMU contains four salmonid streams: Beaver, Money's, Sedge and Fairservice and three lakes: Beaver, Kwassin/Grant and Lost.

LIMITING FACTORS

Primary limiting factors are access and critical period discharge. Beaver Creek was also strongly limited by lack of quality spawning habitat but enhancement efforts by the Cowichan Lake Salmonid Enhancement Society since 1983 have greatly improved this situation.

PRODUCTION OPTIONS

19 production options are located in the OMU. They are outlined in Table 12. More detail is present in the stream files.

Table 12: Production Options in OMU 13

No.	Location	Activity	Priority
381	Beaver Creek	Continue substrate upgrade	1
382		Working agreement with landowners	2
383		Wetland impoundment	1
384		Beaver Lake fry stocking	1
385		Halfway diversion adjustment	2
386		Monitor beaver dams	1
387		LWD addition	3
388		Beaver Lake Cutthroat improvement	1
389		Dam improvements	1
390	Moneys	Coho colonization(lakes)	2
391		Moneys Creek restoration	2
392		Subsequent Moneys Creek imp.	2
393		South Moneys headwater storage	2
394		Moneys Wetland extension	2

395		Diversion ditch wall stabilization	1
396	Fairservice Creek	Wetland impoundment/flow augmentation	1
397	Fairservice cont.	Fry salvage	1
398		LWD addition if supplemental flow established	2
399	Sedge (Burns) Cr.	Headwater storage	1

Stream Code: 9202577608

Stream Name: Beaver Creek and Lake

Operational Management Unit: Lake Cowichan South

CVRD Electoral Area: F and partly within the Town of Lake Cowichan

A) BIOPHYSICAL OVERVIEW: This stream flows from Beaver Lake to Cowichan Lake skirting the west portion of the Town of Lake Cowichan through TimberWest working forest. Beaver Creek drains a broad, low relief basin. Beaver Lake is a mature lowland lake of 19.3 Ha.

Air Photos	BC 82007 137 - 138
Topographic Map	92 C/16, 92C.090
Salmonids	Co to 2,838 m and Beaver Lake and occasionally through the lake to the Halfway Diversion intake,. In November 2001, 30 coho passed through Beaver Lake and spawned in the inlet that is fed by the diversion which has been termed Jim's Creek since Jim Humphey routed it through the Beaver Lake Campsite. 100 coho spawned in Jim's Creek in 2002. Ct to 2,838 m and Beaver Lake and (as of 2001) in the Halfway Diversion inlet/perimeter drain. Smallmouth Bass formerly reported in Beaver Lake, but very few. None have been seen or captured in the period CLSES has been involved with the system (since 1983).
Obstructions	None. The beaver dam formerly prevented fry from accessing the lake but it has settled with age and CLSES has swaled it
Max. Temp. (C)	19 ((8/9/85) 20.5 (R1 – 7/27/98)
Min. Disch. (m^3)	0.007 (8/9/85) at 1,900 m. However the creek can dry if flow through the beaver dam at the lake outlet is not maintained. .1052 (R1 – 9/2/98)

BEAVER CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	5	2	8200	.1	UC	H		280	560
Reach 2	4	2	2440	1.6	CON	N	.01	223	446
Reach 3	4	2	5410	.8	FC	L	.014	1462	2924
Reach 3A	15	8	9100	.001	OC	M	.007	224	1792
Reach 3B	40	30	1000	.001	UC	M	.005	357	10710
Reach 4	20.0	5	8200	.01	UC	H		292	1460
Total								2838	17892

JIM'S CREEK

	Channel Width	Wetted Width	Subsrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	2	0*	6400	1.7	CON	N	0	135	0*
Reach 2	4	0	1000	.1	CON	N	0	118	0
Reach 3	2	0	3520	1.9	CON	N	0	98	0

* Jim Humphrey pumps water from Beaver Lake to provide summer flow

Jim's Creek is the Halfway Diversion which was constructed in 1991 Prior to 2001, it went around the south perimeter of the mill yard/campsite. In 2001, Jim Humphrey ran the creek though the approximate middle of the campsite.

BEAVER LAKE

Area (ha)	Elevation (m)	Volume (m^3)	Max. Depth (m)	TDS (mg/l)	Max. Surface Temp.
19.31	184	67,200	7.5	34	27.9 (7/28/98)

B) FISH UTILIZATION LAND LIMITING FACTORS

Coho and cutthroat trout utilize the system along with an occasional brown trout. Brown trout fry were introduced to the creek in 1988. A few smallmouth bass were present in Beaver Lake prior to 1987 but none have been seen or reported since. Both Cowichan Lake cutthroats and Beaver Lake cutthroats spawn and rear in Beaver Creek. Beaver Lake cutthroats are larger and spawn earlier. Their average length is about 46 cm and, based on Feb. 2000 observations, most spawn in the 40 m section of enhanced gravel just below Fairservive Main. Their spawning period appears to be from about February 25 to mid-March. Art Watson saw 14 spawning below Fairservice Main on Feb. 29, 2000. Gary Glad man and Len Watson saw a school trying to leave Beaver Lake on March 27, 2000. In the spring of 2002, 12 Beaver Lake cutthroats spawned in Jim ‘s Creek which is the portion of the perimeter drain around the Beaver Lake Campsite which has been routed through the site. It is fed by the Halfway Diversion. Spawning occurred on April 7. Cowichan Lake cutthroats are somewhat smaller and spawn later. Their average length is about 38 cm and their spawning period is from about March 25 to mid-April which coincides with Mesachie Lake cutthroats that spawn in Mesachie Creek. Cowichan Lake cutthroat spawners appear to utilize the lower sections of Reach 3. Eight were seen on March 26, 2000. They were located between the 68 m point of R3 and the 565 m point. However seven fresh redds were also seen further upstream on that day. They were from 565 m to the Brown Bridge at the 976 m point of R3.

Prior to 1983 Beaver Creek was in an advanced stage of maturity. The upper 2,200 m of channel was muck - detritus with three small zones of low quality gravel (18 m^2) in Reach 3 which dried by May in most years. In August of 1983, the Cowichan Lake Salmonid Enhancement Society rehabilitated 1,900 m of this reach by removing muck - detritus overburden and adding gravel, boulders and drop logs. Beaver Ponds were not present at the time so the total length of R3 was 2043 m. Spawning capability, hydraulic cover and habitat complexity were vastly improved. A low dam was constructed 350 m below Beaver Lake in 1984. It provided 1 m storage and delivered flows of 0.02 to 0.007 cms through the very dry summer of 1985. The dam was been taken over by beavers then replaced by a concrete structure with stop boards in 1996 for purposes of continued flow management and coho smolt release (Hillier and Burns, 1996). Beaver Lake often dropped below the level of the beaver dam before the smolts were able to leave the lake. The dam stores an additional 30 - 40 cm above the level of the beaver dam to provide smolt release water.
A six-inch pipe under the dam and complex of Big O pipes in the lake provide CDP flow.

Reach 1 was extended by 50m in 1984. In 1987, a secondary channel was excavated through Saywell Park. Coho fry increased from almost nil to about 2,000 in Reach 1. The secondary channel was removed in 1989.

Reach 2 was improved from 1986-88 by adding small weirs to increase pool depth and area. Wetted area was increased by 480 percent and coho fry numbers went from virtually none to approximately 2,500.

A diversion pipe from Upper Halfway Creek to Beaver Lake was added in 1991. Upper Halfway once flowed to Beaver Lake but was diverted to the Mesachie system many years ago so its deltaic fan could be utilized for a sawmill. The pipe was 8" in diameter and carried flows averaging 10 LPS. That pipe was replaced by a 20 inch pipe in 1994; it provides spill averaging about 25 –30 LPS. The objective is to provide Beaver Lake with enough water to produce enough spill down Beaver Creek to attract spawners and provide some flushing and to keep Beaver Lake full for as long as possible. Upper Halfway Creek dries by early July or sooner in most years. Beaver Lake is water short without Halfway flow because its inlet streams are very small and ephemeral. The diversion also benefits Mesachie Creek by reducing flooding.

Five new spawning platforms were added to Leo's Loop in 1996 and a flow control-smolt release dam was built just below the Beaver lake Beaver dam in the late summer of 1996.

Coho also spawn in two Beaver Creek tributaries: Bartel Creek and Coho Road Creek. Spawners are present for 100 m in Bartel and 180 m in Coho Road. Both streams dry early. In some years like 1998, Coho Road Creek dies before fry emergence even begins. NOTE: Coho Road Creek was improved in the fall of 1998 and summer of 1999 by adding gravel to its lower end. TimberWest provided the gravel. NOTE: In November 2002, 20 coho migrated through Beaver Lake to spawn in Jim's Creek (the portion of the Halfway Diversion that flows through Beaver Lake Campsite).

C) PRODUCTION OPPORTUNITIES

1. ***CONTIUED SUBSTRATE UPGRADES***: Careful addition of new substrate, particularly spawning gravel (Production Option # 381) and cover will optimize structural quality of Beaver Creek.

2. ***WORKING AGREEMENT WITH THE LANDOWNERS***: .An agreement for long-term management of the system should be worked out with the landowners. It should include maximum allowable storage in Beaver Lake, guaranteed access to the stream and lake and agreement on future improvements. The present arrangement is based on good relations between the Cowichan Lake Salmonid Enhancement Society and Pacific Logging/TimberWest. and Gerry Quennville. NOTE: TimberWest and CLSES formulated a protection plan for the portion of the basin within TimberWest lands (almost all) in July 1999 (Production Option # 382).

3. ***WETLAND IMPOUNDMENT / CDP FLOW RELEASE***: Additional storage potential of 3 Ha is present in tributary wetland basins which could provide about .6 L/sec. for 180 days (Production Option # 383).

4**.** ***CONTINUED BEAVER LAKE FRY STOCKING*** The stream's potential coho smolt yield based on 1 fry/m of summer stream area and 8 percent fry to smolt survival, is 333. Lake yield should approximate 14,475 at .15 fry/m and 50 percent fry to smolt survival. Some Beaver Creek fry also rear in Cowichan Lake. Beaver Lake is usually stocked with fry salvaged from Robertson Sidechannel in April or with hatchery fry from Beaver Creek adults. Stocking rate has been as high as 29,000 but should has been reduced to less than 10,000 in the 1990's. Smolts were somewhat undersized at the higher stocking rate. Cutthroat fry or parr should also be stocked in Beaver Lake. The lake has a huge stickleback population which needs to be cropped. The present trout population is low because the beaver dam and smolt release dam have prevented normal spawner and fry movements out of and into the lake. The beaver dam was modified to permit normal movement in 1998 but there is a fear that the smolt release dam may hinder spawner movement out of the lake. (Production Option # 384).

5. ***HALFWAY DIVERSION ADJUSTMENT***: Periodic adjustment of the Upper Halfway diversion pipe is required as stream conditions change (Production Option # 385). The pipe needed to be lowered in the summer of 1995. Berms are sometimes constructed below the pipe to increase flow to Beaver Lake.

6. ***BEAVER CREEK BEAVER DAM MONITORING***: Periodic maintenance of beaver dams along the creek is also required. They sometimes become high enough to block migration (Production Option # 386).

7.***INCREASED COMPLEXITY VIA LWD ADDITION***: Addition of LWD in portions of Reach 3, especially in Leo's and Ted's Loops and in the sub-reach just below Fairservice Main would provide cover – complexity benefits (Production Option # 387)

8**.** ***BEAVER LAKE CUTTHROAT IMPROVEMENT***: The Beaver Lake cutthroat trout population is low and the stickleback population is extremely high. There is a need to increase cutthroats for their own sake because this lake is excellent cutthroat habitat and to control the stickleback population somewhat so rearing coho have a better survival chance. It's probable that the Beaver Lake Dam is interfering with normal cutthroat use patterns, particularly their downstream spawning migration. At the time most of the trout would drop down from the lake to spawn in Beaver Creek, the dam is at or near maximum height and the trout are likely reluctant to navigate the drop of 1.25 m. Measures to improve trout fry recruitment like establishing spawning habitat in the Halfway Diversion, modifying the dam drop by installing a slide or collecting Beaver Lake brood stock and rearing their eggs in the hatchery, need to be examined (Production Option # 388). NOTE: A spillway was constructed on the south side of the dam in the summer of 2000. It should allow cutthroats to move in and out of the lake when the dam is storing. There is also a spillway on the north side of the dam but it is a six-inch pipe.

9. ***DAM IMPROVEMENTS*** : Periodic upgrades of the 1996 smolt release dam are necessary to provide better access for fish into and out of Beaver Lake and to increase operating safety. Beaver lake cutthroat spawners drop out of the lake at about the same time storage begins (late Feb. – early March) and the fish appear reluctant to drop over more than about four 4" boards and would have a difficult time re-entering the lake with more than 3 or 4 stop boards in place. An open spillway on the south side of the dam that could operate in conjunction with the dam would allow free access for trout to and from the lake and would give coho smolts another option for leaving the lake. They to seem reluctant to drop over the dam at times. A site has been surveyed (Production Option # 389) NOTE: The spillway was constructed in the summer of 2000.

D) LAND USE FACTORS

Forestry/RV

The basin is covered by advanced second growth. A cedar mill was located on Beaver Lake from the late 1950's until 2000 when an RV resort was located at the old mill site which had previously been the site of the original Camp 10 (Lake Logging). The RV park is still in the early stages of development (2002), A logging road (Fairservice Main but sometimes known as Joginder's Road) crosses the creek near the 2546 m. point. Log hauling in the winter of 1988-89 produced an almost continuous flow of sediment which greatly reduced egg survival in Upper Beaver Creek. The road was repaired in 1990 and there were no problems until Nov. 1998 when a contractor plugged the lower end of Coho Road Creek. The problem was quickly solved and Pacific/TimberWest/Johel Brothers provided an additional 7 m^3 of gravel to the sub-reach below Fairservice Main (Frank's Loop).

Residential

The lower 400 m flow through Lake Cowichan and are subject to urban runoff. A fish kill occurred in the fall of 1993. Some 300 coho parr and 5 juvenile cutthroats perished in lower Reach 2. It was speculated that a toxic substance might have come from the BC Hydro sub-station located on the creek. Water samples were provided to MOE but no results were ever reported.

Risk Potential

Moderate, due the potential sediment input from the logging road. This road was upgraded in 1990 and is seldom a problem.

E) Historical Notes

Beaver Creek coho escapement increased from a base of perhaps 10 prior to improvement to 150 in 1986, 250 in 1987 and 600 in 1988.

ESCAPEMENT

Year	Co	Ct
1986	150	Both Cowichan Lake and beaver Lake cutthroats spwan in Beaver Creek and Beaver Lake cutthroats spawn in Jim's Creek. Beaver Creek also has resident stream dwelling cutthroats. Cutthroats are not counted except on an incidental basis because they spawn over a very prolonged period.
1987	250	
1988	600	
1989	168	
1990	297	
1991	40	
1992	10	

1993	127	
1994	250	
1995	70	
1996	48	
1997	100	
1998	262	
1999	75	
2000	143	
2001	287 (30 spawners in inlet)	30 CT spawned in Jim's Creek
2002	144 (100 spawners in inlet)	

SMOLT PRODUCTION FROM BEAVER LAKE

Total smolt production was only measured in 2000 when a trap below Fairservice Main was operated from April to June: yield was 763 (Gladman and Burns, 2000). Limited trapping also occurred in 1992 and 1998. The 1992 trapping yielded 203 smolts but the lake level fell below the dam before all the fish could leave. Large schools of smolts could be seen swimming above the beaver dam for several days after the lake dropped. 318 were trapped in a fyke trap in 1998 (Burns, 1998). This was an effort to salvage smolts from the lake when, again, the lake fell below the top of the dam before the smolt run was completed.
A trap was operated below Fairservice Main again in the spring of 2001. Catch was 1537 lake smolts and 502 creek smolts. Lake smolt survival was 20.79% (Burns and Birosh, 2001)

E) PROTECTION NEEDS

Beaver Creek has three basic areas of sensitivity: the deltaic wetlands on the fan (Reach 1 and Reach 1 of Cowichan Lake's Shorezone), the adjacent slopes greater than 30 % most of which are located on the east side of the valley in Reach 3 although there is a short section in Reach 2 and extensive riparian lands which are most substantial in Reaches 3 and 4. All these lands are included in the Fisheries Sensitive Zone. The portion of the creek in the Town of Lake Cowichan is protected under development permit regulations and parks and institution designation.
TimberWest developed a protection plan for their portion of the creek (which is most of the watershed) in 1999. Art Klassen did the mapping with input from Art Watson, Rick Jaccard and myself. A meeting was held to discuss the plan on July 23, 1999. It was accepted as viable by CLSES and TW .

Stream Code: 9202577582

Stream Name: Kwassin and Grant Lakes and Money's Creek

Operational Management Unit: Lake Cowichan South

Municipal: Town of Lake Cowichan

A) BIOPHYSICAL OVERVIEW: This system includes two shallow lakes with a combined area of 7 HA; connected by a ditch. They receive drainage from numerous small wetlands to the southeast and west. The lakes drain to the Cowichan River via a man-made spill channel, which was blasted out in 1971, and Money's Creek, a tiny stream that has been almost destroyed by the Town of Lake Cowichan and adjacent landowners. Money's Creek is now fed entirely by local seepage. Prior to 1971, it was a very important coho-cutthroat system. Juvenile coho and cutthroats still rear in Moneys Wetland which is a remnant riparian wetland resulting from Cowichan River backflooding and runoff from Money's, South Moneys/ Greenwell/100 Houses and Ravine Creeks These streams are no longer fish bearing and are largely culverted in the Town of Lake Cowichan.

Air Photos	BC 82007 137 - 138
Topographic Map	92 C/16, 92C.090
Salmonids	Co, Ct
Obstructions	Money's Creek effectively ends at Pine St. due to culverting. Its summer headwaters is 50 m above Cottonwood Street.
Max. Temp. (C)	17 (8/31/85) 19 (7/31/97, 8/22/97) 22.8 (7/29/98)
Min. Disch. (m^3)	0.002 (8/31/85 R1) .001 (9/20/96 R1) .00042 (9/6/97 R1) 0 (8/10/98) 0 Money's Wetland outlet (8/31/98)

MONEY'S CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4.0	1.0	5410	.2	FC	L	27	27 *
Reach 2	6.0	5.0	1000	.01	OC	M	22	110 *
Reach 3	3.0	3.0	1000	.1	CON	N	118	354 *
Reach 4	1.5	.5	2710	1.5	CON	N	240	120 (0 late summer 1998)
Reach 5	1.0	0	9100	.1	CON	N	400	0

* = wetland reaches

DITCH

Reach 1	3.0	1.0	6310	10.0	ENT	N	50	50
Reach 2	3.0	1.0	6310	2.0	ENT	N	150	150
Reach 3	3.0	1.0	7300	1.0	FC	L	100	100
Reach 4	3.0	1.0	8200	0.5	UC	NA	100	100

KWASSIN LAKE

Area (ha)	Elevation (m)	Volume (m^3)	Max. Depth (m)	TDS (mg/l)
1.4 HA	180	18,420	2.5	20

GRANT LAKE

2.2 HA	180	43,000	2.5	24

B) FISH UTILIZATION LAND LIMITING FACTORS

Angling and snorkel surveys in 1985 and 1986 revealed a large population of sticklebacks but no other fishes. In 1979 the Fish and Wildlife Branch lake survey, netting yielded no fish. (Kwassin and Grant Lakes). Prior to diversion of its headwater flow, Money's Creek supported a strong population of coho which spawned in the creek and the connector channel between the two lakes. Spawning also occurred in the inlet to Grant Lake. There's a good possibility that coho also used Greenwell Creek and the South Fork of Moneys. Greenwell Creek originates in wetlands behind 100 Houses and enters a culvert near the top of Pine Street. It joins Money's in its culvert at the junction of Pine and Cowichan Avenues. South Money's originates in wetlands south of the E&N right of way and used to flow north to join Money's near Eldred and Grant's Lake Road; a remnant remains near Boundary and Comiaken but present flow of South Money's has been diverted west along the E&N right of way from near the end of Boundary Road to Greenwell Creek. Rainbow and cutthroat trout were also present in the original Moneys Creek.
All that remains of Moneys Creek is a remnant wetland at its confluence with the Cowichan. Large numbers of coho winter in the wetland and a substantial number of spring fry swim up from the Cowichan River to early rear. Most leave before mid – July when oxygen and temperature levels become dangerous to survival. In 1997, substantial numbers of coho fry stayed all summer despite oxygen levels in the 2 – 4 mg./l range. In, the very hot summer of 1998, Money's Wetland became virtually anoxic in late July and all fish left or perished. Aside from one reading of 2.24 mg./l at the confluence of the West Lobe, all readings were .04 - .06 mg/l on 8/10/98. Even sticklebacks vacated the wetland. The water became very rust coloured and stagnant. By August 29, outflow from the wetland had ceased as had flow in Ravine Creek which, along with Money's Creek itself, is the last of the wetland influent creeks to dry. In my tenure in Lake Cowichan (since 1981) the wetland outflow had never dried.

C) PRODUCTION OPPORTUNITIES

1*. COHO COLONIZATION*: Combined coho smolt yield potential of Kwassin and Grant Lakes: 2,700 smolts; fry required: 5,400. Best source: Robertson Sidechannel. Fry must be stocked early in the spring (before May) or in the fall (after mid - October) **(Production Option # 390)**. Lake surface temperatures reach 24 on hot summer days although there is a spring on the west side of the lake that allows for later stocking.

2*. MONEYS CREEK RESTORATION*: The possibility of restoring Moneys Creek and providing controlled discharge should be investigated (Production Option # 391). It presently flows all year in most years in its lower 400 m due to seepage. Residents have stocked and fed a few coho fry at times in the mid-1980's and CLSES maintained instream incubators at a site near 32 Cottonwood St. where fish had spawned in previous years. A mobile home was placed over the creek in this location in 1990. At least 17 private lots would be involved if restoration were to proceed. If South Money's were included, 11 more lots would be involved.

3. *SUBSEQUENT MONEYS CREEK IMPROVEMENT*: If restoration is undertaken, creation of pools and substrate improvement in Money's Creek (Production Option # 392) would increase spawning and rearing value. Addition of cover in the form of small windfall logs should also improve yield. This is a very

small, shallow stream. As of 1994, it had almost disappeared. Moneys Creek coho smolt yield potential with 1m wetted width is 51. In order to maintain summer flow, a small weir with a siphon hole would need to be constructed at the outlet of Kwassin Lake. Kwassin and Grant Lakes would provide an additional 2700 smolts. .5 m of storage would yield 1.2 LPS for 120 days with a .3m evaporation loss. This could be supplemented by siphoning deeper in the lake in the area influenced by the spring.

4.***HEADWATER STORAGE AND CDP FLOW REALEASE FOR MONEY'S WETLAND*:** Money's Wetland could be improved by headwater storage on South Money's/Greenwell Creek where five wetland basins with a combined water yield of 3.86 LPS for 90 days are present (Production Option # 393)

5. ***MONEYS WETLAND EXTENSION*:** If permanent flow through the wetland can be established, extension can occur through excavation. This option was lessened by constructionof tennis courts in the summer/fall of 2001 (Production Option # 394).

6. ***DITCH WALL STABILIZATION:*** Sections of the walls of Kwaasin Ditch (1971) are unstable and subject to failure. Willow wattle fencing and terracing could be employed to increase stability in this dangerous place (**Production Option # 395)**.

D) LAND USE FACTORS

The lakes (more properly "lake" because Trevor Green has informed me that the two lakes were originally one lake called Grant's and that lowering created the two bodies of water we have today) originally drained through Lake Cowichan Town and Money's Creek to enter the river 1,000 m below the weir. They now drain north via a ditch and enter the Cowichan River 4,000 m. downstream from the outlet. The ditch was constructed through a zone of clay which lines 150 m of it and contributes small amounts of sediment to the Cowichan River's most important spawning zone during high runoff periods. The ditch was created by excavation and blasting in July 1971. Lowering the lake level allowed more housing development. Not only Moneys Creek has been filled but a significant portion of the shore zones of the two lakes have been filled.

Risk Potential

High.

Fishery Officer Narrative

E) PROTECTION NEEDS

The most important parts of Money's Creek system – Kwassin and Grant Lakes, Money's Creek and Money's Wetland are within the Town of Lake Cowichan. In the past, a great deal of damage was done to the system through land development in South Lake Cowichan: the diversion channel, filling of the creek and wetlands surrounding Kwassin and Grant Lakes and filling much of Money's Wetland. The Town even wanted to construct low cost housing around Money's Wetland which likely would have involved more filling. The system is now protected in the new Official Community Plan (1998) via watercourse protection area (DPA), floodplain and park designation (Money's Wetland). Note: Tennis courts were constructed in 2001.The possibility that Quamichan Ave. could be extended to King George as South Lake Cowichan develops should be considered. I f this happened, the Town might need to fill a portion of the wetland to extend the existing right of way. This should not be permitted.

Stream Code: 9202577512

Stream Name: Fairservice Creek and Lost Lake

Operational Management Unit: Lake Cowichan South (OMU 13)

A) BIOPHYSICAL OVERVIEW: Fairservice Creek enters the Cowichan River from the southwest 7,500 m below the Cowichan Lake weir. The basin is steep and narrow above the 250 m contour then broadens over a wide gravel terrace before descending to the Cowichan River floodplain. Fairservice is a complex creek. It dries early between Reaches 3 and 9 (except for Reach 7 which is fed by Devil's Club Spring). Reaches 1 and 1a flow is provided by Fairservice Sidechannel (A111). In Reach 2, base flow is very low. Sedge (Burns) Creek provides much of the spring flow to Reaches 2 through 4. It is more influenced by wetland storage than is Fairservice. What seems to happen is that Faircervice water is present in its mountain valley section but when the water reaches the broad gravel plain below Reach 10, it sinks in to the material and comes out in Reaches 1 – 3.

Air Photos	BC 82007 138 - 139
Topographic Maps	92 C/16, 92C.090, 92C.080
Salmonids	Co to about 4358 m. St to about 4358 m. Ct to 4911 m. Bt to 626 m. Cm to 626 m
Obstructions	Rapidly steepening gradient a 4358 m, frequent log jams and even steepe above 4911 m.
Max. Temp. (C)	11 (8/7/84) R1, 13.2 R's 1-3 (8/2/02), 11.2 R7 (8/4/02), 10.9 R12 (8/11/02)
Min. Disch. (m^3)	0.003 - 0.02 (8/7/84) R2 R1 .103 (8/2/02) R1a .0095 (8/2/02) R2 .0005 R2 (8/2/02) R7 .00433 (8/4/02) R10 .002 (8/4/02) R12 .00002 (8/11/02)

FAIRSERVICE CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confineemnt	Side Channel	LWD	Length	Area
Reach 1	6	4	1360	1.7	CON	M	.057	29	174
Reach 1a	7	3	1450	1.5	FC	M	.0014	10	70
Reach 2	7	2	1450	1.7	FC	L	.0007	186	1302
Reach 3	7	Int.	1450	2.1	FC	L	.0016	430	430
Reach 4	7	0	1450	1.9	FC	L		1072	0
Reach 5	7	Int.	1450	1.5	FC	L		35	35
Reach 6	8	0	1630	1.1	FC	L		1725	0
Reach 7	8	2	2620	1.2	FC	L	.007	34	68
Reach 8	6	0	1630	2.1	FC	L		567	0
Reach 9	6	0	1360	4.5	FC	L		300	0
Reach 10	6	2	1270	15	CON	N		523	3138
Reach 11	5	0	1180	17	CON	N		119	0
Reach 12	5	1	1180	25	CON	N			
Reach 13									
Reach 14									

LOST LAKE*

Area (ha)	Elevation (m)	Volume (m^3)	Max. Depth (m)	TDS (mg/l)
2	185			

*Lost Lake is not in the Fairservice Creek watershed. A low berm separates them. It contains a small population of SmB which mature at 30 - 35 cm. however only 2 adults were seen on nests in the 1985 spawning period during a snorkel survey.

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead spawners utilize about 4,358 m of Fairservice Creek. Resident cutthroats are present for an additional 553 m and a few young brown trout are present in the lower 623 m. Chum salmon also spawn up to about the 623 m point.
Production is limited by very low to nil summer discharge.
Production is also limited by high fall - winter discharge.
NOTE: Three chinook smolts were salvaged near Fairservice Main in May 1996. One was tagged (net pen release)

C) PRODUCTION OPPORTUNITIES

Lost Lake has no outlet. This is unfortunate because it could yield 1,500 CO smolts. But it could also contribute smallmouth bass to the Cowichan.

1. *WETLAND IMPOUNDMENT*: Thirteen wetlands (Production Option # 396) larger than 1 HA are present on the gravel bench portion of the basin (180 - 200 m). Utilizing them for storage and low flow release might provide 0.14 cms in the critical discharge period. Subsequent observation reveals they dry about the same time as the creek and may not be capable of holding very much water.

2. *FRY SALVAGE*: Fry losses are sometimes high; especially coho. On the basis of 1/m in the summer dry accessible area, 24314 coho fry might be available for fry salvage **(Production Option # 397)**. Numbers are usually less however. In the spring of 1989, an average escapement year, only 500 fry were present in the area of Reach 3 salvaged. However, as many as 10,000 fry were salvaged in the early 1990's and 37,000 fry were salvaged in 1996. Numbers are highly dependent on flow duration. In years when the creek flows long enough to permit full emergence, numbers can be very high.

3. ***INCREASE COVER - COMPLEXITY*:** If more CDP water can be provided, there is an abundance of opportunity to improve habitat via LWD delivery. Much of Reach 3 is LOD starved. (**Production Option # 398)**

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Logging and thinning began in the early 1990's.

Risk Potential

Low.

E) PROTECTION NEEDS

Reaches 1 and 1a are on the Cowichan Floodplain where they blend with Fairservice Sidechannel (111A) then fan into the Cowichan River. This highly sensitive riparian unit is included in the Cowichan Corridor. Reach 2 of Fairservice along with part of Reach 3 is in a shallow ravine which is in the FSZ. The upper reaches flow largely through upland landscapes but there are adjacent riparian areas and extensive wetlands are located on tributaries from the west. There is a fear that some of these wetlands will be lost in the next wave of residential expansion by the Town of Lake Cowichan. Some are located in Block 200 and are owned by the Johel Family.

Stream Code:

Stream Name: Sedge (Burns) Creek

Operational Management Unit: Lake Cowichan South (OMU 13)

Municipal: CVRD Area F

A) BIOPYSICAL OVERVIEW: A major tributary of Fairservice Creek. Originates in a large wetland and is very stable and well – buffered. Gradient is low –generally less than one percent. A short stream draining a large flat. Have only three tiny tributaries which are also well buffered by pocket wetlands. It's unfortunate that this stream dries. Sedge Creek is also responsible for keeping much of Fairservice Creek flowing in the spring months. For example, on April 4, 2001 Fairservice was dry above Sedge Creek (between Sedge Creek and the logging road) but Sedge was running at 30 LPS and providing this to Fairservice below the confluence.

Air Photos:	BC82007 138-139
Topographic Maps:	92 C/16, 92C.090
Salmonids:	Co 784 m, Ct 784 m
Obstructions	None
Max. Temp.	
Min. Disch.	0

SEDGE CREEK

	Channel width	Wetted width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	5	0	2620	1	FC	L	.0053	190	0
Reach 2	8	0	6310	.8	FC	L	.0055	180	0
Reach 3	7	0	2530	1.3	FC	L	.003	94	0
Reach 4	10	0	6310	.7	FC	L		272	0
Reach 5	15	0	1000	.001	UC	L		48	0

B) FISH UTILIZATIOM AND LIMITING FACTORS

Coho and cutthroat spawn and early rear in Sedge Creek. Most spawning occurs In Reach 1 but redds have been noted in Reach 3 also.
Production is limited by drying. The stream dries by July of most years.

C) PRODUCTION OPPORTUNITIES

1. HEADWATER STORAGE: The stream's source is a wetland of approximately 23 ha. With 1 m of storage it could provide 6.65 LPS for the 120 day CDP of Sedge Creek. It would also provide this flow to approximately 2800 m of Fairservice Creek (Production Option # 399). Some fry salvage is usually carried out in this stream by CLSES.

D) LAND USE FACTORS

Forestry

Some 500 m of the stream was logged in 1998. A small leave strip was left but much of it blew down. The area has high wind exposure and the water table is high in the winter months.

E) PROTECTION NEEDS

A larger retention zone was required to protect this stream from full exposure. It is likely that the stream was dry when TimberWest biologists checked it and didn't believe it was fish bearing.

F) HISTORICAL NOTES

OPERATIONAL MANAGEMENT UNIT 14 : RIVER SOUTH

OVERVIEW

River South OMU includes all the anadromous salmonid streams on the south side of the Cowichan River east of Fairservice Creek but not including the Koksilah. There are a total of nine: Jungle (Marwood), Cameron, Double D, Lodge (Ernie's Gulch), Dry Bend, Holt and Fish Ladder.
This OMU is relatively undeveloped. There is some rural residential and agricultural development in the Glenora – Deerholme area which influences Fish Ladder Creek but from there upstream, the area is industrial forest. There are forestry related impacts to streams in this section where second growth logging is well underway and there are impacts remaining from the first cut, the BC Hydro powerline right of way and the CN grade. For the most part, these are not significant.

LIMITING FACTORS

Primary limiting factors in the River South OMU are fish access and low summer flows. Secondary limits are lack of cover – complexity in some areas of streams and winter habitat.

PRODUCTION OPTIONS

There are 19 production improvement opportunities in the River South OMU. They are outlined and prioritized in Table 1.

Table 1: River South Production Options

No.	Location	Activity	Priority
400	Jungle Creek	Link with wetland	1
401		LWD addition	1
402	Cameron Creek	Inc. summer flow/controlled diversion	1
403	Bear Creek	Steelhead colonization	2
404,405		Coho colonization/headwater storage	3
406	Dale's Creek	Barrier improvement	1
407		Fry salvage/coho colonization	1
408		LWD addition	3
409	Holt Creek	Barrier monitoring	1
410-412		coho colonization	1
413		Flow augmentation	2
414		LWD addition	2
415	Fish Ladder Creek	Sidechannel development	2
416-417		Spawning platforms	3
418		Monitor fishway	2
19			

Stream Code: NA

Stream Name: Jungle (Marwood) Creek

Operational Management Unit: River South

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: One of a series of two (Jungle and Cameron) very difficult creeks in the Fairservice/Double D Complex at the base of Big Mesachie Mountain – Skidder Hill. These creeks have upland runoff components then sink into the flat, porous ground at the slope toe before emerging as productive groundwater streams where the flat breaks to the river. Jungle Creek enters the Cowichan some 500 m below the CN 70.2 trestle.

Air Photos:	BC 87024: 040,041
Topographic Maps:	92B.071, 92B.080
Salmonids:	Co to 210 m summer rearing but spawners can go further: 380 m
Obstructions:	None. Stream simply becomes indistinct.
Max. Temp:	10 (est.)
Min. Disch.	10 LPS (est).

MARWOOD CREEK

	Channel Width	Wetted Width	Substrate	Slope %)	Channel Confinement	Side Channel	Length (m)	Wetted Area (m)
Reach 1	3	1	1360	4.0	CON	N	70	70
Reach 2	3	1	1630	5	FC	L	140	140
Reach 3	3	0	1630	.5	CON	N	170	0
Reach 4	3	0	1450	1.5	OC	N	50	0
Reach 5	4	0	1000	.5	UC	N	indefinite	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout are present in the first 210 m. Production is limited by size and the fact that potentially habitable areas above the wetted zone are dry except in peak runoff events.

C) PRODUCTION OPPORTUNITIES

1. ***IMPROVE ACCESS TO LATERAL HABITAT-LINK WITH WETLAND:*** An adjacent wetland complex that carries permanent flow of some 5 – 15 LPS is only accessible at higher flows. It enters Marwood Creek from the southeast at the 45 m point in Reach 1 and contains a few cutthroat trout. Slight lowering of its outlet would add some summer flow to Marwood and, more importantly, provide additional summer rearing in this capable segment of habitat. The outlet channel - 1(0) CON 4.0 1360 – should also be slightly stepped to allow easier access (Production Option # 400)
2. ***LWD ADDITION:*** Reach 2 is LWD deficient. A good opportunity to install a windfall log is present at the 70 m point of the reach (Production Option # 401)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth (approx. 1935); Logging is well underway (Pacific). Part of Reaches 2 and 3 have been logged adjacent to with no adverse results. In fact the company left more of a leave strip than they needed to in Reach 3.
More logging is imminent.

E) PROTECTION NEEDS

The lower 135 m of Marwood Creek is located in a small ravine which is included in the FSZ. For the next 120 m there is a small riparian zone which includes a pocket wetland on the west side of the stream at the 250 m point. The adjacent wetland complex that enters at 45 m is a very important component of the FSZ. Above the 250 m point, there is almost no fisheries sensitive landscapes – the small wetland / riparian area by Fairservice Main and some oversteep adjacent slopes in the mountain slope component of the stream. Heli – logging will likely be utilized in that area.
NOTE: In general terms, river proximate lands in this area are very unstable and subject to heavy erosion or failure from relatively small events. The Cowichan Corridor is up to 400 m wide in places in this area to account for this and includes the FSZ of Marwood Creek including the adjacent wetland/spring complex.

Stream Code: NA

Stream Name: Cameron Creek

Operational Management Unit: River South

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: A very complex watercourse that is supplied by both groundwater in the form of both upwelling from below and springs form its banks and a surface runoff component. There is an adjacent runoff channel that comes very close and was very likely once part of Cameron Creek. Cameron Creek' channel is much enlarged from what it needs to be to carry its existing flow regime indicating that it once carried a great deal more flow. Enters the South Channel of the Cowichan River (what was once Outer Double D – 97A) about 440 m above Double D Creek which is very close to the Maple Tree Pool at the confluence with the old channel.

Air Photos:	BC 87024: 040, 041
Topographic Maps:	92B.071, 92B.080
Salmonids :	Co to 609
	Ct to 609
	Bt to 609
Obstructions	Increasing gradient, decreasing size @ 609 m
Max. Temp.	12 (est.)
Min. Disch.	10 LPS (est.)

CAMERON CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side	Length Channel	Wetted (m)	Area
Reach 1	6	2	1630	2.0	FC	L	155	310	
Reach 2	5	0	3610	1.4	FC	N	315	0	
Reach 3	2	1	2800	1.3	FC	N	97	97	
Reach 4	2	1	2710	2.2	CON	N	42	42	
Reach 5	1	1	1540	8.0	CON	N	40	40	
Reach 6	-	-	-	-	-	-	-	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Cameron Creek is utilized by coho, cutthroats and brown trout. Production is limited by low summer flow and the short length of the stream.

C) PRODUCTION OPPORTUNITIES

1***. INCREASED SUMMER FLOW- CONTROLLED DIVERSION***: an underground pipe or French drain between the upper end of the runoff channel where flow is almost permanent at Fairservice Main and may be permanent further upstream and Cameron Creek could increase summer flow and likely provide water to Reach 2, the summer dry section of Lower Cameron (Production Option # 402)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth (circa 1935) and logging is well underway. Road and culvert location flags are present.

E) PROTECTION NEEDS

Cameron Creek is, for the most part, contained in a ravine with some section of very unstable sidewalls. Numerous springs, areas of significant erosion and small slope failures are located along the walls. A broad buffer between the ravine and roads or cut blocks is required to provide a margin of safety. NOTE: There are four gullies between Cameron and Double D Creeks.

Stream Code: 920 2478 503

Stream Code: NA

Stream Name: Double D Creek

Operational Management Unit: River South

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters outer Double D Sidechannel 300 m above its confluence with the main stem which is 4,000 m above Skutz Falls. This stream drains a short, steep and narrow basin.

Air Photos	BC 404 098 - 090 BC 82007 139 - 140
Topographic Map	92 B/13, C/9
Salmonids	Co to 560 m. Ct to 560 m.
Obstructions	Log jams at 390, 430 and 480. M. Passage is questionable at the 430 m jam. 3 m falls at 560 m.
Max. Temp. (C)	13 ^{o}C (9/8/89)
Min. Disch. (m^3)	.0124 cms (9/8/87)

DOUBLE D CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	30	0	1540	1.0	UNC	H	86	0	
Reach 2	7	2	1360	2.0	CON	N	70	140	
Reach 3	5	2	136R	3.5	FC	L	420	840	
Reach 4	3	2	1261	25.0	CON	N	2000	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and resident cutthroat are present in the lower 560 m; their numbers are sparse.

Production is limited by gradient, cold temperatures and lack of spawning habitat.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. The first cut contributed to several slope failures on steep, moist, silt clay soils adjacent to the stream and at least five large, long-term logjams.

Risk Potential

Moderate to high.

F) PROTECTION NEEDS

Double D Creek is located in the Southside Brown Clay Zone which extends up the south side of the Cowichan River to Beaver Creek and beyond. It is characterized by substantial areas of unstable ground. For much of its length, Double D Creek flows though a steep sided ravine with areas of unstable side slopes some of which resulted from yarding damage from the first cut. A substantial buffer should be left adjacent to the ravine and much of the upper basin should not be roaded.

Stream Code: 920 2478 418

Stream Name: Bear Creek

Operational Management Unit: River South

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan from the south 1 km above Skutz Falls. Drains a watershed that is relatively broad and of comparatively low relief above the 700 m contour. Between the 700 m and 150 m contours, the basin is steep and narrow. Below the 150 m contour, the stream gradually descends to the Cowichan River floodplain.

Air Photos	BC 82007 138 - 140
Topographic Map	92 B/12, B/13, C/9
Salmonids	Co to 800 m. St to 800 m. The winter steelhead run arrives between May 3 and May 12 as highly mature fish. Cm to 200 m. Rb to 3,800 m.
Obstructions	Complex falls at 800 m. Total drop of 5 m in 4 stages and two channels. Series of three falls (1 m, 2 m over 3 and 2.5 over 4) at 2,300 m. Series of falls totaling 100 m over 350 at 4,800 m.
Max. Temp. (C)	10 (8/28/85) 500 m above first falls.
Min. Disch. (m)	0.34 (8/28/85) 500 m above first falls. 0.008 (8/21/85) Reach 5.

BEAR CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	18.0	5.0	1450	1.5	OC	H	800	4000
Reach 2	15.0	6.0	136R	1.5	CON	N	1500	9000
Reach 3	11.0	5.0	136R	4.0	CON	N	2500	12500
Reach 4	7.0	3.0	116R	10.0	CON	N	4000	12000
Reach 5	7.0	3.0	1252	1.0	FC	M	2500	7500

LAKES AND WETLANDS IN UPPER BASIN

	Area	Elevation
Lake 1 at main stem headwaters	60,000	755
Wetland on Reach 5	75,000	720
Wetland tributary to R wetland	10,000	745
Lake at headwaters of small tributary to R4	75,000	695

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and steelhead utilize the lower 800 m; resident rainbows are present for another 3,000 m.

Production is limited by access, high fall - winter discharge and cool summer temperatures.

C) PRODUCTION OPPORTUNITIES

1. *JUVENILE STEELHEAD COLONIZATION* : The Fish and Wildlife Branch attempted several times to **improve the first falls** for steelhead passage. A weir was constructed at the base of the falls to back flood them and lessen the leap. These are mature, late run steelhead unable to surmount the falls. **Upstream fry stocking may yield better results (Production Option # 403)**. Reaches 2 and 3 are excellent summer habitats for juvenile steelhead.

2. *COHO COLONIZATION AND HEADWATER IMPOUNDMENT: Reach* 5 and on associated lake and wetlands plus a lake tributary to Reach 3 are more suitable for coho **(Production Option # 404, 405)**. With wetland impoundment, coho **colonization yield potential is** 18,200 to 92,000.

Bear Creek is also large enough to support Chinook salmon. Reaches 2 and 3 provide reasonable juvenile habitat. This stream is also worthy of brown trout colonization consideration.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. Campbell Group (Hancock Timber) constructed a road and bridge just above the falls to log the area between Bear Creek and Double D Creek. (1992).

Risk Potential

Low.

E) PROTECTION NEEDS

For much of its length, Bear Creek and its tributaries are contained in steep sided ravines with areas of moist, unstable slopes. Although Bear Creek is located in the Southside Brown Clay Zone, the stream is does not suffer from the same degree of adjacent hill slope instability as some of the other streams in this Operational Management Unit, Nonetheless, there are some very significant sensitive areas such as the large feeder bluff on the east side of Upper Reach 1 and many areas of over steep sidewalls that were never logged and never should be. A substantial ravine buffer zone is required along with a commitment to highly limit roads.

Stream Code: N/A

Stream Name: Dale's (Devil's Club or Summit) Creek

Operational Management Unit: River South - Unit 13

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan River from the south 500 m below Davie Corner Pool, approximately 8.5 km below Skutz Falls and opposite the end of Wildwood Road, a short branch of Riverbottom Road near Sahtlam Lodge. The basin is broad and of low relief below the 180 m contour then steep and narrow to the headwaters at 500 to 600 m elevation. Stream flow is non-buffered.

Air Photos	BC 82007 139 - 140
Topographic Map	92 B/12, B/13, .071
Salmonids	Co to 706 m. Cm to 706 m. Ct to 3,480 m. Ct in Shady and Nettle Creeks tributary to Reach 3 for distances of 400 and 460 m respectively. Ct in the East Fork for a distance of 76 m prior to 2000. None were seen in a July 2001 survey
Obstructions	1.83 m over 4.77 at 706 m. 1.45 m over 4.26 m at 726 m. 1.0 m over 3 at 826 m. 4.5 m combination falls/log jam falls at 3880 m backfilled log jam at16 m on the East Fork. May be passable at high flows boulder jam (3C7) at 76 m on the East Fork Impassable cascade at 56 m point of Knob Creek, a tributary from the west that enters Dale's Creek at the 322 m point of R5
Max. Temp. (C)	17 (8/21/83) 300 m above the falls (R3)
Min. Disch. (m^3)	0.014 (7/23/85) 300 m above the falls. The lower 700 m dry early. Shady 15.2 , 1.07 LPS 8/16/97 Nettle 14.1 , 2.84 LPS 8/16/97

DALE'S CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	10.0	0.0	2530	1.0	FC	L	700	0	
Reach 2	8.0	3.0	1135	5.0	CON	N	150	300	
Reach 3	9.0	2.0	136R	1.5	FC	L	2300	6900	
Reach 4	6.0	3.0	1252	5.0	ENT	N	170	510	
Reach 5	7.0	3.0	1360	5.0	CON	N	512	1536	
Reach 6	6.0	3.0	1171	10.0	CON	N	48	144	
Reach 7	4.0	2.0	1171	20.0	CON	N	800	-	
Reach 8	-	-	-	8.0	-	-	500	-	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and a few chums spawn in the lower 700 m. Resident cutthroats are present for 3,480 m as well as the Lower East Fork and Lower Knob Creek in some years (fry only). In some years a few coho pass the falls and utilize Reach 3 (2300 m). A few may also reside in Reaches 4 and 5 in these years. Cutthroat density (all sizes) is 0.12/m in Reach 3 and 0.003 in Reaches 4 and 5 as evidenced by pole seining. Cutthroats are also present in Shady and Nettle Creeks which are small tributaries of R3.

Production is limited by access, low summer flow (the lower 700 m dry) and high fall - winter discharge. This stream is highly responsive to runoff.

C) PRODUCTION OPTIONS

1. *BARRIER IMPROVEMENT:* Barrier removal is feasible. The first falls can be bypassed on the east by blasting and notching **(Production Option # 406)**. The second obstruction is improvable by widening and notching or installation of a small fishway like a steep pass. The third falls is passable. Mel Sheng and Russ Doucet viewed the falls May 28, 1998. Russ thinks the second falls is the stopper and that a steep pass fishway in the channel on the north side of the falls could do the job. There is a total of 9246 m^2 of suitable above barrier habitat in Dales Creek and its tributaries.

2. *FRY SALVAGE-**COHO COLONIZATION :*** **Most fry can be salvaged from the lower 700 m of this stream** which often dries completely by as early as mid-May. And is always dry by July 1. Access is via Skutz Falls Forestry Road or by boat from Stoltz Pool. The cable car at Sahtlam Lodge is another option. Fry stocking access is good for Reach 3 by way of the forestry road. Difficult wading and hiking is necessary for fry planting in Reaches 4 and 5. Fry requirements for Above Barrier Dales plus Shady and Nettle Creeks are 7105. If the falls are improved, upstream stocking should not be required and fish can be utilized for Bear Creek (Production Option # 407)

3.*STRUCTURAL* *IMPROVEMENT- LWD ADDITION*: Large **wood debris placement (Production Option # 408).** Long stretches of Reach 3 are shallow and lack cover/complexity. Judicious placement of large wood debris would increase habitat value. This portion of the stream has excess bedload, most of which originates from a feeder bluff near the upper end of R3.

This stream is well suited for brown trout rearing.

A Fish and Wildlife Branch crew removed a large log jam from the falls in the summer of 1979.

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth which is beginning to be logged. Beginning at Reach 2, most adjacent slopes are moist and very steep with a high percentage of clay in places. There are several slope failures on 60 - 70% slopes adjacent to Reach 5 on the west side of the creek. Soils there have high clay content and become saturated in winter. Road construction should be avoided in this zone. Aside from a large flat on the north side of Reach 1 and lower Reach 2, a large percentage of the "stream adjacent" basin presents difficult logging - engineering problems largely due to slope angle and, in some cases, soil moisture conditions. Soil moisture levels generally tend to decrease upstream and stream adjacent slopes grade from salmonberry-swordfern landscapes toward Salal-Oregon grape units especially on the east side. Careful design and operational standards are necessary to avoid impact. Impact potential is high in places, high enough to carry significant amounts of sediment to the Cowichan. Extensive upslope logging is underway in 2000 – 2001 on lands within Shawnigan Division. Basin forestlands are a combination of Crown (SBFEP) and private (M+B) The lower portion of Dale's Creek is in Cowichan River Park.

Risk Potential

High.

E) PROTECTIVE NEEDS

This creek and the entire south side of the Cowichan River between Hudgrove Road and Glenora, is forestland and should remain so as the wild side of the Cowichan River. Hopefully, urban land use won't be a factor in this basin although there is already a real estate sign along the Skutz Falls Forest Road.
Very careful road building and harvest planning will be required in this watershed, particularly in areas adjacent to the Fisheries Sensitive Zone which has two major components: moist riparian lands and stream adjacent ravine slopes that often contain substantial areas of very steep and moist sidewalls.

Fishery Officer Narrative

Stream Code: N/A

Stream Name: Ernie's Gulch (Lodge Creek, Gleadle Creek, Finlay's Creek)

Operational Management Unit: River South

CVRD Electoral Area: F

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan River from the south 3,000 m above Dry Bend Backchannel's confluence. This is a short, steep drainage basin.

Air Photos	BC 82007 139 - 140
Topographic Map	92 B/13, 92B. 071
Salmonids	Ct to 140 m
Obstructions	CN Rail culvert at 40 m: 2 m vertical drop. 5R15 at 140 m.
Max. Temp. (C)	10 (8/22/83)
Min. Disch. (m^3)	0.007 (8/22/83)

ERNIE'S GULCH

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	3	1	1360	2.5	ENT	N	40	40	
Reach 2	3.5	1	1360	3.0	CON	N	100	100	
Reach 3	-	-	-	10.0	-	N	1000	-	

B) FISH UTILIZATION AND LIMITING FACTORS

A few resident cutthroat trout reside in the lower 140 m. Productivity is limited by slope and high fall - winter discharge. Accelerated flow from the CN culvert has scoured the lower 40 m (Reach 1).

C) PRODUCTION OPTIONS

None. The CN culvert could be replaced but cost would be high and little benefit would result.

D) LAND USE FACTORS

Forestry

Steep, moist slopes with soils composed largely of clay are present on the west side of Reach 2. Several small slope failures have occurred in the last six years.

Residential

Nil. This stream is Sahtlam Lodge water supply.

Risk Potential

High.

E) PROTECTION NEEDS

This in the Cowichan Southside brown clay zone. There are a number of moist, unstable sidewalls along the ravine that much of the creek flows through. The ravine should be given a wide berth.

Stream Code: N/A

Stream Name: Dry Bend Creek

Operational Management Unit: River South

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: This stream enters Dry Bend Side Channel from the south, draining a short, steep basin. Dry Bend Side Channel joins the Cowichan 5,000 m above its confluence with Holt Creek.

Air Photos	BC 82007 139-140
Topographic Map	92 B/13
Salmonids	Co 120 m. Ct 120 m.
Obstructions	CN Rail culvert at 120 m a velocity barrier. 3 m over 7 m cascade at 160 m. 4 m falls at 210 m.
Max. Temp. (C)	13 C (8/4/87)
Min. Disch. (m^3)	0.015 (estimated 8/4/87).

DRY BEND CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel		Length (m)	Wetted Area (m^2)	
Reach 1	12-NA	2.0	2520	1.0	UC (delta)			H	50	100
Reach 2	6.0	3.0	1360	2.5	CON	N		70	210	
Reach 3	5.0	5.0	1235	4.0	CON	N		90	0	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and resident cutthroats are present in the lower 120 m.

Production is limited by gradient, high fall - winter discharge, low summer flows and short accessible length.

C) PRODUCTION OPTIONS

None apparent.

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. Considerable recent logging in Upper Basin. This stream is within M+B's (Weyerhaeuser) Shawnigan Division.

Risk Potential

Low.

E) PROTECTION NEEDS

Dry Bend Creek flows though a ravine for much of its length. In some places, the sidewalls are oversteep and unstable. They should be avoided with a broad leave zone.

Stream Code: 9202577207

Stream Name: Holt Creek

Operational Management Unit: River South

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Holt Creek enters the Cowichan River from the south 15.5 km above the estuary. This system drains Koksilah Ridge and Lois and Tadjiss Lakes. The upper and lower portions of the basin are of relatively low relief but the middle section (100 - 500 m.) is steep and narrow.

Air Photos	BC 82007 139-140, 163-164
Topographic Map	92 B/12, B/13
Salmonids	Co to 270 m.
	St to 6,820 m.
	Rb to 6,820 m
.	Cm to 270 m
Obstructions	2 falls at 270 m.
	3 m over 5 and 2.5 m over 5.
	Holding pool between two
	9 m falls at 6,820 m.
Max. Temp. (C)	11 (8/29/85) Shawnigan Main (H Line).
Min. Disch. (m^3).	.40 (8/29/85) Shawnigan Main (H Line).

HOLT CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	14	5	145R	1.7	CON	N	.00079	270	1350
Reach 2	11	3	1360	2.2	CON	N		4000	1200
Reach 3	9	6	127R	5.0	CON	N		2500	15000
Reach 4	9.5	6	136R	1.5	FC	L		3500	21000
Reach 5	2	.5	1261	10	CON	N		3000	1500

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, steelhead and chums utilize the lower 270 m. A few steelhead were thought to pass obstructions at this point and utilize Reaches 2 and 3 (DeLeeuw, pers. comm.). No fry or parr were observed there in August, 1985 but they were plentiful in August and September, 2000 checks. The falls were greatly improved in 1989 and steelhead are now able to move up to the next falls at 6820 m. It was believed that coho could also pass the improved falls but none were seen in an extensive check on September 23, 2000. They were also present in Water Tank Creek below the road. The falls work was done by the Cowichan Fish and Game Club. A Fish and Wildlife Branch crew also chipped the falls in 1979.

Productivity is limited by low summer flows and high fall - winter discharge.

C) PRODUCTION OPTIONS

1. *BARRIER MONITORING*

The first pair of falls was made passable in 1989 by jack hammering steps in the shale. Four were placed on the first falls and one on the second (Atkinson, 1995). These measures have allowed steelhead utilization of an additional 24,000 m^2 of spawning and rearing habitat. Coho and even a few chums were said to be able to pass the barrier in the first year after the work but, as of 2000, only steelhead are making the journey. This barrier needs at least once a year monitoring to make sure it's passable (Production Option # 409)

2. *COHO COLONIZATION*

An additional 21,000 m^2 is present above an insurmountable falls at 6,820 m. This area (Reach 4) is most suited to coho or brown trout colonization (Production Option # 410).

Lois Lake (25 HA) and Tadjiss Lake (7 HA) (Production Options # 411 and # 412) have combined coho smolt yield potential of 25,600 coho smolts. These lakes are occasionally stocked with trout. A good brown trout fishery has developed in Lois.

3. *FLOW AUGMENTATION*

These lakes could also be used to augment downstream flows (Production Option # 413). One meter of storage on each would provide 0.014 cms for the critical summer discharge period. This would increase the 1985 minimum flow by one third.

4. *LWD ADDITION*

LWD is virtually absent in Holt Creek. Only R1 was surveyed specifically and its LWD density is a paltry .00079 of poor quality material. While the other reaches were not surveyed for LWD, it's almost certain that the level is very similar. Addition of anchored windfall logs at strategic locations would provide considerable benefit (Production Option # 414)

D) LAND USE FACTORS

Forestry

Eighty percent of old growth has been harvested. The basin is covered by early to advanced second growth.

Some very steep terrain (40 percent plus) on the east slope of Reach 3 remains unlogged.

Risk Potential

Moderate. The unlogged slopes adjacent to Reach 3 represent a risk to fish production. Lois Lake is subject to winterkill.

E) PROTECTION NEEDS

The Holt Creek Fisheries Sensitive Zone consists largely of adjacent steep slopes, riparian areas are few. Reaches 1 and 3 are contained in steep walled ravines along with Reach 5. The Fisheries Sensitive Zone also includes the ravine portions of tributaries such as Watertank 1 and Watertank 2 Creeks and several others such as Devil's Club Gulch.

Stream Code: N/A

Stream Name: Fish Ladder (Twesum) Creek

Operational Management Unit: River South

CVRD Electoral Area: E

Cowichan Tribes

A) BIOPHYSICAL OVERVIEW: This stream enters the Cowichan adjacent the downstream (south) side of the White Bridge. The basin is low relief; however, its drainage pattern is very complex. At large number of small seepage tributaries are present along with a number of small wetland basins. Flow is relatively stable due to the buffer provided by the wetlands and the large groundwater contribution.

Air Photos	BC 82007 161-162
Topographic Maps	92 B/13, 92B.072
Salmonids	Co, Act, Cm
Obstructions	None.
Max. Temp. (C	14 (9/2/85) at Indian Road.
Min. Disch. (m^3)	0.0042 (9/2/85) at Indian Road.

FISH LADDER CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)	
Reach 1	3.0	2.0	2620	1.5	FC	L	800	1600	
Reach 2	3.0	1.0	7210	3.0	CON	L	715	715	
Reach 3	2.0	1.0	9100	3.0	FC	M	465	465	
Reach 4	1.0	0	1000	5.0	CON	N	174	0	
Reach 5	2.0	0	1000	5.0	FC	M	327	0	

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and sea run cutthroat are present for at least 1980 m. Chums are present for approximately 800 m.

Production is limited by low summer flows and levels of substrate sediment. Fishladder Creek flows through the Cowichan South brown clay zone, which is characterized by low gravel content and high levels of silt and clay.

The Fishway occasionally becomes plugged with debris and requires periodic cleanout.

C) PRODUCTION OPTIONS

1. *SIDECHANNEL DEVELOPMENT*

A 53 m long relic channel at approximately 400 m has excellent potential for development It requires a slight degree of excavation and the addition of a few pieces of LWD to convert it to high quality winter – spring habitat (Production Option # 415)

2*. SPAWNING PLATFORMS*

Potential spawning platform sites at 2490 m. Although there is no shortage of gravel in Fishladder Creek, most of it is compact and carries a high level of sediment. There is a need for a guaranteed high quality spawning site well up in the system(Production Options # 416 and 417)

3.. .MONITOR FISHWAY

The fishway tends to plug somewhat at the end of most winters. It needs to be checked then and cleaned if necessary (Production Option # 418)

D) LAND USE FACTORS

Forestry

Ninety percent of the basin is advanced second growth. Some small-scale logging is currently underway. A skid road has been punched in from the old CN grade to access wood in the upper basin. A high-risk bridge has been constructed at 2671 m. This operation contributed sediment to the creek and has the potential to contribute much more.

Agriculture

A few farms are located in the upper ten percent of the basin.

Risk Potential

High.

E) PROTECTION NEEDS

The ravine portions of Fishladder Creek (Reaches 1 – 4) are exceedingly sensitive. The stream is very vulnerable to sedimentation from almost any land use. The silt-clay slopes are generally greater than 60% and are laced with small seepage streams Substrate quality in the mainstem is naturally low and any addition of fines would be significant.
Most of Fishladder Creek is located within the Cowichan Tribal Lands.

OPERATIONAL MANAGEMENT UNIT 15 : KOKSILAH SIDECHANNELS

OVERVIEW

There are 27Koksilah River Sidechannels. They extend from the Lower River upstream to a point just below Cowichan Station Bridge. The sidechannels are very reflective of the character of the Lower Koksilah River – unstable with substrates dominated by sand and small gravel. 13 are flood channels, 8 are relic, 4 are back and only 2 are active. Flood channels only carry water during high river flows. Relic channels usually do not carry river water, if they are wetted at all its by the winter water table or upland seepage or runoff. Back channels are wetted by river or tidal backflooding. Active channels are permanently wetted by river flow.

LIMITING FACTORS

Koksilah Sidechannel fish production is primarily limited by lack of permanent flow and unproductive substrates.

PRODUCTION OPTIONS

18 production improvement possibilities are present on the Koksilah Sidechannels. They are outlined and prioritized in Table 1.

Table 1: Koksilah Sidechannels Production Options

No.	Location	Activity	Priority
419	7kb	Spawning platforms	3
420	8kb	Spawning platforms	3
421,412, 423, 424	9kf	Spawning platforms, diversion, lower spillway	3
425	18f	Diversion (part of 9kf)	2
426,427 428	20r	Spawning platforms, fry salvage, diversion	2
429	21r	Channel excavation	2
430	23a	Linkage with cut off portion	2
431	24f	berm	2
432	25f	Fry salvage	2
433	28r	excavation	2
434	29r	excavation	2
435	30f	Elevate berm, excavate	2
436		Fry salvage	2

Sidechannel I. D.	**1kf**	**flood**	**LAST CHANCE FLOOD CHANNEL**
Ave channel width	10		% pool
Min. wetted width	0		% riffle
Min. flow	0		% run
Channel length	332		% glide
Gradient	.1		% slough
Substrate	9100		
Wetted area	0		
Debris (%)	20		
Compaction	H		

Site location: 100 m below outlet
Date: 12/22/89
Crew: TB
Air photos: BCC 394: 158,159 and 148,149
Access: MB Rd., farm rd.

Fish Utilization

None

Enhancement Assessment

No opportunities. Sand substrate, wetted only during floods and by the winter water table in places.

Sidechannel I. D.	**2kb**	**Back**	**CLEM CLEM BACKCHANNEL**	
Ave. channel width	6		% pool	
Min. wetted width	0		% riffle	
Min. flow	0		% run	
Channel length	170		% glide	
Gradient	0		% slough	100
Substrate	8200			
Wetted area	0			
Debris	10			
Compaction	H			

Site location: 100 m above confluence with Koksilah
Date: 12/8/89
Crew: TB
Air Photos: BCC 394: 158,159
Access: Walk dyke then bushwhack

Fish Utilization

Probability of coho and trout overwintering.

Enhancement Assessment

No opportunities. Wetted by backflooding and the winter water table and occasional big floods from the mainstem; dries early

Sidechannel I.D.	**3kb**	**back**	**flood**	**FULL CURL BACKCHANNEL**	
Ave. channel width	10			% pool	
Min. wetted width	0			% riffle	
Channel length	200			% run	
Gradient	.01			% glide	
Substrate	8200			% slough	100
Wetted Area	0				
Debris	10				
Compaction	H				

Site Location: 100 m above confluence
Date: 12/8/89
Crew: TB
Air photos: BCC 394: 158,159
Access: Dyke, bushwhack

Fish Utilization

Probability of wintering trout and coho, chance of an occasional chum spawning in upper section. Doubtful egg survival in mud-fine gravel substrate.

Enhancement Assessment

No evident opportunities. Channel wetted by highwater spill and backflooding from the mainstem as well as the winter water table. A combination back-flood channel that dries early.

Sidechannel I.D. **4kr** **relic with a flood component** **RAILROAD**

BRIDGE RELIC

Ave. channel width	7	% pool
Min. wetted width	0	% riffle
Channel length	520	% run
Gradient	.1	% glide
Substrate	9100	% slough
Wetted area	0	
Debris	0	
Compaction	H	

Site location: 30 m above outlet
Date: 12/22/89
Crew: TB
Air photos: BCC 394: 158,159
Access: MB rd. then farm track

Fish Utilization

None

Enhancement Assessment

It might be possible to excavate a chum spawning - coho wintering channel but gradient is very low, gravel quality is poor and the Koksilah has little flow to spare in low water. Upper end wetted by flood spill which dissipates in fields.

Sidechannel I.D.	**5kr**	**relic**	**RELIC CHANNEL ALONG CN GRADE**
Ave. channel width	15		% pool
Min. wetted width	0		% riffle
Min. flow	0		% run
Channel length	360		% glide
Gradient	.1		% slough
Substrate	9100		
Wetted area	0		
Debris	20		
Compaction	H		

Site location: 60m above confluence with Koksilah
Date: 12/22/89
Crew: TB
Air photos: BCC 394: 158,159.
Access: Old CN grade

Fish Utilization

None

Enhancement Assessment

No viable opportunities. This is a very mature channel that was partly created by excavation for the CN grade and M+B's road. Both are no longer used. Wetted by the winter water table but only when levels are very high.

Sidechannel I.D.	**6kb**	**back**	**tidal**	**MIDDLE ARM TIDECHANNEL TRIBUTARY**	
Ave. channel width	7			% pool	
Min. wetted width	0-7			% riffle	
Min. flow	0			% run	
Channel length	800			% glide	
Gradient	0			% slough	100
Substrate	9100				
Wetted area	0-5600				
Debris	2				
Compaction	H				

Site location: just below Tzouhalem Rd.
Date: 9/4/89
Crew: TB
Air photos: BCC 394: 158,159
Access: Cowichan Bay Rd.

Fish Utilization

Chance of wintering coho and occasional chum spawning

Enhancement Assessment

No evident opportunities. This is a tidal channel with some input from the winter water table.

Sidechannel I.D. 7kb tide flood MIDDLE ARM TIDE - FLOOD CHANNEL

	R1	R2		
Ave.channel width	30	4	% pool	
Min. wetted width	0-30	0-7	% riffle	
Min. flow	0	0	% run	
Channel length	2500	160	% glide	
Gradient	0	.5	% slough	100
Substrate	9100	4600		
Wetted area	0-75000	0-1120		
Debris	1	10		
Compaction	H	H		

Site location: just below Tzouhalem Rd.
Date: 9/4/89
Crew: TB
Air photos: BCC 394 158,159
Access: Cowichan Bay Rd., farm track, path, hike for inlet

Fish Utilization

Possibility of wintering coho, chum spawning in most years. Marine fishes in R1.

Enhancement Assessment

No evident opportunities in Reach 1. Construction of spawning platforms in Reach 2 would aid chum production (**Production Option # 419)**
Wetted by tides and winter river flow. Primary flow is tidal backflooding.

Sidechannel I.D. **8kb** **Tide - Flood** **SOUTH ARM OF KOKSILAH**

Ave. channel width	15	% pools
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	3000	% glide
Gradient	.01	% slough
Substrate	3700 (grades to 9100 and 1000 in intertidal)	
Min. wetted area	0	
Debris	5	
Compaction	M	

Site location: Upper 500 m.
Date: 10/22/87
Crew: TB
Air photos: BCC 394 158, 159
Access: Bushwhack and paths from Cowichan Bay Rd.

Fish Utilization

Chum spawning, coho wintering

Enhancement Assessment

Construction of spawning platforms in the upper 500 m would aid chum production **(Production Option # 420)**
Wetted by tidal action and winter flow from the mainstem.

Sidechannel I.D.	**9kf**	**Creek/Flood**	**GOLF COURSE CREEK FLOODCHANNEL**

Ave. channel width	6	% pool	20
Min. wetted width	0	% riffle	10
Min. flow	0	% run	0
Channel length	550	% glide	20
Gradient	.1	% slough	50
Substrate	8200		
Min. wetted area	0		
Debris	10		
Compaction	H		

Site location: 5 m below Cowichan Bay Rd.
Date: 12/13/89
Crew: TB
Air photos: BCC 394 158, 159
Access: Walk from Cowichan Bay Rd., take driveways

Fish Utilization

A few chums (4 -20) spawn in the lower 250 m. Egg to fry survival is questionable. Gravel is sparse and of low quality. The channel dries very early in most years. Coho sometimes winter in the wetland portion of the channel complex.
This is a very complex channel system wetted by a combination of the creek from the golf course reservoir (which originates above the Island Highway), the winter water table, backflooding from the South Arm of the Koksilah at high tides and high flows and flood spill from the mainstem via the flood channel below the highway bridge.
The golf course creek is 300 m long below the reservoir, supports no fish and dries early.

Enhancement Assessment

Spawning platforms **(Production Option # 421)**, a diversion from the Koksilah via Below the Highway Bridge Flood Channel **(Production Option # 422)** and a lower spillway from the golf course reservoir **(Production Option # 423)** could bring this channel to a higher level of production, especially for chums.
Much more study is required however, especially for (**Production Option # 424)** This diversion could also help alleviate flooding of Cowichan Bay Road and nearby farmland but there is little elevation difference between the Koksilah and this channel.

Sidechannel I.D.	**10kr**	**Relic**	**RED OSIER RELIC CHANNEL**
Ave. channel width	6		% pool
Min. wetted width	0		% riffle
Min. flow	0		% run
Channel length	176		% glide
Gradient	.001		% slough
Substrate	8200		
Min. wetted area	0		
Debris	15		
Compaction			

Site location: 5 m above confluence with South Arm
Date: 10/22/87
Crew: TB
Air photos: BCC 394 158, 159
Access: Bushwhack from Cowichan Bay Rd.

Fish Utilization

None

Enhancement Assessment

No opportunities.
Wetted sporadically by the winter water table, subject to winter drying.

Sidechannel I. D. **11kr** **RELIC** **OLD PATH RELIC CHANNNEL**

Ave. channel width	8	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	220	% glide
Gradient	.1	% slough
Substrate	9100	
Min. wetted area	0	
Debris	20	
Compaction	H	

Site Location: 60 m below inlet
Date: 12/22/89
Crew: TB
Air Photos: BCC 394: 158, 159
Access: Path from M&B road

Fish Utilization

None

Enhancement Opportunities

None. This is a poorly defined channel that is seldom wetted as a distinct unit. It is flooded during large floods.

Sidechannel I. D. 12kf FLOOD SANDY FLOOD CHANNEL

Ave. channel width	7	% pool	10
Min. wetted width	0	% riffle	
Min. flow	0	% run	
Channel length	135	% glide	
Gradient	.5	% slough	90
Substrate	9100		
Min. wetted area	0		
Debris	10		
Compaction	M		

Site location: 60 m above Koksilah confluence
Date: 12/22/89
Crew: TB
Access: path from M&B road near bridge
Air photos: BCC 394: 158 ,159

Fish Utilization

Possibility of occasional chum spawning, probability of coho and trout wintering in the lower 30 m.

Enhancement Opportunities

This channel could be excavated for chum and coho spawning and coho and trout wintering. It would be difficult to defend against erosion and sedimentation however.

Sidechannel I.D. 13kf FLOOD NARROW BAR FLOOD CHANNEL

Ave. channel width	7	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	120	% glide
Gradient	.5	% slough
Substrate	5500	
Min. wetted area	0	
Debris	20	
Compaction	M	

Site Location: 30m below inlet
Date: 12/13/89
Crew: TB
Air Photos: BCC 394: 158, 159
Access: Hike across field from Cowichan Bay Rd. then faint path in NW corner

Fish Utilization:

A few chums occasionally spawn in this channel. Egg survival is questionable due to poor quality gravel, lack of stability and dewatering when mainstem flows fall below 30 - 40 CMS. This is strictly a flood channel. Only two pools were present on a day of average December discharge.

Enhancement Opportunities

None

Sidechannel I. D's. 14 and 15kf FLOOD SNOWBERRY HELL FLOOD CHANNELS

APPLIES TO BOTH CHANNELS

Ave. channel width	8	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	300	% glide
Gradient	.01	% slough
Substrate	8200	
Min. wetted area	0	
Debris	30	
Compaction	H	

Site Location: About 200 m above confluence
Date: 10/22/87
Crew: TB
Air photos: BCC 394: 159, 160
Access: Bushwhack from old M&B rd.

Fish Utilization

Probability of some overwintering coho, steelhead and cutthroat at times.

Enhancement Opportunities

None in practical terms. A great deal of expense would be required to make these channels habitable and little benefit would result. Provision of summer flow would detract from the water-starved mainstem. Winter flow is not a problem.

Sidechannel I. D. 16f FLOOD LOST CAUSE FLOOD CHANNEL

Ave. Channel width	4	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	100	% glide
Gradient	.01	% slough
Substrate	7300	
Min. wetted area	0	
Debris	10	
Compaction	M	

Site Location: 50 m below inlet
Date: 10/22/87
Crew: TB
Air Photos: BCC 394: 159, 160
Access: From Cowichan Bay Road, cross field and bushwhack.

Fish Utilization

None

Enhancement Opportunities

If a stronger berm could be constructed at the inlet, a buried drain could be installed to provide permanent wetting - gravel is present just below the surface.

Sidechannel I. D. 17r RELIC LOST CAUSE RELIC CHANNEL

Ave. channel width	5	% pool	
Min wetted width	5	% riffle	
Min. flow	0 (standing water)	% run	
Channel length	260	% glide	
Wetted length	50	% slough	100
Gradient	.01		
Substrate	8200 (gravel underneath)		
Min. wetted area	250		
Debris	15		
Compaction	M		

Site Location: 150 m above outlet
Date: 10/22/87
Crew: TB
Air Photos: BCC 394 159, 160
Access: Cross fields from Cowichan Bay Road and bushwhack

Fish Utilization

Probability of coho overwintering in the lower 100 m. Wetted by backflooding and the winter water table along with mainstem spill in floods. Above 100 m, there are generally only scattered pools in winter. The lower 50 m is wetted year round by a combination of backwatering and local seepage.

Enhancement Opportunities

It would be possible to divert some mainstem water into this channel to provide permanent flow but the problem with the Koksilah is that summer water is most effective in the mainstem which cannot afford to loose any because there is so little of it in the May to October period.

Sidechannel I. D. 18f FLOOD (has a relic portion) FLOOD CHANNEL BELOW THE HIGHWAY BRIDGE

Ave. channel width	10	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	730 (100 m relic)	% glide
Gradient	.1	% slough
Substrate	8200	
Min. wetted area	0	
Debris	1	
Compaction	H	

Site Location: 10 m below Cowichan Bay Rd.
Date: 12/13/89
Crew: TB
Air Photos: BCC 394 158, 159
Access: From Cowichan Bay Road

Fish Utilization

None. An emerging flood channel wetted by flood - high tide spill from the mainstem. Relic portion (100m) is wetted by winter water table as well as floods.

Enhancement Opportunities

If this channel were excavated and linked to Golf Course Creek Flood Channel, 10,600 m^2 of chum and coho spawning habitat and coho - trout winter habitat could result. If 2 m wetted width could be maintained through the summer, 2560 m^2 of coho rearing habitat would be provided. Projected yield:

Chum fry - 5,300,000
Coho smolts - 12,508

This channel would also help control the flooding problem in this area.
(Production Option # 425) already mentioned in 9kf)

Sidechannel I. D. **19b** **BACK** **DARKWATER BACKCHANNEL**

Ave. channel width	8	% pool	
Min. wetted width	0	% riffle	
Min. flow	0	% run	
Channel length	180	% glide	
Gradient	0	% slough	100
Substrate	8200		
Min. wetted area	0		
Debris	1		
Compaction	H		

Site Location: 20 m below E&N crossing
Date: 12/28/89, 10/22/87
Crew: TB
Air Photos: BCC 394 160, 161
Access: E&N tracks

Fish Utilization

Winter - spring coho and chinook rearing and coho and trout wintering.
Wetted by backflooding and minor flow from Reed Grass Relic Channel. Also receives water from mainstem flood peaks via Grand Fir Flood Channel Complex. Dries in early summer.

Enhancement Opportunities

None.

Sidechannel I. D. 20r RELIC INDUSTRIAL PARK RELIC CHANNEL (Old Koksilah Village Channel and sometimes called Trestle Creek)

REACH 1

Ave. channel width	70	% pool	
Min. wetted width	0	% riffle	
Min. flow	0	% run	
Channel length	1000	% glide	
Gradient	.01	% slough	100 in winter. Pools and riffles form
Substrate	9100		in spring as area drains.
Min. wetted area	0		
Debris	20		
Compaction	H		

REACH 2

Ave. channel width	3	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	777	% glide
Gradient	.1	% slough
Substrate	8200	
Min. wetted area	0	
Debris	0	
Compaction	M	

Note: From the top end of Reach 1 to Boal Road is 777 m. There are usually 2 reaches within this zone. The first extends from the top of R1 to the upstream end of the culvert at the Windsor Plywood drive. The channel is summer dry below that point but wetted above. Source of the water is Eagle Heights Creek which enters the channel 123 m above the Windsor Plywood Drive. Summer flow in the creek is very minimal to nil (it was flowing .125 LPS at the Koksilah Road culvert on 8/30/02 but no water was reaching the channel. Earlier summer flow from this creek is captured in the channel by a gravel plug that extends downstream from the confluence of the creek and the channel and by a sediment wedge below it. The water was 21.5 degrees on August 30, 02 with oxygen levels of 2 – 3 mg/L. A few sticklebacks were present.

Site location: R1 - E&N tracks, Miller Rd. and Upper Melgaard property
R2 Polkey Rd.
Dates: 10/22/87 - 5/2/96
Crew: TB
Air Photos:BCC 394 160, 161
Access: Polkey Rd., Miller Rd., E&N tracks

Fish Utilization

Wintering coho and cutthroat juveniles are sometimes abundant. Coho occasionally spawn near the 380 m point of R2 just below the confluence of Eagle Heights Creek where patchy gravel is present. Two redds and 100 fry were noted there in May 1996. This complex channel is wetted by the winter water table, Eagle Heights Creek, a small tributary at the 200 m point in R2 (west side of Windsor Plywood), seepage and runoff above the Eagle Heights confluence (water comes in from the ditch along Boal Road where a perimeter drain behind the recycling depot picks up seepage, the continued dictch along Polkey Road, the ditch along Allenby Road for at least 200 m above the junction with Koksilah Road and along the Koksilah Road ditch for some 700 m. Phillips Road ditch also contributes flow to the Koksilah Road ditch.) and backflooding from the mainstem. There is also local runoff from hard surfaces of cmmercial developments along Polkey Road. A culvert from the north at the 182 m point of R2 drains the Growell Property where hog fuel/bark mulch is sometimes stored and black liquor runoff occasionally enters the channel at this point. According to Cowichan elders, at one time this channel was connected to the Cowichan River and was a very important fish producer including chum salmon.

Enhancement Opportunities

Construction of a spawning platform below the confluence of Eagle Heights Creek where a little gravel accumulates naturally and coho spawn in some years **(Production Option # 426)** and fry salvage in years of coho spawning such as 1996 **(Production Option # 427)**. Linkage with Lower Cowichan via a pipe with a gate valve should also be investigated (**Production Option # 428)**. As little as 20 LPS of summer flow would do wonders for this channel.

Another possibility is wetland impoundment on Eagle Heights Creek. A number of small wetlands are present especially near the junction of Glenora Road and the rail grade. One or more could be impounded for summer flow release. This option is not numbered as more investigation is required to document the possibility.

Yet another possibility is providing access into Eagle Heights Creek. A 28 m flume with a slope of 9 -12 % is present at the confluence with the channel. An occasional coho or sea –run cutthroat may navigate it. A large fish was seen below the Koksilah Road culvert (some 50 m above the top of the flume). This culvert is very poorly considered. It is only 60 cm in diameter and is made of cement. It blasts flow into the channel below it causing considerable bank and channel erosion and is impassable for fish. It drops 1.5 m over 2 over shot rock which has been plced to protect the banks. If fish could get into the culvert, they couldn’t get far because of it,s smooth surface and 9% slope. If this culvert could be replaced by a more appropriate structure, fish could utilize Eagle Heights Creek and investment (headwater storage) ciold be made to improve both this creek and Industrial Park Channel.

NOTE: Koksilah Elementary School has taken a strong stewardship role in the channel (2001)

Sidechannel I.D. 21r RELIC REED GRASS RELIC CHANNEL

Ave. channel width	2	% pool	
Min. wetted width	0	% riffle	
Min. flow	0	% run	
Channel length	1200	% glide	20
Gradient	.01	% slough	80
Substrate	1000 Much of the bottom is detritus, the channel gets little flushing		
Min. wetted area	0		
Debris	1		
Compaction			

Site Location: 150 m above Darkwater Backchannel to which Reed Grass is tributary
Dates: 10/22/87, 12/28/89
Crew: TB
Air Photos: BCC 394 160, 161
Access: E&N tracks

Fish Utilization

Probability of wintering coho and trout.
Channel wetted by the winter water table, two small upland creeks known as Mitchell and Krause, a number of springs and occasional flood spill from the mainstem. Highly polluted by barnyard runoff. Manure washes into the stream from a large stockpile on the Cuthbert Farm and two calf carcasses were in the channel on 12/28/89. Manure also gets in from upland farms such as River Water. A great deal of sediment also washes down the creeks from upland farmland and settles out where the creeks meet the floodplain of the Koksilah which is where the creeks become the sidechannel. If it weren't for the presence of the E+N rail grade, the creeks (which enter the floodplain only 140 m apart) would enter the Koksilah directly. The rail grade diverts the streams to the north.

Enhancement Opportunities

Channel excavation could prolong winter rearing **(Production Option # 429).**
Note: The possibility of purchasing the Cuthbert Farm by a public conservation body has been considered (Duncan, L. 2000).

Sidechannel I. D. **22f** **FLOOD** **GRAND FIR RELIC CHANNEL**

Ave. channel width	3	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	450	% glide
Gradient	.5	% slough
Substrate	9100	
Min. wetted area	0	
Debris	40	
Compaction	H	

Site Location: 150 m below inlet
Date: 12/28/89
Crew: TB
Air Photos: BCC 394 160, 161
Access: E&N tracks, bushwhack

Fish Utilization

None.
This channel is very poorly organized and indistinct. The Koksilah floods across this bend and has cut into the fine floodplain materials in a more or less random manner.

Enhancement Opportunities

None, too unstable for channel development.

Sidechannel I. D. 23a ACTIVE HAYMAKER ACTIVE CHANNEL

Ave. channel width	10	% pool	40
Min. wetted width	5	% riffle	21
Min. flow	.0324	% run	0
Channel length	249	% glide	16
Gradient	.1	% slough	23
Substrate	3700 in 1987, 5500 in 2001 with infill		
Min. wetted area	1245		
Debris	10		
Compaction	L		

Site Location: Reach break 35 m upstream. R1 is a backwater at low flow: 14(5)FC .01 9100
Date: 10/23/87
Crew: TB
Air photos: BC7760 239, 240
Access: Koksilah Rd., farm access rd. (Dingwall), path, wade or walk E&N tracks down from Bright Angel.

Fish Utilization

Coho and chum spawning, coho and trout rearing and wintering. Steelhead spawning in some years.
This channel carries 15% of the Koksilah River's low flow. It is endangered by mainstem migration. A narrow berm (20 - 50 m) of alluvium is all that protects it. The railroad prevents any lateral migration of the channel to the southeast. It has also cutoff a portion of the channel.

Enhancement Opportunities

Provide access to the cutoff portion which is stable, spring fed and clear – a quality winter habitat unit in an area that lacks this element of habitat (**Production Option # 430)**

Note: April 1, 01 flow: 1.083 CMS
Sedimentation and compaction has increased since 10/23/87
Debris: .0092 ppcw

Sidechannel I. D. 24f FLOOD LOG JAM FLOOD CHANNEL

Ave. channel width	10	% pool	100
Min. wetted width	7		
Min. flow	0 (four pools generally persist over summer)		
Channel length	212		
Gradient	.1		
Substrate	2520		
Compaction	L		
Min. wetted area	750		
Debris	10		

Site location: 100 m below head
Date: 10/26/87
Crew: TB
Air photos: BC7760 239, 240
Access: Dingwall Rd. from Koksilah Rd. then faint path under fence

Fish Utilization

Coho rearing, chum spawning in high return years.
This channel has resulted from diversion of high flows caused by a log jam that forms periodically on the deltaic wedge of Norrie Creek. The jam has increased in size greatly since 1985 but has a history of washing out. Fisheries agencies tried to burn it out on at least one occasion in the 1960's. Dave Hurn told me "you could see the glare in the night sky from Vancouver." Its present area (1987) is 4200 m^2. The jam was worked on again during Rivers Week 1996 by volunteers under direction from the Cowichan Watershed Council. It was much reduced from 1987 levels. At present (2001), it is very small.

Enhancement Opportunities

A rip - rap berm at the channel head might allow "normal" high flows but prevent erosive flow thus providing better chum spawning conditions and more stable winter habitat for coho and steelhead juveniles **(Production Option # 431)**.

Sidechannel I.D. 25f FLOOD BIG BAR FLOOD CHANNEL

Ave. channel width	12	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	349	% glide
Gradient	.9	% slough
Substrate	1810	
Min. wetted area	0	
Debris	2	
Compaction	L	

Site location: 50 m below inlet
Date: 4/2/01
Crew: TB
Air Photo: BC82007 142
Access: Walk E&N from Bright Angel Park. Best access is from the top end near the Swing Rope Pool.

Fish Utilization

Chum spawning in high escapement years, coho fry become trapped when high spring flows carry them into this channel.

Enhancement Opportunities

Occasional fry salvage required. The channel often dries before full fry emergence. **(Production Option # 432)**

Sidechannel I. D. **26f** **FLOOD** **CANARY FLAT FLOOD CHANNEL**

Ave. channel width	12	% pool
Min. wetted width	0	% riffle
Min. flow	0	% run
Channel length	530 m	% glide
Gradient	.5	% slough
Substrate	9100	
Min. wetted area	0	
Debris	5	
Compaction	H	

Site Location	120 m
Date	8/9/01
Crew	TB
Air Photos	BC820007 142
Access:	Trail from secondary parking area in Bright Angel Park for 132 m to a grade then follow it down to Koksilah Floodplain and channel. Channel follows toe of slope.

Fish Utilization

This channel is a floodchannel that is 2.5 m plus deep in Koksilah peak flow events. During these events, the entire floodplain is inundated and the channel is just part of the river. It is at medium high flow events that the channel is distinct. A few chum spawn in years of high general abundance in the system.

Enhancement Opportunities

None.

Sidechannel I. D.	27a	ACTIVE	COWICHAN STATION ACTIVE CHANNEL

Ave. channel width	15	% pool	42
Min. wetted width	4	% riffle	32
Min. flow	.176	% run	2
Channel length	244	% glide	20
Gradient	.5	% slough	2
Substrate	2710		
Min. wetted area	976		
Debris	2		
Compaction	L		

Site Location: 100 m below inlet
Date: 9/15/87
Crew: TB
Air photo: BC82007 142
Access: walk or drive through field on west side of river below Cowichan Station Bridge

Fish Utilization

Permanent use by coho, cutthroats and steelhead. Chum spawning and early rearing for chinooks.
Sidechannel flow pattern mirrors that of the mainstem - volatile in late fall and winter. Summer flow is sufficient but this could change if a big flood built a higher inlet berm or caused major down cutting.

Enhancement Opportunities

Construction of a stronger inlet berm could protect the channel from flood ravages. However the stream banks at the inlet are tightly bound with willow roots and rip - rap might cause high energy eddies to form which could erode them. Recommendation: annul monitoring to see if negative features develop.

Sidechannel I. D. 28R RELIC SHEEP PASTURE RELIC CHANNEL

Ave. channel width	5	% pool	na
Min. wetted width	0	% riffle	na
Min. flow	0	% run	na
Channel length	225	% glide	na
Gradient	.5	% slough	na
Substrate	8110		
Min wetted area	0		
Debris	0		
Compaction	H		

Site location: 50 m below inlet end
Date: 7/29/00
Crew: TB
Air photos: BC82007: 160-161
Access: Park in St. Andrew's lot in Cowichan Station (just E of the E & N underpass). Walk E&N for 315 m to left side of Ayers Creek. Look for deer trail on left to leave tracks to fence line. Step over low fence then walk down slope to Ayers Creek. Follow creek down to park - like clearing and see channel to the south.

Fish Utilization

None. Channel only occasionally wetted by Koksilah spill.

Enhancement Options

Channel excavation to the water table would produce 1125 m^2 of stable spawning; rearing and winter habitat and it would blend in to the lower end of Ayers Creek, a small temporary stream from the east. Alternatively, an inlet pipe could be installed. The Koksilah lacks stable lateral habitat. The closest thing it has to a groundwater sidechannel is 26 A just across the river (Cowichan Station Active Channel) but that channel is quite volatile in the winter. It is not far enough removed from the river (**Production Option # 433).**

Sidechannel I. D. 29R RELIC THREE SPRINGS CHANNEL

THREE SPRINGS CHANNEL

	Channel Width	Wetted Width	Substrate	Slope %	Con	SC	LWD	Length	Wetted Area
Reach 1	3	0	1000	.5	FC	N	.037	45	0
Reach 2	3	1	1000	.5	FC	N	.001	67	67

A small channel at the slope toe well into Reach 2 of the Koksilah River. Three small springs near the head provide permanent flow to R2 but flow is not substantial enough to provide year round habitat benefit.

Site location: At springs 22 m below head
Date: 8/3/01
Crew: TB, PW
Air Photos:
Access: Drive to Forest Rd. via Hillbank Rd. Follow Forest to Freur Farm lower pasture. Walk south to upstream end of pasture and look for a faint deer trail down a short but steepish bank to the river. Walk and wade upstream.

Fish Utilization

Coho and cutthroat overwintering.

Enhancement Opportunities

Minimal excavation should be able to provide permanent flow. The channel is well separated from the river and flooding should not be a problem (**Production Option # 434)**

Sidechannel I.D. 30F FLOOD CHAUNCEY'S CHANNEL

CHAUNCEY'S CHANNEL

	Channel Width	Wetted Width	Substrate	Slope %	Con	SC	LWD	Length	Wetted Area
Reach 1	12	0	8200	.6	FC	N	.004	80	0
Reach 2	12	0	1450	1.5	FC	N	.001	240	0

A substantial Koksilah Sidechannel located well into Reach 2 on the east side of the river. Upslope farmers draw water from the channel and the Koksilah at the channel inlet. They also remove small amounts of gravel from the channel periodically.

Site location: 105 m
Date: 8/3/01
Crew: TB, PW
Air Photos:
Access: Hillbank Road to Forest Rd. Follow this road down to Freur Farm Lower Pasture then hike to south end of pasture and find a faint path down to the Koksilah. Hike and wade upstream to the channel.

Fish Utilization

Coho and chums spawn and early rear in this channel.

Enhancement Opportunities

By increasing the height of the inlet berm and excavating the channel below it, it should be possible to provide permanent flow. This is a relatively stable flood channel that operates more like an active channel except for the fact that it is summer dry in most years (**Production Option # 435)**
Fry salvage is also required in most years (**Production Option # 436)**

OPERATIONAL MANAGEMENT UNIT 16: KOKSILAH BASIN

OVERVIEW

The Koksilah Basin is a large and complex OMU. With the exceptions of the Island Highway Strip, the Eagle Heights area, Cowichan Station area, Fairbridge and the Koksilah Industrial Park, there are no areas of concentrated urban land use. Of the above, only the industrial park really fits the urban category. However, the lower elevations of the OMU are very intensively farmed and this use has had major impacts on the Koksilah River and tributaries such as Kelvin, Glenora, Patrolas, Spiers, Big Fill and Norrie. Increased sedimentation from raw bank erosion and pasture, cropland and barnyard runoff, loss of riparian and wetland areas due to clearing, drainage and overgrazing, pollution from barnyard, field and pasture runoff and from stock having free access to creeks and more rapid runoff due to the large amount of drainage improvement and clearing has greatly influenced the productivity of these streams, particularly the Koksilah.

In the upper portions of the basin, forestry related impacts are present. Because the upper basin contains several steep and narrow sub-basins such as the South and West Forks of the Koksilah, considerable slope damage has resulted and added to the already high sediment levels of the Lower Koksilah.

LIMITING FACTORS

Primary limiting factors are low summer flow, access, high sediment levels and flow instability.

PRODUCTION OPTIONS

There are 50 opportunities to improve salmonid production in the OMU. They are outlined and prioritized in Table 1.

Table 1: Production Opportunities in the Koksilah Basin OMU

No.	Location	Activity	Priority
437	Koksilah River	Coho colonization	1
438		Marble Falls fishway replacement	2
439	Spiers Creek	Structural Improvement	2
440		Riparian restoration	2
441		Adult access improvement	2
442	Treffery Creek	Structural improvement	5
443	Kelvin Creek	Coho colonization	1
444 445	Hellebore Creek	Headwater storage/coho colonization	2
446	Bush Baby Creek	Headwater storage	3
447		Potential barrier removal	2
448	Glenora Creek	Fry salvage	1
449 450		Glenora Oxbow linkage(2)	1
451		LWD addition	2

452	East Glenora	Sidechannel development	2
453		LWD addition	2
454	Middle Glenora	LWD addition	2
455	Big Fill Creek	Riparian restoration	2
456		Spawning platforms	3
457		Barrier removal	1
458		Structural improvement	2
459		Cutthroat col. without barrier removal	3
460		Channel relocation	2
461	Norrie Creek	Barrier removal (Koksilah Rd.)	1
462		Barrier removal (Mountain rd.)	1
463		Flow augmentation	1
464		Riparain fencing	2
465	Weeks Creek	Pool creation at bend and base of falls	2
466		Spawning platform	2
467		Fry salvage and pond colonization	1
468		Cushion pool below culvert	1
469		Summer flow augmentation	2
470	Neel Creek	Fry salvage	2
471		Storage and summer flow augmentation	2
472	Patrolas Creek	Coho colonization	2
473		Dougan Lake cutthroat recruitment imp.	2
474		Riparian restoration	1
475	Wild Deer Creek	Coho colonization	3
476		Wild Deer Lake cutthroat recruitment imp.	2
477	Grant Lake	Coho colonization	1
478	Kapoor Creek	Coho colonization	3
479	West Koksilah	Coho colonization	2
480	South Koksilah	Coho colonization	2
481		Headwater storage	1
482	Fellows Creek	Steelhead or coho colonization	3
483	McPherson Creek	Coho colonization/headwater storage	3
484	Old Truck Creek	Coho colonization	4
485	Mystery Creek	Coho colonization	2
486		Headwater storage	2
	Total		50

Stream Code: 9202577023

Stream Name: Koksilah River

Operational Management Unit: Koksilah Basin

CVRD Electoral Areas: B, C, E

A) BIOPHYSICAL OVERVIEW: The basin is broad and of low relief below Norrie Creek. Above Norrie Creek it begins to narrow and adjacent slopes crowd the stream. At 9,000 m the stream becomes very confined. It remains confined or entrenched for the next 9,330 m. At that point, the valley broadens somewhat for 9,000 m, before the river enters another one of confinement and entrenchment for 7,500 m. Above this point, the valley opens into a low gradient headwater basin with numerous small, mature wetlands.

Air Photos	BC 82007 142-143, 193-196, 163-164
Watershed Area	325 km
Topographic Maps	92 B/12, B/13, 92B.061, 062, 071, 072
Salmonids	Coho (Co) to 13,400 m (Marble Falls). A few coho pass the fishway in some years and may migrate as far as the second falls at 26,330 m. Chinook (Ch) to 13,400 m (Marble Falls). Since 1982, chinooks have not been seen in the vicinity of Marble Falls. Steelhead (St) to 26,330 m. Chums (Cm) an occasional fish to 13,400 m in high escapement years. Most chums spawn in the lower 9,000 m. Anadromous cutthroat (Act) to 13,400 m but most sea-run cutthroats do not ascend the Koksilah beyond Petrolas Creek; their uppermost spawning stream which enters the Koksilah at 7,000 m. Cutthroat (Ct) to 26,330 m. Rainbow trout (Rb) to the headwaters at 43,330 m.
Obstructions	**Marble Falls**: a series of small chutes, cascades and small falls. The greatest vertical drop is about 1 m. Total drop is 5 m over 25 m. A vertical slot fishway was constructed in 1980 on the southeast side of the river but does not pass many fish. The slots appear to be too narrow and are subject to jamming with gravel and boulders. **Boil Hole:** 1m over 2 at 15,900 m. High velocity chute with highwater bypass (notched weir) **Little Falls:** 2.5 m over 6 at 24,330. Easily passed by steelhead but could pose problems for any coho and chinooks that pass Marble Falls. **Koksilah Falls:** 30 m over 50 at 26,330. A huge boulder jam wedged into a narrow canyon with several vertical drops of 4 m or greater. **Last Falls:** 2.2 m over 4 at 28,830. This obstruction is redundant because all potential anadromous salmonid migration is blocked by Koksilah Falls.
Max. Temp. (C)	21.5 (R1 @ Bright Angel 8/10/81)
Min. disch. (m^3)	.056 (R1 @ Cowichan Station 10/10/16) .017 (R4 50 m above Fellows Cr. 9/10/85) .005 (R5 near M & B S line Xing 10/23/87) .117 (R1 Cowichan Station 8/17/77)

KOKSILAH RIVER

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	30	15	2710	.5	FC	L	9,000	135,000
Reach 2	18	12	1342	1.6	CON-ENT	N	9,330	111,960
Reach 3	25	13	1360	1.4	CON	N	11,000	117,000
Reach 4	15	4	136R	2.0	CON	N	7,500	30,000
Reach 5	13	5	1360	1.0	FC	L	1,500	7,500

Reach 6	10	6	2350	.8	FC	L	5,000	30,000

B) FISH UTILIZATION AND LIMITING FACTORS

Coho, chinook and chum salmon; anadromous and resident cutthroat trout, steelhead and resident rainbow are present (Tutty, 1984).

10 year average 1970-1980 for chinook, coho and chums is:

Chinook: 558
Coho: 6780
Chum: 5300

Production is limited by high fall-winter discharge which also fluctuates widely, low summer flow which, along with wetted area and volume reduction, produces large areas of "still water" in Reach 1 pools. Coho and trout density is very low there in mid and late summer. Fish crowd the riffles and glides at this time.

High levels of substrate sediment, particularly in Reach 1, limit egg survival. Most of Reach 1 is surrounded by the Cowichan Soil Type which has large amounts of fine-grained marine sediments which are poorly drained and very erodible.

Irrigation withdrawal from the Koksilah is high. As much as .298 CMS is licensed (Bryden, 1978) Note that this is more than minimum flow in most summers (Tutty, 1984).

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Coho - above barrier fry colonization (Spring Stocking)

Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
Reach 2 49,300	1.0	49,300
Reach 3 117,000	1.0	117,000
Reach 4 54,000	0.5	27,000
Reach 5 7,500	1.0	7,500
Reach 6 30,000	1.0	30,000

TOTAL FOR SPRING STOCKING = 230,800
(**Production Option # 437)**

2. ***REPLACEMENT OF MARBLE FALLS FISHWAY WITH STEP POOL PASSAGE:*** Unfortunately, it appears that Marble Falls Fishway is unable to do its job because of structural problems. It should be replaced with a series of blasted pools (**Production Option # 438)**

D) LAND USE FACTORS

Agriculture

The portion of the basin below the 50 m contour is utilized for agriculture and residential purposes - about 20%. The rest is forestland in various stages of growth. There are substantial agricultural related impacts in the basin.

Forestry

Most watershed forests are advanced second growth where there has been considerable logging since the mid-1980's. Some upper elevation old growth remains.

Residential - Urban

Residential use of the basin is fortunately light and generally limited to upland areas. The Koksilah Industrial Park is on e area where development has intruded riverine lowlands/riparian/floodplain. This development also eliminated much of a sidechannel that flowed between the Cowichan and Koksilah Rivers known formerly as Old Koksilah Village Channel but now termed Industrial Park Relic Channel.

Risk Potential

Moderate

Fishery Officer Narrative

E) PROTECTION NEEDS

The Koksilah Fisheries Sensitive Zone or Koksilah Corridor is rather broad and sometimes difficult to define precisely in the lower basin and floodplain. The river occasionally occupies the majority of its floodplain but there has been little intrusive development there. Most uses are agricultural in nature and, while considerable impact has occurred, its reversibility potential is high. One exception is Koksilah Industrial Park. The FSZ narrows above the Kelvin Creek Lowland portion of the floodplain but there are still small areas of riparian lands almost up to the bottom of the canyon. Above this point, the FSZ is largely composed of steep lands adjacent to the river, smaller riparian zones (with the exception of the Upper Koksilah Wetlands in the upper two reaches) and scattered small wetlands.

Stream Code

Stream Name Spiers Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: D

A) BIOPHYSICAL OVERVIEW A small stream that drains a steep sided ravine; largely fed by groundwater seepage from the adjacent slopes. Enters the South Arm of the Koksilah River .6 km above the estuary.

Air Photos	82007 160, 161
Topographic Map	92B/13, 92B.072
Obstructions	1 m culvert under Hillbank Rd. @ 1400 m Culverts under Cowichan Bay Rd. are said to give Chums problems
Salmonids	Co 1400 m although the majority are concentrated in R2 (425 m) Ct very sparse, largely limited to R2 Cm few, largely limited to R2
Max. Temp.	19 (7/29/96)
Min. Disch.	.00225 lower R2. Flow gradually diminishes upstream until it ceases at the 250 m point in R5, a distance of 1143 m above the estuary.

SPIERS CREEK

	Channel Width	Wetted Width	Substrate	Slope	Channel Confinement	Side Channel	Length	Wetted Area
Reach 1	5	5	6400	.001	CON	N	35	175 (tidal)
Reach 2	4	2	2800	1.0	FC	L	425	850
Reach 3	4	2	1360	2.0	CON	N	113	226
Reach 4	4	1	2430	1.5	FC	L	320	320
Reach 5	3	1	1450	2.5	CON	N	250	250
Reach 6	3	0	!540	3.0	CON	N	257	0
Reach 7	2	0	8200	2.5	CON	N	500	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon were abundant in the first 300 m of R2 then diminished to very sparse levels above the top of R2. A small tributary termed the first north fork (2(1) CON 6.0 2260 1LPS, no fish) enters here supplying 45% of the flow which is already somewhat reduced at this point because there are three small springs below it. Cutthroat trout are sparse in R2 and were not seen above it.
Very low base flow and the lack of pools above R2 strongly limit production, especially for cutthroats. High sediment levels, particularly above R2, are a problem and are partly responsible for the lack of pools.

C) PRODUCTION OPPORTUNITIES

1. ***STRUCTURAL IMPROVEMENT:*** Pool and cover creation via the judicial placement of large wood debris and boulders is the primary need. Pool excavation and installation of cross logs should be undertaken (Production Option # 439).

2. ***RIPARIAN RESTORATION :*** Disturbed slopes, especially adjacent to R4, need to be restored via fencing, improved drainage and perhaps terracing in a few places (Production Option # 440)

3. ***CHUM ACCESS:*** Replacement of the culverts under Cowichan Bay Rd. would allow for easier chum access **(Production Option # 441)**

D) LAND USE FACTORS

Agriculture

Cattle have been allowed to range on the north side of the creek and a tributary termed the second north fork. Small access roads and trials have been constructed there as well. Because the ravine slopes are so steep and moist in the area, considerable damage has resulted and a good deal of fine material has carried down slope to the creek. Impacts are most severe in R4.

Urban

Residential use is light and is located well back from the ravine edge.

E) PROTECTION NEEDS

Reach 1 of Spiers Creek is estuarine while Reaches 2 and 3 have strong riparian components. Nearly the entire stream is contained in a ravine with 50 to 100 % slopes. Cattle use of the ravine and riparian must be much more controlled or excluded. The steeper, moister portions of the ravine require fencing. New residential development must be set back from the ravine edge.

Stream Code

Stream Name: Treffery Creek

Operational Management Unit Koksilah Basin

CVRD Electoral Area: D

A) BIOPHYSICAL OVERVIEW: A very small stream remarkably undisturbed for most of its length. Fed mainly by groundwater seepage from adjacent slopes. Flows through a steep sided ravine to join the South Arm of the Koksilah 1.4 km above the estuary. Begins at a small seepage zone in a pasture near Bench Road some 300 m west of the Island Highway.

Air Photos	BC 82007 160-161
Topographic Map	92B/13, 92B.072
Obstructions	Island Highway culvert at 845 m is a velocity barrier
Salmonids	Co to 845 m but the vast majority are limited to Reaches 1 and 2 (300 m)
Max. Temp.	16 (7/29/96)
Min. Disch.	.0015 R2 (7/29/96). Flow gradually diminishes upstream until drying begins at 688 m. Stream is highly intermittent above that point.

TREFFERY CREEK

	Channel Width	Wetted Width	Substrate	Slope	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	3	1	4600	1.0	CON	N	45	45 (tidal)
Reach 2	3	1	2710	1.5	FC	L	255	255
Reach 3	3	1	1270	3.0	CON	N	388	388
Reach 4	3	0	1270	3.0	CON	N	157	0
Reach 5	2	0	1000	0.5	CON	N	200	0

B) FISH UTILIZATION AND LIMITING FACTORS

A few coho are present along with a very occasional cutthroat trout. Production is limited by low summer flows and lack of pools. The stream Is generally very shallow including the pools.

C) PRODUCTION OPPORTUNITIES

1. ***STRUCTURAL IMPROVEMENT:*** Pool excavation at selected points and installation of cross logs to create scour would increase the habitat value of Treffery Creek (Production Option # 442)

D) LAND USE FACTORS

Agriculture

Most of Reach 5 is bordered by agricultural use. Because this constitutes only 12 % of stream length, impact is minimal.

Urban

All adjacent urban development including Cowichan Golf and Country Club is set back from the edge of the ravine. At one point, the creek supplied local water systems and three old pump houses still remain. There has been some runoff acceleration and associated slope erosion due to the golf course but it is very minor and impact is low. The golf course and a few property owners have cleared very close to the ravine edge and dumped cuttings and other green waste over the edge.

E) PROTECTION NEEDS

New development must continue to be set back from the edge of the ravine which should be a Greenway extension of the Koksilah Corridor. Stock access to Reach 1 must be prevented.

Stream Code: 9202577023083

Stream Name: Kelvin Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Areas: B, E

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah from the southwest, 3,500 m above the Koksilah - Cowichan influence. A very complex stream system. The basin is broad and gentle in Reach 1; it constricts in Reach 2 and forms a short canyon in the upper portion of this reach. Above the canyon, the basin widens into a broad flood plain and the stream branches into two summer groundwater fed channels of approximately equal size and character. One fork, known as Goat Farm Brook, occupies the east side of the floodplain and extends to the valley height of land. The other, which is the Kelvin Creek mainstream, turns west well before the end of the valley then steepens considerably where it drains the southwest end of Koksilah Ridge. Both branches are summer dry above the 120 m contour and have sub-branches.

Air Photos	BC 82007 161-162
Topographic Map	92 B/12, 92B.072
Salmonids	Co to 6,918 m. St to 6,918 m. Cm to approximately 4600 m where a log jam is often located Act to 6,918 m. Ct to 14,000 m.
Obstructions	A log jam at a point 700 m above the powerline in R2 is a chum salmon barrier (2001) Series of cascades and falls starting at 6808 m: 1 m over 10 at 6808 m. 1 m over 10 at 6893 m. 2 m over 3 at 6918 m 4.6 m at 6,953 m. Combination falls log jam at 14,000 m on Upper Kelvin. Several high falls and steep gradient above this point. (Kelvin Creek is summer dry above 8,500 m). No obstructions on Goat Farm Brook which enters Kelvin Creek in Reach 4 well above Kelvin Creek Falls (some 1750 m above the top falls).
Max. Temp. (C)	17 (7/29/81) R1 11 (9/10/85) R3 15.2 (9/4/89) R4 13.1 (9/4/89 Goat Farm Brook R1 13.2 (9/4/89) R3 14.0 (8/18/96) R2
Min. disch. (m^3)	0.018 (9/10/83) R3 near fence site 0.042 (9/12/85) R1 at Koksilah Rd 0.36 (10/28/87) R1 at Koksilah Rd 0.008 (9/4/89) Goat Farm Brook at Alder Bridge (R1) 0.007 (9/4/89) Lower R4 .06 (9/21/86) R3 at Cedar Bridge .004 (9/21/86) R4 at Railroad Bridge .002 (9/1/86) R4 at Railroad Bridge .043 (9/4/89) R3 at fence .0288 (8/18/96) R2 just below Hellebore Creek confluence

KELVIN CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	12	7.0	8200	0.5	FC	L	220	1400
Reach 2	10	7.0	1450	1.5	FC	L	1903	13,321

Reach 3	10	7.0	1360	1.8	FC	L	4600	32,200
Reach 4	7	5.0	1252	3.0	CON	N	361	1805
Reach 5	11	7.0	1540	1.0	FC	L	852	5957
Reach 6	4	2.0	1810	.8	FC	L	1,400	2,800
Reach 7	8	0.0	136R	10.0	CON	N	5,000	0

GOAT FARM BROOK

	Channel Width	Wetted Width	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	4	2	1810	.8	FC	L	1,440	2,880
Reach 2	3	0	1540	1.0	FC	L	3,200	0

B) FISH UTILIZATION AND LIMITING FACTORS

Kelvin Creek supports coho, cutthroats (including sea-runs), chums and steelhead. 1976 smolt production for coho and steelhead was 18,174 and 1,568 (Argue et al, 1979) Resident cutthroat are present above the falls in Kelvin Creek and Goat Farm Brook. Individuals to 15 cm have been captured.

A falls at 6,918 m blocks anadromous fish. However, chums are seldom reported beyond Reach 3 where gravel diminishes. An occasional coho or steelhead may navigate the barriers in ideal flow conditions.

Coho, cutthroat and steelhead production is limited by low summer flows and the barrier falls which excludes them from prime above barrier habitat, particularly for coho and anadromous cutthroats. High fall and winter discharge and lack of quality winter habitat below the falls is also limiting.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Colonization of coho, anadromous cutthroat and steelhead fry above the barrier is the most significant option. Coho have been stocked in Reaches 5 and 6 of Upper Kelvin and Reach 1 of Goat Farm Brook at approximately 1 fry/m^2 since 1986 (Bams PBS) with fry to smolt survival as follows: 1987: 16.5%, 1988: 6.25%, 1989: 2.50%. Smolt yield decreased following extensive logging of the valley floor. The logging had little direct impact but it allowed Great Blue Herons much better access to the creek and their predation is thought to be a very significant factor in out planted coho survival (Production Option # 443)

1. Coho - above barrier fry colonization (Spring Stocking)

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
KELVIN CREEK			
Reach 3	10,000	0.5	5,000
Reach 4	2,800	0.5	1,400
GOAT FARM CREEK			
Reach 1	2,880	0.5	1,400
			TOTAL FRY 7,800

D) LAND USE FACTORS

Forestry

Much of the valley floor portion of the Upper Kelvin Basin has been logged in the last three years. Little direct impact has occurred despite the fact that the area is covered with moist, fine-grained soil of an alluvial nature. Logging was done in the summer and a narrow buffer strip was retained.

Agriculture

Less than 10% of the lower basin is utilized and it is concentrated below the 10 m contour. About 30% of the upper valley floor is utilized for grazing and forage production. The combination of logging and

agriculture has lowered the capability of the upper basin for salmonid production: this is unfortunate because most agriculture is "hobby" and logging was mainly for firewood.

Risk Potential

Low. Most impacts have already occurred. However, there is some potential for residential expansion and associated impacts; particularly water withdrawal from the streams or their sub-surface aquifers.

E) PROTECTION NEEDS

Kelvin Creek's largest sensitivity factor is its broad riparian zones – especially in Reaches 1 and 2 where it blends with the Koksilah Corridor and again in the above barrier reaches (5 and 6) where riparian conditions are very extensive and cover much of the valley floor.

ESCAPEMENT COUNTS

Year	Co	Cm	Comments
2000	24	0	Two count segments that are contiguous: form the P/L @ 2719 m U/S 500 m to seasonal trib. Seg. 2 proceeds U/S to Farirburne Farm at a point opposite the end of Jackson Rd.
2001	119	106	

Stream Code:

Stream Name: Hellebore Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Enters Kelvin Creek from the west 5.2 km above the Kelvin-Koksilah confluence. Drains a broad basin well buffered by headwater wetlands which originate almost at MacMillan Bloedel's old L Mainline in the East Glenora Area. This is a remarkably stable and productive stream.

Air Photos	BC 82007 161-162
Topographic Maps	92B/12, 92B.072
Salmonids	Co to 940 m
	Ct to 940 m
Obstructions	None
Max. Temp.	15 (8/18/96)
Min. Disch.	.002 CMS (8/18/96)

HELLEBORE CREEK

	Channel Width	Wetted Width	Substrate	Slope	Channel Confinement	Side Channel	Length (m)	Wetted Area (m^2)
Reach 1	4	2	2620	1.5	FC	L	180	360
Reach 2	4	2	2620	1.5	CON	N	670	1340
Reach 3	6	0	5410	.5	CON	N	90	0

B) FISH UTILIZATION AND LIMITING FACTORS

Hellebore Creek supports a strong coho - cutthroat population.
Production is limited by low summer flows. Aside from minor local seepage, the creek's entire summer flow is supplied by Little Hellebore Creek, a very small headwater tributary that enters at 850 m. Little Hellbore (1(1) CON 2.0 2350) supports cutthroat fry.

C) PRODUCTION OPPORTUNITIES

1 . ***HEADWATER STROAGE: COHO COLONIZATION:*** Impoundment of the main headwater wetland (Twinberry) of 7 Ha. could improve summer base flow. 1 m of storage would yield .003 CMS for 180 days. This would more than double minimum flow.
Stocking coho fry in the impoundment (10,500) could yield 1050 smolts (Production Options # 444, 445)

D) LAND USE FACTORS

Forestry

The basin is covered by advanced second growth. MacMillan Bloedel is the primary landowner.

Agriculture

Minor.

E) PROTECTION NEEDS

For most of its length, the stream flows through a steep sided (60%) ravine. Logging should be set back at least 15 m from its edge. It looses its ravine in Reach 1 but this segment is within the FSZ of Kelvin Creek.

Stream Code

Stream Name: Bush Baby Creek

Operational Management Unit: Koksilah Basin (16)

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: A very small tributary of upper Reach 2 of Kelvin Creek. The majority of its flow is from groundwater seepage. There is an upland runoff component but it is minor and is buffered by the headwater wetland basin that it is tributary to. For most of its length, the stream flows through a shallow ravine.

Air Photos	BC82007 161, 162
Topographic Maps	92B/12, 92B.072
Salmonids	Co for 381 m Ct for 381 m and 140 m in South Fork Rb to 381 m
Obstructions	Increasing gradient and decreasing organization with small debris jams above 381 m. Flow also begins to dwindle above this point. A culvert at 228 m is a potential barrier. The creek has cut under and around it but it and the skid trail it supports could plug in the future and beavers could take advantage of it. A beaver dam at 114 m is passable.
Max. temp. (C°)	9.8 R1 (5/25/99)
Min. disch. (CMS)	.0108 R1 (5/25/99)

BUSH BABY CREEK

	Channel width	Wetted Width	Substrate	Slope	Confinement	Side Channel	Length	Wetted Area
Reach 1	2	1	1450	3.2	CON	N	102	102
Reach 2	4	1	6400	.5	OC	M	40	40
Reach 3	3	1	2710	1.5	FC	L	36	36
Reach 4	2	1	1450	3.0	CON	N	73	73
Reach 5	3	1	1810	2.7	CON	N	130	130
Reach 6	4	0	7210	2.3	FC	L	100	0
Reach 7	4	0	9100	1.0	OC	M	45	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout are present for 381 m of the stream's 526 m total length. A few cutthroat fry are present in the South Fork for its full 140 m length. South Fork trout densities are very low but coho densities in the mainstem are very high. Mr. Rigby, a local resident (2900 Mtn. Rd., 748-7266) told Paul Wilson that the creek has always had a strong coho run and that it's a favourite of local bears.
Production is limited by the small size of the creek and by low summer flows. All other habitat components are good: canopy, temperature, stability, spawning habitat and instream cover. Unlike many area streams, there is an abundance of LWD.

C) PRODUCTION OPTIONS

1.***HEADWATER STORAGE:*** A .25 ha wetland basin could yield .00014 CMS for the creek's 150 day CDP **(Production Option # 446)**

2. *POTENTIAL BARRIER REMOVAL:* The culvert and skid trail crossing at 228 m should be removed to prevent future problems with debris plugging or beaver activity **(Production Option # 447)**

D) LAND USE FACTORS

Forestry

The lower 228 m of stream was logged about 15 years ago while the upper section was harvested about 30 years ago. For the most part, logging occurred to the streambanks and logs were yarded across the creek and its ravine. Initial impacts must have been high but the stream has recovered nicely and there is an abundance of LWD. MacMillan Bloedel is the landowner.

E) PROTECTION NEEDS

Land use activities should be set back at least 15 m from the top of the bank in the gully sections of the stream. Except for R's 2 and 3, the creek is contained in a shallow ravine with slopes ranging from 15 to 50%. The north slope is very moist in R1. There are a number of seepage points in this area. Where there is no defined ravine, the setback should be at least 15 m.

ESCAPEMENT COUNTS

Year	Co	Ct	Comments
1999	20		Many bears. Count sec. Is 300 m above mouth
2000	5		
2001	56		

Stream Code: 9202577023083135

Stream Name: Glenora Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Enters Kelvin Creek from the NW 1915 m above the Koksilah - Kelvin confluence. The basin is broad and of low relief below the 120 m contour; above this level, it is steep and narrow. Glenora Creek is one of the more complex streams in the Cowichan – Koksilah watershed. It consists of five major tributaries: Big Fill Creek, the East Fork, the Middle Fork, Keating Lake Branch and Sweetheart Creek. Aside from Big Fill Creek which is buffered by a headwater wetland and Keating Lake Branch, the system is non – buffered and subject to high discharge fluctuation, bedload transport and de-watering. Most of the system originates in a series of ravines/gullies near the 700 m level of Koksilah Ridge which is an important component of Weyerhaeuser's Shawnigan Logging Division.

Air Photos	BC 82007 161-162	
Topographic Map	92 B/12, B/13 92B.072	
Salmonids	Co	
	Mainstem	9,713
	East Branch	1785
	Keating Lake Br.	1,000
	Sweetheart	1162
	Middle Fork	1911
	Ct	
	Mainstem	9,713
	East Branch	1785.
	Keating Lake Br.	1,000
	Sweetheart	1162
	Middle Fork	1911
	St	
	Mainstem	9713
	CM	
	Mainstem	7500 plus but very few above Old M + B haul rd. crossing (3189 m). In fact, during the 2001-2002 Glenora spawner count, chums were only seen as far upstream as Big Fill Creek at 1022 m (Lee et.al. 2002)
Obstructions	Mainstem - 6 m falls at 9,713 m. East Branch – 4R9 @ 1785 m just below washed out culvert on old L Main Keating Lake Branch - culvert at 600 m, a possible fry barrier Sweetheart – increasing gradient @ 1162 m Middle Fork – falls – log jam combo @ 1640 m often passable then 4R12 falls just below old L Main @ 1911 m	
Max. Temp. (C)	Mainstem - 11 (9/15/85 - M&B line) 12 (9/4/89) R1 Mainstem – 22 (8/9/81) E. Branch - 10 (9/15/85 - M&B line) 22 (8/9/81) R1 Mainstem 16 – Old L M/L 9/13/02 See other branches in succeeding files	
Min. disch. (m^3)	0.0033 (9/15/85 - M&B mainline) R1 0.0232 (9/4/89) R1 .001 (9/13/02) Old L M/L stream just barelt trickling but deep water and fish below v – notch cedar log weir 30 m D/s M/L. Weir constructed by M&B via FsRBC in 2001 and 2001. see other branches in succeeding files	

Glenora Creek

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
				Mainstem				
Reach 1	10.0	3.0	2620	1.0	FC	L	581	1743
Reach 2	10.0	4.0	2620	1.5	FC	L	2475	9900
Reach 3	9.0	0.0	1360	1.5	FC	L	2138	0
Reach 4	9.0	1.0	1270	1.5	FC	L	653	653
Reach 5	9.0	2.0	2350	2.0	FC	L	150	300
Reach 6	9.0	2.0	5500	.5	FC	L	467	934
Reach 7	6.0	2.0	2350	2.0	FC	L	663	1326
Reach 8	5	2	5500	.5	FC	102	204	
Reach 9	5	2	7300	1.0	FC	515	1030	
Reach 10	6	2	5500	1.5	FC	530	1060	
Reach 11	6	2	2350	1.0	FC	289	578	
Reach 12	6	0	1450	1.8	CON	350	0	
Reach 13	4	0	1270	2.5	CON	800	0	
Reach 14	4	2	127R	3.0	CON	500	1000	
Reach 15	4	2	127R	20.0	CON	2500		
				Keating Lake Branch				
Reach 1	3.0	0.0	6400	1.0	FC	L	600	0.0
Reach 2	2.5	1.0	8200	0.001	CON (DITCH)	N	400	400

B) FISH UTILIZATION AND LIMITING FACTORS

Glenora Creek supports coho, cutthroats, steelhead and chums. Production is limited by low summer flows (3288 M OF THE ACCESSIBLE SECTION DRIES) and lack of winter habitat with the exceptions of Keating Lake and a few relic channels. Lack of LWD cover is a strong secondary limiting factor. Sections of East Glenora were measured for LWD density and it only averaged 0.011pieces/BFW which is very low.

C) PRODUCTION OPPORTUNITIES

1. ***FRY SALVAGE:*** Losses of fry during the dry period in the summer can be considerable. As many as 36,250 coho, 400 cutthroat and 400 rainbow/steelhead have been salvaged (Burns, et al, 1987). There are few above barrier summer release sites, however Keating Lake branch is one possibility for coho introductions for supplemental production (Production Option # 448)

KEATING LAKE BRANCH (Spring Stocking)			
Reach 2	400	1.0	400

KEATING LAKE (Fall Stocking)			
Reach 3	500,000	.15	75,000

2. ***GLENORA OXBOW LINKAGE (2):*** Provision of access for juvenile salmonids would allow winter/spring utilization of two meanders which was cut off by MacMillan Bloedel's haul road (built in 1950 but no longer in use). Glenora Oxbow 1 is 145 m long and requires a somewhat larger culvert at its outlet to the creek and possibly a small inflow from the creek. Glenora Oxbow 2 requires more inflow from Glenora Creek. NOTE: In the interests of stream stability the creek may have to be returned to theses meanders, especially Glenora Oxbow 2 (**Production Option # 449, 450)**

4. LWD ADDITION: Judicious placement of LWD would add cover and complexity to this creek which is highly deficient in this material. However, most of Glenora has a high capacity to flush material out and cause damage in the process. A very specific program should be developed and should start off

very small scale in the more stable portions of the system (Production Option # 451). A v – notch cedar log weir and LWD was placed at a site 30 m below Old L Mainline by MacMillan Bloedel (Bill Pollard) in 2000. This site is relatively stable and the project has been successful to date. A deep pool has been scoured and LWD cover is functioning (2002).

D) LAND USE FACTORS

Forestry

90% of the undeveloped portion of the watershed is covered by advanced second growth.
MacMillan Bloedel left some serious problems behind when it abandoned its haul road, to Cowichan Bay, especially the portion between Marshall Rd. and Big Fill Creek. A Glenora Creek crossing that is not passing bedload to a desirable level and is a barrier to juvenile salmonids at times will have to be removed along with about 35 m of road. The crossing is also partly responsible for heavy bank erosion in Glenora Creek below the crossing for a distance of some 1000 m. There are also problems with road stability. Four slope failures have occurred in recent years and at least 200 m of the road is at risk of collapse into the stream and its ravine. Then there are the two meander cutoffs (Glenora Oxbows 1 and 2) which have caused significant changes in the stream's energy regime. These both may have to be restored although it would be desirable to retain Glenora Oxbow 1 as a winter refugia, Finally there is the huge fill at Big Fill Creek where some 20,000 m^3 of fill will have to come out. NOTE: private land logging on Big Fill and Glenora Creek near Lower Big Fill resulted in significant impacts in the winter of 2001 – 2002.

Agriculture

Approximately 40% of the basin is utilized for agricultural purposes. Mainstem impact is minimal but a tributary at 1,022 m has been degraded (Big Fill Creek).

Residential

Light.

Risk Potential

High.

Fishery Officer Narrative

Counts:

Year	Co	Cm	Comments
1999	55		
2001	165	99	2 segments: 1 from mouth U/S 900 m, 2 for 500 m D/S Marshall Rd. Seg. 1 111 Co, 99 Cm. Seg. 2 : 54 Co

D) PROTECTION NEEDS

The Glenora Creek FSZ encompasses riparian and adjacent steep slope lands as well as upland wetland basins. The FSZ is broadest near the Kelvin confluence, in the upper Doupe Road area where an upland wetland basin is attached to the corridor and around Keating Lake where the lake's shore zone is wide. A logging operation invaded the creek's FSZ in the fall of 2001 with significant results in terms of stream impact.

Stream Code: 920257702308135

Stream Name: East Glenora Creek

Operational Management Unit: Koksilah Basin - 15

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: A medium sized non-buffered runoff stream that originates from a number of small feeder streams at about 700 m ASL on Koksilah Ridge. The basin is steep and narrow for about 2345 m. Below this point; the creek levels off for its final 1640 m where it flows though second growth forest and farms. The creek becomes highly unstable in its lower 1268 m below the confluence of the Middle Fork.

Air Photos	BC82007 161, 162
Topographic Map	92 B/12, 92B/13, 92B.072
Salmonids	Co to 1785 m Ct to 1785 m Occ. ST to 1785 m Cm to 1268 m
Obstructions	4R9 falls at 1785 m just below M+B washout on L
Max. temp. (C°)	22 (8/9/81) 16.2 @ 69 m 7/28/99
Min. Disch. (m^3)	.0033 (9/15/85) .00624 @ 120 m 7/28/99

EAST GLENORA CREEK

	Channel width	Wetted width	Substrate	Slope	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	8	1	1540	1.5	FC	L		151	151
Reach 2	9	0	1450	1.5	FC	L	.011	748	0
Reach 3	8	2	1450	1.8	CON	N		514	1028
Reach 3	4	2	1450	2.2	CON	N		372	744
Reach 4	4	2	136R	3.5	CON	N		145	290
Reach 5	3	2	1252	10	CON	N		800	1600
Reach 6	2	2	1252	36	CON	N		1000	2000
Reach 7	1	1		20	CON	N		400	400

B) FISH UTILIZATION AND LIMITING FACTORS

East Glenora supports coho salmon and cutthroat trout. A few steelhead and chum salmon also utilize the stream.
Production is limited by low summer flows, unstable substrate and lack of winter habitat. A secondary factor is the lack of instream cover, particularly LWD.

C) PRODUCTION OPPORTUNITIES

1. ***SIDECHANNEL DEVELOPMENT:*** A man made channel is present near MacMillan Bloedel's old L Mainline. It could be excavated to provide winter habitat. The channel is 38 m long and 5 m wide. It should be excavated down approximately .6 m overall and several deeper pools should be created. LWD should be added to the pools. There is an abundance of large cedar logs in the area left over from the first cut. The new channel should be about 3 m wide. A new culvert should replace an existing cedar log box culvert between the channel and East Glenora. A DFO sidechannel development specialist should provide advice on culvert placement and design. In the event that M+B's old mainline is deactivated; it will be necessary to protect the channel. The road should be left in place and armored. **(Production Option # 452)**

2. ***LWD ADDITION:*** East Glenora is LWD deficient as are most Southeast Vancouver Island streams. Placement and anchoring of very large windfall logs would increase instream cover, create scour pools and possibly increase spawning habitat by holding back gravel. However, this option should

be very carefully considered because the creek is very unstable with weak alluvial banks. LWD addition could cause more detriment than benefit **(Production Option # 453)**

D) LAND USE FACTORS

Forestry

Upper East Glenora is in MacMillan Bloedel's Shawnigan Division (South Island Woodlands). It also traverses a block of Crown forestland. Most of the creek is bounded by second growth forest but the upper reaches flow through a ravine where advanced second growth and some old growth are present. New logging is occurring in the headwaters.

Agriculture

Reach 1 and a small part of Reach 3 are bounded by farms. There has been some agricultural related impact in Reach 1 (bank damage from stock, excessive clearing). The Reach 3 farm has had very light impact on the creek
and has added some habitat value in the form of a dug out stock watering pond that serves as quality overwinter habitat.

Residential

Nil

E) PROTECTION NEEDS

The ravine section of east Glenora (Reaches 4 through 6) should remain unlogged. Below reach 4, the Fisheries Sensitive Zone is relatively narrow and, with the exceptions of the confluence zones of the Middle Fork and east Glenora and the West Fork and east Glenora where more extensive riparian landscape units are present, the standard 15 m buffer zone should protect stream integrity and fish habitat.

Stream Code:

Stream Name : Sweetheart Creek

Operational Management Unit: Koksilah Basin - 16

CVRD Electoral Area : E

A) BIOPHYSICAL OVERVIEW: A small non – buffered tributary of Middle Glenora; drains the northeast face of Koksilah Ridge. In the main, this stream is very stable and holds its summer flow very well.

Air Photos	BC 82007 161-162
Topographic Map	92B/12, 92 B/13, 92B.072
Salmonids	Co 1162 m
	Ct 1162 m
Obstructions	Rapidly increasing gradient @ 1162 m
Max. temp. (C°)	14.6 (R1 - 7/30/99)
Min. Disch. (m^3)	.001756 (R1 – 7/30/99)

SWEETHEART CREEK

	Channel width	Wetted width	Substrate	Slope%	Confinement	Side Channel	LWD	Length	Wetted area
Reach 1	3	1	1360	3.5	CON	N		927	927
Reach 2	2	1	1360	7.5	CON	N		235	235
Reach 3	2	1	1261	20	CON	N		1200	1200

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout are present for 1162 m. Utilization decreases with distance upstream and fish may not be present to the end of the potential accessible length every year.
Production is limited by stream size and low summer flows

C) PRODUCTION OPPORTUNITIES

None

D) LAND USE FACTORS

Forestry

Located in MacMillan Bloedel's former Shawnigan Division and accessed from L Main. Most of the basin is covered by advanced second growth with scattered stands of old growth in the Sweetheart Creek Ravine.

Agriculture

Some agricultural use adjacent to lower R1

Residential

Nil

E) PROTECTION NEEDS

Sweetheart Creek flows through a ravine for much of its length. Its walls range from about 20 to 120 percent and are moist in places. Maintaining the integrity of the ravine is Sweetheart Creek's primary protective need.

Stream Code

Stream Name: Middle Glenora Creek

Operational Management Unit: Koksilah Basin - 16

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: A non-buffered tributary of Glenora Creek. The basin is steep and narrow above the 180 m contour but broad and of low relief below that point.

Air Photos	BC 82007 161, 162
Topographic Map	92B/12, 92B/13, 92B.072
Salmonids	Co to 1911 m but some times only to 1640 Ct to 1911 m Cm to 1640 m
Obstructions	Combination falls log jam 2XR3 @ 1640 m often passable for coho and cutthroats
Max. temp. (C°)	16.3 R1 7/30/99 15.0 R5 7/30/99
Min. Disch. (m^3)	.00256 R1 (7/30/99) .008 R5 (7/30/99)

MIDDLE GLENORA

	Channel width	Wetted width	Substrate	Slope %	Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	5	2	1450	1.8	FC	L		485	970
Reach 2	4	0	1360	4.0	CON	N		428	0
Reach 3	3	1	1360	4.0	CON	N		356	356
Reach 4	5	2	1360	3.7	CON	N		189	378
Reach 5	5	1	1261	4.7	CON	N	.045	453	453
Reach6	3	1	1261	30	CON	N		1600	1600

B) FISH UTILIZATION AND LIMITING FACTORS

Coho salmon and cutthroat trout are present for 1911 m but often only to 1640 m. Chum salmon to 1640 m or less.
Production is limited by very low summer flows (R2 dries) and lack of cover – complexity.

C) PRODUCTION OPPORTUNITIES

1. *LWD PLACEMENT:* Selective LWD placement would add cover and complexity and help create pools (**Production Option # 454)**

D) LAND USE FACTORS

Forestry

Most of the basin above the 180 m contour is covered with advanced second growth. There is some impressive old growth in the ravine that begins near the 180 m level.

Agriculture

One large farm is present. Impacts are moderate but this farm has provided some habitat benefit in the form of stock watering ponds at bends that are slightly offset from the creek and provide good overwinter habitat.

Residential

Nil

E) PROTECTION NEEDS

The Middle Glenora Ravine extends from near the 180 m contour to the headwaters. It s slopes are very steep and moist in places. Logging would involve high risk over most of the ravine. A somewhat wider riparian leave zone is required on parts of the farm property especially in upper R1 and R2.

Stream Code:

Stream Name: Big Fill Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: Enters Glenora Creek from the northwest 1022 m above the Kelvin - Glenora confluence. Drains a small, low relief basin intensively utilized for agriculture. Occupies a ravine for most of its length - groundwater flow.

Air Photos	BC 82007 142-143 BCC 394 163-164
Topographic Map	92 B/12, B/13, 92B.072
Salmonids	Ct to 159 m Co to 159 m Cm to 159 m
Obstructions	Culvert under M&B road is a velocity barrier. Migration period velocity is at least 3 m/sec. plus and the water is very shallow (2-5 cm). A reservoir (60 x 8 m) is present at 333 m; its spillway is navigable.
Max. Temp. (C)	12 (8/31/89)
Min. disch. (m^3)	.022 (8/31/89)
Mean Nov. – April disch.	.145

BIG FILL CREEK

	Channel Width	Wetted width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted area
Reach 1	3	2	1360	2.1	CON	L	.016	159	318
Reach 2	3	2	3520	2.0	CON	N		816	1632
Reach 3	3	2	3520	1.0	CON	N		314	628

B) FISH UTILIZATION AND LIMITING FACTORS

A few cutthroat trout and coho salmon fry are present below the culvert; none have been observed above it. Chum salmon are also present in most years.

Production is limited by access and limited recruitment potential for the entire stream due to lack of suitable gravel and high percentage of sediment. This is a very small, shallow stream with limited capacity to support trout yearlings other than in the reservoir and areas with large wood debris.

C) PRODUCTION OPPORTUNITIES

Big Fill Creek requires considerable enhancement - restoration to maximize habitat values. The following measures are recommended:

1) ***RIPARAIN RESTORATION:*** Fencing at the edge of the ravine to prevent erosion from cattle use on its slopes and banks and planting along the highly modified R3. (**Production Option # 455)**

2) ***SPAWNING HABITAT IMPROVEMENT:*** Spawning platform construction in reaches 1 and 3. The nearby Butler Brothers gravel pit on Langtry Road contains excellent 2-5 cm gravel (**Production Option # 456)**

3) ***BARRIER REMOVAL:*** Replacement of the culvert under M&B's road with an arch culvert 3 m in diameter. The present structure is a round, smooth, .85m pipe some 80 m long unsuitable for baffles. As of 1999, it was rusting out badly and was impassable. A wooden grid at its outfall should be removed also. The problem with removing this

culvert is that it's buried under approximately 20,000m^3 of fill circa 1950. As of 1998, the road this culvert is located on (M and B's Cowichan Bay Haul Road) is no longer in use. M & B (Weyerhaeuser since 1999) sold the road and the portion of Glenora Creek Corridor that extends from just east of Big Fill Creek to Marshall Road, to Art Mendenhall. It could be that the fill is largely composed of gravel and has enough value to pay for the cost of removal **(Production Option # 457).**

4) ***STRUCTURAL IMPROVEMENT:*** Pool excavation in Reach 3. Cedar cross logs should be installed to provide vertical scour at pool heads. It should be possible to combine pools and spawning platforms at most locations (**Production Option # 458)**

5) ***CUTTHROAT COLONIZATION :*** If culvert replacement is considered too costly (at least 20,000 m^3 of fill will have to be moved), anadromous cutthroat fry colonization should be undertaken. At 1 fry/m^2, 1,680 are required. At 14% fry to smolt survival, 235 smolts should result. They should yield 24 adults at 10% smolt to adult survival **(Production Option # 459)**

6) ***CHANNEL RELOCATION:*** Most of Reach 1 is greater than 2% gradient. Little quality gravel is present and the channel is in a vertical erosion phase. There is a small spill channel on the right (west) bank that offers good opportunity to reduce slope and add some spawning capability by relocating a short section of the channel in the spill channel. Gravel is present there and the gradient is close to .5 % (**Production Option # 460).**

D) LAND USE FACTORS

Agriculture

90% of the basin is utilized for agriculture - diary cattle grazing and forage production (hay). Impact has been high, especially in terms of ravine erosion and nutrient input. Ravine slopes are composed of fine-grained sediments - mostly silt and clay at steep angles - many greater than 70%.

Risk Potential

High. Low to moderate with fencing.

E) PROTECTION NEEDS

Big Fill Creek drains a steep sided ravine (60 – 70%) for much of its length. Agriculture, forestry and land development must be set back from the top of this feature by at least 15 m. Fencing may be necessary for much of the ravine length. Reach 3 opens and is highly utilized for agriculture. The creek is partly ditched. Fencing may also be necessary here to prevent stock intrusion.

F) NOTES

Escapement

Year	Co	Cm	CT
1999	10	10	
2000	6		
2001	16	17	

Stream Code: 9202577023

Stream Name: Norrie Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area; E

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah from the west at the Log Jam Flood Channel, 5,000 m above the Cowichan - Koksilah confluence. A broad basin of low relief above the 50 m contour, it narrows and steepens somewhat below. This is a small stream that can be almost intermittent in dry summers.

Air Photos	BC 82007 160-161
Topographic Map	92 B/12, 92B.072
Salmonids	Act to 1,810 m. Co to 910 m but occasionally to 1,810. Occ. St to 1810 m Cm to 910 m but some to 1810 m since Fish First re-worked the area below the Koksilah Road culvert in 2000.
Obstructions	1.8 m culvert at 910 m. (Koksilah Rd.) 3.3 m culvert at 1,810 m. (Mountain Rd.)
Max. Temp. (C)	15 (8/31/89) R2 20.5 (8/14/98) R6 16.5 (8/24/98) R2
Min. disch. (m^3)	R1 0 10/28/87 R2 .0005 10/28/87 R1 .0033 8/31/89 R2 .0055 8/31/89 R2 .00306 8/24/98 R6 .00067 9/1/89 R4 .00026 8/12/98 R5 .00033 8/12/98 R6 .00071 8/14/98

NORRIE CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	5.0	0.0 - 2.0	3700	0.7	FC	M	150	0 - 300
Reach 2	4.0	2.0	1531	1.5	CON	N	674	0 - 1348
Reach 3	5.0	2.0	2620	1.0	CON	N	86	172
Reach 4	4.0	2.0	6400	.5	FC	L	300	600
Reach 5	4.0	2.0	2620	1.0	CON	N	600	1,200
Reach 6	3.0	2.0	2620	1.0	CON	N	850	1,700
Reach 7	2.0	0.0	9100	2.0	OC	L		
Reach 8	2.0	0.0						

B) FISH UTILIZATION AND LIMITING FACTORS

Anadromous cutthroats are present for 1,810 m. I believe this stream is a very important component of Koksilah cutthroat production. Aug. 1989 fry density was $2/m^2$ in reaches 4 and 5 above the coho barrier.

Coho utilize the first 910 m and occasionally pass the Koksilah Road culvert in substantial numbers. For example, in 1979, a high escapement year, 85 were counted below Koksilah Road but only 2 were seen above. However, in 1997, a low escapement year, 6 coho made it above Koksilah Road. As many as 600 coho spawners have been counted in the section of Norrie Creek between Koksilah and

Mountain Roads according to a local resident (Mr. Art Vickers). The Cowichan Valley Enhancement Project (1983) constructed a concrete weir below the culvert to back flood its plunge pool to a level where coho could navigate it. The weir was soon undermined and provided minimal benefit. The culvert causes a good deal of local erosion and the channel has down cut .8 m since 1989.
The Mountain Road culvert is relatively recent. The road was straightened and raised and the creek was realigned. In the process of raising the roadbed, the culvert was elevated. Nearby property owners (Grbavec) have complained to the Ministry of Transportation and Highways and to JJM, the local maintenance contractor because the highly elevated culvert is causing bank erosion on their property.

Production is limited by very low summer flows, high substrate sediment and volatile fall - winter discharge along with the man made barriers. Nevertheless, Norrie Creek still produces at a high level; higher seemingly higher than it should considering its strong limitations. Observers have noticed a fall upstream migration of coho and trout juveniles from the Koksilah and, if the fish stay to smolt, this may account for elevated production.

C) PRODUCTION OPPORTUNITIES

1. ***BARRIER REMOVAL:*** The culverts at both Koksilah Rd. and Mountain Rd. must be replaced with passable structures which would allow coho, anadromous cutthroats and chums to utilize another 1750 m. Resident cutthroats are present for at least 1000 m above Mountain Rd. (Production Option # 461, 462) Note: The leap at the Koksilah Rd. culvert was reduced to .9 m at low flows and nil at high flows by constructing two weirs below the culvert and re-inforcing the banks. The work was done in the summer of 1999 (FsRBC/Fish First). The 1983 concrete weir was broken up and used in the upper weir. A series of concrete casements were stacked adjacent to the Mountain Rd. Culvert in the summer of 2001 to serve as a bypass fishway.

2. ***FLOW AUGMENTATION:*** The East Fork of Norrie enters the mainstem at the approximate 200 m point of R6. A 1 m dam is present 17 m from the confluence. The dam impounds a reservoir and would be barrier to upstream migrant coho or sea-run cutthroat if the Norrie culverts were removed. The reservoir could be utilized to augment low flows in Norrie Creek. A small amount of water leaks from it even in the driest times. In high runoff, a good deal of water spills. This situation needs more assessment before prescriptions can be made but it is clearly an important component of Norrie Creek (Production Option # 463). Additional wetland basins are present in the system.

3. RIPARIAN FENCING : Fencing to protect the FSZ from cattle damage is required at several locations but particularly above Mountain Road where both ravine and riparian landscape units have been impacted by unrestricted stock access (Production Option # 464) Note: Fish First initiated a fencing project in 1999.

D) LAND USE FACTORS

Agriculture

70% of the basin is utilized for cattle and forage production. Considerable land and adjacent slope damage is evident and is responsible for much of the substrate sediment. Fencing problem areas would be beneficial.

Residential

Light but with some spot impacts. An earth dam for summer irrigation is located at the 230 m point of Reach 4 and some kitchen garbage was seen below it on Sept. 1, 1989. When this dam washes out, it contributes considerable sediment downstream, much of it settles in Reach 4, an already highly sedimented area. The dam should be constructed of gravel or not built at all. There is no water to spare in Norrie Creek in late summer.

Risk Potential

High due to high sediment levels during runoff. Remedial measures will lower the risk.

Fishery Officer Narrative

E PROTECTION NEEDS

Norrie Creek occupies a ravine for much of its length. Urban and agricultural development must be setback from the edge of this feature by at least 15 m. Where the ravine levels out above Reach 6, riparian areas are present and have been intruded by pasture and stockyard.

NOTES

1998 At least 255 coho spawned above Koksilah Rd. in the fall – winter of 1998-99. Art Vickers saw 200 near his place and another resident saw 55 near Mountain Road.

1998 A commercial fisher who lives on Lower Norrie reported 400-500 chums in R1 in the fall – winter of 1998-99. A number of sea-run cutthroats were among the chums. Chum salmon used to spawn right up to the Rigby Property above Fleetwood Road which is well above the present barriers at Koksilah and Mountain Roads.

ESCAPEMENT

Year	Co	Cm	Ct	ST	Comments
1999	112	4			
2000	62		1		
2001	608	10			3 Cm above the Koksilah Rd. Culvert

Two segments of Norrie have been counted: Segment 1 runs from 185 m above the mouth to a point 500 m upstream. Segment 2 extends form 70 m above the Koksilah Road culvert to a point 400 m upstream.

Stream Code:

Stream Name: Weeks Creek

Operational Management Unit: Koksilah Basin - 16

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: A very small Koksilah tributary at Cowichan Station. Enters the Koksilah from the east. Drains hayfields, forest and light residential areas. Summer headwaters are a series of springs in upper R5 and extreme lower R6. Winter headwaters are a dugout pond at the 1188 m point. The stream is non-buffered.

Air Photos:	BC 82007 160-161
Topographic Maps:	92 B/12, 92B.072
Salmonids:	Co to 123 m
	Act to 123 m
	Occ. Cm to 123 m
Obstructions:	3R6 falls @ 123 m
	3m dam @ 163 m
Max. temp.	19.9 upper R1 (7/19/00)
	18.1 lower R1 (7/19/00)
	14.8 R4 (7/19/00)
Min. discharge:	.0022 R1 (7/19/00)

WEEKS CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	2	1	2530	1.4	FC	L	.016	124	124
Reach 2	2	1	0144	4.0	ENT	N	0	40	40
Reach 3	15	15	1000	.0001	UC	N		55	825
Reach 4	1	.5	2530	1.9	CON	N		50	50
Reach 5	2	1	6210	2.5	CON-ENT	N		52	52
Reach 6	2	0	1360	2.8	CON	N		120	0
Reach 7	2	0	2710	1.2	FC	L		427	0
Reach 8	1	0	1000	2.0	OC	L		320	0
								1188	1091

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and sea-run cutthroats are present up to the 3R6 falls at 124 m. Occasional chums are also reported. Production is limited by the short accessible length and lack of pools and quality spawning habitat. Low summer flows are also limiting. It appears that Reach 1 has been ditched between the Kelly property and the adjacent property to the north on the Koksilah floodplain.

C) PRODUCTION OPTIONS

1. ***POOL CREATION:*** Good potential for pool creation exists at 71 m and 124 m. The 71 m site is at a bend that is trying to establish. The outside of the bend could be pulled back (extended) and a pool could be constructed at the base of the slope which will need to be armored. Another pool should be created at the base of the falls at 124 m (**Production Option # 465)**
2. ***SPAWNING PLATFORMS:*** Spawning platforms could be constructed in conjunction with pool creation. The lower platform should be just above the pool at 71 m and the second would be at the bottom end of the falls pool **(Production Option # 466).**
3. ***COHO FRY SALVAGE/COLONIZATION:*** Temporary flood pools and sidechannels form on Koksilah River bars near Weeks Creek confluence. Coho and a few trout fry (ST and CT) become stranded when these dewater. The fish can be salvaged and transported up to an 825 m^2 reservoir (Reach 3) for release. The Kelly family has been doing this for a number of years **(Production Option # 467)**.

4. ***CUSHION POOL AT BASE OF RESERVOIR SPILLWAY CULVERT:*** Smolts produced in the reservoir must drop 3 m into shallow water over bedrock. A small weir could be located below the drop point to back flood a small pool to cushion impact (**Production Option # 468)**.
5. ***SUMMER FLOW AUGMENTATION:*** Cheri Ayers believes that it may be possible for both Cowichan Station School and Cuthbert's (a major upland property owner) to provide some summer flow from their water systems which are groundwater sources. If each could provide just 1 LPS, it would more than double existing minimum flow (Production Option # 469)

D) LAND USE FACTORS

Agriculture

Some 26 % of the mainstem length is cleared and R1 appears to have been ditched between the adjoining properties. Otherwise agricultural impacts are relatively light.

Residential

Light residential use adjacent to R's 3-6. Relatively light impact except for obstructions at road crossings including a driveway between R4 and R5 (1 m hanging culvert), a hanging high flow bypass culvert at the E and N crossing which has caused some downstream erosion and a 2 m hanging culvert at Koksilah Road. These barriers are not significant however because of the natural falls at 124 m and the dam at 164 m.

E) PROTECTION NEEDS

Weeks Creek Fisheries Sensitive Zone includes the Koksilah River floodplain and associated slope break and the small ravine which encloses the creek up to the top of Reach 7.

Stream Code: 9202577023175

Stream Name: Neel Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: E

A) BIOPHYSICAL OVERVIEW: A very small, temporary stream that enters the Koksilah at Camp Criena, 8,000 m above the estuary.

Air Photos	BC 82007 161-162
Topographic Map	92 B/12, 92B.072
Salmonids	Co, Ct Co to 155 m
Obstructions	2 m drop over a 10 m section of bedrock at 155 m, 1R6@175 m, 1R1.5@289 m.
Max. Temp. (C)	22 R 5 (7/24/00), 16.8 R2 (7/24/00)
Min. disch. (m^3)	0 8/30/89 and in most summers during Aug. and Sept. July 25, 2000 flow was 3.84 LPS

NEEL CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	3	0	2800	1.5	FC	L	.019	117	0
Reach 2	4	0	1360	3.1	CON	N	.013	38	0
Reach 3	4	0	1252	9	CON	N		105	0
Reach 4	4	0	1261	3	CON	N		56	0
Reach 5	3	0	1540	2.1	FC	L		128	0
Reach 6	3	0	5500	2.5	CON	N		4000	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho fry were dense in R1 and there were about 20 in R2 on July 24, 00. A section of R1 had six redds. Coho spawning is likely heavy in mid R1 in some years. 1999 was a poor coho escapement year yet fry numbers were high. Spawning conditions are excellent in a 50 m section. A few resident cutthroats are present above the falls and sea-run cutthroats have been reported spawning in R1. Because the entire stream dries in most summers, a few trout must get over the falls each year. I have observed cutthroat and coho parr well up the series of cascades. It may be easier for juveniles to pass above them than it is for adults.

C) PRODUCTION OPPORTUNITIES

1.***FRY SALVAGE:*** Fry salvage should be undertaken just prior to drying in July in R's 1 and 2. Fish can be released in the Koksilah River at the confluence. Coho and trout densities in the Koksilah have been relatively low in recent years and the addition of 50 to 200 fry should not be a concern in terms of displacement. Access is very good via Shaw Road and Camp Creina (**Production Option # 470).**

2. ***STORAGE AND SUMMER FLOW AUGMENTATION:*** Reach 5 is an old reservoir basin with the dam berm still intact. Re-impoundment to a depth of 2 m could provide 7680 m^3 of storage which could provide about .35 LPS for the 180 day critical discharge period. However, the 180 day figure is a worst-case year. In most years the CDP would be about 120 days. Yield at this rate would be about .52 LPS which would be significant in the small channel of Neel Creek (Production Option # 471)

D) LAND USE FACTORS

About 50% of the basin is in agricultural production; the rest is forestry.

Risk Potential

Moderate.

Fishery Officer Narrative

E) PROTECTION NEEDS

Aside from R1 which is a moist floodplain and part of the Koksilah's Fisheries sensitive Zone and R5 which is also a moist floodplain and was once dammed and flooded, the lower approximate 1200 m is contained in a ravine with side slopes up to 100 % plus in places. This ravine is the main component of Neel Creek's Fisheries Sensitive Zone.

Stream Code: 9202577023160

Stream Name: Patrolas Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B, C

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah from the southeast 6,500 m above the Cowichan River. Drains a broad, low relief basin that includes Dougan Lake.

Air Photos	BC 82007 160-161
Topographic Map	92 B/12, 92B.071
Salmonids	Co to 247 m. Ct to 247 m (probability of some anadromous) plus in upstream reaches except R6 in summer and in Dougan Lake. PMB have been reported in ponds on Wikkerink Creek 7/26/99 PMB reported from Patrolas Creek at Hillbank Rd. Paul Wilson caught 14 in a minnow trap.
Obstructions	Falls: 1 m over 10 at 142 m. 30 m at 247 m. Dam: 3 m at 874 m.
Max. temp. (C)	11 (9/12/85) R1, 22.9 (7/15/96) lower R6, 26.5 (7/15/96) upper R6.
Min. disch. (m^3)	0.053 (8/12/85 at Moss Road). Flow ceases in R4 but channel (ditch) is entirely wetted. Early summer flows are strong but irrigation withdrawal and drying produce almost nil flow by late summer in R7 which is the Dougan Lake wetland basin.

PATROLAS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	6.0	3.0	4600	1.0	FC	L	142	426
Reach 2	5.0	2.0	1333	15.0	CON	N	120	240
Reach 3	5.0	3.0	1531	3.0	CON	N	731	2193
Reach 4	6.0	3.0	1234	2.5	CON	N	115	345
Reach 5	6.0	3.0	5500	1.5	FC	L	449	1347
Reach 6	6.0	3.0	1000	.01	Ditched	N	2548	7644

DOUGAN LAKE

Area	Elevation	Volume	Max. Depth	Mean Depth	TDS
12	48	2720	13 m	2 m	112

B) FISH UTILIZATION AND LIMITING FACTORS

The lower 200 m is utilized by coho and cutthroats. A few cutthroats are resident in Reach 3 and are stocked by the Fish and Wildlife Branch in Dougan Lake. Dougan Lake also receives rainbows at times, some of them catchables. Pumpkinseeds have been reported in farm ponds on Upper Wikkerink Creek.

NOTE: Paul Wilson caught 14 pumpkinseeds in a Gee trap at Hillbank Rd. (R6). NOTE: The section from the Koksilah to the falls was counted 99/00 . No spawners were seen and the gravel was very compact.

Production is limited by short accessible area, high sediment levels, and ditching (R6). Reach 6 summer oxygen levels often fall to near zero (Burns, 1996).

C) PRODUCTION OPPORTUNITIES

Coho colonization for Dougan Lake is tempting, however, since it is managed as a trout fishery and stocked annually by the Fish and Wildlife Branch, that strategy should be discouraged at this time. Dougan Lake supports very popular spring, fall and early and late winter fishing for cutthroat trout.

1. ***COHO COLONIZATION:*** Coho - above barrier fry colonization (Spring Stocking)

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
PATROLAS CREEK Reach 5 (**Production Option # 472)**	1347	1.0	1347

2. ***DOUGAN LAKE CUTTHOAT TROUT RECRUITMENT IMPROVEMENT***

In order to maintain natural cutthroat stocks and reduce the need for hatchery input, opportunities to improve natural recruitment should be taken advantage of. Most Dougan Lake trout are presently thought to spawn in Reach 5 but conditions are far from ideal. A man made spawning bed was present in Reach 6 about 60 m below Dougan Lake and, to some extent, still exists. It could be improved by periodic cleaning and adding new material. Selected areas of Reach 5 could also be treated in this manner. Note: Locals say the spawning bed was closer to Dougan Lake than 60 m which is where a farm road crosses with two culverts underneath. The original Dougan Lake platform was constructed when Dave Hurn was the regional fisheries biologist.
There are eight tributaries of Reach 6 of Petrolas Creek. At least four of these have some recruitment potential: North Creeks (Fisher and Wikkerink); South Creeks: James and Ridley. Potential appears to be minor but further assessment is required. There is a chance that Dougan Lake cutthroats use these creeks and each has at least one location or zone where spawning platforms could be installed. All these creeks were still flowing slightly in mid-July, 1996. None had any trout fry. Potential spawning platform locations are: Fisher - just below Island Highway Culvert, Wikkerink - just below first crossing of Wikkerink driveway, James - 50 m below WFE gravel pit road, Ridley - just below Thain Road. (**Production Option # 473)**

3***. RIPARIAN RESTORATION***

Reach 6 is exposed to full sun which causes lethal temperatures to salmonids and encourages growth of reed canary grass and other instream vegetation such as *Carex* and *Equisetum.* Drainage becomes impaired increasing lateral flooding which increases the need for periodic ditching to restore drainage. Restoration of a streamside canopy would lower summer temperatures, provide cover for salmonids (only sticklebacks are present summer residents in R6) and eliminate the need for periodic ditching. Some effort has been made but it needs to be followed up. Fencing is required where cattle are having their way with the stream in Lower R6. There are also riparian improvement needs on the main inlet system – Charles Creek. Dougan Lake is very turbid after large storms due to raw bank erosion in this feeder stream (Production Option # 474).

D) LAND USE FACTORS

Agriculture

80% of the basin is utilized for agriculture. Reach 6 of the creek is located in an intensively farmed area and has been ditched along with the lower ends of all the tributaries to the reach . Some of Reach 6 is old lakebed. This is one of the oldest farming areas in the province.

Residential

Light.

Risk Potential

High

E) PROTECTION NEEDS

A Riparian Use agreement is required for Reach 6, which is intensively farmed. This reach is highly riparian and subject to extensive flooding, it is also intensively farmed, Some of the flooding is attributable to the Hillbank Road crossing which restricts peak flows.Too much of the riparian area has been converted to pasture/hayfield. The rest of the most sensitive lands on Patrolas Creek are in the Koksilah River FSZ.

F) NOTES

Lower Patrolas Creek was discharging very turbid water on July 24, 2000. The flow began sometime in mid – afternoon and continued beyond 1900. I accessed the Koksilah at a path off Lower Riverside Rd. that hits the river just below the mouth of Patrolas. When I went up the river around 1300, the creek was running clear. When I came back at 1800, it was almost black and all the people who had been swimming below Patrolas had moved above it. A swimmer said the dirty water started near 1500. I drove upstream to Hillbank Road at 1820, the creek was clear in that area. A few days later, health officials reported very high coliform counts in the Koksilah at Bright Angel Park.

Stream Code: 9202577023234

Stream Name: Heather Bank Brook

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) Biophysical Description: A very small, inaccessible stream that is groundwater fed in summer. Majority of flow is seepage from Quarry Lake. Enters the Koksilah over a high falls in Reach 2, 7,500 m upstream from the Koksilah - Cowichan confluence.

Air Photos	BC 82007
Topographic Map	92 B/12, 92B. 072, 92B.062
Salmonids	None
Obstructions	15 m falls at confluence with Koksilah
Max. Temp. (C)	13.1 (9/6/89)
Min. disch. (m^3)	.001 (9/6/89)

HEATHER BANK BROOK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	2	1	0009	150	UC	N	17	17
Reach 2	2	1	2710	1.5	CON	N	1,000	1,000
Reach 3	4	1	9100	.2	FC	N	2,000	2,000

B) FISH UTILIZATION AND LIMITING FACTORS

No fish have ever been found but sampling has not been extensive.
A commercial Atlantic salmon pen rearing operation is present at Quarry Lake. A large number of juveniles escaped in the summer of 2000. Paul Wilson reported catching numerous fish in the 20 – 25 cm category in July and August. The outlet to Heather Bank Brook is screened but there is concern that the screen could plug and flow could overtop it and its headwall in high water allowing young Atlantics to escape to Heather Bank Brook and the Koksilah. The screen is double and the outlet culvert is about 17 cm above mean winter lake level. It appears that the outlet system has been constructed to prevent escape because the creek used to spill across the road.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

The basin is in transition between forest and light rural residential. Thain Meadows is an important agricultural component of the basin.
A very steep road (up to 70% grade) has been punched from the end of an old mill site below Hillbank Road down to the Koksilah. It has high erosion potential and should not be traveled by vehicles.

Risk Potential

There is a general need for more detailed input to rural residential development plans in this portion of the Koksilah River including tributaries. Adjacent slopes are very steep and highly erodible in sections where sand and silt dominate.

The Lower Koksilah's spawning capability has been highly impaired by erosion and deposition of fines from upstream agriculture - residential activities. Prevention and restoration are required.

Fishery Officer Narrative

Stream Code: 9202577023369

Stream Name: Hume Brook

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: A very small stream that enters the Koksilah from the north just 5 meters above the end of Reach 2, 17,235 m above the Cowichan - Koksilah confluence.

Air Photos	BC82007 160-161
Topographic Map	92B/12
Salmonids	None
Obstructions	None
Max. Temp. (C)	12 (9/1/89)
Min. Disch. (m^3)	.002 (9/1/89)

HUME BROOK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	1.5	1	1180	8.0	CON	N	100	100
Reach 2	2	1.5	1360	1.5	CON	N	500	750

B) FISH UTILIZATION AND LIMITING FACTORS

No fish are present. The stream is tiny.

C) PRODUCTION OPPORTUNITIES

None.

D) LAND USE FACTORS

Forestry

Advanced second growth.

Fishery Officer Narrative

Stream Code: 9202577023489

Stream Name: Wild Deer Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah from the northwest 1,000 m above Burnt Bridge. Drains a steep, narrow basin and Wild Deer Lake.

Air Photos	BC 82007 194-195
Topographic Map	92 B/12
	Co to 500 m.
	St to 500 m.
	Rb to 6,000 m.
Obstructions	2.5 m falls at 500 m.
Max. Temp. (C)	10 (9/6/85 - 200 m above Koksilah).
Min. Disch. (m^3)	0.09 (9/6/85 - 200 m above Koksilah).
	0.03 (9/6/85 - 3,000 m above Koksilah).

WILD DEER CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	7.0	2.0	127R	4.0	CON	N	1,500	3,000
Reach 2	7.0	2.0	1360	2.0	FC	L	6,000	12,000
Reach 3	4.0	0.0	2620	0.5	OC	L	1,000	0

B) FISH UTILIZATION AND LIMITING FACTORS

Steelhead fry and parr are present in the lower 500 m. If coho pass Marble Falls, a few might spawn in Reach 1. Gradient is limiting however.

Rainbow trout are stocked by Fish and Wildlife in Wild Deer Lake. A few may spawn in a 250 m long section of the creek below the lake. Gravel patches and sufficient flow are present but no redds or fry were observed in the spring - early summer of 1985. A few resident rainbows are thought to be present in Reach 2, although none were seen or captured in the summer of 1985.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZTION:*** Coho - above barrier fry colonization (Spring Stocking)

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
WILD DEER CREEK			
Reach 1	3,000	0.5	1,500
Reach 2	12,000	0.5	6,000
			TOTAL 7,500

Wild Deer Lake supports a popular sport fishery for introduced rainbow trout. Coho colonization is an incompatible strategy.
(**Production Option # 475)**

2. ***WILD DEER LAKE RAINBOW RECRUITMENT:*** Construction of spawning platforms in Reach 3 of Wild Deer Creek could provide natural recruitment of rainbows to Wild Deer Lake. **(Production Option # 476)**

D) LAND USE FACTORS

Forestry

60% of the basin is covered by advanced second growth. The remainder is early regeneration in the valley bottom.

Risk Potential

Low. The most sensitive area - a basal till seepage zone at 5,500 - 5,600 m that was roaded and logged 30 years ago - is now stable.

Fishery Officer Narrative

Stream Code: 9202577023548

Stream Name: Grant Lake Creek and Grant Lake

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: An 800 m long stream between Grant Lake and Koksilah River. Consists of short, moderate gradient reaches at its upper and lower ends and a steep gorge in the middle. Grant Lake is a steep sided oligotrophic lake. Ownership is private and access is discouraged.

Air Photos	BC 82007 194-195
Topographic Map	92 B/12
Salmonids	St 70 m.
Obstructions	6 m falls at 70 m. High gradient (15%) gorge for 520 m. There are 14 falls and cascades in this section. 2 m over 3 cascade at 790 m. 1 over 2 cascade at 795 m.
Max. Temp. (C)	11.5 (9/6/85 - 50 m above Koksilah)
Min. Disch. (m^3)	0.16 (9/6/85 - 50 m above Koksilah)

GRANT LAKE CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	5.0	1.5	118R	30	CON	N	70	105
Reach 2	4.0	1.5	0172	15.0	ENT	N	530	795
Reach 3	9.0	2.0	3610	1.0	FC	L	180	360
Reach 4	4.0	1.0	019R	6.0	CON	N	20	20

GRANT LAKE (PRIVATE PROPERTY)

Area	Elevation	Volume	Max. Depth	Mean Depth	TDS
52	224		40.5	20 m	

B) FISH UTILIZATION AND LIMITING FACTORS

A few steelhead fry and parr utilize Reach 1. Grant Lake supports rainbow and cutthroat trout. Most spawn in the outlet channel above the dam. Stream production is limited by short habitable length and high gradient. Flow fluctuation is minimal because Grant Lake is the primary flow source.

C) PRODUCTION OPPORTUNITIES

1.***GRANT LAKE COHO COLONIZATION***

The lake was stocked with a mix of salvaged and wild coho fry in 1985 and 1986. 53,100 (.102/m^2) were stocked in 1985 while 76,100 (.146/m^2) were introduced in 1986. Smolt survival for both years was identical - 18.9%.

Coho fry were introduced in July of both years. In 1986, R. Bams (Pacific Biological Station) planted fry below the thermocline via a pump and "Big O" pipe due to surface temperatures near 20 (Bams, 1989). Coho fry should be stocked in Grant Lake as early as possible to avoid this problem.

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
GRANT LAKE			
Reach 5	500,000	0.15	75,000

Probable smolt yield: 14,175 (18.9%)
(Production Option # 477)

D) LAND USE FACTORS

Forestry

Basin cover is advanced second growth.

Risk Potential

Low.

Stream Code:

Stream Name: Kapoor Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah River from the west 1,500 m above the mouth of Grant Lake Creek. Drains a steep, narrow basin although part of the system drains the summit complex of Mt. Lazar which is of relatively low relief with scattered lakes and wetlands most of which drain to Cragg Creek and Leech River.

Air Photos	BC 82007 194 -195
Topographic Map	92 B/12
Salmonids	St to 1000 m.
Obstructions	1 m over 5 cascades at 1,000 m. 2 m falls 1,020 2 m falls at 1,040 2 m over 5 cascade at 4,500
Max. Temp. (C)	10 (9/6/85)
Min. disch. (m^3)	0.030 (9/6/85 - 50 m above Koksilah River) 0.006 (9/6/85 - 2,500 m above Koksilah River)

KAPOOR CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	7.0	3.0	1360	2.0	CON	N	1,000	3,000
Reach 2	5.0	2.0	136R	2.0	CON	N	3,500	7,000

B) FISH UTILIZATION AND LIMITING FACTORS

A few steelhead utilize the lower 1,000 m. The stream is small for steelhead spawning.

Production is limited by low summer flows, high fall - winter discharge and lack of winter habitat.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Coho - above barrier fry colonization

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
KAPOOR CREEK (Fall Stocking)			
Reach 1	3,000	0.5	1,500
Reach 2	7,000	0.5	3,500
		TOTAL	5,000

(**Production Option # 478)**

D) LAND USE FACTORS

Forestry

Basin cover is 90% advanced second growth and 10% early regeneration.

Risk Potential

Stream Code: 9202577023734

Stream Name: West Koksilah

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah River from the southwest 750 m above the South Koksilah and Koksilah River confluence. The basin is steep and narrow below the 500 m contour then broadens and flattens above it. The stream divides into two branches at 3,000 m.

Air Photos	BC 82007 192-193
Topographic Map	92B 92 B/12
Salmonids	St 1,000 m.
Obstructions	Mainstem: 6 m falls at 1,000 m. 40 m falls at 2,000 m. Branch 1: 10 m falls at confluence with mainstem. 12 m falls at 500 m. Branch 2: 8 m falls at 500 m. 1.5 m over 2 falls at 530 m. 2 m over cascade at 600 m. 2 m over 5 cascade at 620 m. 2 m over 3 falls at 630 m.
Max. Temp. (C)	Mainstem: Branch 1: 7 (9/7/85 at 510 m) Branch 2: 8 (9/7/85 at 3,130 m) Branch 2: 11 (9/7/85 at 550 m)
Min. Disch. (m^3)	Mainstem: 0.025 (9/7/85 calculated from Branch 1 and 2 flows) Branch 1: at 510 m 0.0079 Branch 2: at 3,130 m 0.006 Branch 2: at 550 m 0.017 - all at 9/7/85

WEST KOKSILAH

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
				Mainstem				
Reach 1	10.0	4.0	1243	4.0	CON	N	1,000	3,000
Reach 2	8.0	3.0	1243	5.0	ENT	N	1,500	4,500
Reach 3	8.0	3.0	1252	10.0	ENT	N	500	1,500
				Branch 1				
Reach 1	5.0	2.0	1252	10.0	ENT	N	500	1,000
Reach 2	5.0	1.5	1261	2.5	CON	N	1,000	1,500
Reach 3	4.0	1.0	1261	8.0	CON	N	1,500	1,500
				Branch2				
	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	7.0	2.0	1234	6.0	ENT	N	1,000	2,000
Reach 2	7.0	2.0	1810	1.5	FC	L	2,500	5,000
Reach 3	5.0	1.0	1270	8.0	CON	N	1,000	1,000

B) FISH UTILIZATION AND LIMITING FACTORS

Steelhead utilize the lower 1,000 m. Production is limited by high fall - winter discharge and lack of winter habitat.

C) PRODUCTION OPPORTUNITIES

1.***COHO COLONIZATION:*** Coho - above barrier fry colonization (Spring Stocking)

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
WEST KOKSILAH MAINSTEM (Spring Stocking)			
Reach 1	4,000	0.5	2,000
Reach 2	4,500	0.5	2,250
WEST KOKSILAH BRANCH 1 (Spring Stocking)			
Reach 3	1,500	0.5	750
WEST KOKSILAH BRANCH 2 (Spring Stocking)			
Reach 2	5,000	1.0	5,000
			TOTAL 10,000

(**Production Option # 479)**

D) LAND USE FACTORS

Forestry

Basin cover is 90% early second growth and 10% old growth.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code:

Stream Name: South Koksilah

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah River from the south 1,500 m below Fellows Creek - Koksilah confluence. The basin is steep and narrow for 4,000 m (stream length), then broadens for 2,500 m and is of low relief in the upper basin where wetlands help buffer flow.

Air Photos	BC 82007 192-193
Topographic Map	92 B/12
Salmonids	St 4,000 m.
Obstructions	Falls 4 m over 6 m at 4,000 m.
Max. Temp. (C)	8 (9/7/85 at 5,000 m)
Min. disch. (m^3)	0.16 (9/7/85 at 5,000 m) 0.20 (9/7/85 at confluence with Koksilah) 0.008 at 6,000 m near headwaters

SOUTH KOKSILAH

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	15.0	4.0	1360	2.5	CON	N	1,000	4,000
Reach 2	12.0	4.0	1270	2.0	CON	N	1,500	6,000
Reach 3	10.0	4.0	127R	4.5	CON	N	2,500	10,000
Reach 4	5.0	2.0	1261	1.5	FC	L	2,500	5,000

B) FISH UTILIZATION AND LIMITING FACTORS

Steelhead utilize the lower 5,000 m. This section of the stream is high gradient and marginal coho habitat (coho are not present in this part of the system due to Marble Falls).

Production is limited by high fall - winter flows and lack of winter habitat in the accessible area. These factors are less significant in the inaccessible upper 2,500 m where several small wetlands are present, gradient is much less and steep tributaries are absent. This portion of the system is excellent coho habitat; it presently supports no fish. It was extensively electro fished on May 23, 2000.

C) PRODUCTION OPPORTUNITIES

1) ***COHO COLONIZATION:*** Coho above barrier fry colonization

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
SOUTH KOKSILAH MAINSTEM (Spring Stocking)			
Reach 1	4,000	0.5	2,000
Reach 2	6,000	0.5	3,000
Reach 3	10,000	0.5	5,000
Reach 4	5,000	1.0	5,000
		TOTAL	15,000

(Production Option # 480)

2) ***WETLAND IMPOUNDMENT- HEADWATER STORAGE***

13 hectares of headwater wetlands could yield 5.32 LPS for 180 days with 1 m of storage. More important, it would improve survival and migration of stocked coho.
(Production Option # 481)

D) LAND USE FACTORS

Forestry

Forest cover is 90% early second growth and 10% old growth. About 1% of the old growth is a buffer strip on very steep slopes (60% plus) adjacent to portions of the lower 4,000 m of river.

Risk Potential

Low.

Fishery Officer Narrative

F) PROTECTION NEEDS

The South Koksilah is contained in a deep ravine with very steep sidewalls for much of its length in Reaches 1-3. Logging and roads need to be set well back from its edge. Reach 4 is strongly riparian for much of its length and may require a substantial setback.

Stream Code: 9202577023766

Stream Name: Fellows Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah River 500 m below Koksilah Falls. Drains a steep, narrow basin although the upper portion of McPherson Creek, its major tributary, drains a relatively broad, low relief area.

Air Photos	BC 82007 163-164
Topographic Map	92 B/12
Salmonids	St 2,000 m.
Obstructions	2.5 m falls at 500 m. 8 m falls over 12 m at 2,000 m, vertical drops of 2, 2 and 4 m. 3 m falls over 5 m at 2,500 m.
Max. Temp. (C)	11 (9/9/85 50 m above Koksilah)
Min. disch. (m^3)	0.05 (9/9/85 50 m above Koksilah)

FELLOWS CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	15.0	4.0	136R	2.5	CON	N	2,000	8,000
Reach 2	6.0	4.0	1126	30.0	ENT	N	400	1,600
Reach 3	7.0	4.0	136R	2.0	CON	N	4,000	16,000
Reach 4	--	--	--	16.0	CON	N	2,000	0

B) FISH UTILIZATION AND LIMITING FACTORS

Fellows Creek supports steelhead. Coho will also utilize the stream when access above Marble Falls stimulates population expansion.

Production is limited by high fall - winter discharge and lack of winter habitat. Accessible length is also limiting. Including McPherson Creek, coho would have access to only 4% of its potential habitable length. Steelhead use 20%. For Fellows Creek alone, coho could utilize 9% and steelhead are present in 36%.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Coho - above barrier fry colonization

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
FELLOWS CREEK MAINSTEM (Spring Stocking)			
Reach 1	8,000	0.5	4,000
Reach 2	16,000	0.5	8,000
		TOTAL	12,000

Note: Steelhead colonization is also possible in R3 which is better steelhead habitat than coho with a 2% gradient and mainly boulder substrate. At .2 fry/m^2, 3200 fry would be required.
(**Production Option # 482)**

D) LAND USE FACTORS

The basin is covered by 40% early regeneration, 40% early to advanced second growth and 10% old growth.

Risk Potential

Low. Most high-risk areas have been harvested with minor impacts.

Fishery Officer Narrative

Stream Code:

Stream Name: McPherson Creek and Lake

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: A small tributary of Fellows Creek. It joins Fellow Creek 2,000 m above the Fellows - Koksilah confluence. Its basin is steep and narrows in the first 1,000 m (stream length). It then flattens and broadens somewhat in the next 5,000 m. A small lake and three wetland basins are located in this reach. Above 5,000 m, the basin narrows and steepens again.

Air Photos	BC 82007 163-164
Topographic Map	92 B/12
Salmonids	A few rainbow/steelhead are present in the first 400 m.
Obstructions	A 30 m falls over 40 m at 400 m.
Max. Temp. (C)	10 (8/29/85)
Min Disch. (m^3)	.013 (8/29/85)

MCPHERSON CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	7	3	1252	6.0	ENT	N	1,000	3,000
Reach 2	5	2	1432	2.0	CON	N	5,000	10,000
Reach 3	3.5	1.5	136R	4.0	CON	N	2,000	3,000

MCPHERSON LAKE

Area	Elevation	Volume	Max. Depth	Mean Depth	TDS
3	560				
6 (with impoundment to flood wetland margins)					

B) FISH UTILIZATION AND LIMITING FACTORS

A few rainbow/steelhead utilize the portion of Reach 1 below the falls.
Production is limited by the falls and steep gradient below along with high falls - winter discharge and lack of winter habitat.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION /HEADWATER STORAGE:*** Coho - above barrier fry colonization

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
McPHERSON CREEK (Spring Stocking)			
Reach 2	10,000	0.5	5,000
McPHERSON LAKE (Spring Stocking)			
Reach 2A	30,000	0.15	4,500

TOTAL 9,500

If McPherson Lake was impounded and flooded to increase wetted area, an additional 4,500 coho fry could be supported. If the three tributary wetlands were impounded, another 6 ha. of coho habitat could be provided at .15 fry/m^2, another 90,000 fry could be carried.

However, wetland flooding to increase coho carrying capacity is considered to be chancy in this case. The wetland basins are quite mature (they are fully covered with hardhack and associated species of vegetation) and winter inflow is slight. Aside from McPherson Lake, impoundment might produce stagnant ponds with high oxygen demand. (Production Option # 483)

D) LAND USE FACTORS

Forestry

The basin is intensively managed for forest products. Most of it has been logged with minor impact. Advanced second growth now covers most of it.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code:

Stream Name: Old Truck Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah River (Reach 5) from the north 3,700 m above Marble Falls. Drains a basin of moderate slopes and relief.

Air Photos	BC 82007 163-164
Topographic Map	92 B/12, 92B.071
Salmonids	None.
Obstructions	None.
Max. Temp. (C)	7 (9/1/85)
Min. Disch. (m^3)	0.002 (9/1/85)

OLD TRUCK CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	5.0	4.0	127R	5.0	CON	N	1,000	4,000
Reach 2	6.0	3.0	1360	1.5	FC	L	2,000	6,000
Reach 3	--	--	--	9.0	CON	N	1,500	0

B) FISH UTILIZATION AND LIMITING FACTORS

No fish present. This stream enters the Koksilah River above the barrier to anadromous salmonids. Small size, low summer flow and high fall - winter discharge are limiting.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Coho - above barrier fry colonization

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
OLD TRUCK CREEK (Spring Stocking)			
Reach 1	4,000	0.5	2,000
Reach 2	6,000	1.0	6,000
			TOTAL 8,000

(Production Option # 484)

D) LAND USE FACTORS

Forestry

The basin is covered with early second growth.

Risk Potential

Low.

Fishery Officer Narrative

Stream Code:

Stream Name: Mystery (Highline) Creek

Operational Management Unit: Koksilah Basin

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: Enters the Koksilah in Reach 4 from the southeast 26,830 m above the Cowichan - Koksilah confluence. A two-tiered stream: steep in its' lower reaches then low gradient in the upper basin which is broad and of very low relief.

Air Photos	BC 82007 162-163
Topographic Map	92 B/12, 92B.061
Salmonids	None.
Obstructions	A series of small falls and cascades with a total drop of 32 m in Reach 1. Greatest vertical drop is 4 m.
Max. Temp. (C)	10 (9/15/85)
Min. disch. (m^3)	0 (Int. 9/15/85) Reach 3 .003 (9/15/85) Reaches 1 and 2

MYSTERY CREEK

	Channel width (m)	Wetted width (m)	Substrate	Slope%	Channel Confinement	Side Channel	Length L (m)	Wetted Area (m^2)
Reach 1	4	2	0253	11.5	ENT	N	350	700
Reach 2	4	2	1360	2.0	CON	N	1,040	2,080
Reach 3	3	1	1360	1.0	PC	L	1,500	1,500
Reach 4	1	0	1360	1.0	PC	L	1,250	0

B) FISH UTILIZATION AND LIMITING FACTORS

No fish are present due to the barrier at the confluence with the Koksilah.

Potential production is limited by low summer flow and high gradient in Reach 1.

C) PRODUCTION OPPORTUNITIES

1. ***COHO COLONIZATION:*** Coho - above barrier fry colonization

	Wetted Area (m^2)	Bio-standard (fry/m^2)	Fry Number
MYSTERY CREEK (Spring Stocking)			
Reach 1	1,500	1.0	1,500

Some steelhead production can also be expected from Reach 1. Although its' mean gradient is 11.5%, there are numerous plunge pools that provide excellent habitat. Steelhead fry survival in high gradient habitat can be very good (Slaney, et al., 1980).
(Production Option # 485)

2.***HEADWATER STORAGE AND COLONIZATION***

Wetland impoundment could store 13 ha. of water for summer release. This would yield .51 LPS to the lower 31% of the stream and contribute to low summer flows in the Koksilah in a minor way. If this habitat could be colonized with fall coho fry (1500/ha), 3,900 smolts could result (Production Option # 486).

D) LAND USE FACTORS

Forestry

The basin is part of MacMillan Bloedel's Shawnigan (Cowichan Woodlands) Division. Most of it has been recently logged and is in early stages of second growth.

Risk Potential

Low.

E) HISTORICAL NOTES

First surveyed in September 1985.

Fishery Officer Narrative

OPERATIONAL MANAGEMENT UNIT 17: SOUTHEND

OVERVIEW

The Southend OMU extends south from Outer Cowichan Bay to the south end of the CVRD near B.C. Hydro's 500 kv line crossing of Finlayson Arm on the Malahat. This OMU is a mix of rural residential and agricultural uses in the east grading to upland forestry in the west. Urbanization is relatively light and is mainly limited to the Island Highway strip, Arbutus Point, Shawnigan Lake Village area and Cobble Hill. There are numerous other pockets of urbanization in the form of residential subdivisions and mobile home parks scattered through the eastern portion of the OMU.

There are only 4 significant salmonid systems in the OMU: Garnett Creek at Cherry Point-Boatswain Bank, Shawnigan Creek and Lake, Upper Shawnigan Creek and Johns Creek at Bamberton. These basins are rather diverse in character: Garnett is dominated by agriculture to the point where its productivity for salmonids is highly compromised, Shawnigan Creek is a diverse mix of agricultural, small scale urban, forestry and rural residential, the most important and sensitive portion of John's Creek is in Bamberton Park and Upper Shawnigan Creek is surprisingly wild with some agricultural use adjacent to Reach 1 and some very light residential use in the upper reaches around Shawnigan Lake Rd. and Stebbings Rd. The majority of the basin is forestland.

LIMITING FACTORS

Salmonid production is limited by access (it is highly unfortunate that the Shawnigan system is naturally unavailable to anadromous trout and salmon, especially coho, because of impassable falls low in the system) and low summer flows. Garnett Creek is also limited by heavy sedimentation.

PRODUCTION OPTIONS

There are 15 opportunities to improve salmonid production in the OMU. They are outlined and prioritized in Table 1:

Table 1: Production Opportunities in the Southend OMU

No.	Location	Activity	Priority
487	Garnett Creek	Riparian restoration	1
488		Substrate maintenance and improvement	1
489		Reservoir coho colonization	1
490		Headwater storage	1
491		LWD addition	1
492		Chum salmon boost	1
493		Cherry Point Creek access	1
494	Shawnigan Creek	Increased storage	5
495		Coho transfer/colonization	1

496		Intertidal zone substrate improvement	1
497	Upper Shawnigan	Coho colonization	3
498	Kilmalu	Headwater storage	2
499		Barrier improvement	2
500	Johns	Reach 1 substrate improvement	2
501		Coho colonization	1

Stream Code: 9202448

Stream Name: Garnett Creek

Operational Management Unit: Southend

CVRD Electoral Area: C

A) BIOPHYSICAL OVERVIEW: A small rural stream that originates in pasture and woodland west of Telegraph Road and flows east for 3025 m to enter Satellite Channel at Boatswain Bank. The stream is contained in a low ravine for much of its length. The basin is of relatively low relief. The South Fork of Garnett Creek is known as Cherry Point Creek and supplies much of Garnett Creek's flow below the confluence.

Air Photos:	BC 87024: 76-77
Topographic Maps:	92B/12, 92B.073
Obstructions:	1.7 m falls at 2425 m
Salmonids:	Co to approximately 2100 m
	Ct to approximately 2100 m
	Cm to approximately 900 m
Max. Temp.	17 R2 (8/5/96)
Min. Disch.	.00975 R2 D/S res. trib. confluence (8/5/96)
	.002074 R5 (8/5/96)
	.00001 R7 (8/5/96)

GARNETT CREEK

	Channel Width	Wetted Width	Substrate	Slope %	Channel Confinement	Side Channel	LWD	Length	Wetted Area
Reach 1	8	2	6220	.5	UC	L	0	48	Tidal
Reach 2	6	3	2440	1.0	FC	L	.008	1147	3441
Reach 3	4	1	1450	2.0	CON	N		253	253
Reach 4	3	1	1360	2.5	CON	N		40	40
Reach 5	4	1	3700	1.0	FC	L		332	332
Reach 6	3	1	1630	1.5	CON-ENT	N		312	312
Reach 7	2	0	6310	2.0	CON	N		554	0
Reach 8	1	0	9100	1.0	FC	L		466	0

B) FISH UTILIZATION AND LIMITING FACTORS

Garnett Creek is utilized by small numbers of coho salmon and cutthroat trout. Chums were reported in the past and occasional fish may still utilize the stream. Three were reported in 1998.
Production is limited by low summer flows and degraded substrate and riparian condition. The basin is intensively used for agriculture and sediment-laden runoff from raw ditches, bare fields and cattle trodden slopes is a common occurrence. Fish kills have been experienced from manure (liquid fertilizer) washing into the stream in heavy runoff events. On one occasion, manure was spread on crusted snow only to have much of it flush into the creek when the thaw arrived with heavy rain a few days later. The stream also lacks LWD. Another fish kill occurred below Cherry Point Creek on August 30, 2001. All fish present below the confluence were killed. No explanation was found but it was felt that low quality water from the depths of Wikkerink's Reservoir may have been displaced (driven to the surface) by cool inflow water from Cherry Point Creek runoff and flowed down the creek. Cherry point Creek makes up some 70 % of Garnett Creek's summer flow.
A May 28, 2001 survey between the estuary and Cherry Point Creek confluence revealed that coho fry were numerous to a point 270 m above Cherry Point Road then dwindled fast. Only cutthroats were present above the 270 m point. This leads to the question that could the Garnett coho population be upstreamers from the Cowichan – Koksilah? Fish First counted the creek for the last two years without seeing a single coho spawner.

C) PRODUCTION OPPORTUNITIES

1.*RIPARIAN RESTORATION*: Riparian slope and bank restoration is required (especially in Reach 2 and in the upper reaches above Telegraph Road where pasture replaces ravine). Fencing and planting is needed. An agreement with the landowners will have to be worked out (Production Option # 487) Three significant slope failure areas are present at 395, 490 and 567 m of R2. A combination of rock revetment at the slope toes and planting upslope is needed. NOTE: Fish First has accomplished a good deal of riparian restoration in both R2 and in sections of both branches above Telegraph Road.

2. *SUBSTRATE MAINTENANCE AND IMPROVEMENT:* periodic substrate cleaning in spawning areas at the beginning of fall freshets would improve productivity. Spawning platform construction or at least periodic addition of clean gravel at the primary spawning sites (Reach 2) would further improve fry recruitment (Production Option # 488). NOTE: Fish First added a spawning platform just below Cherry Point Creek in the summer of 2001.

3.*COHO COLONIZATION:* The reservoir on Cherry Point Creek has a coho smolt yield potential of 108. The inlet to the reservoir also has some capability (Production Option # 489)

4. *HEADWATER STORAGE:* A number of wetland basins are present in the Upper Basin: Judge Wetland, Padur Pond, and Spirea Wetland along with the Wikkerink Reservoir. Total available CDP flow with 1 m of storage is 3.58 LPS. Padur Pond is .3, Spirea Wetland is .2, Judge wetland is 2.8 and Wikkerink reservoir is .28 (Production Option # 490).

5.*LWD ADDITION:* Much of Garnett Creek is LWD deficient. Judicious placement would be of considerable benefit. A priority site is the mainstem – Cherry Point Creek Confluence Pool area. R2 LWD density to the confluence of Cherry Point Creek is only .008. There are a number of sites where installation of windfall logs or angled scour logs would provide considerable benefit. A number of suitable old cedar logs are present nearby (Production Option # 491).

6. ***CHUM SLAMON BOOST:*** A remnant chum run is present but numbers are very low and the run doesn't occur every year. If a stronger run could be established, considerable benefit to substrate quality and overall productivity would result (**Production Option # 492)**

7. *CHERRY POINT CREEK ACCESS:* Cherry Point Creek (South Fork of Garnett) is blocked by an earth fill dam at its confluence with Garnett. The dam was constructed in the early 1960's to store water for irrigation. A spill channel (no spillway is present) on the north side of the fill. It could possibly be modified into a fishway so coho and anadromous cutthroat could access the creek and reservoir. Good spawning and rearing habitat is present above the reservoir (**Production Option # 493)**

D) LAND USE

Agriculture

About 70 % of the basin is utilized for agricultural purposes. Most of the creek ravine is still wooded but cattle have free access for much of it and the upper portions of the mainstem and several small tributaries are cleared,

Residential

Light residential development mostly along Cherry Point Road. Some residences practice minor backyard dumping into the ravine and some homes are set too close to its edge.

E) PROTECTION NEEDS:

A comprehensive stewardship/protection plan is required for the Garnett Basin. David Groves of the Cowichan Watershed Council has suggested that a Bonsall Creek type process might be an appropriate model. Most of the creek below Telegraph Road is contained in a ravine with areas of high soil moisture along its walls. Cattle have had their way with portions of the ravine and damaged both the slopes and the stream banks. Fencing is required at the top of the ravine. A local stewardship group should be formed to protect and improve the creek. Its goals should be the following:

1. to map the creek and its network of feeder streams at a scale of 1:2,500 or better.
2. Identify all sources of erosion and sedimentation and identify treatment measures to heal the sources
3. Identify other land use problems such as barnyard runoff and degraded riparian zones and recommend treatment measures

NOTE: The creek was mapped in the spring of 1998 and summer of 1999 by CFDC/Fish First and riparian planting and fencing is progressing especially in the portion above Telegraph Road. A spawning platform and windfall log were added on October 1, 2001 by Fish First. Must of the gravel washed away in November flooding.

Water quality is also a concern in Garnett Creek. Not only does it suffer from agricultural runoff but there is a problem with septic seepage in the estuary. Grey water seeps into the creek from the northwest and seems to be coming from the housing development along Balsam Drive.

Stream Code: 920358000

Stream Name: Shawnigan Creek and Lake

Operational Management Unit: Southend

CVRD Electoral Area: A, B

A) BIOPHYSICAL OVERVIEW: A medium sized stream well buffered by Shawnigan lake where a small weir (1963) is utilized to augment summer flow. The basin is relatively broad and of low relief. Unfortunately for anadromous fish, particularly steelhead and coho, there is a series of impassable falls beginning at tidewater.

Air Photos	BC 87202: 91-92, 113-114
Topographic Maps	92B/12, 92B.062, 92B.063
Salmonids	Ct to Shawnigan Lake and in Hollings/Handysen Creeks and Omar Creek. Also in Shawnigan Lake tribs McGee and West Arm Creek. Rb in mainstem Cm occasional intertidal spawning
Obstructions	15R20 at head of estuary, 4R8, 2R4 and 5R26 just upstream Stonebridge Falls at 274 m: 3R9, 1R3 Third set of falls adjacent to Kerry park Arena and Shawnigan – Mill Bay Rd. in R4: 2R4, 1R3, 4R5. 2R3 350 m upstream and 2R4 600 m above. Numerous small dams are present especially in Reaches 9, 10 and 15. These are not obstructions. A large log jam with some building materials in it is present in R6. It's a potential obstruction.
Max. temp. (C°)	16 (R4 – 8/17/96) 20 (R14 –7/23/98)
Min. Disch. (m^3)	.0408 (R4 – 8/17/98) Mill Bay gauge has read 0 twice: 8/14/77 and 7/23/78 and commonly reads between .001 and .004 CMS 0 at lake outlet across Mason's Beach (9/2/97) but standing water from Renfrew Rd. to weir
Max. Disch.	44.7 (12/18/79)

SHAWNIGAN CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	16	6	0019	25	CON	N	128	768
Reach 2	15	9	1234	5	CON	N	146	1314
Reach 3	15	13	4330	1.0	CON	N	218	2834
Reach 4	18	10	1117	2.0	CON	N	551	5510
Reach 5	6	4	1018	3.0	CON	N	664	2656
Reach 6	12	10	1140	2.5	CON	N	591	5910
Reach 7	13	4	2620	2.0	CON	L	613	2452
Reach 8	14	8	1126	1.0	CON	N	280	2240
Reach 9	9	7	1141	1.0	FC	M	2084	14588
Reach 10	10	7	1450	.5	FC	L	588	4116
Reach 11	150	20	1000	.01	UC	H	1250	25000
Reach 12	11	2	1441	2.0	CON	L	1339	2678
Reach 13	5	3	1126	3.0	CON	N	1055	3165
Reach 14	5	2	1117	2.0	CON	N	266	532
Reach 15	8	6	1261	1.0	FC	L	997	5982

SHAWNIGAN LAKE

Area	Elev.	Volume	Perimeter	Max. Depth	Mean Depth	TDS	Flush time
595 ha	118 m	63,377,230 m^3	26,920 m	39 m	10.67 m	40	1 yr.

Shawnigan Lake drains an area of 61.63 km^2. The lake is of moderate productivity by coastal standards and contains cutthroat and rainbow trout, Smallmouth bass and a wide mix of other species. Kokanee have been reported as have brown bullheads. Lake whitefish were also introduced at one time.

B) SHAWNIGAN LAKE SHOREZONE

Shawnigan Lake's Shore zone is also relatively productive. 96.14 % of its length is Class 2 or better. The primary reason for this is that exposure is generally low which has allowed productive community development on all shore types other than rock.

Reach	Name	Exposure	Slope	Substrate	Riparian	Shoal	Class	Length
1	Mason's	2	.2	7300	L	H	2	100
2	Bass Bay	2	1.5	6220	L	M	2	2200
2A		2	1.5	9100	L	L	2	300
3	Inner Marina Bay	0	.1	1000	H	H	1	380
4	Outer Marina Bay	1	1.0	8200	L	H	2	660
5		2	2.0	5500	L	L	2	700
6		1	1.0	1000	H	H	1	100
7	Windmill	3	80.0	0019	L	L	3	140
8	Rocks	2	2.0	7210	L	M	2	600
9		3	80.0	1135	L	L	3	400
9A	Little Cattail Bay	1	1.0	1000	H	M	1	50
10	B.C. Tel	2	2.0	7210	M	H	2	460
11		2	30.0	2341	L	L	3	400
12		1	2.0	8200	M	M	2	1400
13		2	20	2331	L	L	2	650
14		1	.1	1000	M	M	1	220
15		2	2.0	8200	L	L	2	820
15A	Island	2	30	1261	L	M	2	120
16	Inlet wetlands	1	.01	1000	H	H	1	800
17	Disco City	2	10	3331	L	L	2	950
18		0	.1	1000	M	M	1	120
19		2	1.5	8200	H	L	2	400
19A		1	.5	1000	H	M	1	150
20	Old Shack	2	15	1153	M	H	2	2420
20A		0	.5	1000	M	H	1	50
20B	Behind Island	0	1.0	1252	M	H	1	70
20C		1	2.0	1522	L	M	2	60
21	Dollhouse Bay	1	2.0	100R	M	M	2	520
22	Outer Dollhouse Bay	2	2.0	2341	L	L	2	1500
23	Egg Island	1	2.0	2611	L	M	2	820
24	Egg Is. N	2	5.0	2332	L	L	2	460
25	Round Is. And Shore	2	2.0	2710	L	L	2	650
26	Beyond	2	2.0	4510	L	M	2	1300

	Islet/Outer W.Arm							
27	West Arm	1	2.0	6211	M	M	2	3650
27A		1	.1	1000	H	H	1	200
27B	West Arm Deltaic Wetland	1	.01	1000	H	H	1	200
28	Outer W. Arm Marsh	1	.1	1000	H	M	1	200
29		2	1.5	8200	L	M	2	2000
29A		1	.5	9100	M	M	1	100
29B		1	.5	1000	M	H	1	140
29C		2	70	0019	L	L	3	100
30		1	1.5	9100	L	H	2	160
31		1	2.0	6211	L	H	2	200

Note: Reach 16 (Inlet Wetland) has been identified as having relatively high priority for purchase by a public conservation group like the Nature Conservancy or Nature Trust (Burns, 1978)

C) FISH UTILIZATION AND LIMITING FACTORS

Cutthroat trout dominate the stream but rainbows are also present. Coho salmon are lifted above the falls and transported upstream.
Production is limited somewhat by low summer flows.
Shawnigan Lake supports rainbow and cutthroat trout (cutthroats are more numerous), Smallmouth bass and pumpkinseeds.

D) PRODUCTION OPPORTUNITIES

1. ***INCREASED STORAGE****:* Increased storage at the Shawnigan Lake weir should be investigated (Production Option # 494)

2. ***ADULT COHO TRANSPORT OR COHO COLONIZATION:*** That Shawnigan Creek is inaccessible to coho spawners is a tragedy because it is excellent coho habitat with 78,979 m^2 of wetted area with less than 3% slope above the falls. Potential coho smolt yield is 6318 for the creek alone. The lake's yield potential is also high as is Upper Shawnigan Creek's. The program of transporting adults around the falls should continue with supplemental fry stocking (Production Option # 495)

3. ***INTERTIDAL ZONE SUBSTRATE IMPROVEMENT:*** There is a long history of chum spawning in the intertidal zone which is dominated by muddy sand-gravel in this protected estuarine cove. There is a periodic need to scarify existing spawning sites and add fresh gravel on occasion to keep these sites viable (**Production Option # 496).**

E) LAND USE FACTORS

Forestry

Basin cover is advanced second growth. Forestry is a minor factor in this rural basin dominated by small agricultural holdings and residential use.

Agriculture

A number of small holdings are present throughout

Residential

Limited residential development mainly low density. Very light impact on the stream but parts of the lake's shore zone have been degraded.

F) PROTECTION NEEDS

LAKE

All Class 1 and 2 shore zone needs complete protection. Some of the reaches are very short and would require spot zoning which would be awkward and difficult to map. The entire lakeshore should be designated a development permit area. There are a number of intrusions (deleterious uses) in the shore zone as residents have tried to extend the usable portion of their property by filling and bulk heading, scalping vegetation and other intrusive practices.

STREAM

Shawnigan Creek traverses a variety of landscape features including some extensive riparian and wetland areas and some ravine units. The Fisheries Sensitive Zone reflects this variety. For the most part, intrusions are very few, surprisingly so in an area with such a long history of settlement

Stream Code : 920358000

Stream Name: Upper Shawnigan Creek

Operational Management Unit: Southend

CVRD Electoral Area: B

A) BIOPHYSICAL OVERVIEW: A medium sized stream that drains a basin that is broad and of relatively low relief in Reach 1 (1600 m), then steep and narrow until it reaches its headwaters southeast of Deveraeux Lake at approximately 400 m ASL. Upper Shawnigan Creek and its watershed are relatively undisturbed for a system in such close proximity to urban zones. Upper Shawnigan Creek's main flow carriers are Stebbings and Deveraux Creeks as well as lower tributaries such as Perfection and Van Horne.

Air Photos:	BC87024: 113-114
Topographic Maps	92B/12, 92B.043, 92B.053, 92B.052
Salmonids	Ct throughout and in Chatter, Perfection, Van Horne, Gooseberry Creek, Stebbings and Deveraux Creeks and in Stebbings and Deveraux Lakes. Shawnigan Lake spawners to Punch Bowl Falls at 1704 m. Co occasional spawner to 1704 m. Fish are lifted above falls on Lower Shawnigan Creek, some find their way through the lake to Upper Shawnigan Creek. Rb probable to 1704 m.
Obstructions	Punch Bowl falls at 1704 m 1R2 @ 1784 m 6R12 @ 2124 m 2R3 @ 2726 m 2.5R6 @ 3212 m 2R3 @ 3392 m 1R @ 3702 m 2R3 @ 3758 m 2R3 @ 3781 m 1.5R2@ 4261 m 22R30 @ 4470 m 5R15 @ 4550 m
Max. temp. (C°)	14.5 R1 (9/20/97)
Min. Disch. (m^3)	.0163 R1 (9/8/96)

UPPER SHAWNIGAN CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	10	6	2710	1.0	FC	M	1600	9600
Reach 2	7	4	1270	2.0	FC	M	60	240
Reach 3	5	4	1243	4.0	CON-ENT	N	150	600
Reach 4	8	4	1261	3.0	CON	N	230	920
Reach 5	10	4	1360	2.0	FC	L	80	320
Reach 6	9	5	1540	1.5	FC	M	555	2775
Reach 7	6	4	1342	4.0	CON	N	65	260
Reach 8	8	4	1360	2.0	CON	N	885	3540
Reach 9	5	4	1162	5.0	CON	N	650	2600
Reach 10	6	4	136R	2.0	FC	L	630	2520
Reach 11	5	5	1252	6.0	CON-ENT	N	450	2250
Reach 12	7	4	1720	1.3	FC	L	900	3600
Reach 13	4	0	1630	4.0	FC	L	300	0
Reach 14	3	0	1360	12.0	CON	N	1000	0

B) FISH UTILIZATION AND LIMITING FACTORS

Upper Shawnigan Creek is the main supplier of juvenile cutthroat trout to Shawnigan Lake. Spawning occurs between December and April. Fry emergence begins in May and June. Resident cutthroats are present in the rest of the system below Deveraeux and Stebbings Lakes and in the lakes and are very numerous in some reaches. They are also present in Chatter, Perfection, Van Horne and Gooseberry Creeks
Coho salmon spawners are lifted above the falls on Lower Shawnigan Creek and some continue through the lake to spawn in Reach 1.
Shawnigan Lake rainbow trout likely also spawn in Reach 1 of Upper Shawnigan Creek.
Production of migrant fish is limited by the relatively short accessible length. All other factors are favorable. Upper Shawnigan Creek holds its water well and is highly productive.

C) PRODUCTION OPPORTUNITIES

1. ***POSSIBLE COHO COLONIZATION****:* Probably not practical. Coho colonization above Punch Bowl Falls would yield approximately 520 smolts but stocking would be very difficult due to very spotty access and the small yield. Deveraux and Stebbings Lakes might also be considered (Production Option # 497)

D) LAND USE FACTORS

Forestry

Forestry is the primary use. Second growth harvesting began in the late 1980's and continues. Most of the area is administered by BCFS and logging has been well planned from a stream protection viewpoint.

Agriculture

One farm (Wickheim) is present adjacent to Reach 1 between West Shawnigan Road and Sooke Lake Road.

Residential

Very light. Some small holdings in the Upper Basin off Stebbings Road and some development along Shawnigan Lake Rd.

E) PROTECTION NEEDS

An extensive wetland /riparian zone is adjacent to Reach 1 mainly below West Shawnigan Road. It extends inland along Musk Lily Creek and upstream into the Wickheim Farm. The frontal portion the unit comprises the most productive reach of Shawnigan Lake's shorezone (Reach 16 – 800 m of Class 1 shorezone habitat)/ This wetland/riparian zone is one of the most important in the CVRD. Only the Cowichan Estuary – Somenos Marsh and the Chemainus Estuary – Bonsall Wetlands rank higher (Burns, 1978).
The remainder of Upper Shawnigan Creek's Fisheries Sensitive Zone is comprised of periodic riparian areas like those adjacent to Reaches 6 and 7 and steep adjacent slopes. Significant Fisheries sensitive Zones are also present on Perfection and Van Horne Creeks. and at the confluence zones of Upper Shawnigan and Deveraux Creeks and Deveraux and Stebbings Creeks.

Stream Code:

Stream Name: Kilmalu Creek

Operational Management Unit: 17 - Southend

CVRD Electoral Area: A

A) BIOPYSICAL OVERVIEW: A small rural/semi – urban stream that roughly parallels the Island Highway from the Springwood Trailer Park above Hutchinson Road in the north to Kilmalu Road in the south. Below Kilmalu Road, the stream is located 200 – 500 m east of the highway. The stream originates in Hutchinson (Merilee's) Lake, a shallow basin which is as much wetland as it is lake, a spring above Sitka Way just west of Hutchinson Lake and springs and wetlands below Springwood Trailer Park. The stream is well buffered by wetlands between its headwaters and its small estuary in Mill Bay Community park. The estuary has a small salt marsh (*Salicornia – Distichlis)* which blends into an intertidal zone of sandy mud, gravel, cobbles and boulders.

Air Photos	BC87025: 113-114
Topographic Maps	92B/12, 92B.063
Salmonids	Co to Kilmalu Rd. Culvert @ 635 m, in some years they may only reach cascades in R2 @ 156 m. Co are very sparse. Only 40 were counted in the summer of 2000 and only 19 were counted in July 2001. Ct to Kilmalu Rd. culvert @ 635 m. Also sparse. PMB to man made pond near Sitka Rd. at approximately 4000 m and to Hutchinson lake at approximately 4600 m.
Obstructions	Two cascades in 15 m long canyon (R2) usually passable for Co-CT: 1R3 @ 159 m 1R3 @ 168 m Kilmalu Rd. culvert @ 635 m: 1.2 m vertical drop at low water
Max. temp.	21° in isolated R1 exposed pools but temp. was 17° in nearby shaded pools 7/31/01
Min. Disch.	Int. all the way 7/31/01. Only six pools were present in R1 and only one contained Co – Ct fry. Small springs are present for the entire length of Kilmalu Creek but they are widely scattered. In terms of accessible habitat, an important spring trib. enters at the 205 m point of R3 177 m below Kilmalu Road. It is responsible for most of the water below Kilmalu Rd. Kilmalu Creek was monitored closely in the summer of 2001. July 31 was its lowest flow. Rain fell in early and mid – August and the stream flowed continuously after August 2. Long time residents report that the creek flowed all year before the Island Highway was built in its present location in the 1950's.

KILMALU CREEK

	Channel Width	Wetted Width	Substrate	Slope %	CON	Side Channel	LWD	Length	Wetted Area
Reach 1	4	0	1360	3.5	FC	L	.027	156	30
Reach 2	3	0	0073	10	CON-ENT	N	0	15	15
Reach 3	4	0	1351	4	CON	N	.006	380	20
Reach 4	2	0	1162	7	CON	N		48	0
Reach 5	3	0	1450	2.2	FC	L		36	0
Reach 6	2	0	3250	3.3	CON	N		900	0
Reach 7	2	0	1000	2	FC	L		1600	0
Reach 8	2	0	9100	2.2	FC	L		800	0
Reach 9	2	0	1000	3	FC	L		800	0
Reach 10	1	0	1000	3	FC	L		1000	0

B) FISH UTILIZATION AND LIMITING FACTORS

Coho and cutthroats are present in the lower 635 m below Kilmalu Road but their numbers are very sparse. Long time residents report that C0 – CT moved beyond Kilmalu in the past and that the creek flowed all year before the Island Highway took its present course. The Old Island Highway (Telegraph Road) was located east of Kilmalu Road for the most part. A short section (about 1 km.) was on the

west side of Lower Kilmalu Creek. Pumpkinseeds are present throughout the creek as drop - downs from Hutchinson Lake and a dug out pond near Sitka Road which is just above Hutchinson Road. Production is limited by access and summer flow.

C) PRODUCTION OPTIONS

1) *HEADWATER STORAGE:* There are a number of wetland basins that could be impounded for winter storage and summer release: Hutchinson Lake and the wetlands above Sheppard and Nightingale Roads could impound at least 42,000 cubic metres which could deliver 2.3 LPS for 150 days which is the critical discharge period (CDP) for Kilmalu Creek (Production Option # 498)

2) *BARRIER REMOVAL*: Repositioning of the culvert at Kilmalu Road could make the entire system accessible for coho – cutthroats (Production Option # 499)

D) LAND USE FACTORS

Agriculture

A substantial portion of the basin is utilized for agricultural purposes and some wetlands have been cleared for pasture/forage production.

Highway

The Island Highway dogs the creek for most of its length. Recent widening has necessitated relocation and ditching at several locations. Several ponds have been dug as partial mitigation. These provide some runoff detention and cosmetic value but do not provide any storage.

Residential

Residential use is increasing in the basin and is becoming a factor in terms of hard surface area/runoff acceleration.

D) PROTECTION NEEDS

The most sensitive portion of Kilmalu Creek is the ravine between Kilmalu Road and the estuary. Fortunately much of it is relatively undisturbed. Mill Bay Community Park protects some of the lower ravine and adjacent landholders have not disturbed it unduly. There is some stock intrusion in the upper section of the ravine where it levels out below Kilmalu Road and there have been some minor impacts from the Beehive Campground on the east side of the ravine in terms of clearing too close to the edge of the ravine slope and dumping material over the bank. The ravine needs a high level of protection.
Above Kilmalu Road, sensitivity decreases but there is still need of a protective buffer along the stream and its wetlands. Remember that the entire stream could become salmonid habitat again if Kilmalu Road culvert was replaced and headwater storage was implemented.

Stream Code: 920228800

Stream Name: Johns Creek

Operational Management Unit: Southend (17)

CVRD Electoral Area: A

A) BIOPHYSICAL OVERVIEW: A medium sized stream with two headwater forks. The mainstem originates from seepage that appears to come from Oliphant Lake, a reservoir that served Bamberton (B.C. Cement) and the North Fork which originates in seepage zones adjacent to the old Bamberton Haul road. The mainstem basin is steep and narrow but the North Fork is broader and of much lower relief

Air Photos	BC 7761 019,020
Topographic Map	92B/12, 92B.063
Salmonids	Co 571 m Cm 176 m Ct 571 m (St) 571 m
Obstructions	1R3 cascade at 176 m 5R at 571 m numerous falls above this point
Max. temp. (C°)	15 R2 (8/5/96) 15.5 R1 North Johns 16.9 R7 (7/31/98)
Min. Disch. (m^3)	.00738 R2 (8/5/96) .0024 R7 (7/31/98) .003 R11 (7/31/98) .0105 North Johns (7/31/98)

JOHNS CREEK

	Channel Width	Wetted Width	Substrate	Slope (%)	Channel Confinement	Side Channel	Length (m)	Wetted Area
Reach 1	8	5	2530	.5	OC	L	100	500
Reach 2	8	4	1261	2.0	CON	N	146	730
Reach 3	7	5	1621	1.5	FC	L	208	1040
Reach 4	5	4	1153	5.0	CON	N	117	468
Reach 5	5	4	1126	20.0	CON	N	95	380
Reach 6	5	3	1441	4.0	CON	N	650	1950
Reach 7	4	3	1540	2.5	CON	N	300	900
Reach 8	3	1	1540	2.5	CON	N	75	75
Reach 9	3	1	1270	7.0	CON	N	150	150
Reach 10	3	1	1270	12.0	CON	N	1700	1700
Reach 11	3	1	1450	2.0	CON	L	1000	1000

OLIPHANT LAKE

Elev.	Area	Area Above 6 m	TDS	Volume	Perimeter	Max.Surface Temp.
132 m	23.7ha	213,00 m^2	38	667,000 m^3	3661 m plus 844 m islands	26.1

B) FISH UTILIZATION AND LIMITING FACTORS

Chum salmon are present for the first 176 m while coho, resident and anadromous cutthroats and the occasional steelhead are present for 571 m.
Production is limited by short accessible length and low summer flows. Lack of quality winter habitat is also limiting.
Oliphant Lake contains Smallmouth bass. The lake drains to Spectacle Lake but appears to flow subsurface to Johns Creek. An old earth fill dam is present where Johns Creek would have left the lake. The dam at the south end of the lake is a 5 m high concrete structure. Fish (Rb) become stranded in the plunge pool in late summer.

C) PRODUCTION OPPORTUNITIES

1.*SUBSRATE IMPROVEMENT:* Periodic addition of quality spawning gravel in lower Reach 1 would benefit chum production **(Production Option # 500)**

2. *COHO COLONIZATION:* Coho fry colonization in Reaches 6, 7 and 8 and in Reaches I and 2 of the North Fork would do much to sustain John's Creek coho population which is dangerously low. Available area: Mainstem 2925 m2 @ .5 fry/m^2, North Fork 1800 m^2 @ 1fry/m^2. Total fry needs: Mainstem 1462, North Fork 1800, TOTAL: 3262. Fish should come from John's Creek or Shawnigan/Gold stream donors (**Production Option # 501)**.

D) LAND USE FACTORS

Forestry

Most of the basin is advanced second growth. Some recent logging has restarted from the old Bamberton Haul Road near Malahat 300 (2000).

Agriculture

Nil

Residential

Very light.

E) PROTECTION NEEDS

The most sensitive portion of John's Creek is its lower ravine, which is largely located in Bamberton Provincial Park. Upstream ravine and riparian areas such as those adjacent to Reach 2 of the North Fork are in the Fisheries Sensitive Zone. South Island Development Co. owns important FSZ lands adjacent to John's Creek, especially the North Fork along the old B.C. Cement haul road. A mega – development proposal for the Bamberton Industrial Site has been in the works for some 10 years. The proposal is now off the books (2001).

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