A DETAILED SALMONID FRY SALVAGE PLAN AND COHO COLONIZATION STRATEGY FOR THE COWICHAN RIVER WATERSHED

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A Detailed Salmonid Fry Salvage Plan and Coho Colonization Strategy for the Cowichan River Watershed

by

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ABSTRACT

Burns, T., L. Nelson, L. Goldsmith, T. Fields, T. Morris, E.A. Harding, and B.D. Tutty. 1988. A detailed salmonid fry salvage plan and coho colonization strategy for the Cowichan watershed. Can. MS Rep. Aquat. Sci. No. 1985: v + 27.

A Cowichan watershed fry salvage and coho colonization plan was described by Burns, et al (1987), and its abstract is reproduced below for reference. The paper called for a companion report describing in detail a recommended strategy and methodology. This is that companion report and it describes techniques developed to improve catch and overall efficiency of future fry salvage operations. The report identifies the above-barrier coho-colonization sites in the watershed, which have a seven-fold greater capacity to rear coho than the totals of fry salvaged in 1986 and 1987. The need for a management plan to optimize the production benefits from this seemingly large fisheries potential is a recommendation emerging from this report.

Abstract reproduced from:

Burns, T., R.A. Bams, T. Morris, T. Field, and B.D. Tutty. 1987. Cowichan watershed fry salvage and coho colonization operations (1986): A review and preliminary results. Can. MS Rep. Aquat. Sci. No. 1949: v + 68 p.

Extensive fish habitats frequently dewater during the dry summer months in the Cowichan watershed, Vancouver Island, British Columbia. During the past half century salmonid fry have been salvaged from these habitats and redistributed into anadromous zones of the watershed by Department of Fisheries and Oceans personnel, contractors, and volunteers without the benefit of an evaluation of this fish management strategy. In 1984, a strategic habitat inventory system identified extensive fish habitats above barriers, which were subsequently verified in the dry summer of 1985 as potentially viable. Based on this knowledge, a management team was assembled to plan, conduct, and evaluate the performance and benefits of fry salvage operations in 1986. A total of 174,291 salmonid fry were salvaged (162,219 coho) and 121,306 of these coho were subsequently colonized at specified densities into designated above barrier habitats of which three were selected and trapped the following spring to determine overwintering and eventually ocean survival. Preliminary estimated fry to smolt survival at these three study sites was 6.5% at Bings Creek, 16.4% at Kelvin Creek, and 18.9% at Grant Lake. An economic evaluation of the 1986 fry salvage program indicates that, to break even, at least 100,000 coho must be salvaged and colonized, at the specified densities, into designated habitats, assuming a minimum 1.7% fry to adult survival rate and at 1986 program costs ($22,034 with volunteers). If the highest estimate of 350,000 salvaged coho were obtained at 1986 costs, then a benefit of $50,000 to $115,000 would result with the assumptions of 1.7% and 3.3% fry to adult survival rate, respectively, and a harvest rate of 75%. All economic benefits were derived from the Salmonid Enhancement Program Evaluation model. Economic and operational recommendations to streamline Cowichan fry salvage and transport activities are identified to increase economic benefits and reduce costs in future programs.

RÉSUMÉ

Burns, et al (1987) ont décrit un plan d'ensemencement de saumons cohos et de récupération d'alevins pour le bassin versant de la rivière Cowichan dont le résumé est reproduit plus bas à titre de référence. Le document nécessitait un rapport complémentaire décrivant en détail une stratégie et une méthodologie recommandées. Voici donc ce rapport complémentaire qui décrit les techniques mises au point pour améliorer les prises et l'efficacité globale des opérations futures de récupération d'alevins. On identifie dans le rapport les sites d'ensemencement de saumons cohos situés en amont des barrières dans le bassin versant et dont la capacité d'élevage de saumons cohos est sept fois supérieure à celle correspondant aux alevins récupérés en 1986 et 1987. Le rapport recommande notamment d'établir un plan de gestion pour optimiser les avantages en matière de production découlant de ce potentiel halieutique apparemment important.

Résumé reproduit de:

De vastes secteurs d'habitat du poisson s'assèchent fréquemment pendant les mois secs d'été dans le bassin versant de la rivière Cowichan, sur l'Île Vancouver, en Colombie-Britannique. Au cours des cinquante dernières années, le personnel du ministère des Pêches et des Océans, des entrepreneurs et des bénévoles ont récupéré des alevins de salmonidés dans ces habitats et les ont redistribués dans les zones anadromes du bassin versant, sans qu'on procède à une évaluation de cette stratégie de gestion du poisson. En 1984, dans le cadre d'un inventaire stratégique de l'habitat, on a déterminé l'existence de vastes secteurs d'habitat du poisson, en amont des obstacles, qui se sont avérés un habitat potentiellement viable, de pente faible, pour le saumon coho pendant l'été sec de 1985. À partir de ces connaissances, on a constitué une équipe de gestion pour planifier et réaliser les opérations de récupération d'alevins en 1986 et en évaluer le rendement et les avantages. On a récupéré au total 174,291 alevins de salmonidés (162,219 saumons cohos); 121,306 de ces saumons ont été ultérieurement ensemencés à des densités déterminées dans des habitats désignés en amont des barrières dont trois ont été choisis et fait l'objet d'une pêche au printemps suivant pour déterminer la survie au cours de l'hiver et, éventuellement, la survie en mer. Les taux préliminaires estimatifs de survie des alevins jusqu'au stade de saumoneaux à ces trois sites d'étude ont été de 6,5 % au tuisseau Bings, de 16,4 % au ruisseau Kelvin et de 18,9 % au lac Grant. Une évaluation économique du programme de récupération d'alevins de 1986 montre que, pour atteindre le seuil de rentabilité, 100,000 saumons cohos doivent être récupérés et ensemencés, aux densités prescrites, dans des habitats désignés, en supposant un taux minimal de survie de 1,7 % des alevins jusqu'au stade adulte, ceci aux coûts de programme de 1986 (22,034 $ avec les bénévoles). Si l'on obtenait la plus forte estimation de 350,000 cohos récupérés aux coûts de 1986, il en résulterait des bénéfices allant de 50,000 à 115,000 $ en supposant des taux de survie de 1,7 à 3,3 % des alevins jusqu'au stade adulte et un taux de capture de 75 %. Toutes les retombés économiques ont été tirées du modèle d'évaluation du Programme de mise en valeur des salmonidès. Afin d'accroître les retombées économiques et de réduire les couts des programmes futurs, les auteurs formulent des recommandations d'ordre économique et opérationnel visant à rationaliser les activités de transport et de récupération d'alevins de la rivière Cowichan.

SECTION 1.0 INTRODUCTION

The Cowichan watershed, located on the southeastern portion of Vancouver Island, (Figure 1), contains extensive fish habitats that frequently de-water during the summer months. The problem is most pronounced in the lower reaches of tributaries to Cowichan Lake and in a number of Cowichan River side channels. Salmonid fry are initially trapped in isolated pools, which imperils them through intense predation; the fry perish when the pools dry.

Rescue efforts began in the 1930's and concentrated on saving fish in side channels of the lower Cowichan River stranded by falling water levels (Carl,1937; Sherman, 1938). During the 1940's chum salmon fry comprised a major proportion of rescued fry populations. They were often saved by reconnecting isolated pools to the Cowichan River by hand dug ditches (Neave, 1949). Fry salvage effort gradually expanded in later years to include the lower reaches of Cowichan Lake tributaries where coho fry were the principal species captured. By the 1950's, dyking of the flood plain along the lower river destroyed certain side channel areas where fry salvage had occurred. Construction of the storage control weir at the outlet of Cowichan Lake in 1957 has permitted increased summer flows above natural conditions between April and October of most years.

Burns, 1984, documented streams and areas of fry salvage in tributaries of Cowichan Lake. In recent years most salvage effort has concentrated on Cowichan Lake tributaries and in Glenora Creek, a Koksilah River tributary subject to extensive summer de-watering. (Tutty, 1984).

Figure 1. Cowichan watershed.

In 1986 a cooperative fry salvage and colonization plan was implemented by staff from Department of Fisheries and Oceans (DFO) and the Fisheries Branch of the Provincial Ministry of Environment and Parks with the cooperation and assistance of the two Cowichan community salmonid enhancement societies. A main objective of the 1986 operation was to examine the activity and assess whether fry salvage could be a cost effective fisheries management strategy. A major change implemented in 1986 was the release of coho into above-barrier low-gradient habitats that had been described by Chamberlin et al, 1984, and subsequently verified by Burns and Tutty, 1986. Prior to 1986, fry were often simply moved progressively further upstream and eventually perished as a result of stream de-watering. Colonization of inaccessible habitats makes use of extensive areas not prone to summer drying.

The 1986 fry salvage plan, field operation, and preliminary results were reported by Burns et al, 1987. The report concluded that fry salvage was a cost effective management strategy recognizing certain assumptions of fry capture, cost, and coho survival rates. A recommendation of that report was to prepare a companion report descibing a detailed fry salvage strategy, including techniques to improve catch and increase efficiency of future fry salvage operations.

This report follows up those recommendations and provides a detailed plan and fry salvage activity blueprint. The results of the 1987 fry salvage operations are outlined in Appendix 1 for reference.

SECTION 2.0 FRY SALVAGE AND TRANSPORTATION METHODS.

Salmonid fry can be captured from pools using dip nets, pole seines, and beach seines. Fry salvage conditions vary widely as do catch methods. An ideal fry salvage field crew comprises three members: two people netting a third responsible for holding and transporting the fry. A fourth member, although convenient, is less efficient considering the increased cost.

In small shallow pools, dip nets or pole seines with light lead lines are the preferred tools. In deeper pools bounded by log jams, a modified pole seine can be effective due to its ability to bend into small nooks and crannies where fry seek cover. In larger pools, a large two-person beach seine can be dragged the length of the pool while a third person acts as a beater to drive the fish away from cover and into the net. Appendix 2 presents a pictorial summary of salvage equipment and methods employed in the Cowichan watershed during 1986 and 1987.

In areas of extensive debris and escape cover, salvage efficiency could be improved by electro-fishing. However, this method was not employed in 1986 and 1987 as most fry salvage crews are volunteers or students unfamiliar with the dangers of this technique. Electrofishing efficiency may not outweigh the cost of the equipment. For these reasons, electrofishing is not recommended.

Each salvage crew requires at least six standard 20-litre buckets. The fry are placed in these buckets following capture and carried to a transportation tank situated on the back of a pickup truck. A modified 740-litre commercial fish tote has been used successfully as a fry transportation tank for several years. This tank is aerated via air stones and an air pump (Quality Agitator: Model #AG4DC), which is energized by the vehicle's 12 volt battery. During hot weather, when long carrying distances back to the truck are involved, the fry buckets must be aerated by portable battery-operated air pumps to prevent asphyxiation. A rule-of-thumb is 500 fry per bucket can be held 30 minutes without aeration and on hot days the number of fry should be reduced to 200 - 300 per bucket. With aeration up to 1,000 fry can be held in the buckets for as long as 30 minutes. Alternatively, an in-stream

holding net can retain captured fry prior to transport. The buckets should not be allowed to stand for long in direct sunlight and fry should be transferred to the transportation tank as soon as possible. The transportation tank's carrying capacity with aeration can be as many as 15,000 fry for one hour. No more than 10,000 fry should be held longer than four hours particularly on hot days.

The transportation tank on the pick-up truck is filled with fresh 10 - 14 degree C. water at one of the hatcheries each day (or from an appropriate stream). The tank is equipped with two large marquisette (fine mesh) nets. The top net reduces spillage and fish losses, while the bottom net allows easy fry removal from the transport truck. The cool water in the transportation tank is gradually diluted by the warmer stream water (often 2 - 3 degrees C. warmer) when captured fry are introduced to the transportation tank . Fry salvage crews should be aware of this because water temperatures must not reach lethal levels (about 22 degrees centigrade). When the temperature difference between the transportation tank and the colonization site is greater than 4 degrees centigrade, the fry should be acclimatized by adding water from the stocking site prior to release.

A two-wheel drive pick-up truck is adequate to gain access to most fry salvage and coho colonization sites, however, a four wheel drive vehicle is preferable particularly for Robertson River, Nixon, McKay and Sutton Creeks, and Major Jimmy's side-channel salvage sites.

SECTION 3.0 FRY SALVAGE LOCATIONS, TIMING AND ACCESS.

Stream reaches and certain side-channels dry as early as late April. The lower reaches of the tributaries to Cowichan Lake begin to dry by May in most years and conditions become more severe as the summer advances. The seasonal progression is defined as follows:

- early = late April to mid May
- middle = mid May to early July
- late = late July to first fall rains

Fry salvage sites can be grouped as follows:

- light = 100 - 1,000 fry
- moderate = 1,000 - 2,000 fry
- heavy = 5,000 - plus fry

Table 1 (p. 7) contains the Cowichan Watershed Fry Salvage Sites ranked by area. Table 2 (p. 10) displays the approximate timing of the fry salvage activity for the sites described in Table 1.

Figure 2 (p. 12&13) displays the location of the fry salvage sites described in Table 1, and coho colonization locations are described in Section 4.0 (p. 14).

TABLE 1

Fry Salvage Sites

Site Number	Fry Salvage Sites	Stream Code or Side Channel #[3]	Salvage Area (m^2)	Timing Code[1]	Salvage Code[2]	Access
1	Robertson River	92-4800-585	250,000	M,L	H	Robertson Main & access points
2	Nixon Creek	92-4800-900	120,000	M	H	S Shore Rd
3	Meade Creek	92-4800-650	45,000	M,L	H	Meade Cr Rd, Highway 18
4	Fairservice Creek	92-4800-470	25,200	L	H	Hudgrove or Joginder's Rd
5	Meade Creek Flood Channel	92-4800-651	22,500	E,M	H	Meade Cr Rd, Nantree, private rd
6	Trailer Park Relic Channel	18R	16,200	E	L	Boys Rd
7	Sutton Creek	92-4800-605	16,000	L	H	S Shore, Tamea, Golf Course Rd
8	Across from Bible Camp Flood Channel	36F	14,000	E	H	Bible Camp Bridge, path
9	Robertson Side Channel - Mayo Creek	92-4800-585-251	13,800	E	H	S Shore Rd, private rds
10	Ashburnham Creek	92-4800-600	11,875	L	M	S Shore Rd, Gordon Main
11	Wardroper Creek	92-4800-850	10,000	E	L	N Shore Rd, Spur Rd, path
12	Glenora Creek	92-4800-020-056-130	10,000	M	H	M&B Mainline
13	Major Jimmy's Side Channel	8B	8,692	L	H	Boys Rd, dyke
14	Dale's Creek	92-4800-398	7,000	E	M	Skutz Falls - Holt Cr Rd, CNR path
15	Tom's Creek	92-4800-900-010	7,000	M	L	S Shore Rd, Caycuse Main
16	Misery Creek	92-4800-608	5,600	M	L	S Shore Rd
17	Easy Creek	92-4800-585-201	5,600	M	M	Robertson Main
18	Black Creek Side Channel	7A	5,190	L	M	Tzouhalem Rd, Quamichan Village Rd
19	John's Creek	11A	4,800	E,M	L	John Charlie's Rd
20	Neel Creek	92-4800-020-091	4,500	M	L	Koksilah Rd, Riverside Rd, Shaw Rd
21	Hall (Lakehead N.) Creek	92-4800-904	3,900	E	L	N Shore Rd
22	Norrie Creek	92-4800-020-090	3,800	M	L	Koksilah Rd, Dingwall Rd
23	Upper Stoltz Side Channel	65A	3,600	M	M	Skutz Falls - Holt Cr Rd, C.F.P. *
24	Dale's Flood channel	59F	3,480	E	M	Skutz Falls - Holt Cr Rd, CNR, path
25	Stoltz Bar Flood Channel	64F	3,200	E	M	Riverbottom or Stoltz Rds
26	Dyke Road Active Channel	SF 11A	3,050	M	H	Boys Rd
27	Stanley Creek	92-4800-500	3,000	E	L	Neva Rd
28	Kalkalatza Flood Channel	57F	2,650	E	M	Riverbottom Rd to IR6
29	Outer Fishgut Alley Flood Channel	F13	2,400	E	L	Marchmont Rd, Sewage lagoon dyke
30	Lower Horseshoe Bend Active Channel	72A	2,305	M	L	Mayo Rd, BCFS Campsite Rd
31	A.C. Below Bible Camp Bridge	33A	2,263	M	M	Riverbot. Rd, Bible Camp Bridge path
32	Fishgut Alley Spill Channel	15F	2,200	E	L	Rotary Park dyke
33	Flood Channel across from Bible Camp	39F	2,160	E	L	Bible Camp Bridge, path

1 E = Early; M = Middle; L = Late.
2 L = Light; M = Moderate; H = Heavy
3 See Appendix 3 - Cowichan Side Channel Catalogue.

* Cowichan River Foot Path

TABLE 1 (cont'd)

Site Number	Fry Salvage Sites	Stream Code or Side Channel #	Salvage Area (m^2)	Timing Code	Salvage Code	Access
34	Above Bear Creek Flood Channel	82F	2,150	M	L	Hike from Skutz Falls - Holt Cr Rd
35	Mesachie Creek	92-4800-580	2,040	M	L	Forestry Rd
36	Log Jam Flood Channel	12F (K)	1,908	L	L	Koksilah Rd, Dingwall Rd
37	F.C. Complex across from Bear Creek	79F	1,590	M	L	Skutz Falls Rd, CFP
38	Above Bridge Flood Channel	113F	1,584	E	L	Skutz Falls Rd, Br 51 Rd, CNR, CFP
39	Beadnell Creek	92-4800-501	1,500	M	H	MacDonald Rd, paths
40	Miserable Creek	92-4800-606	1,500	M	L	Boat access from below Grosskegs Hill
41	Horseshoe Bend Active Channel	74A	1,500	M	M	Skutz Falls Rd
42	Bifurcation Flood Channel	SF10F	1,455	E	L	Dyke from Pimbury Br, path
43	Hockey Pool Flood Channel	76F	1,300	E	L	Mayo Rd, H.S. Bend Rd
44	E. Robertson Delta Flood Channels	92-4800-585-400	1,250	M	L	Robertson Main
45	Nineteen Creek	92-4800-585-200	1,200	M	L	Robertson Main, 19 Cr Rd
46	Below the Ranch Flood Channel	44F	1,155	M	L	Riverbottom Rd
47	John's Flood Channel	12F	1,104	M	H	John Charlie's Rd, dyke
48	(Combo above drop-off pool)	86F	1,020	M	L	Skutz Falls Rd, Br 51 Rd, Cow. foot path
49	Mosquito Run Flood Channel	68F	965	M	L	Skutz Falls - Holt Cr Rd, Cow. foot path
50	Fishgut Alley Connector Flood Channel	14F	950	E	L	Marchmont Rd, Sewage lagoon dyke
51	Halfway Creek	92-4800-580	905	M	L	S Shore Rd, E&N grade, path
52	Choke Rope Side Channel (Robertson)	92-4800-585	900	L	L	Robertson Main
53	Little Shaw Creek	92-4800-906	840	E	L	N Shore Rd, Spur Rd
54	Horseshoe Bend Flood Channel	75F	900	E	H	Mayo Rd, rd to H.S. Bend, path
55	Maple Tree Pool Flood Channel	95F	800	E	M	Skutz Falls Rd, Br 51 Rd
56	Thin Slice Flood Channel	41F	779	E	L	Bible Camp bridge, path
57	Art Watson's Flood Channel	117F	750	E	H	Hudgrove Rd
58	South Fork Bar Flood Channel	SF7F	750	E	L	Dyke from Pimbury Bridge
59	Helpful Creek	92-4800-821	500	E	L	S Shore Rd, Caycuse Sort
60	Stoltz Flood Channel A	66F	500	M	L	Skutz Falls-Holt Cr Rd, Cow. foot path, path
61	Dusty Creek	92-4800-609	480	E	L	S Shore Rd
62	Coonskin Creek	92-4800-725	350	M	M	Highway 18, Willow Rd
63	Cougar Run Side Channel	87F	320	M	L	Skutz Falls Rd, Br 51 Rd, Cow. foot path
64	Youbou Creek		300	E	L	Highway 18, Arbutus Park Rd
65	March Creek		300	M	L	East Robertson Main
66	Croft Creek		250	M	L	S Shore Rd
67	Bathtub Outlet Channel	16F	246	E	L	Rotary Park dyke
68	Price Creek		200	E	L	Highway 18, Old grade, CNR
69	Log Dump Creek		200	M	L	S Shore Rd
70	Mossy Creek		180	M	L	S Shore Rd
71	Bathtub Back Channel	17B	163	E	H	Rotary Park dyke
72	Utility Creek		150	L	L	Highway 18, Saseenos Rd, CNR

TABLE 1 (cont'd)

SUBTOTALS

Stream or Side Channel	Salvage Areas (m^2)	Approx. Stream Area (per cent)
Cowichan Lake Tributary	522,820	77.3
Cowichan River Tributary	36,700	5.3
Cowichan River Side Channel	95,121	14.1
Koksilah River Side Channel	1,908	0.3
Koksilah River Tributary	18,300	3.0
Above Skutz Falls (CLSES SALVAGE AREA)	**556,194 m^2**	**82.3 %**
Below Skutz Falls (CEDP SALVAGE AREA)	**119,655 m^2**	**17.7 %**
TOTAL Fry Salvage Area is approximately	**675,849 m^2**	**100.0 %**

TABLE 2

Approximate Timing for Fry Salvage Activity

Site Number and Site Name	Fry Salvage Period: Early April	Early May	Middle June	Middle July	Late August	Late September	Salvage Code
50 Fishgut Alley Connector Channel	**********						light
4 Fairservice Creek	**********						heavy
8 Across from Bible Camp F.C.[1]	**********						heavy
33 F.C. trib. to across from B.C. F.C.	**********						light
32 Fishgut Alley Spill Channel	**********						light
60 Stoltz Flood Channel "A"	**********						light
25 Stoltz Bar Flood Channel	**********						moderate
68 Price Creek	**********						light
64 Youbou Creek	**********						light
11 Lower Wardroper Creek	**********						light
38 Above Bridge F.C.	**********						light
21 Lakehead North (Hall Creek)	**********						light
19 Upper John's Creek	**********						light
42 Bifurcation F.C.		**********					light
67 Bathrub Outlet Channel		**********					light
43 Hockey Pool F.C.		**********					light
9 Mayo Creek - Robertson S.C.[2]		**********					heavy
5 Meade Creek S.C.		**********					heavy
29 Outer Fishgut Alley F.C.		**********					light
14 Dale's Creek		**********					moderate
54 Lower Horseshoe Bend F.C.		**********					heavy
57 Art Watson's F.C.		**********					heavy
58 South Fork Bar F.C.		**********					light
27 Stanley Creek		**********					light
71 Bathtub Back Channel			**********				heavy
55 Maple Tree Pool F.C.			**********				moderate
24 Dale's Flood Channel			**********				moderate
56 Thin Slice Flood Channel			**********				moderate
28 Kalkalatza Flood Channel			**********				moderate
6 Trailer Park Ponds R.D.			**********				light
23 Upper Stoltz A.C.[3]			**********				light
15 Lower Tom's Creek			**********				light

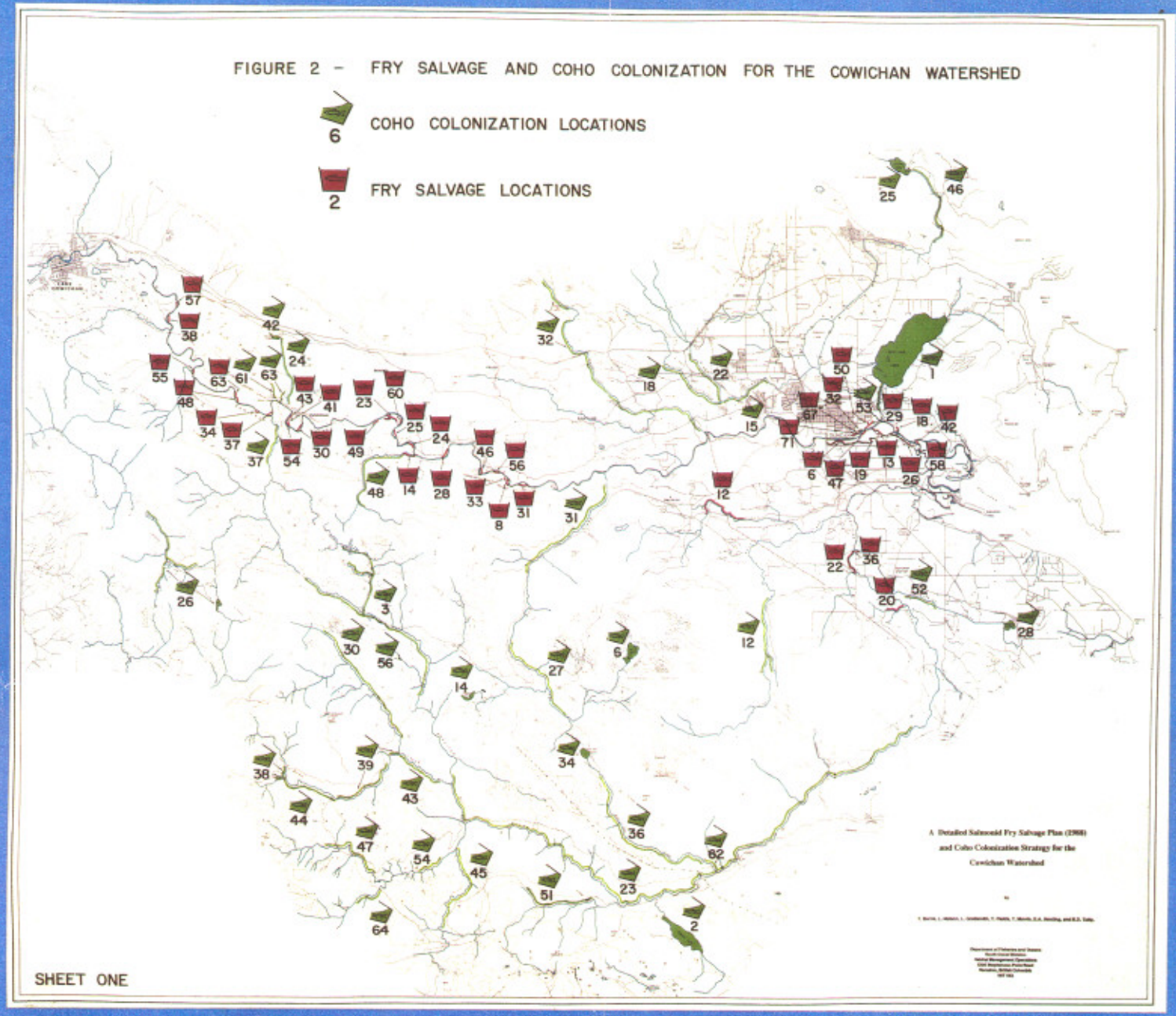
1 Flood Channel
2 Side Channel
3 Active Side Channel

TABLE 2 (cont'd)

Fry Salvage Period

Site Number and Site Name	Early April	May	Middle June	July	Late August	September	Salvage Code
69 Log Dump Creek			**********				light
66 Croft Creek			**********				light
16 Misery Creek			**********				light
40 Miserable Creek			**********				light
61 Dusty Creek			**********				light
17 Lower Easy Creek			**********				moderate
1 Robertson R. from the farm to 19 Creek			**********				heavy
2 Lower Nixon Creek			**********				heavy
3 Lower Meade Creek			**********				heavy
47 John's Flood Channel			**********				heavy
19 John's Creek			**********				light
34 F.C. above Bear Creek			**********				light
72 Utility Creek			**********				light
65 March Creek			**********				light
37 F.C. Complex across from Bear Creek			**********				light
13 Major Jimmy's S.C.			**********				heavy
35 Mesachie Creek			**********				light
44 East Robertson Delta F.C.'s			**********				light
63 Cougar Run F.C.'s			**********				light
30 Lower Horseshoe Bend A.C.			**********				light
49 Mosquito Run F.C.			**********				light
45 Nineteen Creek			**********				light
62 Coonskin Creek			**********				moderate
12 Glenora Creek			**********				heavy
52 Choke Rope Side Channel			**********				heavy
31 Active Channel below Bible Camp			**********				moderate
39 Beadnell Creek			**********				heavy
22 Norrie Creek			**********				light
20 Neel Creek			**********				light
51 Halfway Creek			**********				light
7 Sutton Creek			**********				heavy
18 Black Creek			**********				moderate
36 Log Jam F.C.			**********				light
10 Ashburnham Creek			**********				moderate
1 Robertson R. from 19 Ck. upstream and from the farm to 500m below S.Shore Rd.			**********				heavy

FIGURE 2 – FRY SALVAGE AND COHO COLONIZATION FOR THE COWICHAN WATERSHED



SHEET ONE

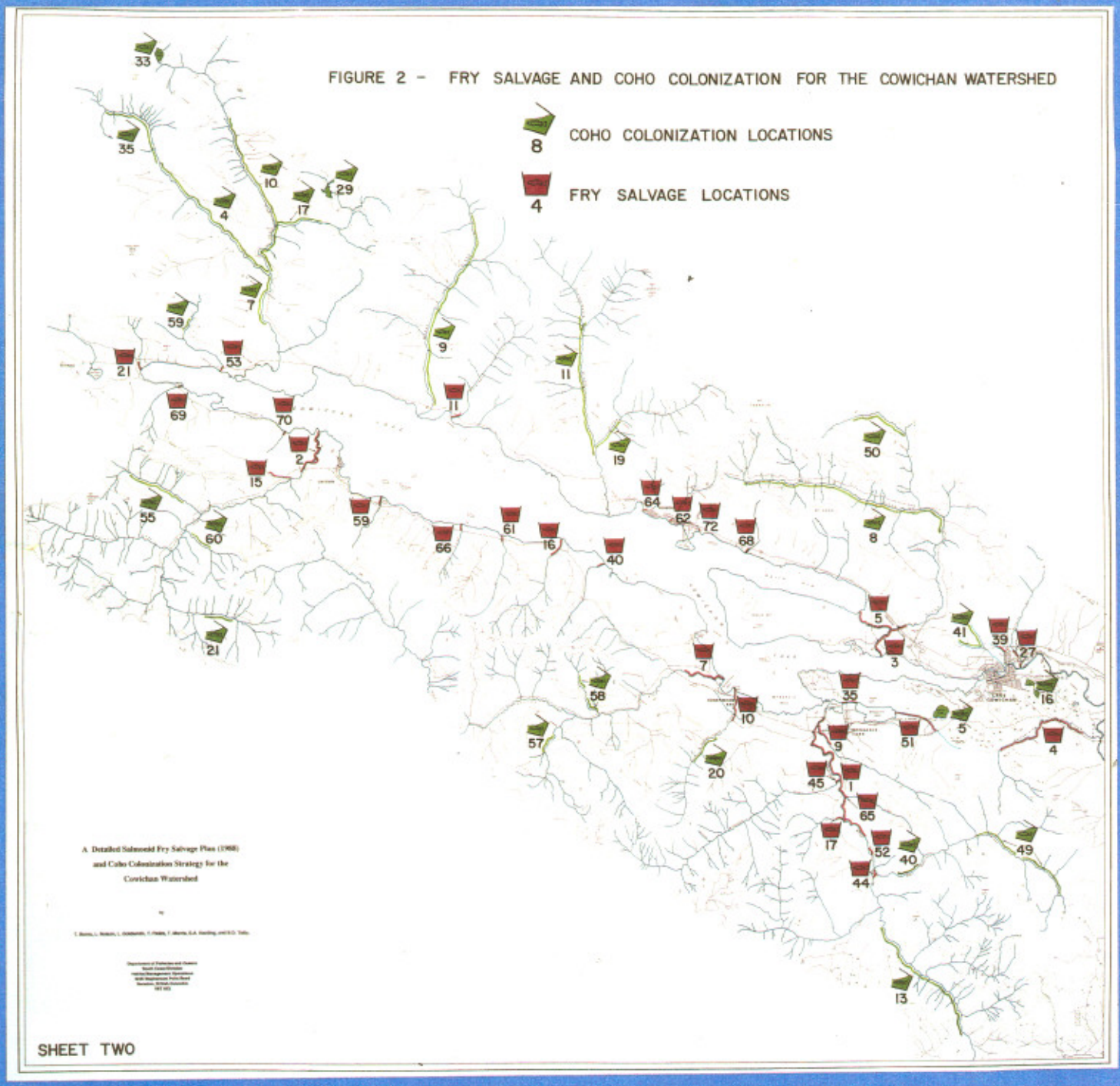


FIGURE 2 - FRY SALVAGE AND COHO COLONIZATION FOR THE COWICHAN WATERSHED
8
COHO COLONIZATION LOCATIONS
4
FRY SALVAGE LOCATIONS
A Detailed Salmonid Fry Salvage Plan (1988) and Coho Colonization Strategy for the Cowichan Watershed
SHEET TWO

Section 4.0 COWICHAN WATERSHED COHO COLONIZATION PLAN

STOCKING DENSITY, COLONIZATION SITES, ACCESS and TIMING

The current **coho stocking densities** approved by this Division of DFO and the Provincial Ministry of Environment and Parks are:

- 1.0 fry/m^2 for stream habitat less than 2% gradient
- 0.5 fry/m^2 for stream habitat greater than 2% and less than 5% gradient
- 0 fry/m2 for stream habitat greater than 5% gradient
- 600 to 1200 fry per hectare for lake habitat.

Schedule A (Table 3) identifies those sites that have been approved by the 1986 fry salvage working group reported in Burns, et. al., (1987) including three additional sites approved by the Provincial Fisheries Branch in 1987. **Schedule B** (Table 3) describes additional viable habitats that are believed suitable and might be considered for colonization. The locations described in Schedule A and B are shown in Figure 2. **N.B. A plan and agency approvals are required before Schedule B sites can be employed.**

Trout are a small percentage (7.5% in 1987) of the annual fry salvage total each year and have been approved by Provincial Fisheries Branch for relocation into Schedule A locations **with the exception of brown trout which are not to be introduced** anywhere but in their home stream or its receiving water (e.g. Cowichan Lake or Cowichan River).

Trout are stocked (along with the prescribed population of coho) in whatever proportion they occur in the catch. In most cases, the salvaged fry from several locations are initially transferred to the CEDP or PIP hatchery as a holding facility until suffieient populations are available before being colonized into the target sites.

SPECIES	CALCULATED TOTALS		SPECIES PERCENTAGE
	(1986)	(1987)	(1987)
Coho fry	162,219	229,812	77.3
Coho pre-smolts	-	748	0.2
Chum	-	43,795	14.7
Chinook	-	185	0.0
Rainbow / Steelhead	12,062	16,302	5.4
Cutthroat	-	4,978	1.6
Brown trout	-	1,627	0.5
TOTAL	**174,291**	**297,447**	**100.0%**

TABLE 3

Schedule A - Coho Colonization Plan:

Coho Colonization Sites, Carrying Capacities, Stocking Timing, Fry Sources and Access to Colonization Sites

Site Number	Coho Colonization Site Name	Coho Population	Colonization Timing*	Colonization Fry Source	Access to Site
1	Quamichan Lake	(232,500 - 465,000)	E or L	Lower Cowichan, Side Channels Glenora Ck. CEDP Hatchery	Tzouhalem Rd., Indian Rd.
2	Grant Lake	(40,500 - 81,000)	A	Koksilah stock where available	Shawnigan - Renfrew Rd., private road
3	Upper Koksilah (R's 5 & 6)	53,000	A	Koksilah stock where available	M&B Shawnigan Div. H Main U line, S line to M line bridge & M5
4	West Shaw	40,000	E	Nixon Cr.	Shaw Main, Shaw W
5	Beaver Lake	(14,500 - 29,000)	E or L	Cowichan L. tribs	South Shore Rd. Old E&N grade to outlet or Ridgewood Mill access road
6	Lois Lake	23,250	E or L	Cowichan L. tribs	H Main, H8, L10
7	Shaw Mainstem	22,500	E	Cowichan L. tribs	Shaw Main
8	Meade Creek	18,800	E	Cowichan L. tribs	Meade Main
9	McKay Creek	17,500	E	Cowichan L. tribs	McKay Main to bridge
10	Middle Shaw	17,500	E	Cowichan L. tribs	Shaw Main, Shaw M
11	Cottonwood Creek	17,000	E	Cowichan L. tribs	Cottonwood Main, release points flagged
12	Upper Kelvin	15,000	A	Kelvin or Glenora Cr.	Koksilah Rd., Mountain Rd.
13	Upper Robertson	15,000	E	Lower Robertson	Robertson Main

***Timing**

E: early (before lakes warm in the spring)
A: anytime (if surface temp. allows, or release at depth)
L: late (after lakes cool or streamflow resumes in the fall)

TABLE 3 (cont'd)

Site Number	Coho Colonization Site Name	Coho Population	Colonization Timing*	Colonization Fry Source	Access to Site
14	Tadjiss Lake	(4,800 - 9,600)	E or L	Lower Robertson	H Main, U line, C line, C3
15	Upper Bings Mainstem	7,500	E	Lower Robertson	Government Rd. Agira Rd. Skinner Rd. Casino Rd. private drive
16	Kwassin and Grant Lakes	(2,685 - 5,370)		Fairservice Cr. or Cowichan L. tribs	Grants L. Rd., access roads on Johel property
17	Lower East Shaw	5,000	E	Cowichan L. tribs	Shaw Main, Shaw E
18	Menzies Creek	5,000	E	Cowichan L. tribs	Sahtlam Rd. Charlie Dougan's Trail, Castley Rd. Curry Rd. Broad land's
19	Widow Creek	3,000	E	Cowichan L. tribs	Widow Main
20	Ashburnham Creek	2,800	E	Cowichan L. tribs	Robertson Main, 19 Cr. Rd. & Honeymoon Bay res. Rd.
21	Upper Nixon Creek	2,000	E	Lower Nixon	Caycuse Main, turn left at summit drive 500m then hike 1km on road
22	Upper Bings above Bings-Menzies Confluence (Bings E)	1,250	L	Lower Nixon	Highway 18, Birch Farm Rd. Judge Farm Rd. Castley Rd.

Schedule A : Coho Colonization Area	Streams	Lakes	Total
Coho fry required	242,850	613,200	856,000

Coho populations for colonization were calculated from the following sources:

Streams	Coho	1 Coho fry/m^2 for habitat less than 2% gradient 0.5 Coho fry/m^2 for habitat between 2% and 5% gradient	Burns, et al., 1987 SEP Biostandards
Lakes	Coho	0.15 fry/m^2 600 - 1200 fry/hectare	SEP Biostandards R. Bams, Pacific Biological Station (pers.comm.)

***Timing**

E: early (before lakes warm in the spring)
A: anytime (if surface temp. allows, or release at depth)
L: late (after lakes cool or streamflow resumes in the fall)

TABLE 3 (cont'd)

Schedule B - Coho Colonization Plan, potential additional sites:

Coho Colonization Sites, Coho Population, Stocking Timing, Fry Sources and Access to Colonization Sites

Site Number	Coho Colonization Site Name	Coho Population	Colonization Timing*	Colonization Fry Source	Access to Site
23	Upper Koksilah (above barrier part of R2 - R4)	187,000	A	Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line, U line, S line
24	Mayo Lake Creek	46,150	L	Cowichan L. tribs Hatchery	Mayo Rd., W. Riverbottom Rd.
25	Crofton Res.	(18,000 - 36,000)	E or L	Cowichan Side Channels Hatchery	Rough road from Robert St. in Crofton
26	Upper Bear Creek	22,000	A	Cowichan L. tribs Hatchery	M&B Shawnigan Div. Mainline, Up Rd., U line, S line, R line
27	Holt Creek (R4)	21,000	A	Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line
28	Dougan Lake	(9,000 - 18,000)	E or L	Cowichan Side Channels Hatchery	Island Highway
29	Gillespie Lake	(9,000 - 18,000)	A	Cowichan. L tribs	East Shaw logging road
30	Fellows Creek	16,000	A	Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line, U line, S line
31	Holt Creek (R2)	15,000	A	Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line
32	Inwood Creek	15,000	L	Cowichan Side Channels Hatchery	Cowichan L. Rd, Menzies Rd, Gibbins Rd, Hwy 18,Hillcrest Rd.
33	Shaw Lake	(7,500 - 15,000)	A	Cowichan L. tribs	Middle Shaw logging road

***Timing**

E: early (before lakes warm in the spring)
A: anytime
L: late (after lakes cool or streamflow resumes in the fall)

TABLE 3 (cont'd)

Site Number	Coho Colonization Site Name	Coho Population	Colonization Timing*	Colonization Fry Source	Access to Site
34	Wild Deer L.	(6,750 - 13,500)	E or L	Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line, W line to W4
35	Upper W. Shaw	10,000	A	Cowichan L. tribs	W. Shaw Main, trails
36	Wild Deer Creek (R2)	9,600	A	Cowichan Side Channels Hatchery	M&B Shawn. Div. H line, W line
37	Bear Creek (R2)	9,000	A	Cowichan L. tribs Hatchery	Skutz Falls - Holt Cr. Rd. old grade, faint path
38	McPherson L. with impoundment	(4,500 - 9,000)	E or L	Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line, M line, X line to X4A
39	McPherson Creek	8,500	A	Lower Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line, U line, S line, M line, X line to X4A
40	East Robertson (R3)	8,000	A	Lower Cowichan Side Channels Hatchery	M&B Shawnigan Div. H line, U line, S line, R line
41	Upper Oliver (Hatchery) Creek and its W. fork	6,000	A	Cowichan L. tribs Hatchery Upper Beadnell Ck.	Youbou Rd., access roads to two cedar mills
42	Mayo Lake	(2,625 - 5,250)	E or L	Cowichan L. tribs Hatchery	Highway 18, Cowichan L. Rd., Mayo Rd.
43	Fellows Creek (R1)	5,000	A	Lower Cowichan Side Channels Hatchery	Inaccessible for fry stocking but fish could be released at M road crossing (M&B Shawnigan Div.)
44	McPherson Creek (R2)	5,000	A	Lower Cowichan Side Channels Hatchery	M&B Shawnigan Div. M&X lines
45	South Koksilah	5,000	A	Lower Cowichan Side Channels Hatchery	Shawnigan - Renfrew Rd.

***Timing**

E: early (before lakes warm in the spring)
A: anytime (if surface temp. allows, or release at depth)
L: late (after lakes cool or streamflow resumes in the fall)

TABLE 3 (cont'd)

Site Number	Coho Colonization Site Name	Coho Population	Colonization Timing*	Colonization Fry Source	Access to Site
46	Upper Richards Creek	5,000	A	Lower Cowichan Side Channels Hatchery	Osborne Bay Rd., logging rd.
47	W. Koksilah (Br.2)	5,000	A	Lower Cowichan Side Channels Hatchery	Shawnigan - Renfrew Rd., M&B K line
48	Dale's Creek (R3 - 5)	4,970	A	Lower Dale's Cr., Dale's Side Channel	Skutz Falls - Holt Cr. Rd. Hiking required for reaches 4 & 5; carrying fish up these reaches is virtually impossible so carrying capacity has been adjusted
49	East Robertson (R5 + 7)	4,300	A	Lower Cowichan Side Channels Hatchery	M&B Shawnigan Div. R line
50	Meade trib. 3	4,000	A	Cowichan L. tribs. Hatchery	Meade Main, old logging road on the rt. at 7km, 4km hike up impassable section off this rd.
51	Kapoor Creek (R2)	3,500	A	Cowichan L. tribs Hatchery	Shawnigan - Renfrew Rd., turn left near junction of upper and lower roads some 800m up the Big Hill, turn left again at 1500m + or - to the stream x' ing 100m in
52	Upper Petrolas Cr. (R3)	3,000	A	Lower Cowichan Side Channels Hatchery	Island Highway, Bench Rd, Koksilah Rd, Lakeside Rd, Moss Rd, Dave Anderson's farm road, E&N tracks
53	Quamichan Creek	2,250	L	Lower Cowichan Side Channels Hatchery	Tzouhalem Rd., paths
54	West Koksilah (Mainstem R1)	2,250	A	Lower Cowichan Side Channels Glenora Ck. Hatchery	Shawnigan - Renfrew Rd., BCFP A line, M&B K line, deer trails

***Timing**

E: early (before lakes warm in the spring)
A: anytime (if surface temp. allows, or release at depth)
L: late (after lakes cool or streamflow resumes in the fall)

TABLE 3 (cont'd)

Site Number	Coho Colonization Site Name	Coho Population	Colonization Timing*	Colonization Fry Source	Access to Site
55	Nixon West	2,000	A	Cowichan L. tribs PIP Hatchery	Caycuse Main, hike; this site is considered inaccessible for stocking
56	Lake trib. to U. Koksilah	(937 - 1,875)	L	Cowichan Side Channels Hatchery	M&B Shawn. Div. H line, S line M line to M1, left at 250m
57	South Sutton	1,500	A	Cowichan L. tribs PIP Hatchery	Sutton Main, wade Sutton Ck. bushwhack; inaccessible for stocking at this time
58	Five Culverts	1,250	A	Cowichan L tribs PIP Hatchery	Sutton Main, climb falls, bushwhack; inaccessible for stock.
59	Little Shaw Creek	1,000	A	Cowichan L. tribs PIP Hatchery	North Shore Rd.,Little Shaw Main which is now impassable. Inaccessible for stocking
60	Nixon East	1,000	A	Lower Nixon	Caycuse Main, hike; inaccessible for stocking
61	Skutz Creek W	1,000	A	Lower Cowichan Side Channels CEDP Hatchery	Skutz Falls Rd.
62	Wild Deer Creek (R1)	1,000	A	Lower Cowichan Side Channels Glenora Ck. Hatchery	M&B Shawnigan Div. H line to W to W3B and W3C
63	Skutz Creek E	800	A	Lower Cowichan Side Channel CEDP Hatchery	Mayo Road
64	W. Koksilah Br. 1	750	A	Lower Cowichan Side Channel CEDP Hatchery	Shawnigan - Renfrew Rd., BCFP A line, bushwhack upstream

***Timing**

E: early (before lakes warm in the spring)
A: anytime (if surface temp. allows, or release at depth)
L: late (after lakes cool or streamflow resumes in the fall)

TABLE 3 (cont'd)

SCHEDULE A: Coho Colonization Area, approved	Streams	Lakes	Total
Coho fry required	242,850	(306,600 - 613,200)	856,050

SCHEDULE B: Coho Colonization Area, potential	Streams	Lakes	Total
Coho fry required	443,820	(122,910 - 245,820)	689,640

SCHEDULE A & B: totals	686,700	(429,500 - 859,000)	1,545,700

Coho colonization populations were estimated from the following sources:

Streams	Coho	1 Coho fry/m^2 for habitat less than 2% 0.5 Coho fry/m^2 for habitat between 2% and 5% gradient	SEP Biostandards & Burns, et al., 1987 SEP Biostandards & Burns, et al., 1987
Lakes	Coho	0.15 fry/m^2 600 - 1200 fry/hectare	SEP Biostandards R. Bams, Pacific Biological Station (pers.comm.)

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APPENDIX 1

Cowichan Fry Salvage Operation: 1987 Catch Results and Costs

Species	Total Caught	Catch Percentage	Release Summary
Coho fry	229,812	77.3	Colonized to above barrier habitats except 21,550 which were released in the Lower Koksilah near Cowichan Station.
Coho pre-smolts	748	0.3	Released to the Cowichan River.
Chum	43,795	14.7	Released to the Cowichan River.
Chinook	185	0.1	Released to the Cowichan River.
Rainbow/Steelhead	16,302	5.5	Colonized to above barrier habitats along with coho except 368 Rainbow trout from Glenora Creek were released in the Lower Koksilah near Cowichan Station.
Cutthroat	4,978	1.7	Same as above except the Koksilah cutthroat release was 492.
Brown trout	1,627	0.5	All browns were from Beadnell Creek. They were relocated to a small impoundment on the creek constructed by the crew.
TOTAL	297,447	100.0%	

Costs (1987)	Wages	Vehicle	Total
CLSES	$ 5041.83	$ 325.00	$ 5461.98
CEDP	$ 3709.38	$ 125.50	$ 3834.88
TOTAL	**$ 8751.21**	**$ 450.50**	**$ 9296.86**

APPENDIX 2

A Pictorial Display of Cowichan Watershed Fry Salvage Operations Techniques

1. A ONE-PERSON FINE-MESH POLE SEINE WITH DEEP BAG

2. A "FLAT BAG" POLE SEINE USEFUL FOR SITUATIONS WHERE "QUICK" CAPTURES ARE NECESSARY. MAJOR BENEFIT IS EASE OF EMPTYING INTO BUCKETS

3. EMPTYING CAPTURED FRY INTO 20-LITRE PAINT BUCKETS

4. A TWO-PERSON POLE SEINE (3 METERS LONG)

APPENDIX 2 (cont'd)

5. A 7-METER FINE-MESH BEACH SEINE USED BY TWO PERSONS IN LARGE POOLS

6. OPERATING THE TWO-PERSON POLE SEINE IN CHEST DEEP POOLS

7. NOTE THE LARGE BILLOWING BAG IN THE TWO PERSON POLE SEINE AND THE FRY HIDING IN IT

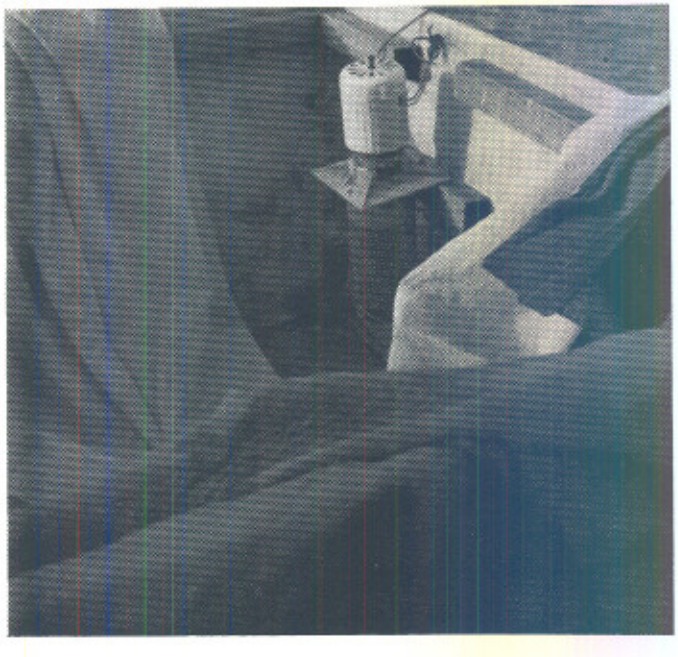
8. A HOOP NET USED TO TEMPORARILY HOLD FRY IN THE STREAM PRIOR TO TRANSFER TO THE TRUCK TANK

APPENDIX 2 (cont'd)

9. PICK-UP TRUCK AND FRY TRANSPORTATION TANK (MODIFIED COMMERCIAL FISH TOTE)

10. FILLING THE TRANSPORTATION TANK PRIOR TO A DAY'S FRY SALVAGE ACTIVITY. NOTE UPPER AND LOWER NETS.

11. UPPER AND LOWER NETS IN THE FRY TRANSPORTATION TANK REDUCE SPILLAGE

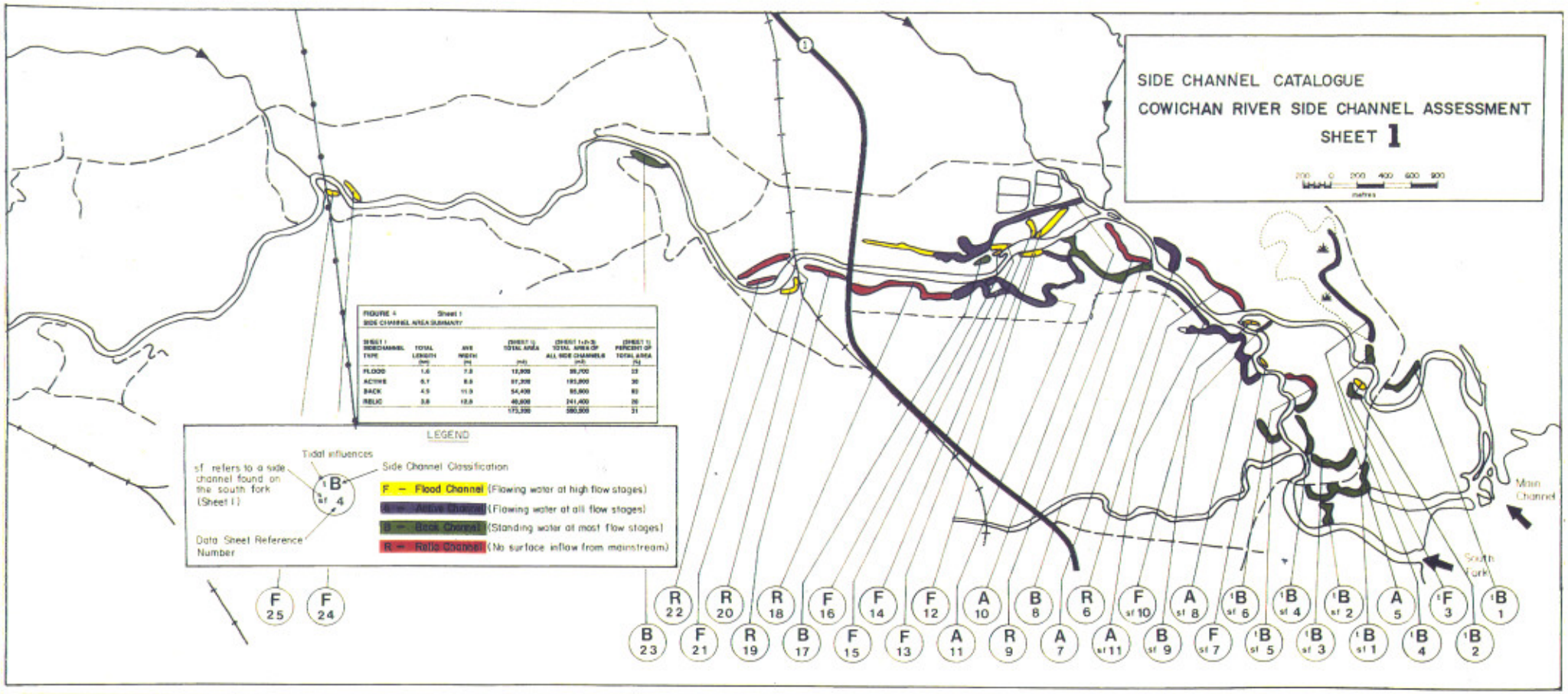


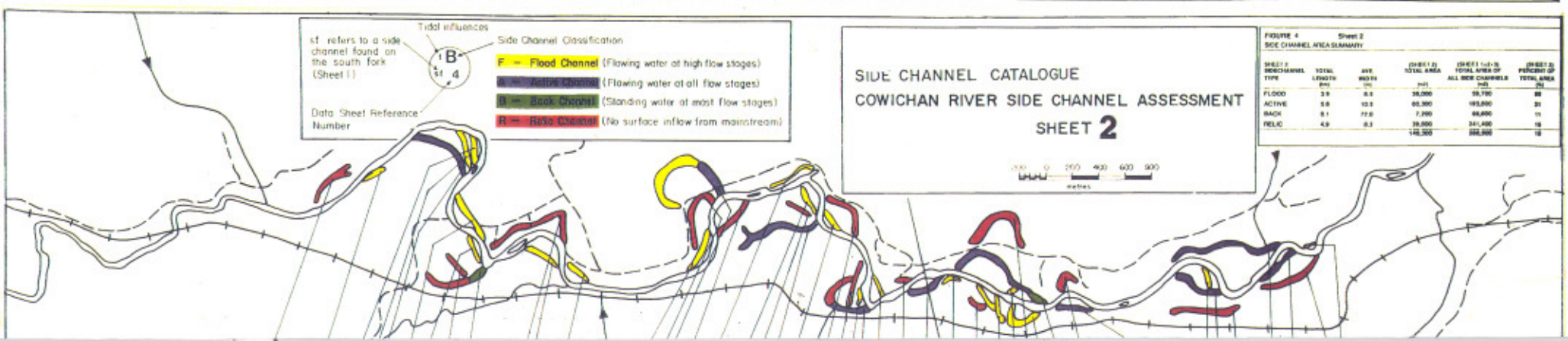
12. AERATOR (POWERED BY 12 VOLT VEHICLE BATTERY). (QUALITY AGITATOR: MODEL # AG4DC)

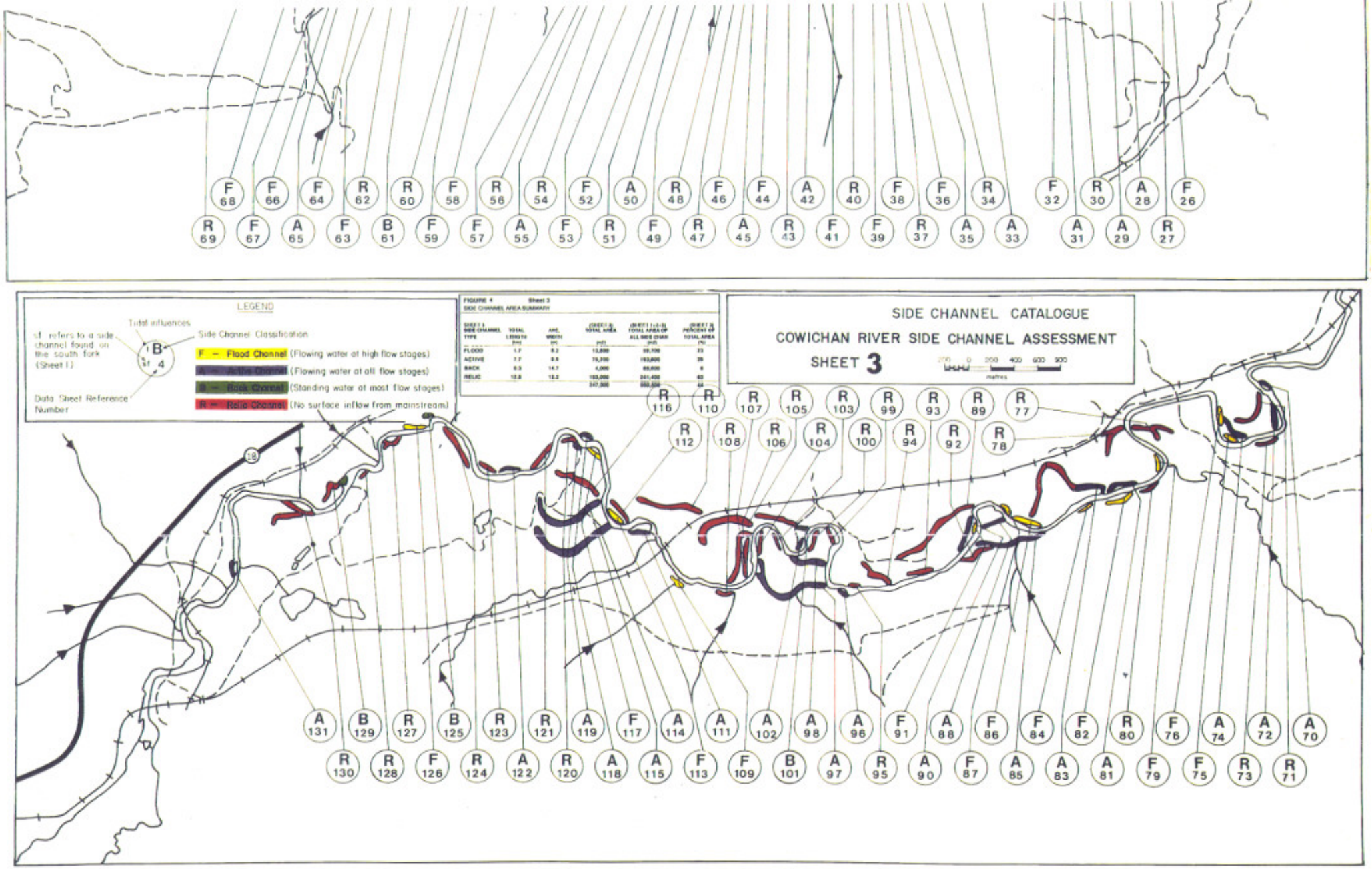
APPENDIX 2 (cont'd)

13. SALMONID ENHANCEMENT SOCIETY HATCHERY AT COWICHAN LAKE

14. THE FINAL STEP: RELEASING A GROUP OF CO-HO FRY INTO AN APPROVED ABOVE-BARRIER HABITAT


SIDE CHANNEL CATALOGUE
COWICHAN RIVER SIDE CHANNEL ASSESSMENT
SHEET 1
LEGEND
Tidal influences
sf refers to a side channel found on the south fork (Sheet 1)
Side Channel Classification
F – Flood Channel (Flowing water at high flow stages)
A – Active Channel (Flowing water at all flow stages)
B – Back Channel (Standing water at most flow stages)
R – Relic Channel (No surface inflow from mainstream)
Data Sheet Reference Number
Main Channel
South Fork


SIDE CHANNEL CATALOGUE
COWICHAN RIVER SIDE CHANNEL ASSESSMENT
SHEET 2
Tidal influences
sf refers to a side channel found on the south fork (Sheet 1)
Side Channel Classification
F – Flood Channel (Flowing water at high flow stages)
A – Active Channel (Flowing water at all flow stages)
B – Back Channel (Standing water at most flow stages)
R – Relic Channel (No surface inflow from mainstream)
Data Sheet Reference Number


LEGEND
Tidal influences
S1 refers to a side channel found on the south fork (Sheet 1)
Side Channel Classification
F – Flood Channel (Flowing water at high flow stages)
A – Active Channel (Flowing water at all flow stages)
B – Back Channel (Standing water at most flow stages)
R – Relic Channel (No surface inflow from mainstreams)
Data Sheet Reference Number
SIDE CHANNEL CATALOGUE
COWICHAN RIVER SIDE CHANNEL ASSESSMENT
SHEET 3
metres