STATUS OF ENVIRONMENTAL KNOWLEDGE OF THE STEWART ESTUARY

by

T.R. CLEUGH

Memorandum Report
Habitat Protection Division
Fisheries and Oceans

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ACKNOWLEDGMENTS

R. Russell and B. Lawley assisted with the sample collections, and B. Raymond identified the benthic samples.

W. Field drafted the figures and T. Collins typed and proofread this memo report.

J. Morrison provided critical comments.

INTRODUCTION

A Master Plan Study for the Port of Stewart was prepared in 1978 for the British Columbia Harbours Board. The purpose was to provide cognizant guidelines for a co-ordinated development plan. The study was to provide a ready reference of information to parties interested in developing port facilities. Included in this plan was an environmental overview of the estuary and area.

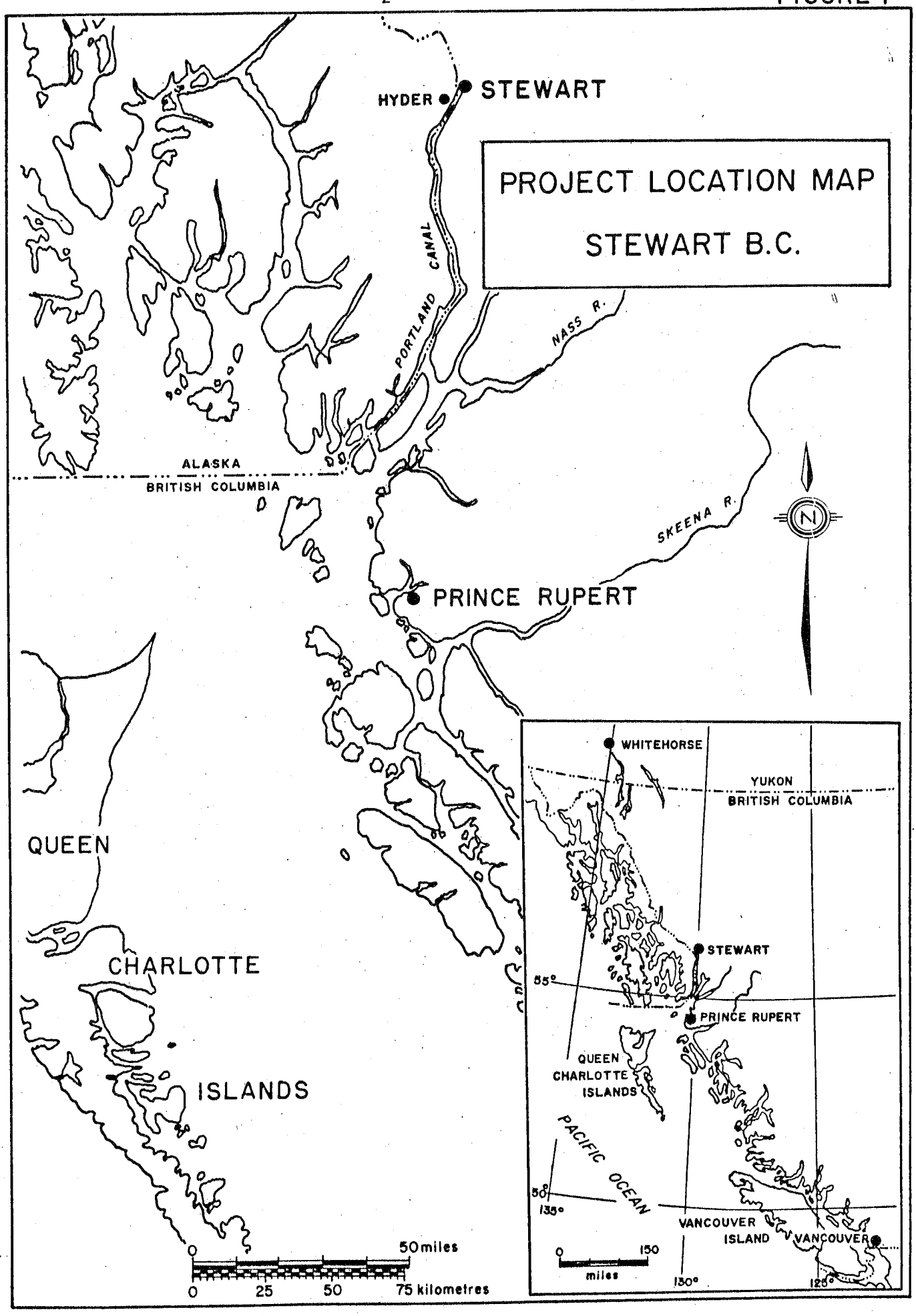
On reviewing the environmental aspects of this document there were several biological statements for which no quantitative or qualitative information was presented. In view of this lack of data a preliminary study was undertaken to document the benthic population and a vegetation mapping on this estuary. Other important environmental data, i.e. water quality and plankton, will be forthcoming. As well as the above noted benthic and vegetation survey this data report will compile other relevant fisheries information.

GEOGRAPHY

The Port of Stewart is situated at the head of the Portland Canal, Canada's most northern Pacific inlet. This inlet forms the international boundary between Canada and the United States of America. Stewart is approximately 700 Km north of Vancouver, 150 Km north of Prince Rupert and 500 Km south of Whitehorse. Stewart is a municipality and is part of the Kitimat - Stikine Regional District.

Two major rivers flow into the head of Portland Canal. The Bear River on the Canadian side and the Salmon River on the

FIGURE 1


PROJECT LOCATION MAP
STEWART B.C.
HYDER
STEWART
PORTLAND CANAL
NASS R.
ALASKA
BRITISH COLUMBIA
SKEENA R.
N
PRINCE RUPERT
QUEEN
CHARLOTTE
ISLANDS
0 50miles
0 25 50 75 kilometres
WHITEHORSE
YUKON
BRITISH COLUMBIA
STEWART
55°
PRINCE RUPERT
QUEEN
CHARLOTTE
ISLANDS
PACIFIC OCEAN
50°
135°
VANCOUVER
ISLAND
VANCOUVER
0 150
miles
130°
125°

American side of the border. Both rivers support towns on their deltas. Stewart, located on the Bear River delta, is located on the north end of this inlet and the Salmon River, and the town of Hyder, is located to the west, see Figure 2.

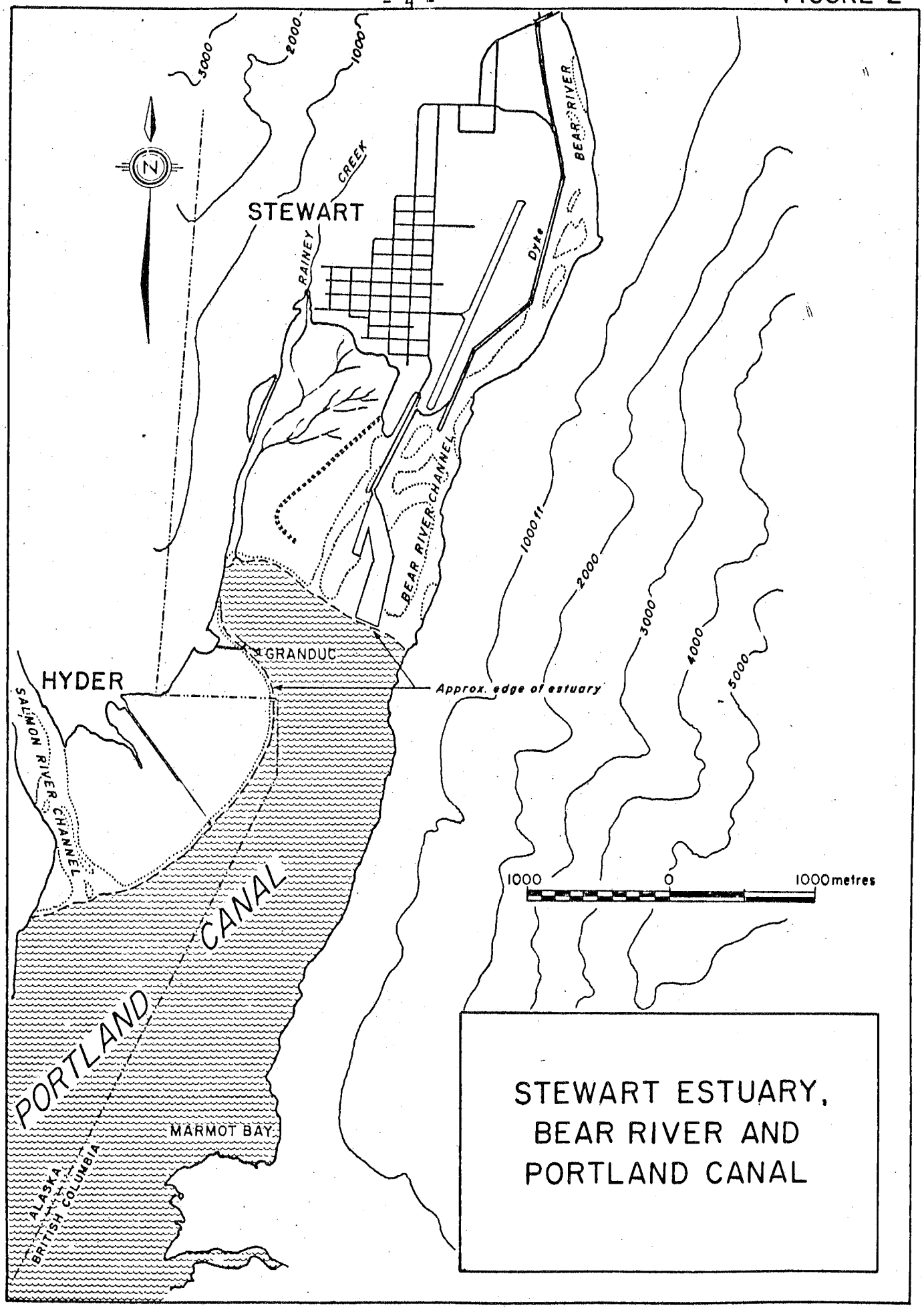
The estuary covers approximately 240 hectares, the Bear River flows through its eastern edge. The substrate in this area is composed mainly of gravel while the mid and western section substrates are composed mainly of mud and silts. The two distinct areas are kept separate by a man-made causeway. Rainey Creek, a small coho stream, runs through the western edge of the estuary.

The Portland Canal is 120 Km long with an average width of 2.2 Km, and maximum depth of 385 m. The annual discharge into the canal is 9,200 cfs. Surface salinities range from 0.1-2 ppt at the head to 5-20 ppt at the mouth, thus the inlet is essentially stored runoff. Mean water level at Stewart is +4.05 m. Tides are, high water 8.4 m and lower water +0.2 m.

CLIMATE

In general winter months, October to March, the weather is frequently overcast, rainy and with strong winds. Summer months the climate is characteristic of continental type modified by the proximity to marine environment. The mean temperature during January is -4.9°C and the mean temperature during July is 14.3°C. The extreme maximum and minimum temperatures are 34.4°C and -30°C respectively. The total precipitation is 1,843 mm with 532 mm of snowfall annually. There are 201 frost free days annually. Prevailing winds in the summer are generally southerly and northerly during the winter months.

FIGURE 2



STEWART ESTUARY, BEAR RIVER AND PORTLAND CANAL

GEOLOGY

This area lies in a mineralized zone (mostly intrusine granitic rocks) in the Coast Mountains, and partly in the sedimentary and volcanic rocks region of the interior basin (Bowser Area). This area has produced many successful mines. The surficial deposits are generally limited to gravel and unconsolidated glacial deposits. The valley floor has large deposits of gravel deposited by the Bear River and its tributary streams; in some areas large alluvial fans are created by these streams.

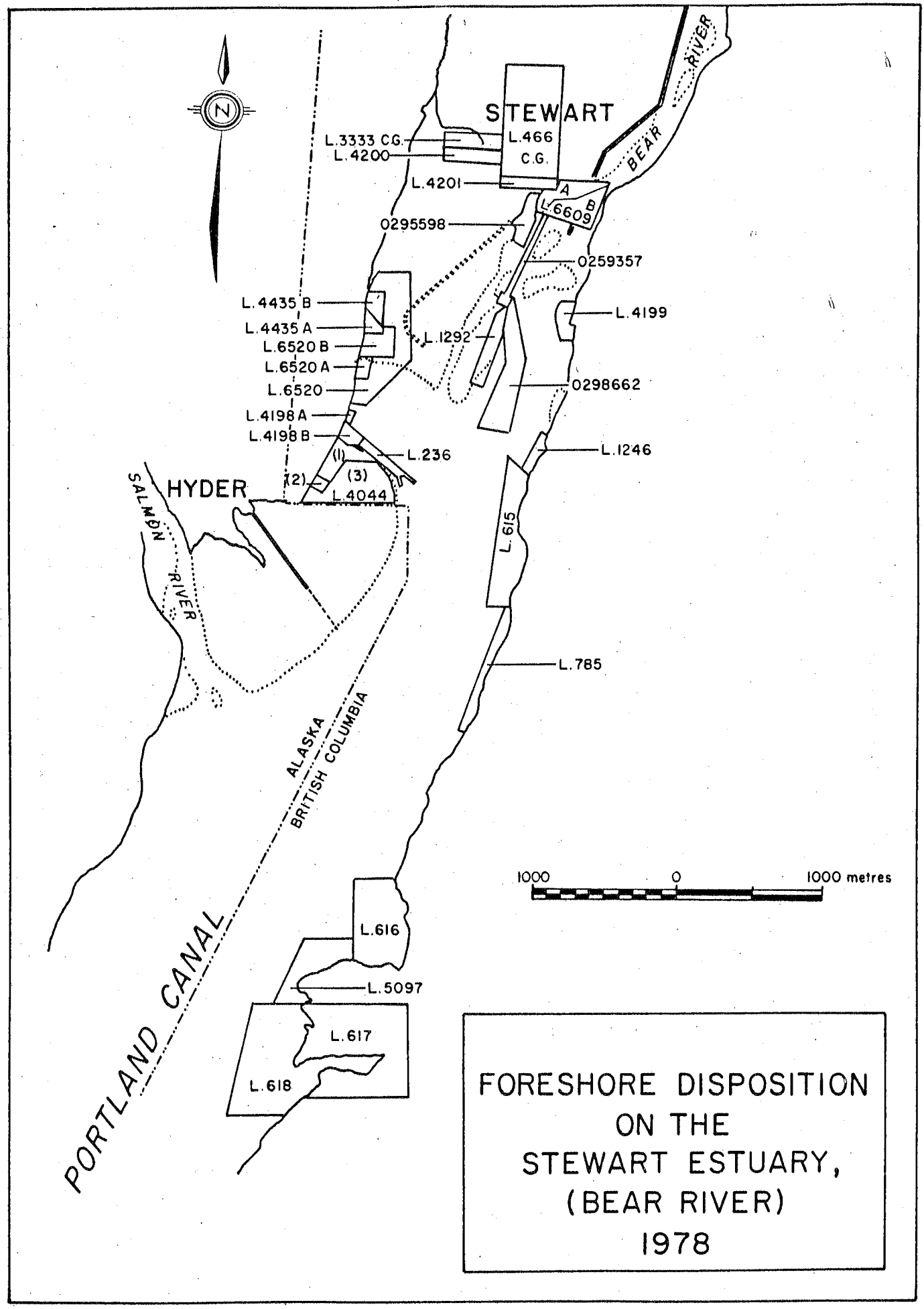
The soils on the Bear River estuary are composed of sand and gravel overlain by silt. Since channelization of the Bear River finer materials have settled on the western side of the estuary while coarse gravel materials have remained on the eastern (river) side of the estuary.

LAND USE

The disposition of the foreshore in the Stewart estuarine area is shown on Figure 3. The reserve areas (established in 1968) are to provide orderly port development thereby reducing conflict between users. At present more than half of the foreshore is being used for industrial purposes.

Lot Number	Ownership Status
236	Granduc Operating Co.
466	Alienated (Portion included in Reserve File 0263955)
615	Vacant Crown Foreshore
616	Vacant Crown Foreshore

FIGURE 3


N
STEWART
L.3333 C.G.
L.4200
L.466
C.G.
L.4201
BEAR RIVER
A
B
L.6609
0295598
0259357
L.4435 B
L.4435 A
L.6520 B
L.6520 A
L.6520
L.4198 A
L.4198 B
L.1292
L.4199
0298662
L.1246
(1)
(2)
(3)
L.236
L.4044
HYDER
SALMON RIVER
L.615
L.785
ALASKA
BRITISH COLUMBIA
PORTLAND CANAL
1000
0
1000 metres
L.616
L.5097
L.617
L.618
FORESHORE DISPOSITION
ON THE
STEWART ESTUARY,
(BEAR RIVER)
1978

Lot Number	Ownership Status
617	Vacant Crown Foreshore
618	Vacant Crown Foreshore
785	Rivtow Straits Ltd.
1246	Rivtow Marine Ltd.
1292	Canadian Cellulose
3333	Alienated (Portion included in Reserve File 0263955)
4044 (1)	Granduc Operating Co. (Portion under lease for marine terminal)
(2)	Shell Oil
(3)	Vacant Crown Foreshore
4198 Blk.A	Reserved for Public Works of Canada for wharf purposes
4198 Blk.B	Granduc Operating Co. (Marine terminal)
4199	Vacant Crown Foreshore
4200	Alienated (Portion included in Reserve File 0263955)
4201	Alienated (Portion included in Reserve File 0263955)
4435 Blk.A	Rivtow Straits Ltd.
4435 Blk.B	Vacant Crown Foreshore
5097	Reserve B.C. Forest Service
6520 Blk.A	Reserved for Dept. of Public Works Canada for wharf purposes
6520 Blk.B	Rivtow Straits Ltd.
6520 Portion	Vacant Crown Foreshore
6609 Blk.A	Dist. of the Village of Stewart
6609 Blk.B	Reserved from alienation in connection with approach to airport

Licence to Occupy

File 0259357 Granduc Mines Ltd.

Letter of Consent

File 0295598 Dydar Resources

Application to Lease

File 0298662 Cassiar Asbestos

Lot Number	Ownership Status
Reserves	
File 0263955	On January 22, 1968, a reserve was established to provide for orderly port development over all unalienated and unreserved lands at the head of the Portland Canal. The reserve extends from the high water mark at the Stewart townsite south to the east extension of the U.S./Canada border where it crosses the Salmon River delta.

HYDROLOGY

The Bear River at Stewart is a typical northern glacial stream having high summer discharge and very low winter flows. Mean August flows are 2,140 cfs while mean February flows are only 85 cfs. The yearly mean flow is 815 cfs from a 135 square mile drainage basin. The maximum instantaneous discharge and maximum daily discharge is 9,570 cfs (Oct. 8, 1974) and 7,950 cfs (Oct.8, 1974) respectively. The minimum discharge is 33 cfs on March 15, 1974. The mean monthly discharge for 1967 to 1976 is given in Table 1.

SALMON ESCAPEMENT

The Bear River supports four species of Pacific salmon, coho, pink, chum and sockeye; the 14 year average (1964-1977) escapement are approximately 3,100, 3,550, 3,500 and 900 respectively. Maximum recorded counts are 10,000 coho, 10,000 pink, 5,000 sockeye and 10,000 chum salmon. Rainey Creek supports a small population of coho salmon; the 1976 and 1977 counts were 125 and 250 respectively. The Salmon River, in Alaska, supports approximately 100,000 chum annually.

TABLE 1: BEAR RIVER ABOVE BITTER CREEK - STATION NO. 08DC006
MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC FEET PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	MEAN
1967	-	-	-	-	761	2270	2010	3000	2860	951	352	153	-
1968	124	105	208	168	818	1260	2510	2010	1610	521	243	94.9	810
1969	50.8	47.7	54.0	138	640	2680	2080	1820	1210	558	871	356	878
1970	89.4	109	117	158	584	1840	2020	2300	1270	947	360	158	834
1971	73.5	121	68.9	162	519	1420	1130	2030	1360	1010	365	180	706
1972	79.9	56.1	110	142	953	1710	3040	2500	1320	1040	335	122	956
1973	91.8	101	96.2	238	764	1270	1820	1660	1460	441	204	72.3	688
1974	40.5	43.3	48.0	209	517	961	1480	2060	1710	2370	460	197	849
1975	106	83.2	76.0	132	790	1430	2320	1720	1170	627	243	173	746
1976	116	98.9	78.4	248	797	1400	2100	2330	1500	829	678	184	866
MEAN	85.8	85.0	95.2	177	714	1620	2050	2140	1550	929	411	169	815

1979 STUDIES

Methods - Twelve benthos invertebrate samples were collected, at 50 meter intervals, on 4 September 1979 as shown on Figure 4. A small 2" x 2" x 6" deep sample was collected from the surface sediment at low tide. Samples were preserved in 10% formalin and laboratory analyzed. Each sample contained about 375 cm^3 of material and represented a surface area of $^1/_{380}$ m^2.

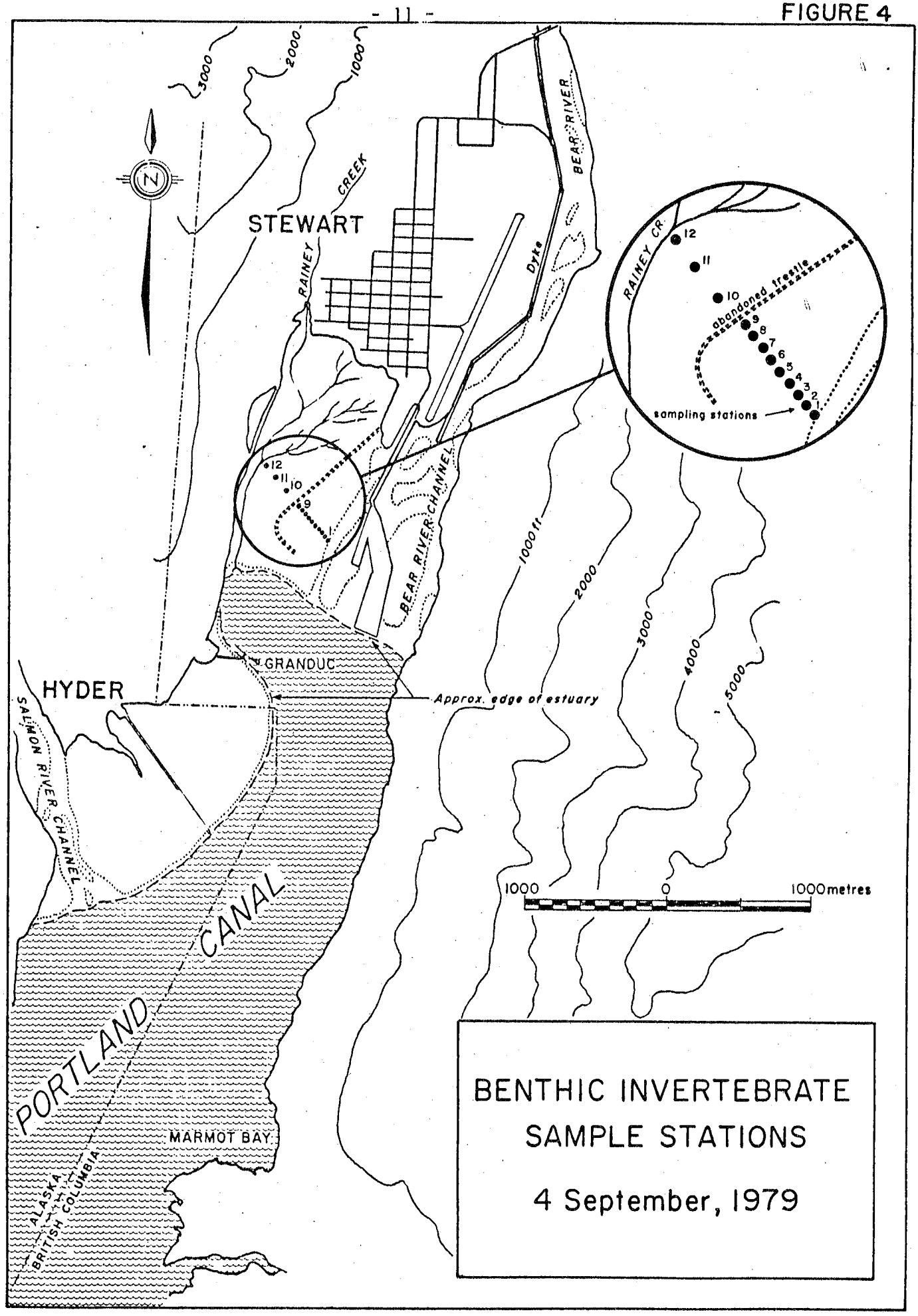
Samples were stained with rose bengal dye and sieved on 75μ and 500μ screens. The 75μ sieve material was subsampled by volume while all the material from the 500μ sieve was examined.

Vegetation mappings were made in May, 1975 and September, 1979. Vertical and horizontal transects were made at 50 meter intervals across the estuary and information plotted on a map. Generic determinations were made in the field; specific determinations were not made.

On July 12, 1975, two Fisheries Service charter vessels, the "CAROUSEL NO. I" and the "BLUE LINE", conducted a test fishing, salinity and water temperature program off the mouth of the Bear River at Stewart, B.C. The purpose was to find out what species of fish were in this particular area at this time of the year and also to find out the salinity and water temperatures at different depths.

Sample sites were chosen at random around the immediate area where the Bear River spills into Portland Canal. These sites are numbered from 1 to 9 and are shown on the attached map (Figure 5).

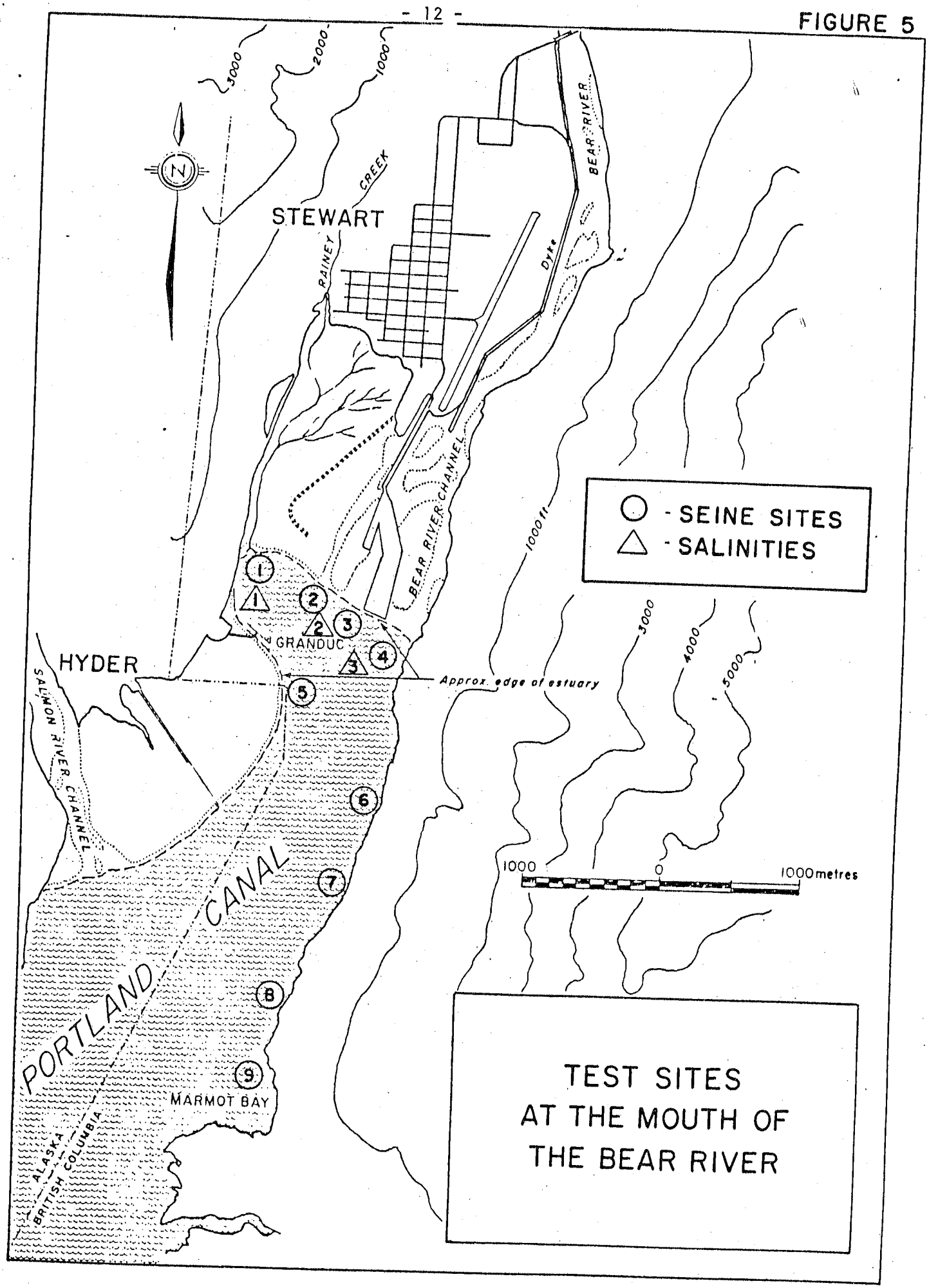
FIGURE 4



BENTHIC INVERTEBRATE SAMPLE STATIONS

4 September, 1979

FIGURE 5


3000
2000
1000
N
STEWART
RAINEY CREEK
BEAR RIVER
Dyke
BEAR RIVER CHANNEL
1000
SEINE SITES
SALINITIES
1
2
3
4
5
6
7
8
9
GRANDUC
HYDER
Approx. edge of estuary
3000
4000
5000
SALMON RIVER CHANNEL
PORTLAND CANAL
MARMOT BAY
ALASKA
BRITISH COLUMBIA
1000
0
1000 metres
TEST SITES
AT THE MOUTH OF
THE BEAR RIVER

The "CAROUSEL NO. I", using a seine net 76 fathoms long by 7 fathoms deep, tested the sites to determine what species were in the area.

The "BLUE LINE" also worked the sites using an inductive salinometer to determine salinities and temperatures at different depths.

Results - Macrofauna and meiofauna detected in the samples are reported in Tables 2 and 3 respectively. A relative abundance by station is shown in Figure 6.

The benthic organisms detected in our samples were mainly freshwater and marine tolerant forms. The largest relative populations were directly associated with the freshwater areas as evident by the lower conductivity and salinities near sample sites 1 and 2 and 7 to 12. The salinities measured in these areas was in the 0-2 ppt range while in sites 3-6 the range was 5-10 ppt.

Sample sites 1 and 2 and 7 to 12 had large numbers of oligochaets and no polychaets whereas the reverse is true for stations 3 to 6. Large numbers of Harpacticoids and Ostracoids were also found associated with the freshwater influence areas. No amphipod were located in the samples, which may be due to the fact that sampling occurred at low tide in the non-vegetated areas of the estuary.

A diversity index and a chi square test were applied to these data. The diversity index for each sample showed a significant difference in diversity values using the $\bar{z}$ test. The X^2 test can only be applied were sufficient numbers of each species (or items) have been collected. Therefore this test was only used on the following data: 1) eggs 2) nematodes

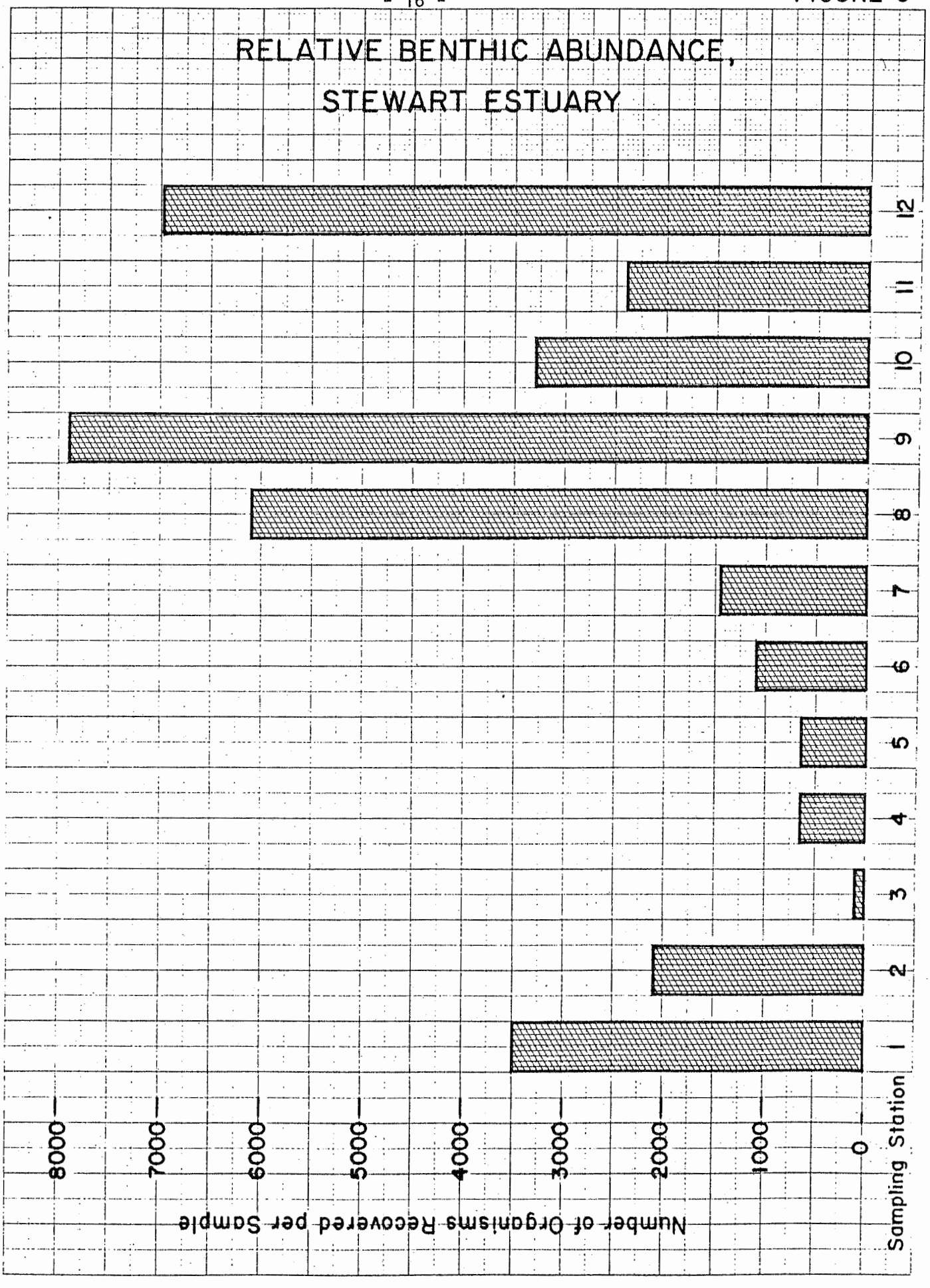
TABLE 2: MACROFAUNA DETECTED IN BENTHIC SAMPLES FROM STEWART, B.C.

	STATIONS											
ORGANISMS	1	2	3	4	5	6	7	8	9	10	11	12
EGGS									1	2		2
NEMATODA	3							17	24	6	2	10
TURBELLARIA										1		
MOLLUSCA												
PELECYPODA	1											
Macoma sp.	4	16	9	18	14	12	12	8	9	14	13	16
OLIGOCHAETA												
ENCHYTRAEIDAE	8	1					18	24	16	25	22	5
NAIDIDAE								3	10	1	17	27
POLYCHAETA												
NEPHTYIDAE		2	5	10	10	14	3			1		
MYSIDACEA												
Neomysis mercedis											1	
DIPTERA LARVA												
HELEIDAE												
Palpomyia grp.												1
TOTALS	16	19	14	28	24	26	33	52	60	50	54	61

TABLE 3: MEIOFAUNA DETECTED IN BENTHIC SAMPLES FROM STEWART, B.C.

	STATIONS											
ORGANISMS	1	2	3	4	5	6	7	8	9	10	11	12
EGGS	233	67		10		20		80	160	160	200	120
NEMATODA	2000	1644	50	580	450	950	520	2720	3800	1900	1060	2200
TURBELLARIA									20			
PELECYPODA				20	30	10		20			20	
OLIGOCHAETA												
ENCHYTRAEIDAE	33							20		80	60	
NAIDIDAE	67	22						60		20	80	320
NAUPLIUS	133					10	40	20			20	20
HARPACTICOIDA	500	356	10	10	20	10	800	420	360	340	200	840
OSTRACOIDA	534	156	80	30	160	170	80	2740	3540	800	740	3400
TARDIGRADA						10						
INSECTA LARVA												
CHIRONOMIDAE								20				
TOTALS	3500	2245	140	650	660	1180	1440	6100	7880	3300	2380	6920

FIGURE 6



3) enchytraeidae 4) naididae 5) harpacticoida and 6) ostracoida. A X^2 test on this data then showed conclusively that all sample sites were not similar. The significant difference in number of species present was $p < 0.0005$.

Vegetation zones found in the Stewart estuary are diagramatically shown on Figure 7. The Bear River channel had little to no observable vegetation on the gravel substrate. The area east of the causeway was easily dividable into mud flats and vegetative zones. The mud flats had some sporadic vegetation associated on rock and old pylons; the majority of this vegetation was Fucus sp. and Ulva sp. Some eelgrass (Zostera sp.) was located near the freshwater drainage channels over the estuary up to the limit of high tide. The upper estuary, vegetative zone, was densely populated with several intertidal grass species as shown in Plate 1. More than half of the intertidal estuary was vegetated. Large numbers of fishes, some coho, were observed in the wetted areas within the vegetated zone.

The species of fish caught along with set times are listed on Table 4 and the salinities and temperatures are listed on Table 5.

Only 3 sites were tested by the "BLUE LINE" when she ran over a piece of rope and was put out of commission. She was then unable to complete all the designated sites.

FIGURE 7

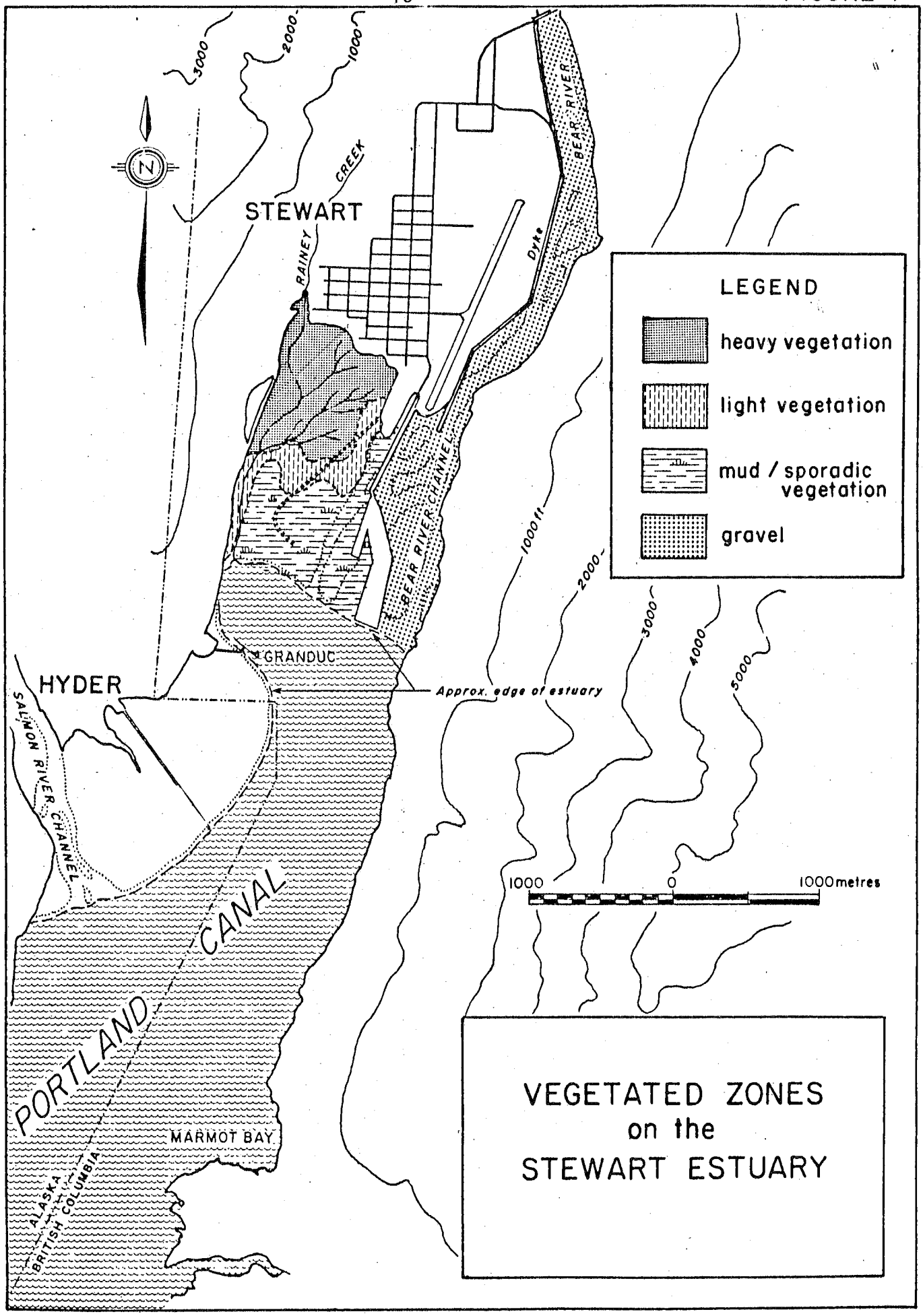

3000
2000
1000
N
STEWART
RAINEY CREEK
BEAR RIVER
Dyke
BEAR RIVER CHANNEL
GRANDUC
HYDER
Approx. edge of estuary
SALMON RIVER CHANNEL
PORTLAND CANAL
MARMOT BAY
ALASKA
BRITISH COLUMBIA
LEGEND
heavy vegetation
light vegetation
mud / sporadic vegetation
gravel
1000
2000
3000
4000
5000
1000 0 1000 metres
VEGETATED ZONES
on the
STEWART ESTUARY

TABLE 4: SPECIES OF FISH CAUGHT
INCLUDING TIMES AND SITE NUMBERS

Date	Time	Site Number	Species Caught
July 12/75	1100	1	41 Dolly Varden, 5 flounders, 7 smelt
July 12/75	1130	2	49 Dolly Varden, 2 eulachons, 4 smelt, 2 juvenile chum, 1 jack sockeye
July 12/75	1200	3	1 Dolly Varden
July 12/75	1220	4	6 Dolly Varden, 2 eulachons
July 12/75	1245	5	17 Dolly Varden, 2 smelt, 1 eulachon, 4 juvenile chum
July 12/75	1610	6	10 Dolly Varden, 1 smelt
July 12/75	1630	7	10 Dolly Varden, 2 smelt, 2 juvenile chum
July 12/75	1650	8	6 Dolly Varden
July 12/75	1705	9	1 Dolly Varden

TABLE 5: SALINITIES AND TEMPERATURES

Date	Station	Time	Depth in Metres	Salinity	Temp.°C
July 12/75	1	1215	0	0.81	7.20
			2	1.24	6.51
			5	2.02	6.12
			10	11.96	6.50
			15	29.93	6.02
July 12/75		1230	0	1.33	5.62
			2	1.34	5.44
			5	2.04	5.52
			10	6.55	6.11
			15	30.39	5.32
July 12/75		1240	0	0.97	5.86
			2	1.07	5.77
			5	1.79	4.83
			10	16.80	6.43
			15	30.48	5.51
			25	32.20	5.56

DISCUSSION

Before any development may be implemented the resource base which may be affected by the proposal within the estuary (study site) should be clearly identified, as a reasonable assessment of any long range impacts by far-reaching developments cannot be undertaken without adequate baseline data. The present information provides an indication for productive estuarine areas, and an appreciation of the probable value to resident and migrating fish stocks.

The foreshore development has fully utilized or alienated more than half of this estuary. The capacity of the system to absorb any future developmental stress must be considered prior to implementation of any master plan.

The potential for development, in this estuary with very limited space, is only now beginning to be realized. Log dumps, mine concentrate, shipping, barge supply depot, fuel distribution, transport terminus and marinas are all presently being considered for development or have been developed on this estuary. There are also several environmental estuary impacts which must be evaluated; these include sewage and garbage disposal, channelization, fill and gravel removal, as well as some post-industrial developments.

Although there is a pressing need for some environmental control this usually can be stated of almost any B.C. estuary with foreshore development. There is, however, one major difference in this estuary, the very limited space. This estuary supports two major salmon rivers and possibly many other commercial species and at present more than half of

the foreshore is already alienated. Without some cognizant guidelines outlining sensitive zones in greater detail this productive estuary may be severely limited in terms of fish usage.

Therefore in order to evaluate the present and proposed developments on the environment and to avoid loss of vital or unique fish habitat as well as realize pre-impact conditiions, the following studies must be implemented:

1. evaluation of fish usage and fish food webs on the estuary.

2. evaluate fish, water quality, plankton and benthos in the Portland Canal near Stewart.

3. evaluate the methods of development to minimize impacts on this study site.

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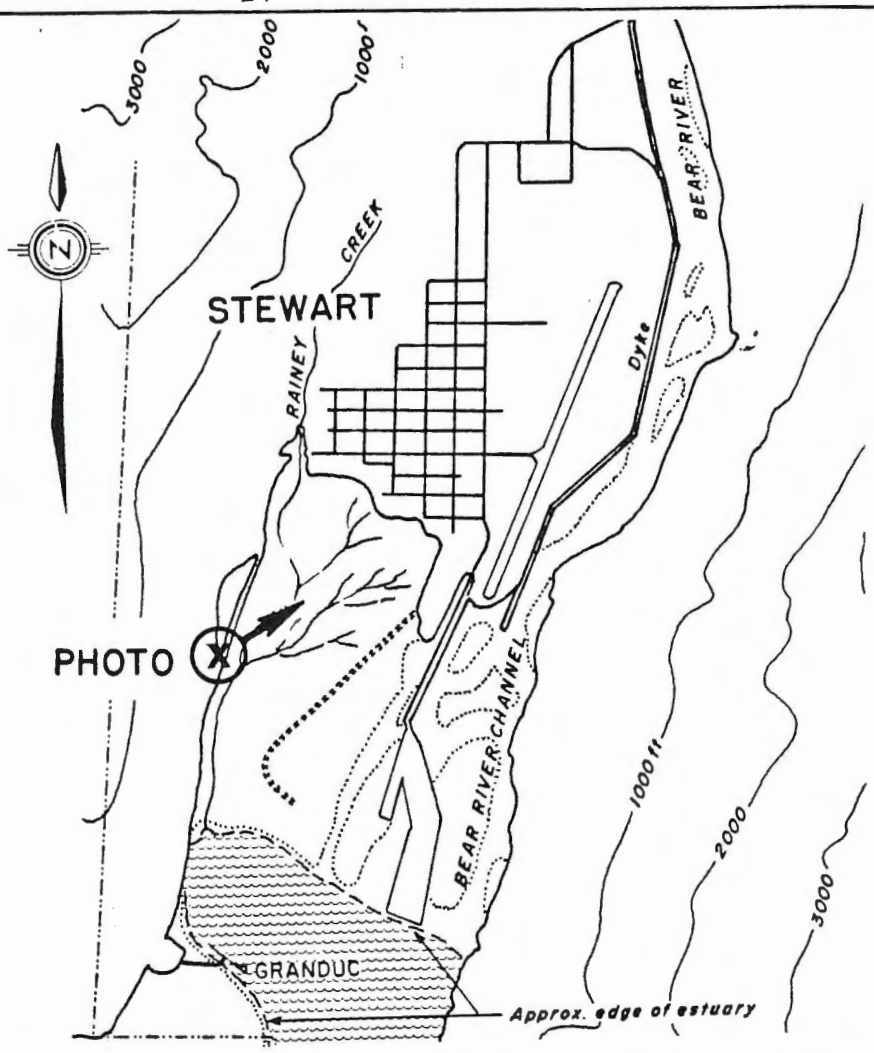

PLATE 1: Upper eastern estuary, STEWART B.C.
28 May, 1975