Kokish River Estuary Rehabilitation and Enhancement Options: A Discussion Paper

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S.H.I.P. Project
H. Paish & Associates Ltd.

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ACKNOWLEDGEMENTS

The author gratefully acknowledges suggestions and assistance provided by Rodger Hunter, Surveys and Resource Mapping Branch, Ministry of Environment, John Lamb, Dept. of Fisheries and Oceans, Art McKenzie, Water Management Branch, Ministry of Environment, and Ken Summers, Ducks Unlimited. Funding for the project was provided by the Salmonid Enhancement Program, Dept. of Fisheries and Oceans.

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1.0 INTRODUCTION

The Kokish River estuary has undergone various forestry related impacts since 1919 when a portion of the estuary was Crown Granted to Beaver Cove Lumber and Pulp Company Ltd. (now property of Canadian Forest Products Ltd. - Canfor).

Prior to 1974 the major impacts included:

1. approximately 3.6 ha. of fill for logging operations and
2. a 724 m rail line spur/causeway which bisected the estuary (see Figure 1).

In 1974 the Department of Fisheries and Oceans (D.F.O.) agreed to further alteration of the estuary (approx. 8.2 ha.) in the form of landfill to create a dryland sort. Included in this agreement was the understanding with Canfor that the causeway would be breached to allow freshwater intrusion into the dyked area (Appendix 1).

Following biological studies comparing the portion of the estuary surrounded by the causeway and the more natural north portion, discussions regarding freshwater access into the causeway area were resumed.

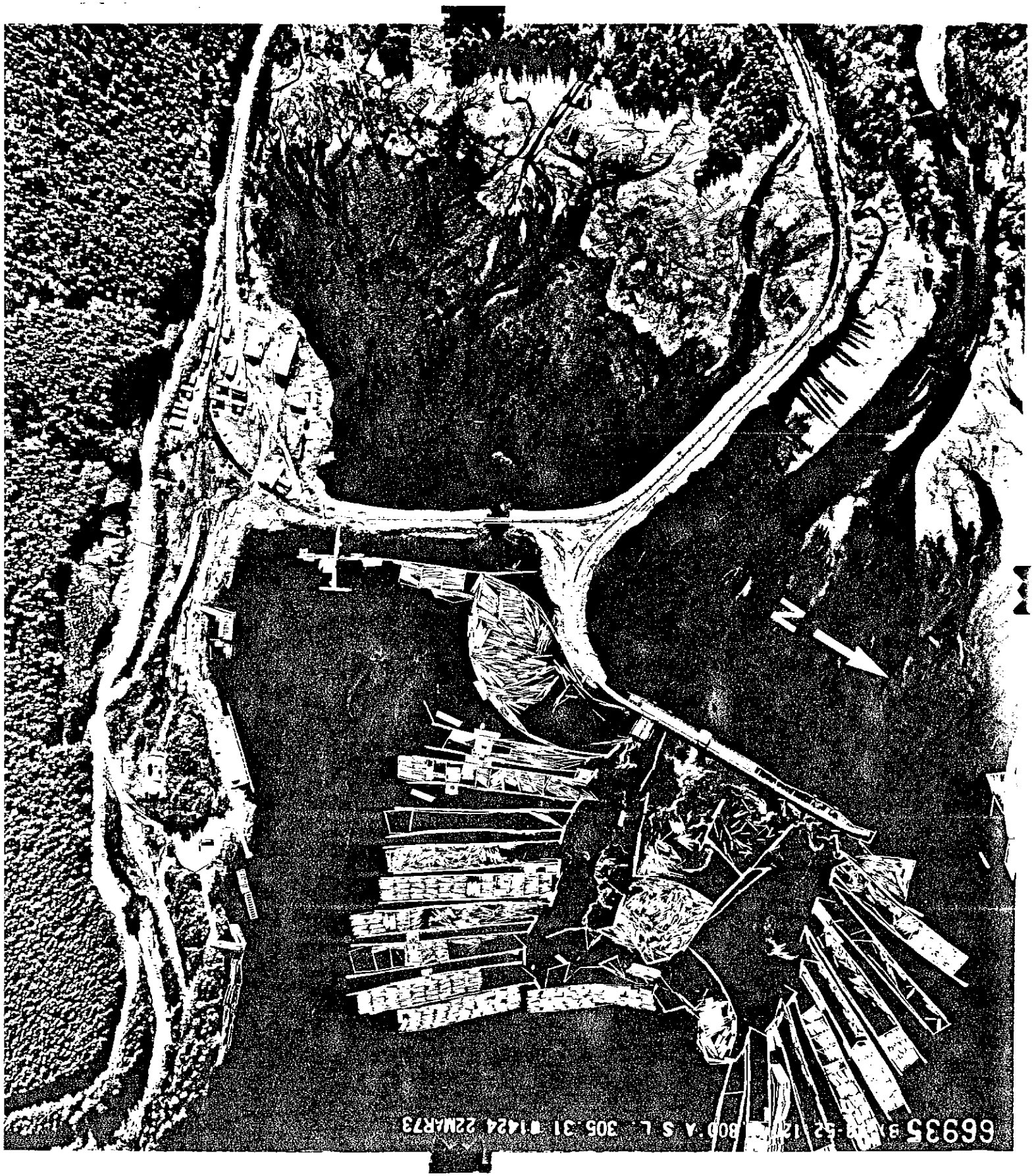
Accordingly, the focus of this report is to provide managers with several options for freshwater access. To address these options this report is divided into three components:

i) a synopsis of biophysical and resource information pertaining to the Kokish estuary

ii) assessment of the pros and cons of several options for removal and/or breaching of the causeway

iii) engineering estimates of volumes of material to be removed in the various options

Figure 1 Kokish River Estuary (March 1973)



2.0 METHODS

Study Area

The Kokish River estuary is located on the east coast of Vancouver Island towards the northern end of Johnstone Strait. The study area is comprised of the southern portion of the Kokish estuary bounded by the causeway (Figure 2).

Resource Information

i) Fisheries data

Salmonid escapement information was taken from the D.F.O. preliminary catalogue for Area 12 (Marshall et al, 1977) and updated from the Port Hardy Fisheries office records.

Sea-run cutthroat, Dolly Varden and steelhead catch data were provided by the Fish and Wildlife Branch, Nanaimo.

ii) Biophysical estuarine habitat mapping

In 1982, the Surveys and Resource Mapping Branch, Ministry of Environment completed a biophysical habitat map of the Kokish estuary. This involved dividing the landscape into habitat types on the basis of physical and biological characteristics as well as position with respect to tidal water.

Engineering Estimates

Estimates of volume of material to be excavated for the various options were provided by Canfor and the Rivers Section of the Water Management Branch, Ministry of Environment. Option 1 and 2 estimates are based upon cross-sections and Option 3 estimates upon office information only.

Figure 2 Kokish River Estuary Study Area

Land Statusing

A land status of the Kokish estuary was completed to indicate private, leased and wildlife reserve lands within the estuary (Appendix 2). This information should enable managers to make decisions on the basis of the realities of land tenure.

3.0 RESULTS AND DISCUSSION

In this section, general impacts resulting from the causeway are considered from a habitat and fisheries resource perspective. Subsequently three options for removal or breaching of the causeway are discussed.

Historically the causeway was used for a rail line spur which has since been removed. Currently only the eastern side of the causeway near and including the bridge is utilized for forestry related activites. The entire causeway is crown property (Provincial) and is included in a wildlife reserve which also covers a portion of the enclosed (dyked) side of the estuary and extends northward encompassing most of the remainder of the delta (Figure 3). There is, however, some dispute between Canfor and the Ministry of Lands, Parks and Housing as to whether an existing log booming and storage lease includes the bridge and adjacent area used for slash burning (Appendix 2). The remainder of the enclosed area, i.e. Lot 692 is the property of Canfor.

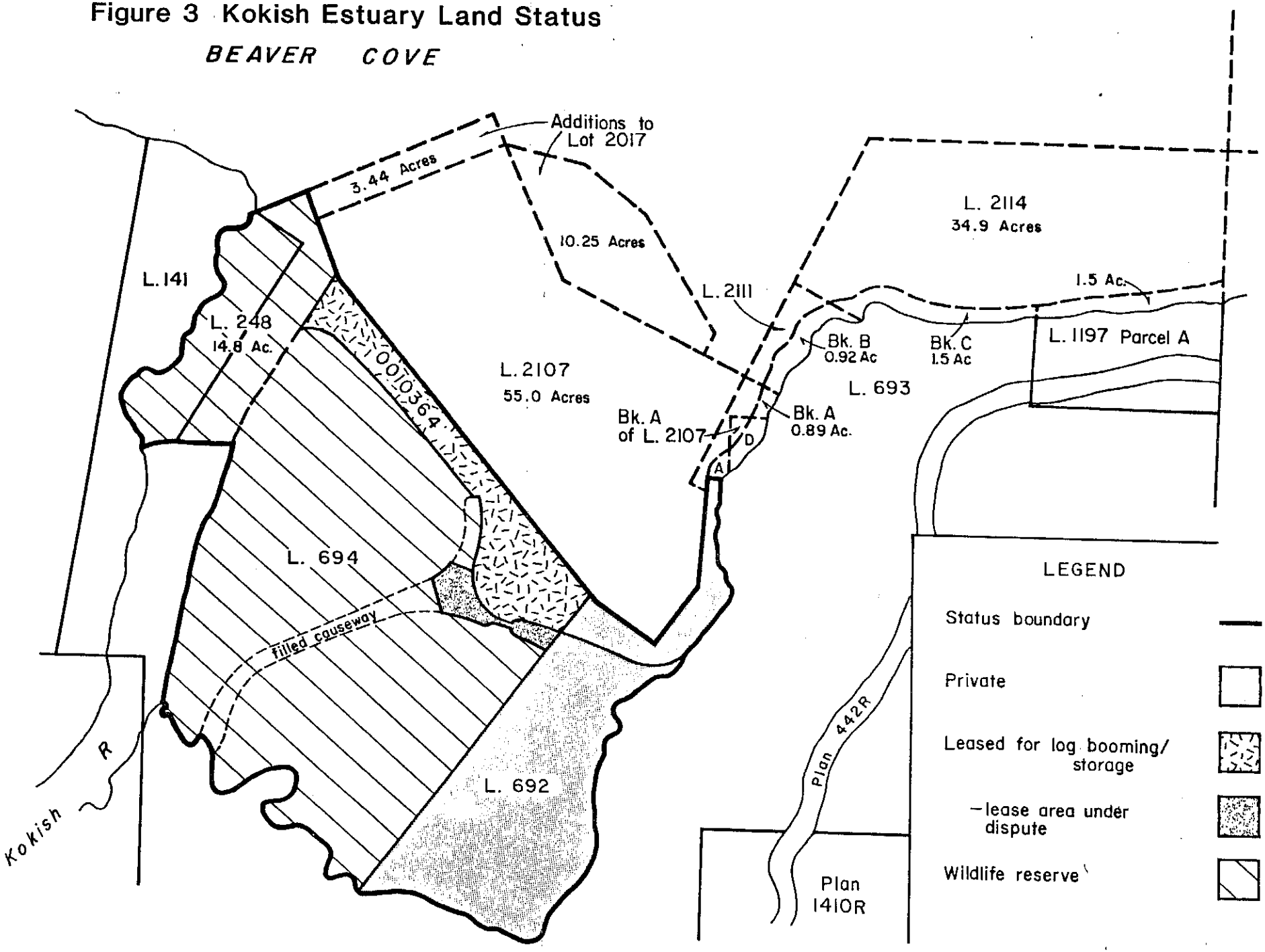
Description of Existing Habitat

A 1:5 000 estuarine habitat map is included in the back cover. This map indicates habitat types which occur throughout the estuary.

This habitat information combined with the D.F.O. studies and large scale color air photos (1980 BCC 270 173-174, 181-182) indicates several differences

Figure 3 Kokish Estuary Land Status

BEAVER COVE



between the enclosed portion of the estuary and the more natural north side. These physical and vegetation differences are compared in Table 1.

As would be expected, the enclosed side is more marine in character and has higher salinities, finer substrates and more salt tolerant vegetation.

Although standing crop measurements were not taken, the unenclosed side appears to have a greater abundance and more vigorous growth of Lyngbye's sedge, a species considered to be a major contributor to biomass production. Because of the physical and biological factors noted above it is highly probable that the unenclosed portion of the delta has considerably greater productivity than the enclosed portion.

Fisheries Resource

Four salmon species, chinook, coho, chum and pink occur in the Kokish system. According to escapement records which represent returning adult stock (Appendix 3), coho and pinks are the most abundant followed by chum and minor returns of chinook. Since 1971 the overall numbers have shown a marked decrease with general escapement ranges of 400-800 coho, 200-700 pinks, 100-500 chum and 25-75 chinook. Steelhead catch (catch to escapement assumed to be 1 to 1) from 1970-83 has averaged 178 (Appendix 4). Production estimates based on accessible stream area and total dissolved solids predict a potential capability of adult steelhead returns of 750. A 1970 stream inventory showed that sea-run cutthroat were existing at minimum levels. Numerous Dolly Varden, however, were observed and it is estimated that the Kokish system supports two to three dozen cutthroat and 800 Dolly Varden (P. Law, pers. comm.).

Juvenile salmonids spend varying amounts of time rearing in estuaries. Department of Fisheries and Oceans sampling for juvenile coho within the estuary yielded coho both within the river and the natural northern portion of the estuary.

Table 1 Differences Between the Enclosed and Unenclosed Portion of the Kokish Estuary

CATEGORIES	ENCLOSED PORTION	UNENCLOSED (NORTH) PORTION
Freshwater Input	- intermittent stream from the S.W. provides only minor amounts of freshwater during high rainfall periods - a culvert in the N.W. portion of the causeway (apparently previously intended to provide freshwater intrusion) has been sealed by sidecast material	- continuous freshwater flow from the Kokish River (estimated maximum of 334 cms)
Tidal Exchange	- causeway completely encloses estuary except for a 24.4 m bridge opening which allows restricted tidal exchange	- natural unimpeded tidal exchange and flushing
Salinity*	- average of 38.7 ppt (surface at bridge 14.6 ppt)	- average of 19.8 ppt
Substrate	- finer substrates occur throughout the intertidal flats and marshes with the latter also having a high organic content	- coaser river borne sediments predominate with little organic build-up
Intertidal Vegetation	- salt tolerant (halophytic) vascular vegetation is common for example, intertidal low marshes are characterized by coastal alkali grass (Puccinella maritima) and sea-side arrow-grass (Triglochin maritimum)	- "brackish" or less halophytic species predominate. Lyngbye's sedge (Carex lyngbyei) and tufted hair grass (Deschampsia cespitosa) are dominants within the low marsh

*based on 1974 high slack tide samples (D.F.O.)

None, however, were captured within the enclosed portion (J. Lamb. pers. comm.). This is likely due to the fact that the high salinities and marine character of the causeway bound portion of the delta does not provide a suitable habitat for juveniles during their critical acclimation period from freshwater to an ocean environment. In fact, the recorded value of 38.7 ppt for the enclosed portion is considerably higher than the summer salinity range of 28-30 ppt for Johnstone Strait (R. Thompson, pers. comm.). The extreme salinities of this portion of the delta may result from evaporation and concentrations of salts coupled with restricted flushing. In addition, access to the enclosed portion is possible only via the bridge. To reach this area juveniles coming downstream are deflected by the hook on the north-east end of the causeway and forced into deeper water and a less protective environment in order to reach the bridge.

Summary of Impacts

The causeway encircles approximately 14.5 ha of intertidal marsh and flat (approximately 40% of the total intertidal area of the Kokish estuary). The major impacts on the enclosed area are:

1. increased salinity (almost twice that recorded on the unenclosed north side)
2. reduced tidal exchange and correspondingly restricted nutrient cycling
3. shift in intertidal vegetation to more halophytic (salt tolerant) species. Also a decrease in productivity is suspected.
4. creation of unsuitable habitat for juvenile salmonids during their acclimation period

Rehabilitation Options

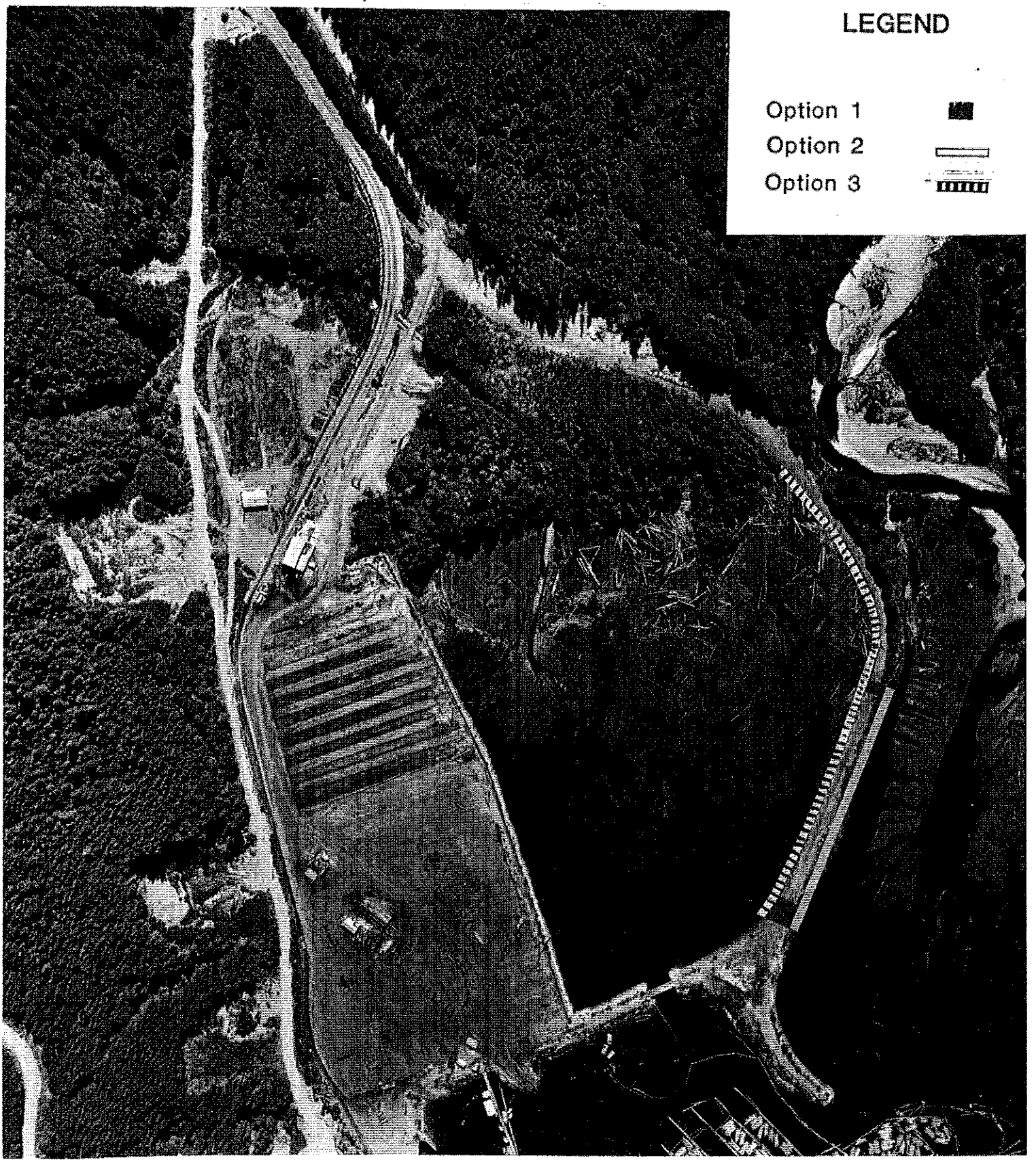
From the information presented it is evident that the enclosure of the

southern portion of the Kokish Estuary has resulted in several negative impacts.

In order to mitigate these impacts, three options for breaching and/or removal of the causeway were developed through discussions with the Department of Fisheries and Oceans and the Surveys and Resource Mapping Branch, Ministry of Environment. For comparative purposes all three options are shown on Figure 4.

Each of the options are considered individually with respect to their advantages and disadvantages from a fisheries resource, habitat and engineering perspective. Options have been plotted onto the estuary map in order to relate them to the adjacent habitats (see Figures 5-7).

Figure 4 Kokish Estuary Rehabilitation Options

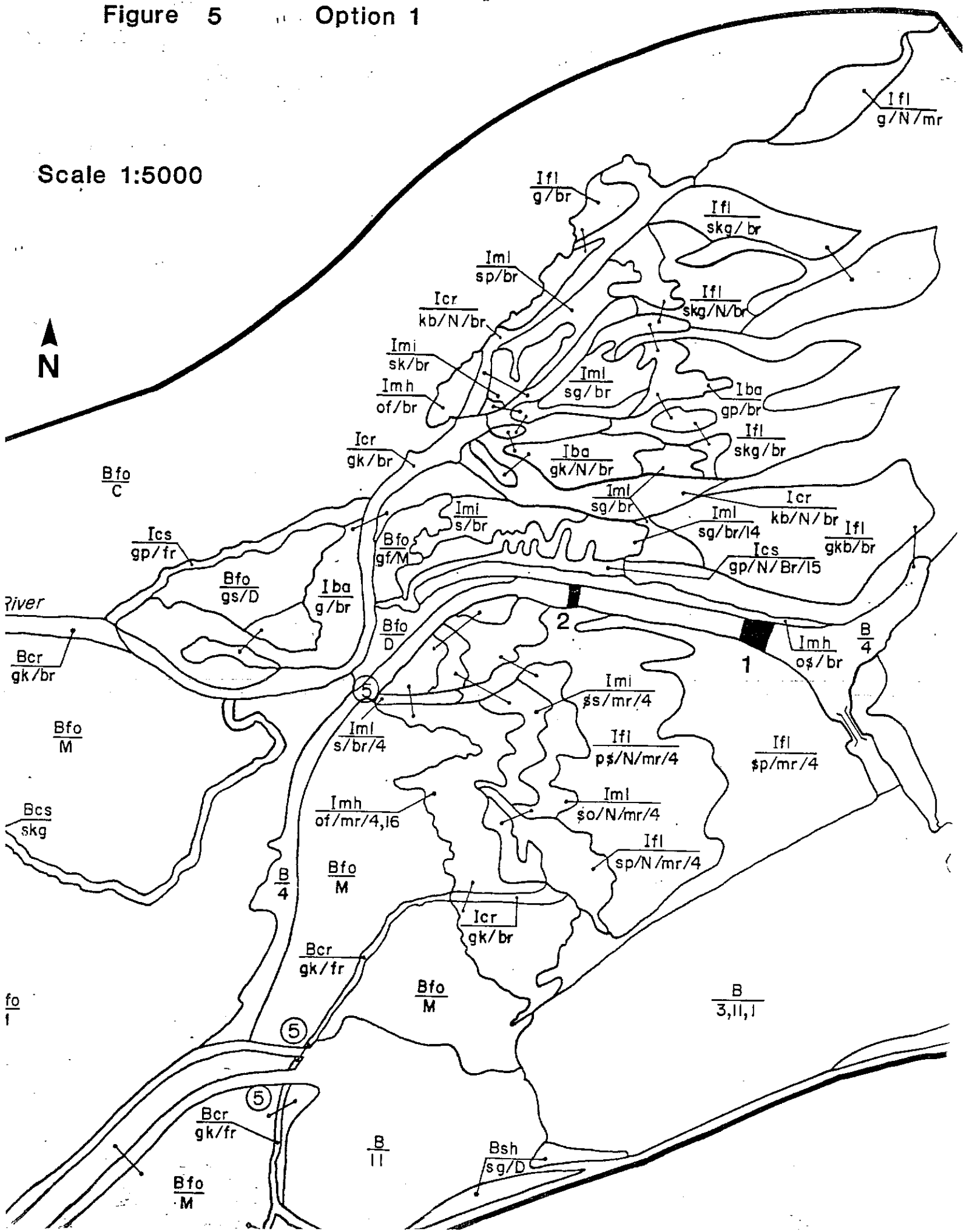


OPTION 1

- Open 2 ports within the causeway (Figure 5)
- Port #1, 30 metres in length, port #2, 9 metres in length
- Estimated material removal of 4300 m^3
- Base elevation of Port #1 is ≈3.4 m and Port #2 ≈ 3.9 m (mean water level according to Alert Bay is 2.9 m, during neap tides average higher high water is 4.5 m).

PROS	CONS
1. will allow limited brackish water intrusion. Creates a limited increase in productivity.	1. salinity decrease would be limited (certainly the salinity would remain higher than the unenclosed side)
2. limited increase in tidal exchange and nutrient cycling	2. although circulation and flushing would increase somewhat, the majority of the causeway still remains to restrict tidal exchange
3. some improvement of habitat for juvenile salmonids (dependent in part upon reduction of salinity)	3. due to 1 and 2 above, benefit to juvenile salmonids may not be cost-effective (definitely is the least beneficial to juveniles of the three options).
4. requires the removal of the least amount of material of any of the options and therefore would be the least expensive	4. may be some hydraulic problems e.g. considering old drainage patterns during ebb tide water-flow may be directed from Port 2 to Port 1, possibly causing scouring at Port 1. If scour channels or pools develop, these may trap water on falling tides which could create fish stranding problems. Port 2 is smaller and due to its base elevation, only limited tidal flushing will occur on neap tides. These factors coupled with adjacent granular material may cause siltation of Port 2.
	5. If at a later date excavation of the causeway section between the ports were required, access to this section would be awkward and costs would be much greater as a result

Figure 5 Option 1

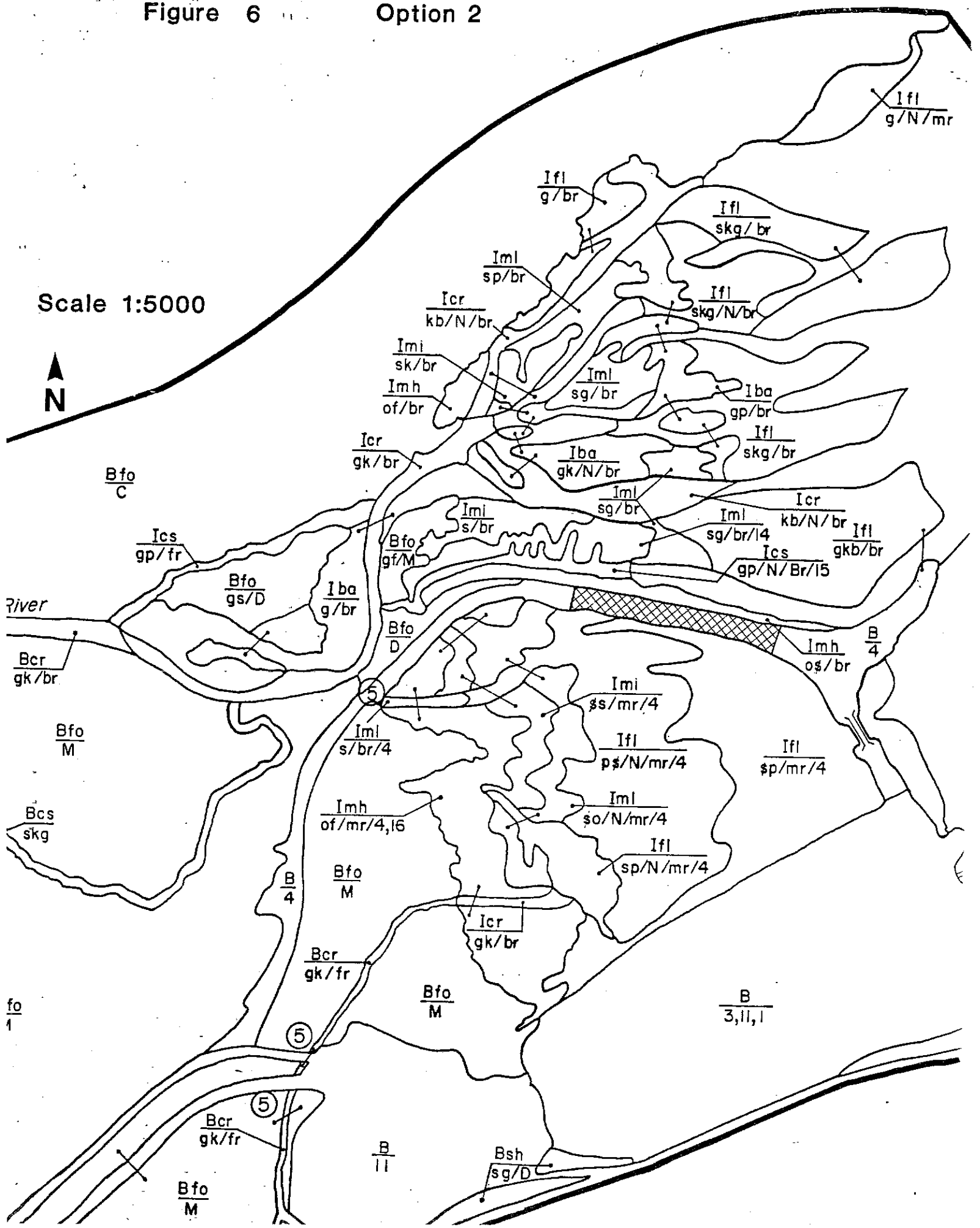


OPTION 2

- Removal of 200 metres of causeway (Figure 6) or, approx. 19,800 m^3 of material
- Section of causeway to be removed corresponds approximately to the upward extent of the intertidal flat habitat

PROS	CONS
1. allows much greater brackish water intrusion than Option 1	1. causeway still restricts direct access of freshwater and salinity would likely still be greater than unenclosed side.
2. definite increase in tidal exchange and nutrient cycling	2. circulation still somewhat restricted (affects both flushing and nutrient cycling).
3. due to 1 and 2 above there will likely be a shift in dominance to a more brackish intertidal marsh with greater species diversity and increased productivity	3. costs will be greater than Option 1.
4. will definitely provide a better environment for juvenile salmonids leading to a corresponding increase in fish utilization.	
5. unlikely to be any hydraulic problems and those suggested in Option 1 would likely be alleviated.	
6. removal of causeway landfill would return approx. 0.53 ha. of former intertidal land	
7. requires the removal of less material than Option 3, therefore less costly	

Figure 6 Option 2

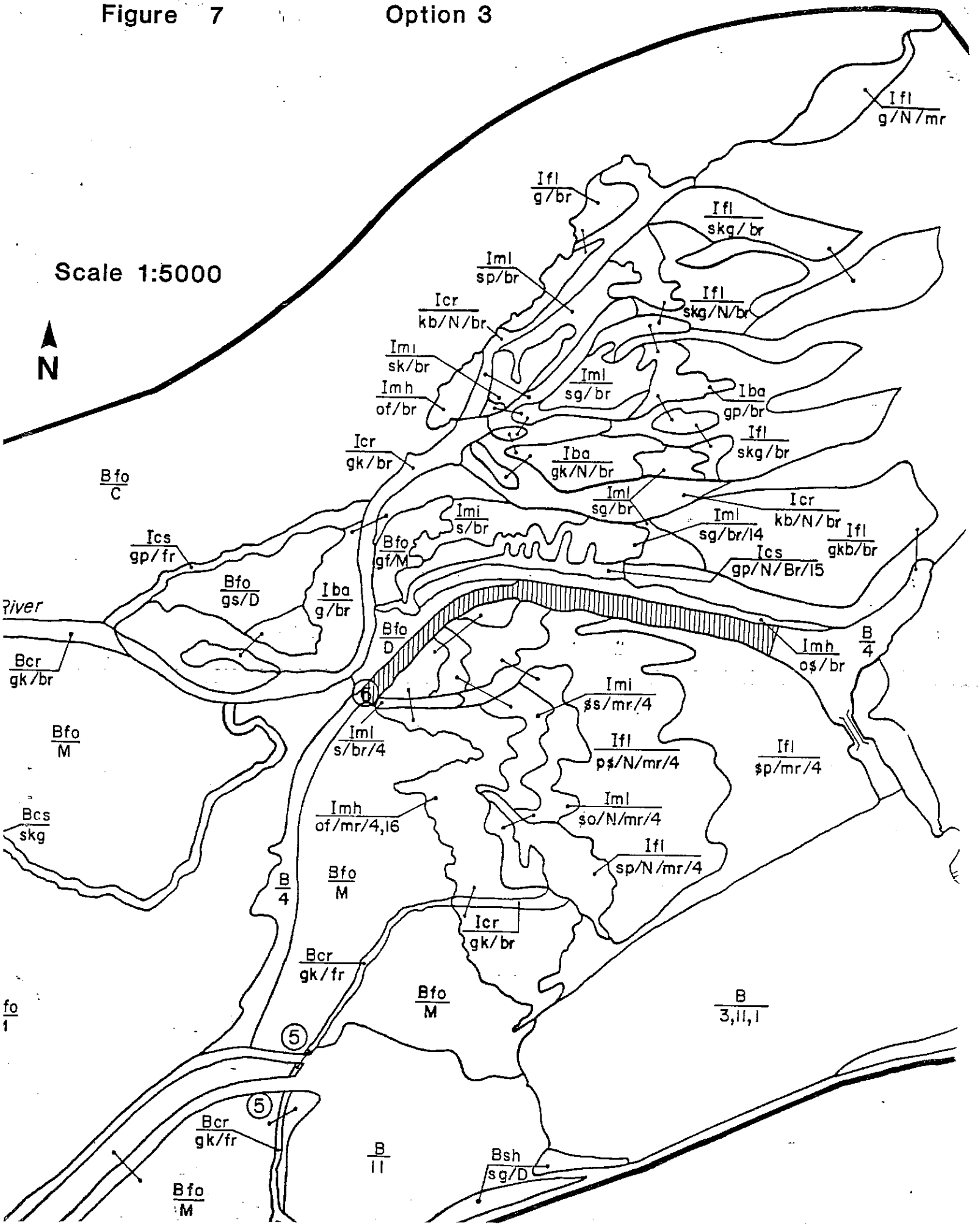


OPTION 3

- Removal of 496 metres of causeway (Figure 7) or approx. 48,000 m^3 of material
- Section of causeway to be removed corresponds to the upward boundary of intertidal habitat and extends to the blocked culvert (indicated as (5) on the habitat map).

PROS	CONS
1. will allow direct access to river channel	1. several possible hydraulic problems. River channel may change course. Rather than heading northward, the major channel may divert to the southeast placing pressure upon the remaining causeway (including the bridge area and the "boot"). Gravel materials from the large intertidal bar (at the present river bend) may be carried and deposited across the former enclosed area. This, coupled with the remaining portion of the causeway acting as a barrier may cause infilling in the intertidal. In addition, the log debris currently along the upper intertidal of the enclosed area would probably shift seaward towards the remaining causeway and bridge.
2. intertidal, except for the eastern side, is no longer dyked	2. Requires the removal of the greatest volume of material. Direct access to river and higher flows may require rip-rap armouring of remaining causeway edges. Costs will be greater than Option 2 and substantially greater than Option 1.
3. circulation is relatively unrestricted and will allow greatest nutrient cycling	
4. intertidal marsh communities should shift to those found on the unenclosed side. Greatest diversity and productivity would be achieved.	
5. creates suitable juvenile salmonid habitat	
6. removal of causeway landfill would return approx. 1.0 ha. of former intertidal land	

Figure 7 **Option 3**



From the preceding discussion, Option 3 should prove to be of greatest improvement from a habitat and fish utilization perspective. However, it is by far the most costly option and could potentially lead to hydraulic problems. Option 1 would be the least expensive, however, it is also the least valuable from a rehabilitation standpoint. Option 2 appears to afford the best balance between habitat enhancement/juvenile salmonid benefits and costs. This option also appears to offer the greatest hydraulic stability

It should be noted that Canfor would like to repair the bridge on the eastern side of the causeway reducing its length from 24.4 m to 12.2 m. Based on a 5.2 m tidal height, this would reduce the opening area from 90.3 m^2 to 45.1 m^2 (W. Green, pers. comm.). If this act were undertaken the effect that this reduction would have on the rehabilitation options should be considered.

The elevation beneath the bridge is esimtated to be 1.5 metres chart datum. Hence, if Option 1 were persued this outlet would have the lowest base elevation of all the openings and thus, the majority of flow would be directed to this outlet. A reduction in the bridge opening would increase any head pressure on this point and increase any scouring or turbulence problems. This could lead to erosion of the adjacent causeway and/or ponded water with subsequent fish entrapment. A hydrological assessment should be conducted to determine the ramification of leaving, deleting or modifying the current outlet associated with the bridge before any decisions on modifications are made.

Given the larger areas for drainage associated with Options 2 and 3, the problems caused by the bridge opening or restricting the bridge opening would presumably be reduced. A hydrologist, however, should be consulted.

4.0 SUMMARY AND RECOMMENDATIONS

1. Impacts upon the 14.5 ha. of enclosed intertidal land include:
   - i) increased salinity
   - ii) little or no juvenile salmonid use
   - iii) reduced tidal exchange, nutrient cycling and productivity
2. Canfor, as part of an understanding with D.F.O. in 1974, agreed to breach the causeway to allow freshwater intrusion.
3. Three options for breaching or removal of the causeway are proposed:
   - Option 1 - excavate 2 ports with a removal of 4300 m^3 of material
   - Option 2 - remove 200 m of causeway $\simeq$ 19,800 m^3 of material
   - Option 3 - remove 496 m of causeway $\simeq$48,000 m^3 of material
4. On the basis of habitat enhancement, productivity and juvenile salmonid utilization the options ranked:

   $1 < 2 < 3$
5. Considering both an economic and rehabilitation perspective Option 2 is recommended and should be given serious consideration.
6. Reducing the present bridge opening by half will be of greatest detriment to Option 1. The impact of the present bridge opening or modification of that opening should be referred to a hydrologist whatever option is persued.

REFERENCES

Jones, L.E. 1982. Kokish Estuarine Habitat Inventory Map. Surveys and Resource Mapping Branch, Ministry of Environment, Victoria, B.C.

Historical Stream Flow Summary of B.C. 1982. Surface Water Data. Inland Waters, Environment Canada, Vancouver, B.C.

Marshall, D.E., R.F. Brown, V.D. Chahley and D.G. Demontier. 1977. Preliminary Catalogue of Salmon Streams and Spawning Escapements of Statistical Area 12. (Port Hardy - Alert Bay). Pac/D-77-2 Fisheries and Marine Service. Vancouver, B.C.

OTHER SOURCES

Green, W. Canadian Forest Products, Woss Lake Camp.

Lamb, J. South Coast Division, Dept. of Fisheries and Oceans.

Law, P. Fish and Wildlife Branch, Nanaimo.

Lirette, M. Fish and Wildlife Branch, Nanaimo.

Thompson, R. Institute of Ocean and Aquatic Sciences, Sidney.

Appendix 1

Canfor Letter of Intent

Canadian Forest Products Ltd.

and affiliated companies

COAST FORESTRY AND LOGGING

April 29, 1974.

Mr. R. A. Crouter,
Manager, Southern Operations Branch,
Pacific Region
Fisheries and Marine
Environment Canada,
1090 West Pender Street,
Vancouver 1, B. C.

Your File: 31-3-K18

31-3-K18

Dear Mr. Crouter:

Thank you for your letter of April 25 in which you state you have accepted our proposal relative to the Dry Land Sort at Beaver Cove. Your letter was an essential input to the Operating Group meeting wherein the project was tentatively approved, subject to final approval of the Department of Lands.

5047

As you know, the original proposal was to have cost $2,952,589.00. The revision will now cost $4,779,200 - an increase of $1,826,110or 62%. This increase is largely due to the relocation to the other side of the lagoon, and as a result, the payback, from an economical point of view is almost completely wiped out. Nevertheless, because of the benefits of environmental improvement, and the implementation of weight scaling, we are prepared to proceed with this project.

We intend to:

(a) Provide freshwater access to the enclosed foreshore at three locations in the existing causeway; access sites to be designated following a field inspection by the Fisheries and Marine Service.

(b) Relocate the small stream between the existing married quarters and the proposed fill.

(c) Remove benthic bark deposits at the deload trestle on completion of present operations.

(d) Confine the width of the proposed fill to 520 feet from the west edge of the Kokish road.

...2

CANFOR

In addition, we will adhere to the provisions included in your letter as follows:

1. Your Service will be notified at least 30 days prior to any construction activity within the foreshore in order that you can undertake necessary field work,

2. We have provided funds to bulldoze three channels in the present causeway to provide freshwater circulation within the lagoon. We cannot, at this time, commit ourselves to do more than this, but if some modification appears necessary we would be pleased to negotiate with you, perhaps on a cost-sharing basis, any additional work. In other words, we cannot make an open-ended commitment.

3. Prior to commencement of the project, your office will receive a copy of the final plans, and we will maintain close liaison with your Department throughout construction and operational phases.

I note you have not sent a copy of your letter to the Director of Lands, from whom we will have to have his concurrence. Consequently, I am taking the liberty of forwarding a copy of your letter to him.

Thank you for your quick response to our proposal, as your concurrence was essential. Future correspondence to your Department will be initiated from O. B. Hennigar's office at the Englewood Division, where we are presently organizing for the project.

I would ask that you please accept our position in (2) above which is at slight variance with the request in your letter of April 25th.

Yours very truly,

CANADIAN FOREST PRODUCTS LTD.

W. B. GAYLE
Vice President

WBG:JMA

cc. Mr. W. Redel,
Director of Lands.

cc. Mr. H. M. Pogue, R.P.F.,
District Forester

Appendix 2

Land Status - Kokish River Estuary (Beaver Cove)

Note: 1) All lots are within the Rupert Land District.

2) No Mineral or Water Rights searches have been undertaken.

Lot 692, C.G. - Lot 692 was Crown Granted in 1919 to Beaver Cove Lumber and Pulp Co. Ltd. but is now property of Canadian Forest Products Ltd.

Lot 694, File no. 0010364 - Lease no. 120021 (5.261 ha., more or less) for log booming and storage. Lease approved Oct. 29, 1979 for a term of 9 years to:
Canadian Forest Products Ltd.

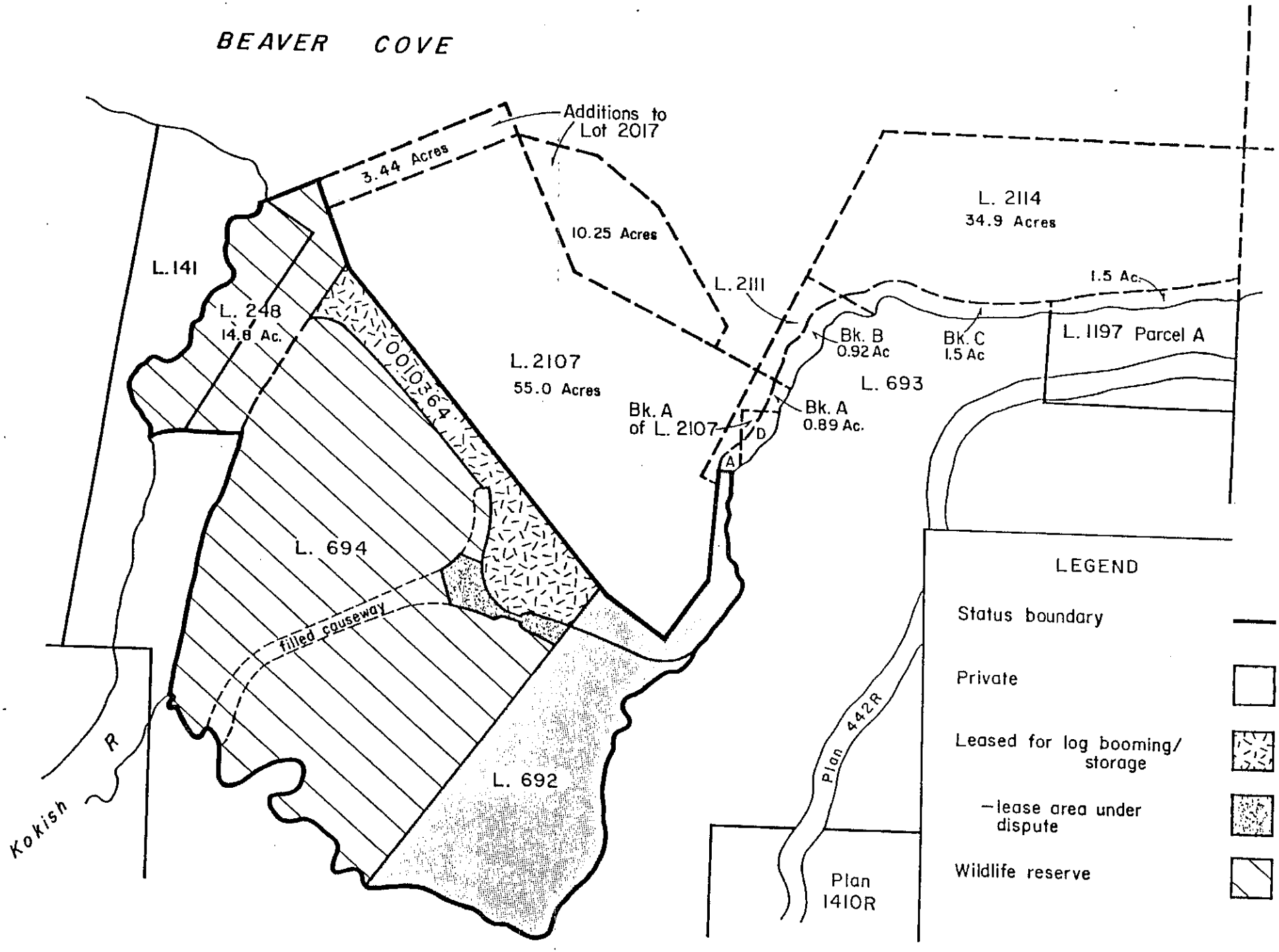
note: The actual location of this lease is unclear and presently under dispute. Canadian Forest Products believes that part of the causeway along the east extension is included in the lease. The Ministry of Lands, Parks and Housing position is that the lease should not and does not cover any part of the causeway. There does not appear to be any legal (binding) survey of the lease boundary. The area under dispute is indicated on the attached status map.

Remainder of Lot 694 and Lot 248 - Reserved by Ministry of Environment, Fish and Wildlife Branch through OiC 262/80 for Habitat Protection and Waterfowl Management purposes.

File no. 07533 - file refers to the original Crown Grant of Lot 692.

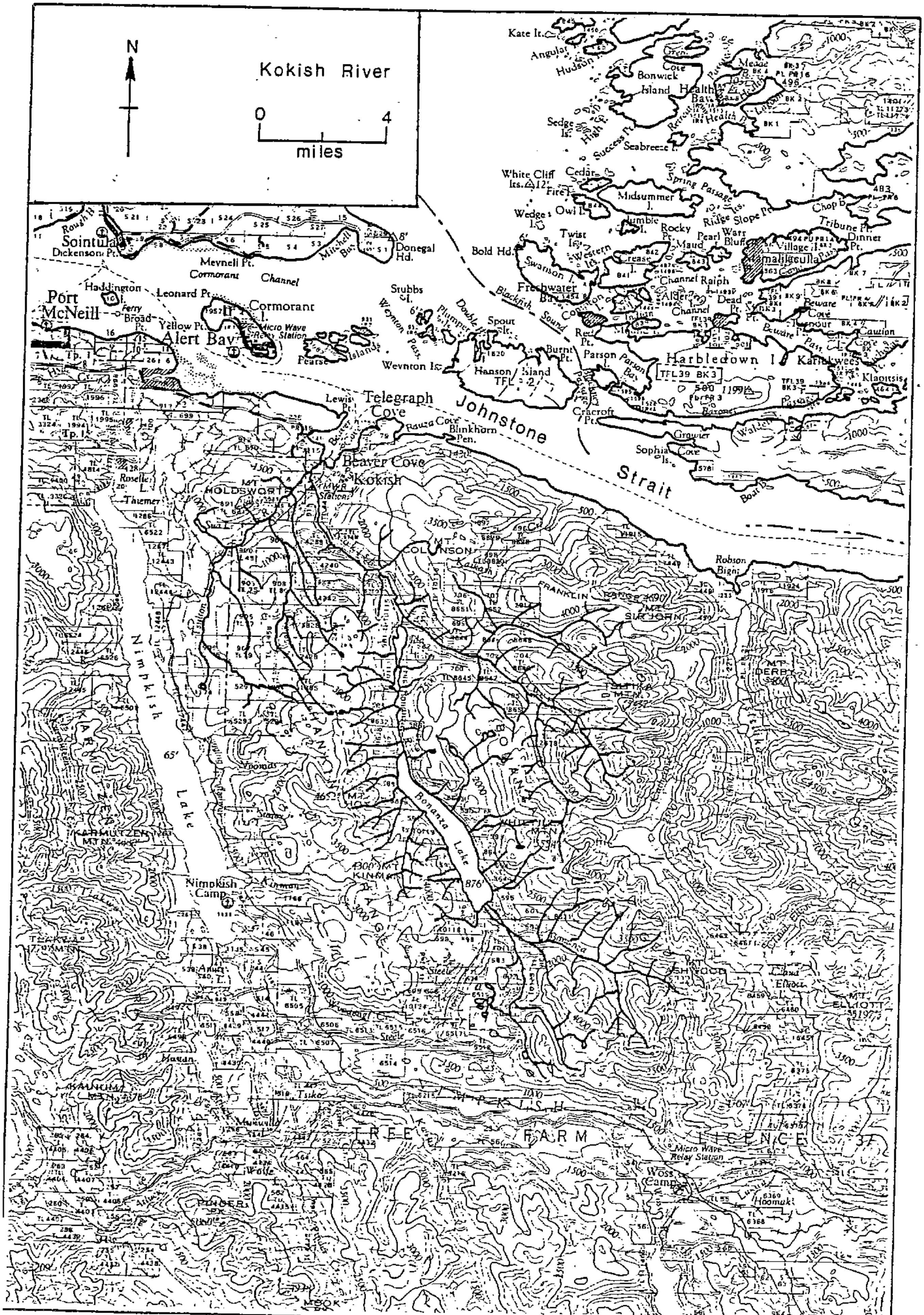
File no. 058854 - Dead file (archived)

D.E. Smith/aj
January, 1984


BEAVER COVE
Additions to Lot 2017
3.44 Acres
10.25 Acres
L. 141
L. 248
14.8 Ac.
L. 2107
55.0 Acres
L. 2111
L. 2114
34.9 Acres
1.5 Ac.
Bk. B
0.92 Ac
Bk. C
1.5 Ac
L. 1197 Parcel A
L. 693
Bk. A
of L. 2107
Bk. A
0.89 Ac.
D
A
L. 694
filled causeway
L. 692
Kokish R
Plan 442R
Plan 1410R
LEGEND
Status boundary
Private
Leased for log booming/ storage
—lease area under dispute
Wildlife reserve

Appendix 3

Spawning Escapement Records for the Kokish River (Area 12)


Kokish River
N
0
4
miles
Sointula
Dickenson Pt.
Donegal Hd.
Meynell Pt.
Cormorant Channel
Mitchell Bay
Haddington I.
Leonard Pt.
Port McNeill
Ferry
Broad Pt.
Yellow Pt.
Cormorant I.
Alert Bay
Micro Wave Relay Station
Pearse Islands
Stubbs I.
Weynton Pass.
Plumper Is.
Wevnton Is.
Kate It.
Angular
Hudson Is.
Bonwick Island
Health Bay
Sedge Is.
Success Pt.
Seabreeze I.
White Cliff Is.
Cedar
Fire I.
Midsummer I.
Spring Passage
Wedge I.
Owl I.
Mumble
Rocky Pt.
Ridge Is.
Slope Pt.
Chop B.
Tribune Pt.
Dinner Pt.
Bold Hd.
Twist Is.
Western Is.
Swanson I.
Crease I.
Maud
Pearl
Warr Bluff
Village I.
Mamalilaculla
Freshwater Bay
Channel
Ralph
Alder I.
Dead Pt.
Beware Pass.
Cove
Spout Is.
Double Bay
Blackfish Sound
Compton
Indian
Hanson Island
TFL 2
Burnt Pt.
Parson Bay
Harbledown I.
Karlukwees
TFL39 BK3
Caution Cove
Klaoitsis
Cracroft Pt.
Telegraph Cove
Lewis Pt.
Johnstone Strait
Rauza Cove
Blinkhorn Pen.
Beaver Cove
Kokish
Growler Cove
Sophia Is.
Walden
Boat B.
Roselle L.
Theimer
MT. HOLDSWORTH
MT. COLLINSON
Kaikash
Robson Bight
FRANKLIN RANGE
MT. SIR JOHN
Nimpkish Lake
MT. DERBY
Tsitika
KARMUTZEN RANGE
KARMUTZEN MTN.
Bonanza Lake
MT. KINMAN
Nimpkish Camp
Kinman
WHITE MTN.
Tlakwa
Bonanza
Steele
MT. ASHWOOD
Elliott
MT. ELLIOTT
Haddon L.
Tsiko
Nimpkish
TREE FARM LICENCE 37
Micro Wave Relay Station
Woss Camp
Hoomuk
Atluck
Wolfe
Woss
PINDER
MOOK

NAME OF STREAM KOKISH RIVER

CONSERVATION DISTRICT 5 STATISTICAL AREA 12

LOCATION OF MOUTH Flows N. into Beaver Cove, SE. of Englewood, Rupert Dist.

POSITION 50 126 NW.

LENGTH 9 MI. WIDTH FT. DRAINAGE 104 SQ. MI.

COMPOSITION: BEDROCK BOULDER COARSE FINE

SILT & SAND UNCLASSIFIED

GRADIENT:

FALL IN FT/000	
0.0 - 2.5	
2.5 - 5.0	
5.0 - 7.5	
7.5 - 10.0	
> 10.0	

WETTED AREA SQ. YD. SPAWNING AREA SQ. YD.

DISCHARGE * 641 CFS MAX 5800 CFS 05/12/62 MIN 15 CFS 28/08/61

TEMPERATURE

BARRIERS OR POINTS OF DIFFICULT ASCENT

SPAWNING DISTRIBUTION:

SPECIES	SECTION OF STREAM USED
SOCKEYE	
CHINOOK	
COHO	Tsulton River
CHUM	Kokish River
PINK (ODD YR)	
PINK (EVEN YR)	
STEELHEAD	

POTENTIAL OF INACCESSIBLE PORTION OF STREAM

GENERAL REMARKS:

- Tsulton River appears to be an excellent spawning stream with good gravel to 6 mi.

* Records were supplied by the British Columbia Hydro and Power Authority from 1957 - 1968.

References:

Fraser, F.J., D.T. Lightly & D.D. Bailey. 1974. An Inventory of East Coast Vancouver Island Streams Important to Chum Salmon. D.O.E., F.M.S., Pac. Reg. PAC/T-74-21 p12.

ESCAPEMENT RECORD FOR KOKISH RIVER (Includes Tsultan River)

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947			UNK	UNK	UNK	UNK
48			UNK	UNK	UNK	UNK
49			7500	3500	UNK	UNK
50			15000	3500	UNK	UNK
51			15000	1500	400	3500
52			15000	1500	3500	1500
53			7500	1500	1500	1500
54			7500	3500	3500	1500
55			15000	750	400	1500
56			7500	1500	7500	
57			3500	1500	750	
58			7500	3500	3500	
59			3500	1500	1500	
60			400	400	400	
61			3500	1500	1500	
62			1500	400	750	
63		400	750	750	400	
64		75	1500	75	3500	
65		400	1500	200	400	
66		200	1500	75	7500	UNK
67		200	1500	200	400	UNK
68		25	3500	75	7500	UNK
69		N/O	N/O	25	N/O	
70		N/O	750	75	1500	
71		75	25	N/O	25	25
72		75	750	75	400	
73		25	800	500	300	
74			300	300	300	
75			75	100	200	
76			400	200	N/O	
*77			300-500	50-100	N/O	
*78		N/O	N/O	N/O	N/O	
*79		0	1000	0	700	
*80		N/O	N/O	N/O	N/O	
*81		N/O	N/O	N/O	N/O	
*82		N/O	N/O	N/O	N/O	
*83		N/O	N/O	N/O	N/O	
84						
85						
Time						
Arr.		E SEPT	E OCT	SEPT	AUG	
Start		E OCT	OCT	OCT	SEPT	
Peak		E OCT	E NOV	OCT	SEPT	
End		NOV	NOV	NOV	OCT	

REMARKS

* Port Hardy Records

Appendix 4 Steelhead Escapement and Production Estimates

Steelhead Harvest Analysis Catch Data for Kokish River
1967-1983

Year	Catch
1982/83	143
1981/82	147
1980/81	121
1979/80	36
1978/79	93
1977/78	221
1976/77	120
1975/76	206
1974/75	151
1973/74	562
1972/73	186
1971/72	256
1970/71	76
mean	178

Note: catch to escapement generally assumed to be 1 to 1.

Steelhead Production Estimates for Kokish River

Anadromous Area (m^2)	Smolts per m^2	Smolt Output	Steelhead Adult Returns
250,000	.024	6,000	750