el 1044578 E

ENVIRONMENTAL PROTECTION BRANCH
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC REGION

MARINE ENVIRONMENTAL SURVEILLANCE MONITORING AT B. C. PULPMILLS 1979

REGIONAL PROGRAM REPORT: 81-16

by

D. L. Sullivan

October, 1980

LIBRARY
ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
PACIFIC REGION

ABSTRACT

During 1979, the Environmental Protection Service conducted environmental surveys of receiving waters of south coastal pulp mills at Powell River, Crofton, Harmac, and Elk Falls, B.C., in order to assess the effectiveness of environmental controls. Parameters examined in the surveys included water column temperature, salinity, dissolved oxygen, colour, sediment character, and trace metals in the sediments and in animal tissue. In addition, sediment samples were analyzed for particle size and total volatile residues at Powell River, Harmac, and Elk Falls, and trawls were conducted at Powell River and Crofton to determine species diversity. The data is presented, results are discussed, and conclusions are drawn.

Surveys at north coastal and interior mills will be reported elsewhere.

RÉSUMÉ

Durant l'année 1979, le Service de la protection de l'environnement a procédé le long des côtes méridionales de la Colombie-Britannique à l'analyse des eaux réceptirces situées à proximité des usines de pâte à papier de Powell River, Crofton, Harmac et Elk Falls, afin de mesurer l'efficacité des contrôles de protection de l'environnement. Parmi les paramètres relevés il faut citer la température de la collonne d'eau, la salinité, la quantité d'oxygène dissout, la couleur, le type de sédimentation ainsi que la présence de métaux à l'état de traces dans les sédiments et les tissus animaux. En outre, on a procédé à des prélèvements de sédiments en vue d'analyser leur composition, particules et résidus volatils, à Powell River, Harmac et Elk Falls; des prélèvements furent faits à Powell River at Crofton en vue de déterminer la diversité des espèces vivantes. L'étude comporte une présentation des données, une discussion des résultats et l'élaboration de conclusions.

Les enquêtes faites à proximité des usines situées le long du littoral septentrional et à l'intérieur des terres feront l'objet d'un autre rapport.

TABLE OF CONTENTS

		Page
ABSTRACT		i
RÉSUMÉ		ii
TABLE OF CONTENTS		iii
	List of Figures	v
	List of Tables	vi
SUMMARY		vii
1.	INTRODUCTION	1
2.	METHODS AND MATERIALS	1
2.1	Hydrographic Sampling	1
2.2	Benthic Sampling	17
2.2.1	Benthic Trawls	17
2.2.2	Sediment Samples	17
3.	RESULTS AND DISCUSSION	17
3.1	Water Quality	17
3.1.1	Powell River, B. C.	17
3.1.2	Crofton, B. C.	18
3.1.3	Harmac, B. C.	19
3.1.4	Elk Falls, B. C.	20

TABLE OF CONTENTS (continued)

		Page
3.2	Trace Metals in Marine Sediments	21
3.2.1	Powell River, B. C.	21
3.2.1.1	Mercury Levels	22
3.2.1.2	Cadmium Levels	23
3.2.2	Harmac Pulp Division	23
3.2.2.1	Mercury Levels	23
3.2.2.2	Cadmium Levels	24
3.2.3	Elk Falls Division	24
3.2.3.1	Mercury Levels	24
3.2.3.2	Cadmium Levels	24
3.2.4	Osborn Bay, B. C.	24
3.3	Benthic Trawls	24
3.3.1	Powell River, B. C.	24
3.3.2	Crofton, B. C.	25
REFERENCES		27
ACKNOWLEDGEMENTS		28
TABLES		29
APPENDIX I		71

LIST OF FIGURES

		Page
1	Location Map	2
2	Water Quality Stations:Powell River, B. C., February, 1979	3
3	Water Quality Stations:Powell River, B. C., August & November,1979	4
4	Water Quality Stations:Crofton, B. C. July & October, 1979	5
5	Water Quality Stations:Elk Falls, B. C., August & November, 1979	6
6	Nearshore Benthic Grab Station:Powell River, B. C., February, 1979	7
7	Benthic Core and/or Grab Stations:Powell River, B.C., February, 1979	8
8	Benthic Grab Samples:Powell River, B. C. August, 1979	9
9	Benthic Core Stations:Elk Falls, B. C., July, 1979	10
10	Benthic Core and Water Quality Stations:Harmac, B. C. July, 1979	11
11	Sediment Stations:Osborn Bay, October, 1979	12
12	Trawl Locations:Powell River, B. C., August, 1979	13
13	Trawl Locations:Stuart Channel, 1979	14
14	Trawl Locations:CR3 (August, 1979) and Osborn Bay (October, 1979)	15

LIST OF TABLES

		Page
1	Water Quality Results:Powell River, B. C., February, 1979	29
2	Water Quality Results:Powell River, B. C., August, 1979	32
3	Water Quality Results:Powell River, B. C., November, 1979	34
4	Water Qualtiy-Colour Analysis:Powell River, B. C., August & November, 1979	36
5	Water Quality Results:Crofton, B. C., July, 1979	37
6	Water Quality Results:Crofton, B. C., October, 1979	39
7	Water Quality-Colour Analysis:Crofton, B. C., July & October, 1979	41
8	Water Quality Results:Northumberland Channel, July, 1979	42
9	Water Quality Results:Northumberland Channel, October, 1979	43
10	Water Quality-Colour Analysis:Northumberland Channel, July & October 1979	44
11	Water Quality Results:Elk Falls, B. C., August, 1979	45
12	Water Quality Results:Elk Falls, B. C. November, 1979	47
13	Water Quality-Colour Analysis:Elk Falls, B. C., July & November 1979	49
14	Sediment Characterization-Surface Grab Samples:Powell River, B. C., February, 1979	50
15	Sediment Characterization-Grab & Core Samples:Powell River, August, 1979	51
16	Trace Metal Levels in Marine Sediment-Grab Samples:Powell River, February, 1979	52
17	Trace Metal Levels in Marine Sediments-Grab & Core Samples: Powell River, B. C., February, 1979	53
18	Particle Sizing and Total Volatile Residues-Grab & Core Samples: Powell River, B. C., February, 1979	55
19	Particle Sizing and Total Volatile Residues-Grab Samples: Powell River, B. C., Februrary, 1979	56

LIST OF TABLES (Continued)

		Page
20	Sediment Characterization-Grab Samples:Powell River, B. C., August, 1979	57
21	Trace Metal Levels in Marine Sediments-Grab Samples:Powell River, August, 1979	59
22	Particle Sizing and Total Volatile Residues-Grab Samples: Powell River, B. C., August, 1979	61
23	Trace Metal Levels in Marine Sediments-Core Samples: Northumberland Channel, July, 1979	62
24	Particle Sizing and Total Volatile Residues-Core Samples: Northumberland Channel, July, 1979	64
25	Trace Metal Levels in Marine Sediments-Core Samples:Duncan Bay, July, 1979	65
26	Particle Sizing and Total Volatile Residues-Core Samples: Duncan Bay, July, 1979	66
27	Trace Metal Levels in Marine Sediments-Grab Samples:Osborn Bay, October, 1979	67
28	Trace Metal Levels in Tissue:Powell River, B. C., August, 1979	68
29	Trace Metal Levels in Tissue:Crofton, B. C., August, 1979	69
30	Trace Metal Levels in Tissue:Osborn Bay, B. C., October, 1979	70

SUMMARY

Powell River, B. C.: Water quality results indicated that there was no an appreciable impact on the receiving environment from the pulpmill discharges. Dissolved oxygen values in the upper 50 meters do not appear to be adversely effected by effluent, although there is an evident seasonal effect.

The marine sediments in the vicinity of the pulpmill showed elevated levels of the trace metals mercury, cadmium, copper, lead and zinc. Trace metal analysis of benthic invertebrates collected in trawls showed low mercury and cadmium levels.

Crofton, B. C.: During both surveys, dissolved oxygen levels were lower at the stations nearest the outfall than at the control sites. Colour was noticeably higher at these locations. In October, a noted depression of D.O. was recorded at all stations.

Analysis of trace metals in Pandalus borealis and Pandalopsis dispar collected in benthic trawls in August indicated that Cd, Cu and Hg were not elevated. The samples from Osborn Bay trawls also had low trace metal levels.

Harmac, B. C.: Water quality profiles from Northumberland Channel did not suggest any appreciable impact from the pulpmill effluent. Dissolved oxygen values during both surveys were from 5.2 to 10.7 mg/l in the top 50 meters. Colour was detected near the outfall but values were low.

Trace metal analysis indicated a localization of elevated levels of copper and zinc in the vicinity of the outfall. Mercury levels were unnaturally high; however, as there was a possibility of contamination, the sites will be re-examined during the next survey period.

Elk Falls, B. C.: The dissolved oxygen profiles from Discovery Passage are indicative of a well mixed water column and minimal effect from pulpmill effluent. The trace metal analysis of marine sediments showned no accumulations of heavy metals or mercury near the discharge location.

1. INTRODUCTION

1.1 Study Areas. The Environmental Protection Service is responsible for conducting surveillance and compliance monitoring programs at coastal pulpmills.

In 1979, surveillance monitoring was conducted at the pulpmills located at Elk Falls, Harmac, Crofton and Powell River, B. C. (Figure 1).

The purpose of the surveys was to examine the condition of the receiving environment at mills which are proposing or instituting major pollution abatement measures.

2. METHODS AND MATERIALS

Water quality surveys were conducted at the four pulpmill sites shown in figure 1 during the perods July to August and October to November, 1979. An additional survey was conducted in Powell River, B. C. in February, 1979. The station locations are shown in Figures 2 to 5 and 10. At each station, samples were collected for dissolved oxygen, temperature, salinity and colour analysis.

Benthic evaluation included marine sediment sampling for trace metals, total volatile residues and particle sizing at the Stations designated in Figures 6 to 11. Benthic fauna was collected by use of an otter trawl at the location shown in Figures 12 to 14. Samples were analyzed for trace metal content.

2.1 Hydrographic Sampling. At each station samples were collected for temperature dissolved oxygen, salinity and colour. All samples were collectd with NIO (National Institute of Oceanography) bottles equipped with paired, protected, reversing thermometers.

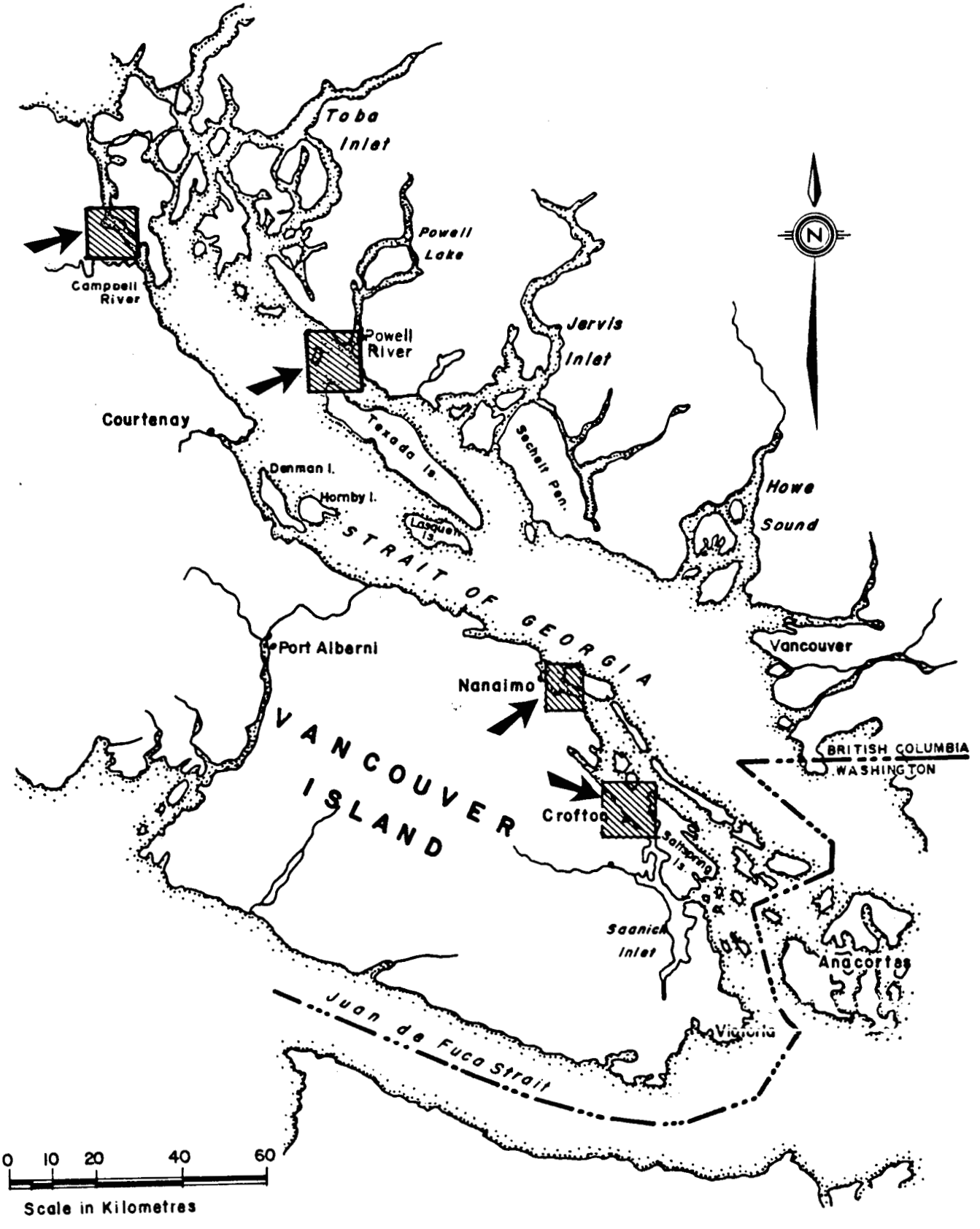

FIGURE 1 LOCATION MAP, 1979

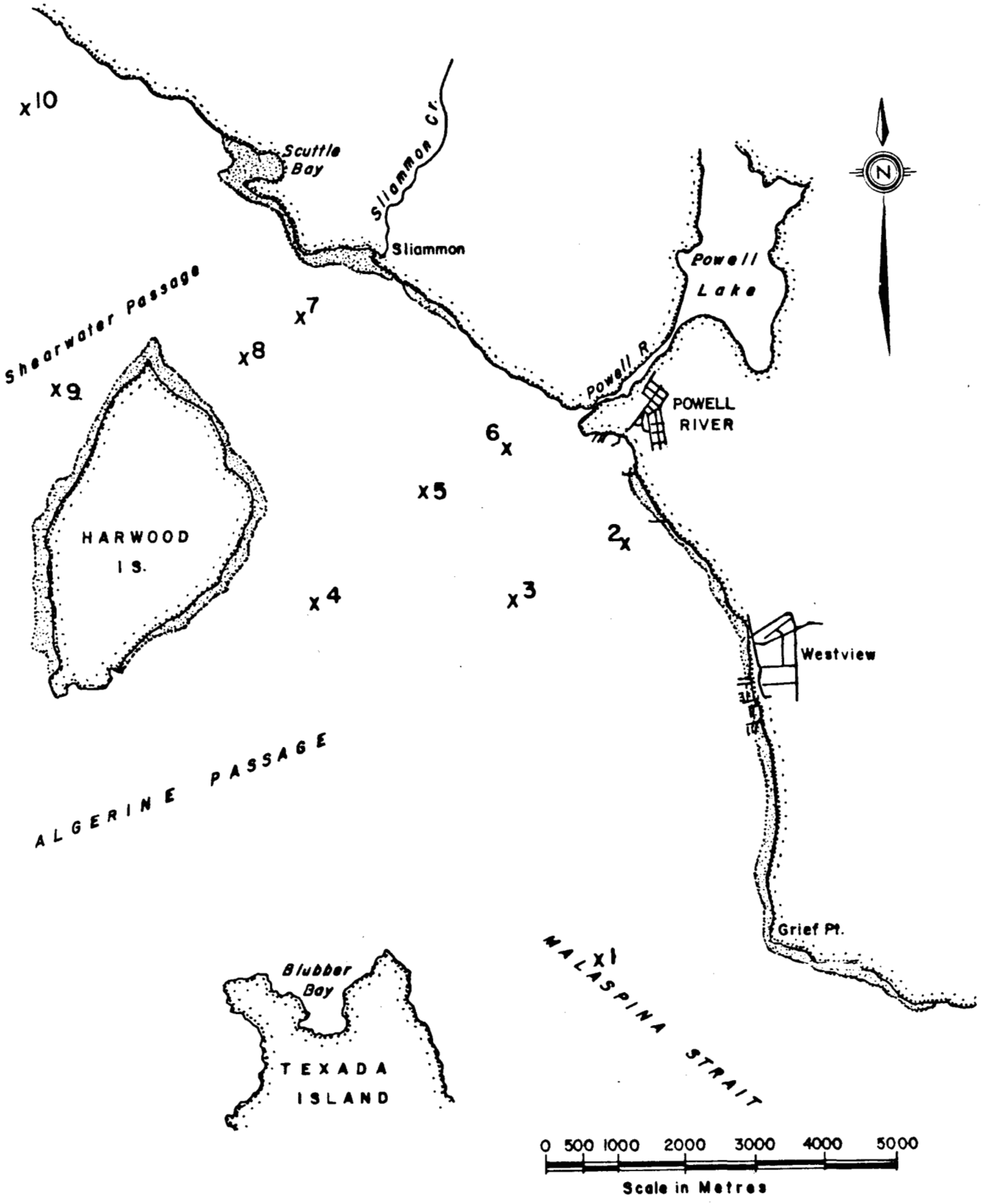

FIGURE 2 WATER QUALITY STATIONS - POWELL RIVER
February 1979

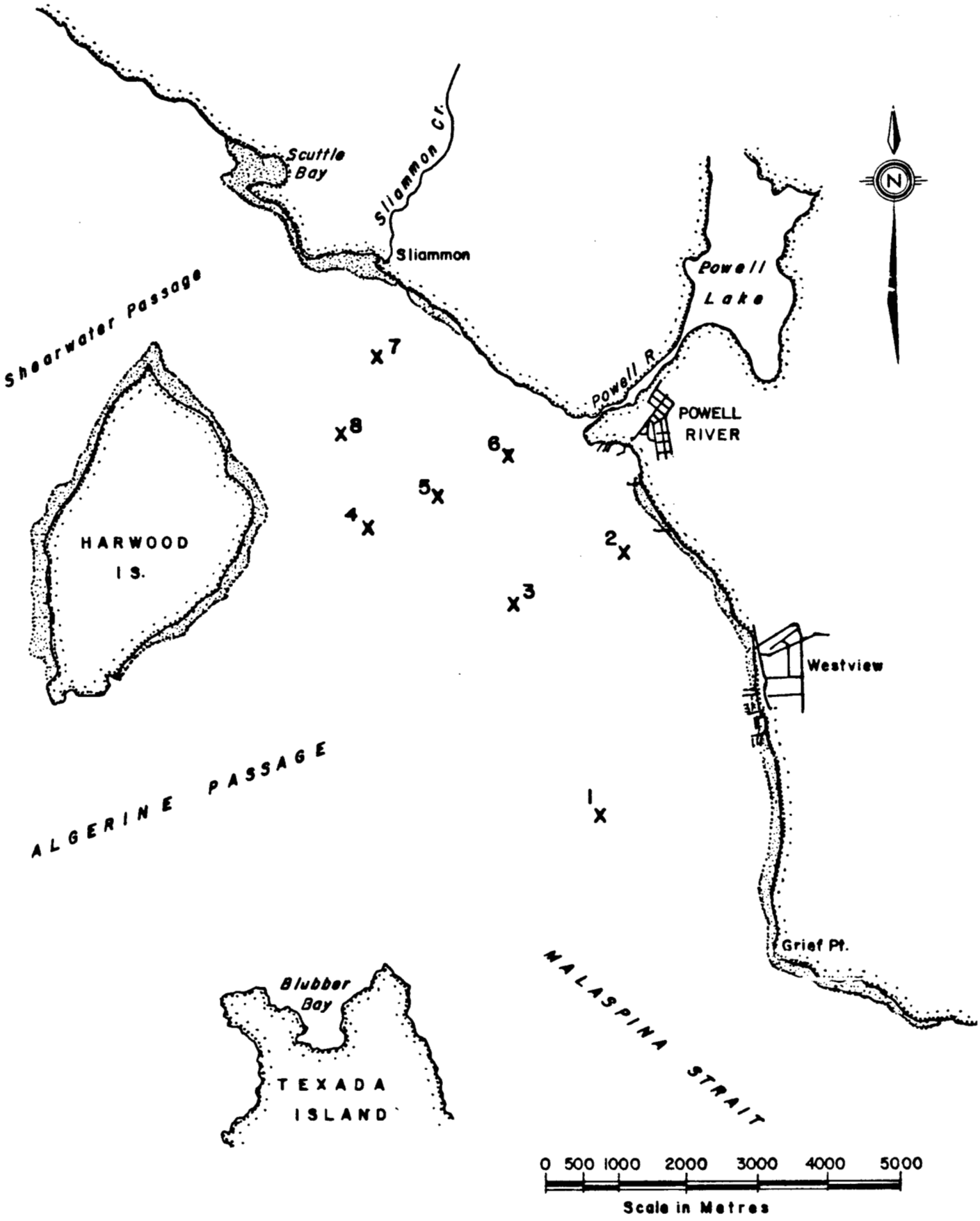

FIGURE 3 WATER QUALITY STATIONS - POWELL RIVER
August and November, 1979

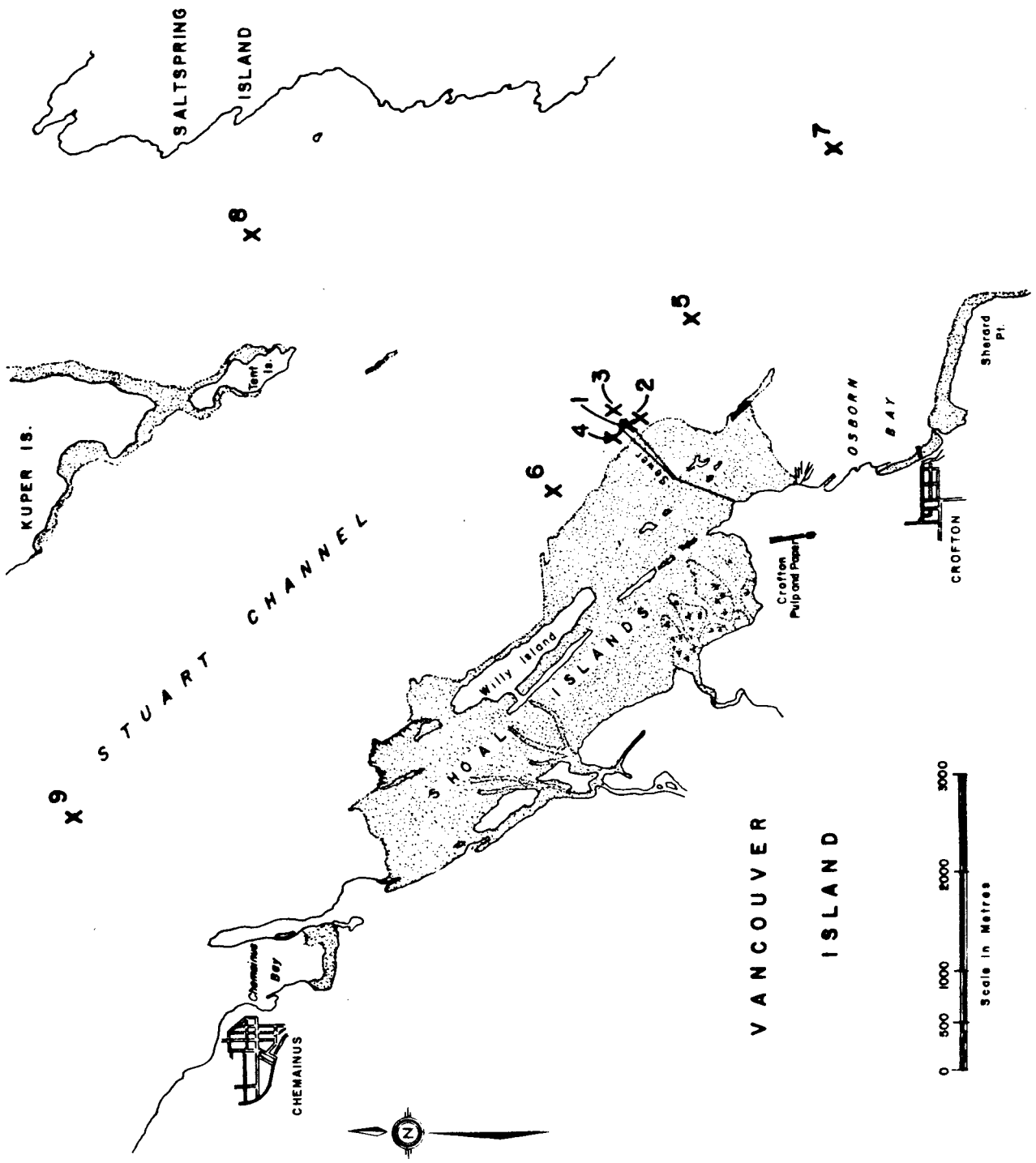

FIGURE 4 WATER QUALITY STATIONS - CROFTON - July and October, 1979

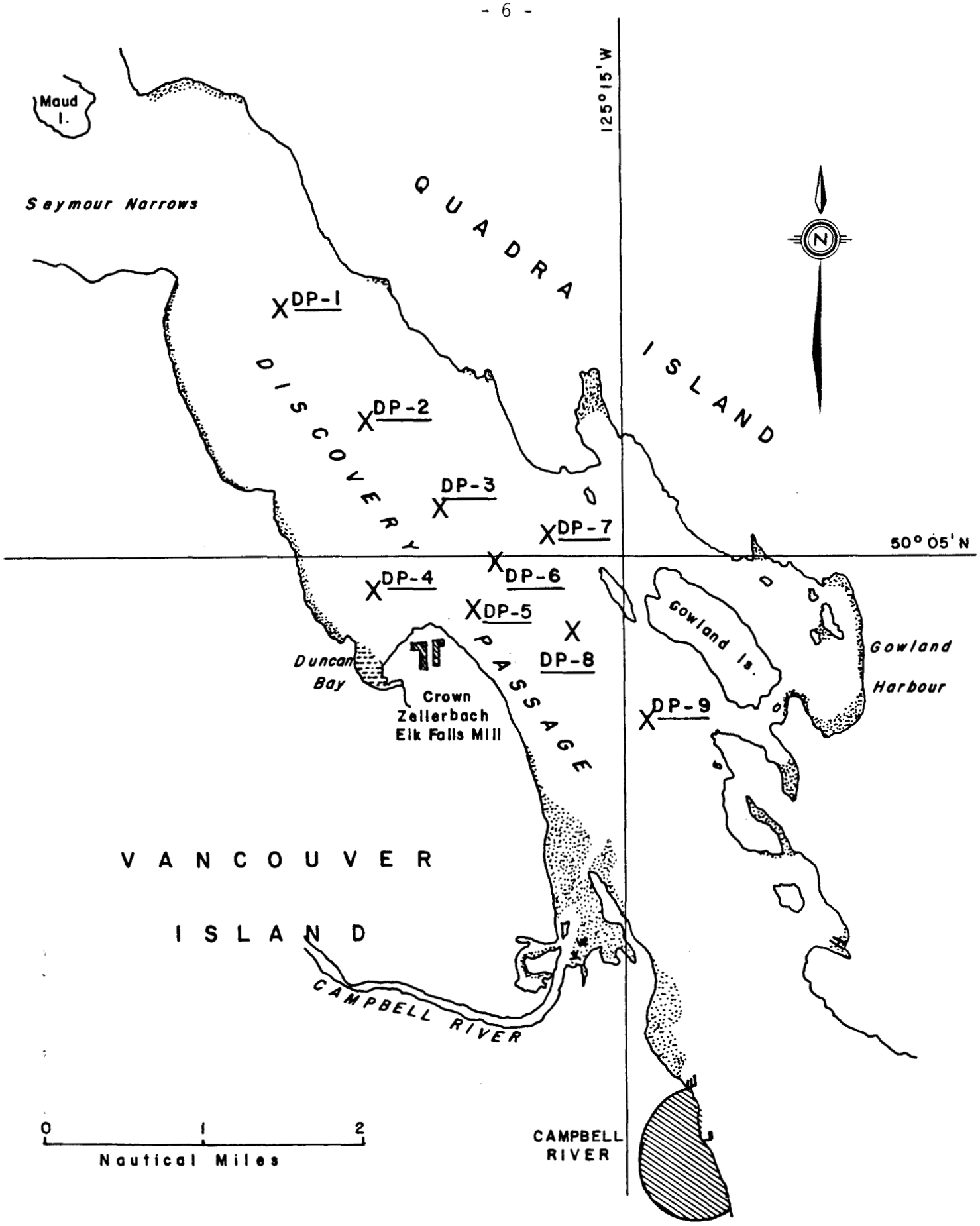

FIGURE 5 WATER QUALITY STATIONS - ELK FALLS
November 7, 1979

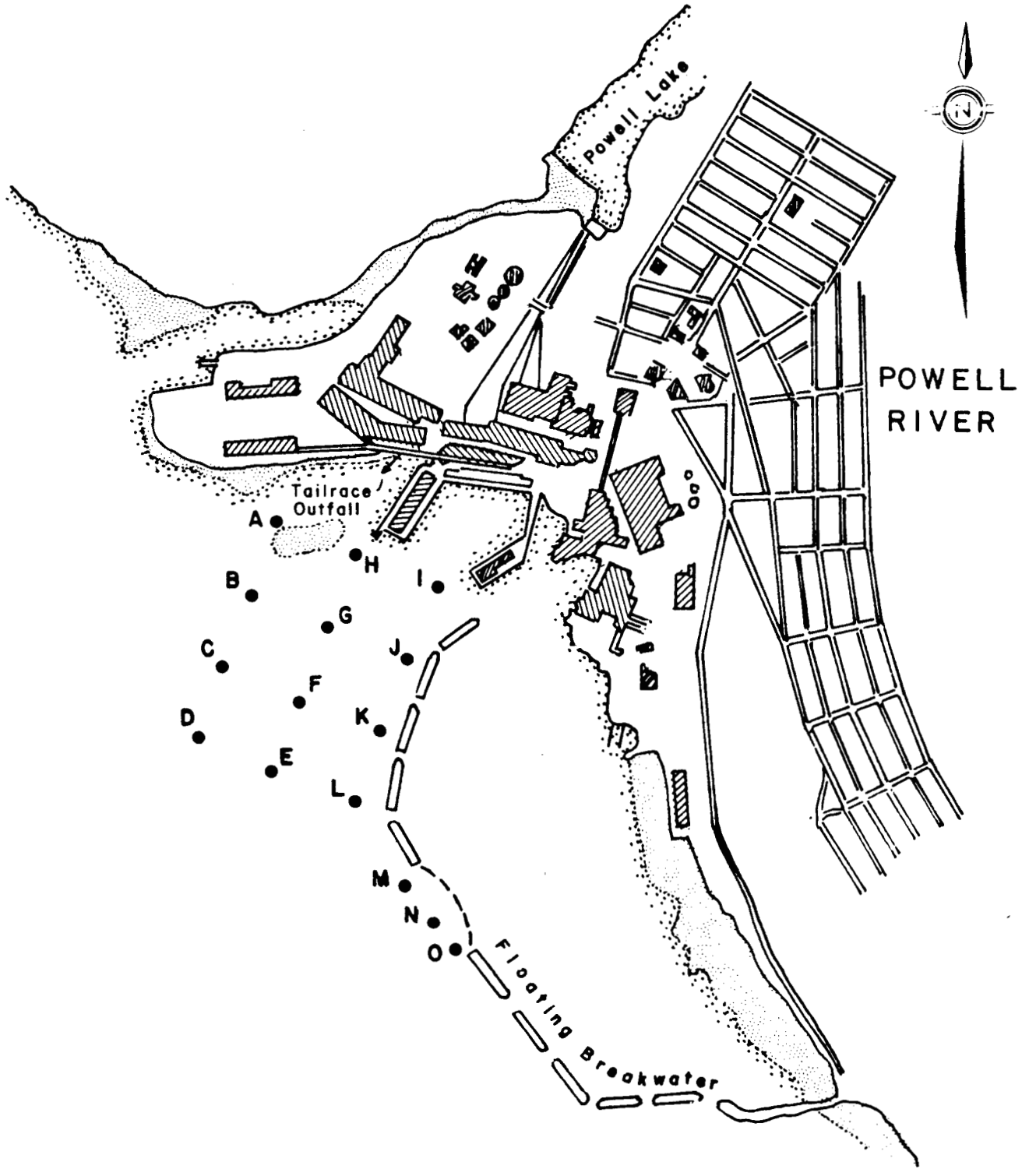

FIGURE 6 NEARSHORE BENTHIC GRAB STATIONS - POWELL RIVER - February 1979

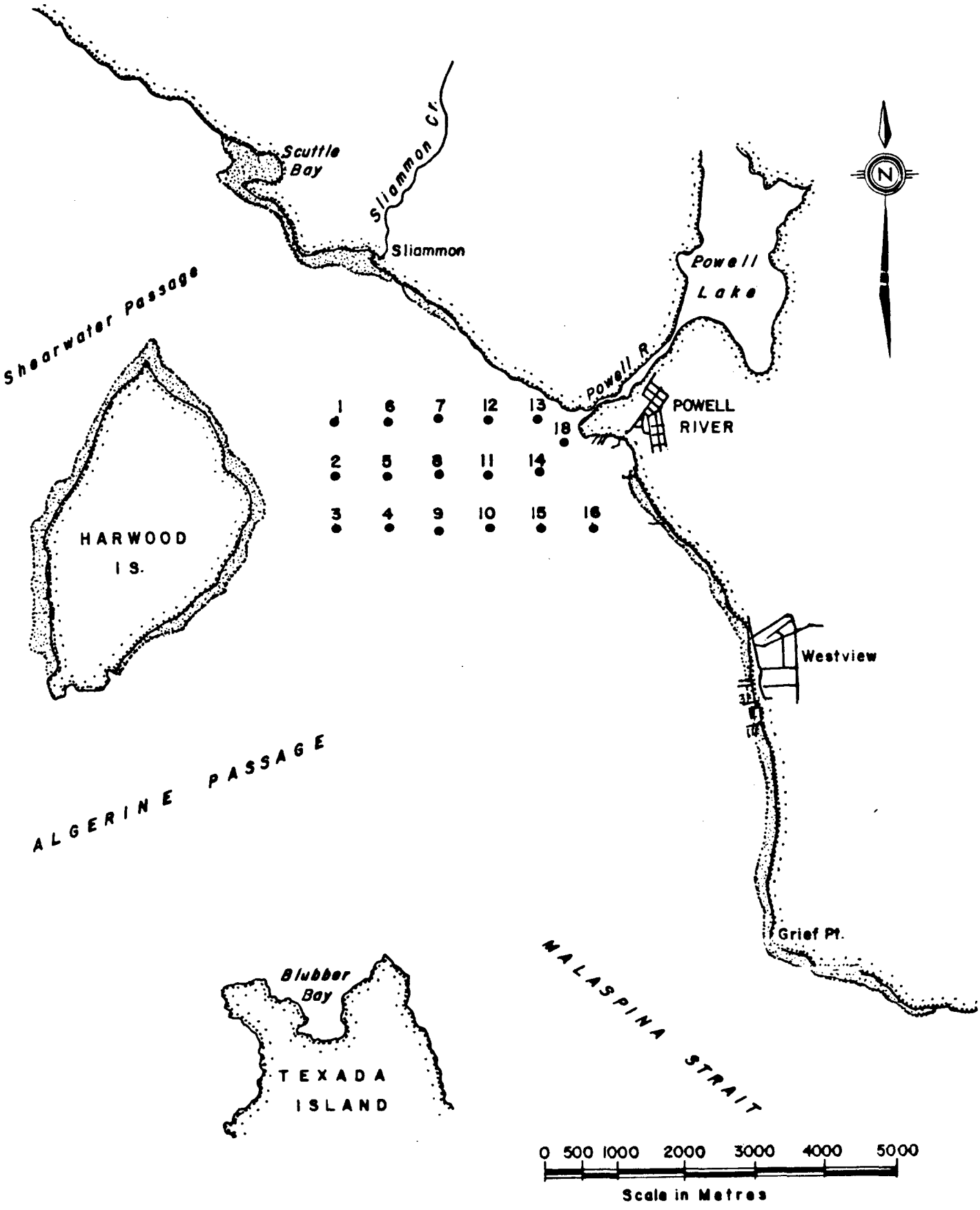

FIGURE 7 BENTHIC CORE AND/OR GRAB STATIONS - POWELL RIVER - February 1979

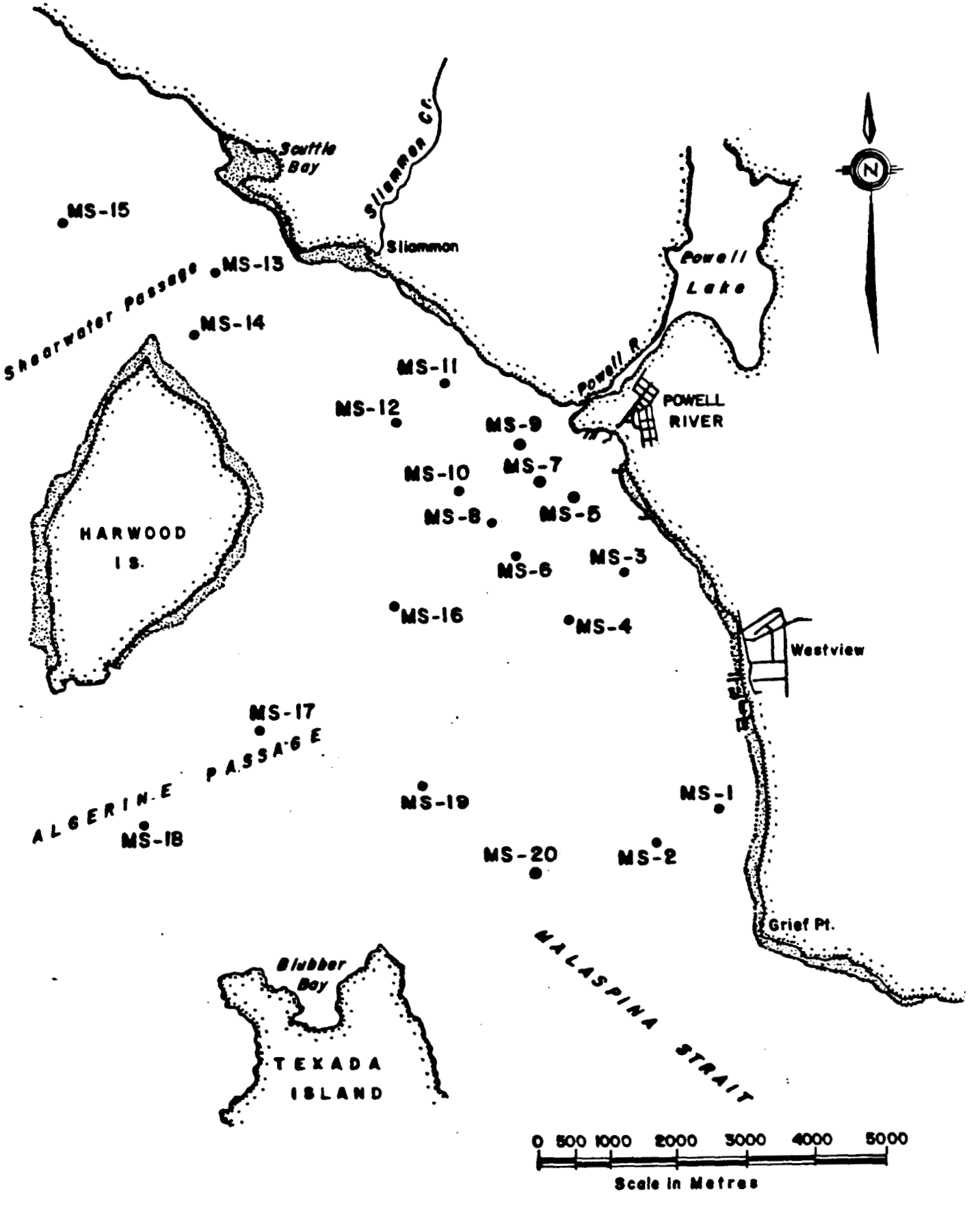

FIGURE 8 BENTHIC GRAB SAMPLES - POWELL RIVER
August 1979

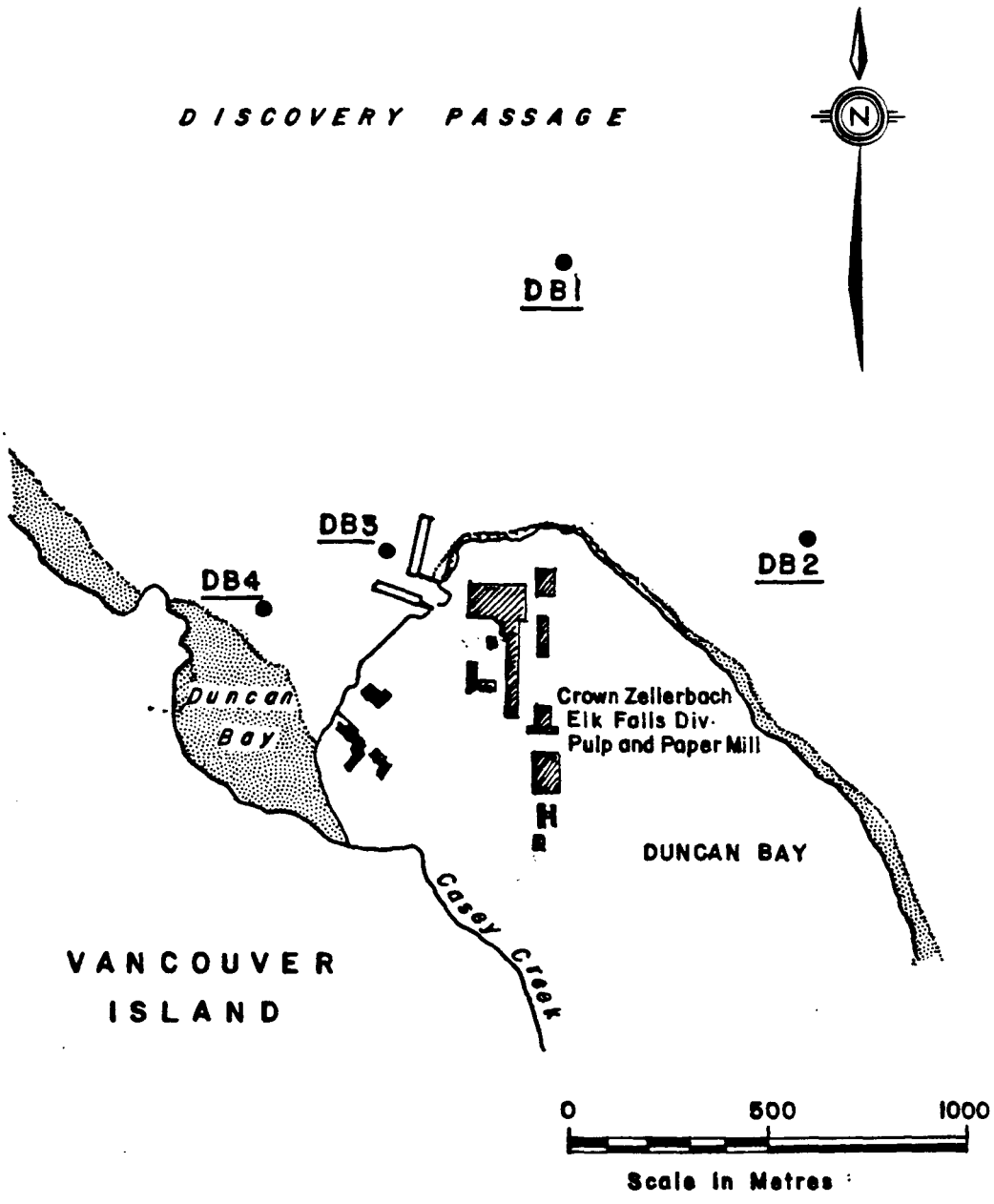

FIGURE 9 CORE STATIONS - ELK FALLS - July 1979

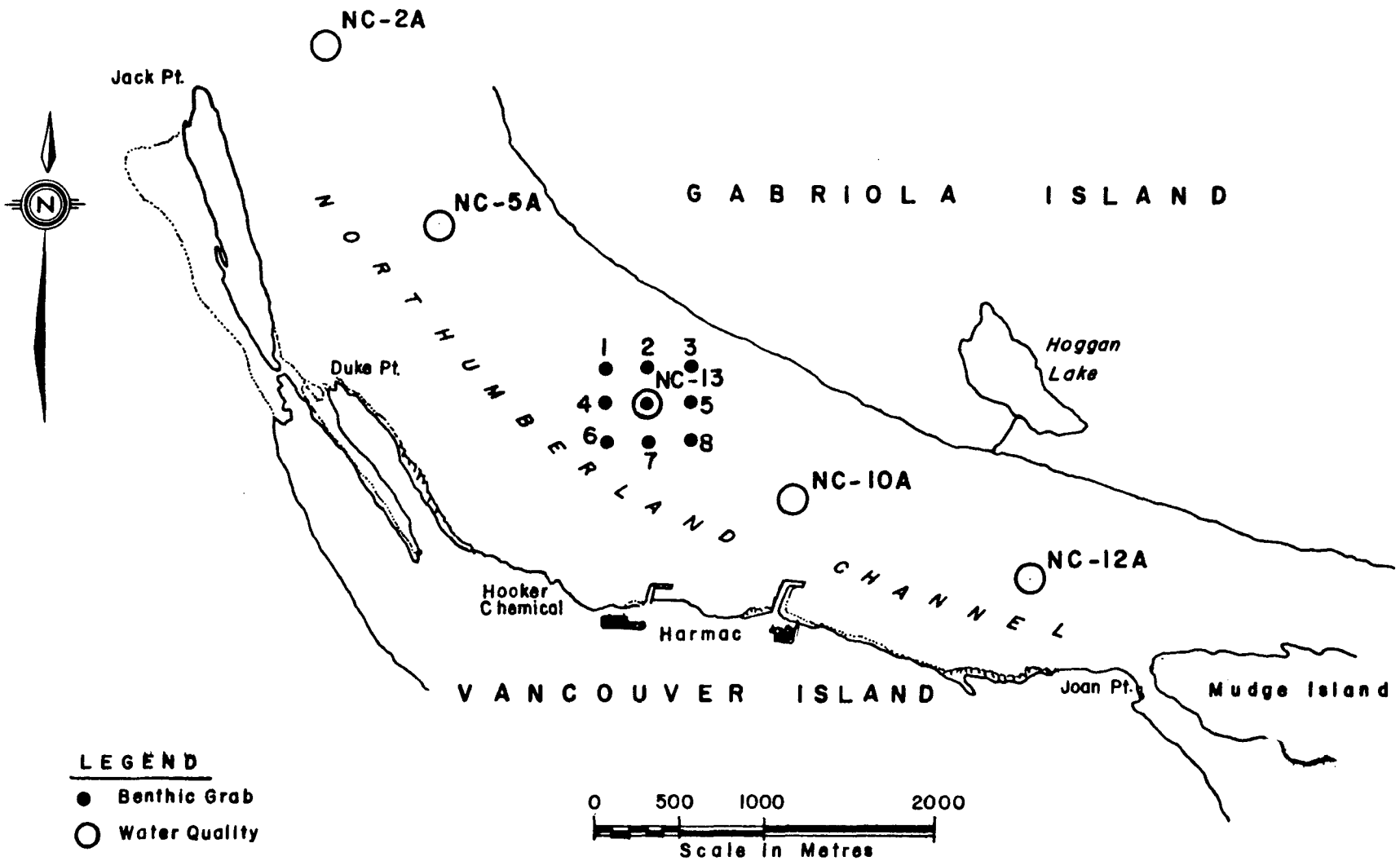

FIGURE 10 WATER QUALITY AND BENTHIC GRAB STATIONS - NORTHUMBERLAND CHANNEL - 1979

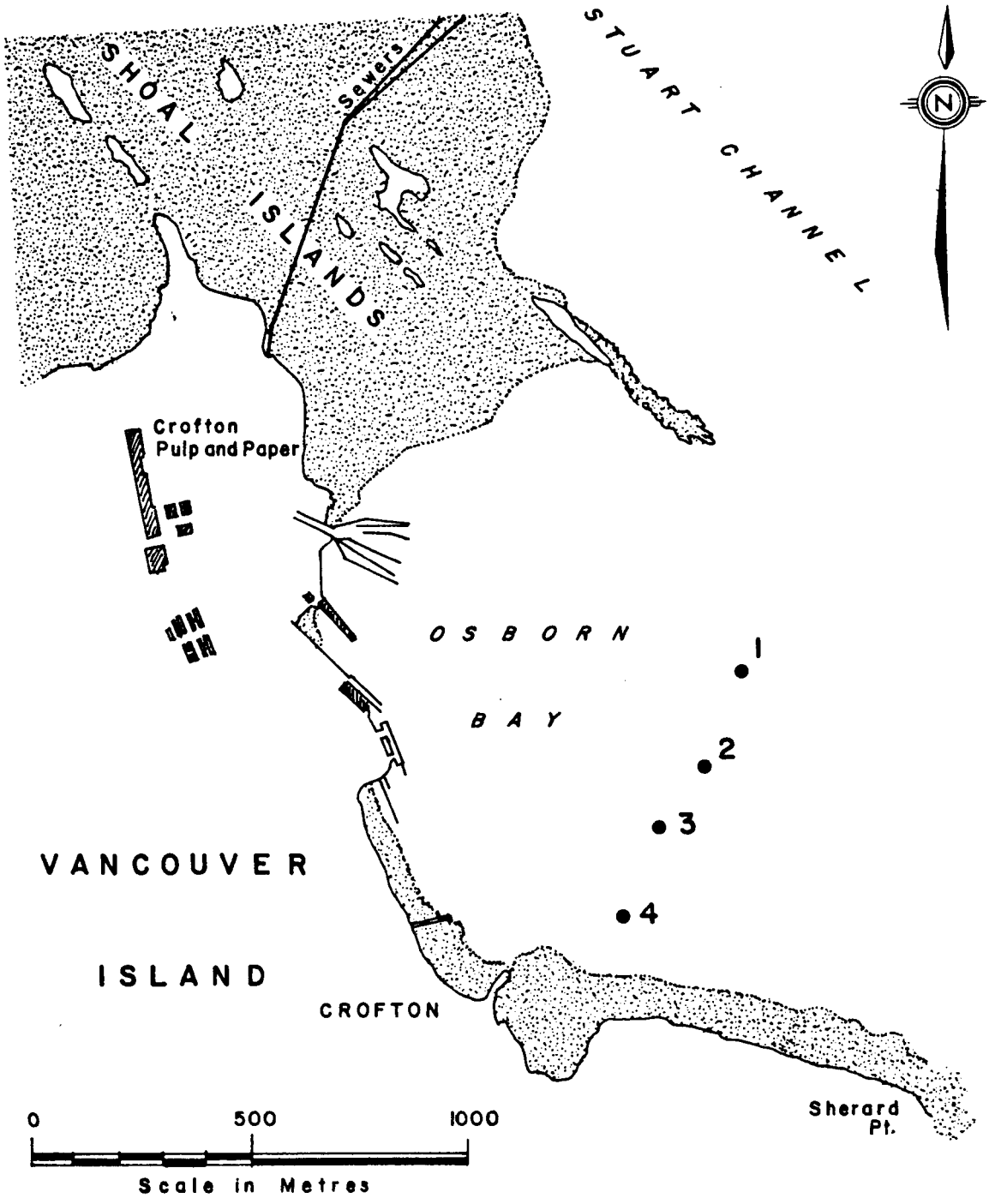

FIGURE 11 SEDIMENT STATIONS - OSBORN BAY - October 1979

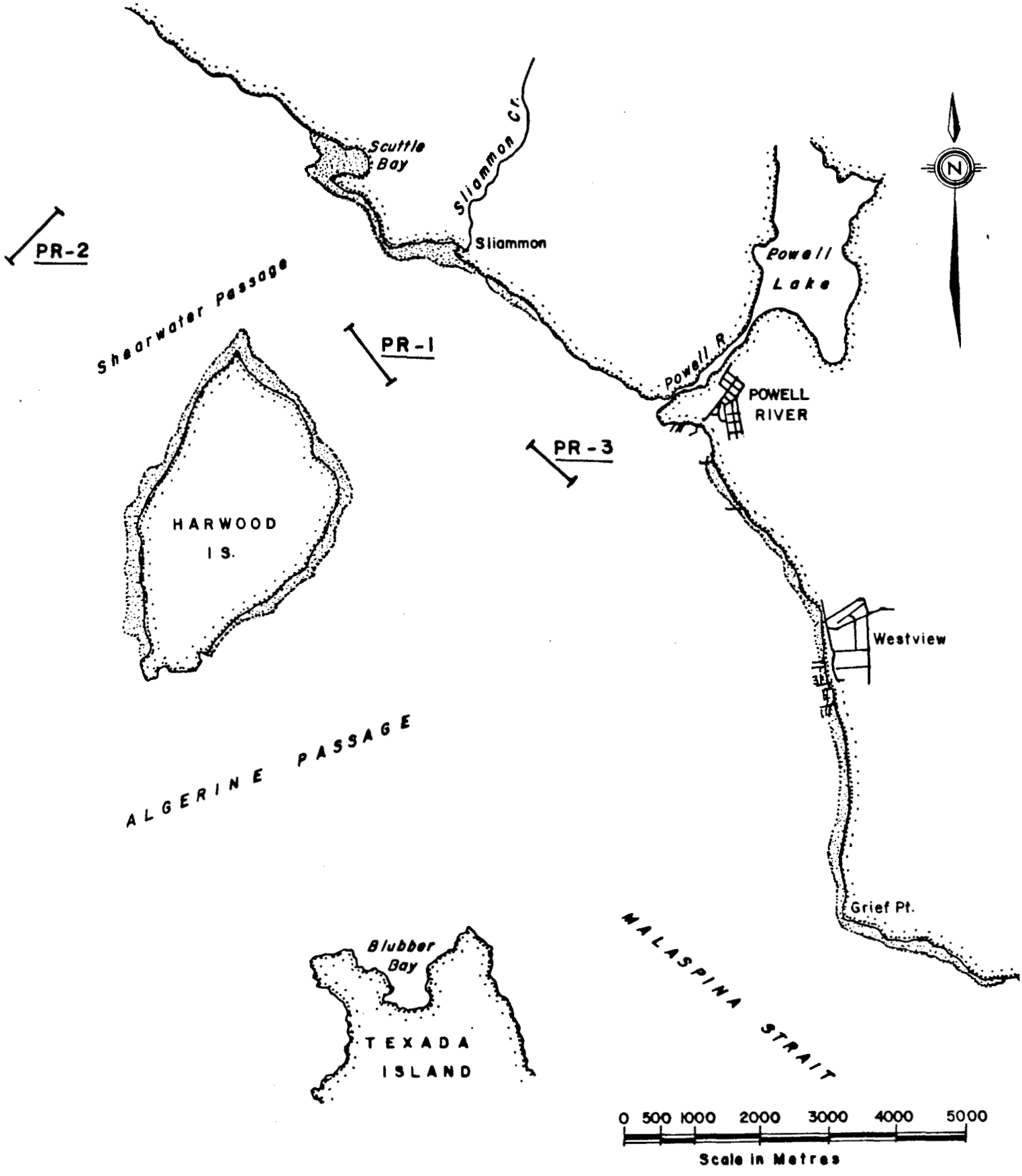

FIGURE 12 TRAWL LOCATIONS - POWELL RIVER - August 1979

FIGURE 13 TRAWL LOCATIONS - STUART CHANNEL - 1979

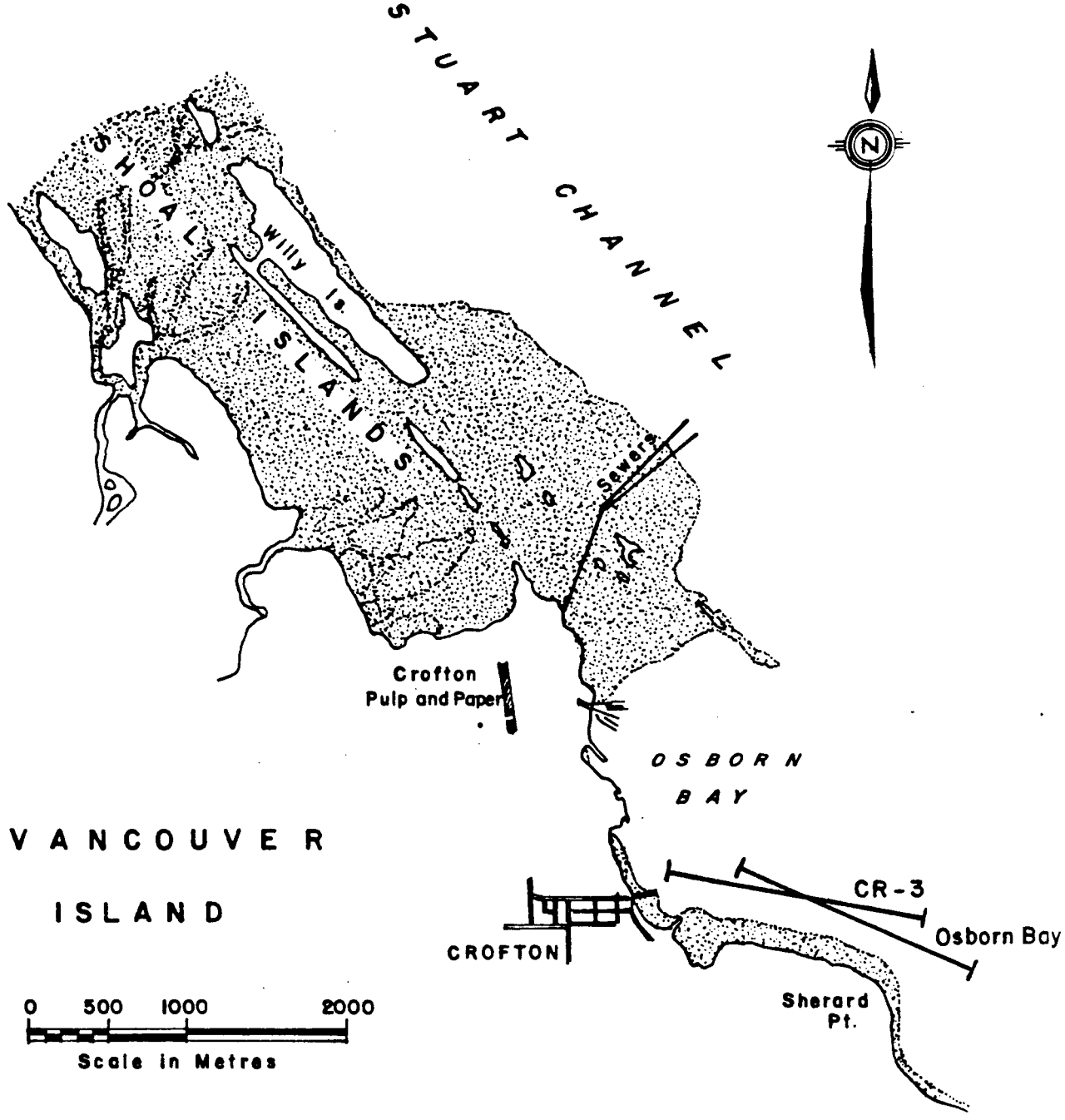

FIGURE 14 TRAWL LOCATION - CR 3 (August, 1979) AND OSBORN BAY (October, 1979)

Temperature values recorded were recalculated to temperature at depth using the equations:

$$T = T^1 + \underline{\Delta}T$$

$$\underline{\Delta}T = \left[\frac{(T^1 - t)(T^1 + Vo)}{K}\right]\left[\frac{1+(T^1-t)(T^1 + Vo)}{K}\right] + I$$

where: T = corrected temperature

T^1 = observed temperature in the main thermometer

t = observed temperature in the auxiliary thermometer

Vo = inner space in of main thermometer up to 0°C

K = apparent coefficient of expansion of Hg.

I = thermometer calibration coefficient (Sverdrup et al, 1946)

Dissolved oxygen was measured using the azide modification of the Winkler method (DOE Laboratory Manual 1979).

Salinity was calculated from conductivity values measured on a Guildline Autosal.(Model 8400).

Percent saturation of dissolved oxygen was calculated using the equation of Jameson and Robertson (1955):

$$\% \text{ Saturation} = \frac{A}{C} \times 100$$

$$C = \frac{475 - (2.65 \times S)}{33.5 + T}$$

where: C = saturation of oxygen in the sample water

S = salinity of the sample water

T = corrected tempertures of the sample water

A = observed dissolved oxygen concentration in the sample

Colour values were determined by the platinum-colbalt tissue comparison method during the August survey. In November the more refined tristimulus method was employed.

2.2 Benthic Sampling.

2.2.1 Benthic Trawls. Benthic trawls were conducted at three locations near Powell River and at nine locations near Crofton. The trawling gear consisted of an otter trawl with 3.8 mesh body, 1.27 cm mesh cod end liner and 5.8 mesh throat. The trawl was lowered to the bottom with a 3 to 1 scope (three times the amount of hydrographic wire as the depth at the trawl location) and towed on the bottom for an estimated 0.8 kilometer. After each tow, the contents of the trawl were washed, sorted, identified, counted, weighed and photographed. Samples of fish tissue and crustacea were frozen and stored for trace metal analysis.

2.2.2 Sediment Samples. A 0.17 meter squared Petersen Grab Sampler was used to collect bottom sediment at each grab station. Samples were removed and frozen in plastic bags prior to analysis for trace metals, total volatile residue and particle size.

Bottom cores were obtained with a BENTHOS Gravity corer. Intact cores were extruded and measured; samples were removed from selected depths to plastic bags and frozen prior to analysis.

3. RESULTS AND DISCUSSION.

3.1 Water Quality.

3.1.1 Powell River, B. C. (Tables 1,2,3, and 4). Temperatures recorded during the February survey showed a reverse gradient with temperatures at the surface slightly lower than at 10 meter depths. Values were measured in a range from 6.65 to 9.18°C. In August, surface temperatures were increased, from 10.28 to 15.8°C in the upper 10 meters, creating a typical summer thermocline between 10 and 25 meters. In November, temperatures were more uniform through the water column and were recorded in a range from 8.52 to 10.7°C.

Salinity values throughout the survey periods were measured in a range from 20.01 to 30.58 °/oo: Strong halocline development was not observed and near isohaline conditions occurred in February.

Dissolved oxygen levels were generally high during all surveys. Values in the upper 50 meters were from 4.50 to 9.40 mg/l. D.O. was very uniform through the water column in February, was slightly higher near the surface in August and values had dropped in the deeper waters in November.

Colour was virtually undetected in the water column at all stations in August, with the exception of the surface at Station 6. Colour values were also very low in November when a more refined analytical procedure was used.

Effluent quality results for 1979 supplied by the company are shown below. Federal toxicity tests were waived in 1979.

	Actual	Permitted
BOD_5	24.9 Tons/day	50.0 Tons/day.(98,530 lb/day)
SS	28.4 Tons/day	33.0 Tons/day. (66,880 lb/day) (yearly averages)

3.1.2 Crofton, B. C. (Tables 5, 6, and 7). Typical summer temperature profiles were recorded in Crofton in July with high surface temperatures and a strong thermocline between 2 and 10 meters. Surface temperatures were recorded between 15.92 and 19.27°C. In October, temperatures were uniform through the water column, 10.45 to 11.89°C, although slightly lower at the surface.

Salinity values were measured in a range from 25.45 to 30.05 °/oo and during both surveys, there was little variation in salinities with depth.

The dissolved oxygen values recorded in July revealed a slight depression of D.O. at the station nearest the outfall (Stations 1 to 4). At these sites D.O. between 2 and 10 meters depths was measured from 3.30 to 5.30 mg/l. By contrast, at the control locations, Stations 8 and 9, values for corresponding depths ranged from 7.30 to 10.30 mg/l. In October, D.O. was poor at all stations although especially at the location nearest to the outfall. At Stations 1 to 4, D.O. in the top 10 meters was from 3.80 to 6.45 mg/l. Surface D.O. at the control locations was 6.70 to 7.10 mg/l; however, at 20 meters depths very low levels of 2.00 to 2.40 mg/l were measured.

Colour values recorded in both July and October showed a concentration of colour around the outfall area (Stations 1 to 4). Outside this immediate area, colour appears to dissipate rapidly. In October, the values indicated the colour was retained in the upper 5 meters, with the exception of Station 2.

Effluent quality results results for 1979 supplied by the company are shown below. Toxicity test results were not available.

	Actual	Permitted
BOD_5	69.5 lb/ADT	45 lb/ADT (89,200 lb/Day)
SS	31.1 lb/ADT	30 lb/ADT (62,300 lb/Day) (yearly averages)

3.1.3 Harmac, B. C. (Tables 8, 9, and 10). Temperatures recorded in Northumberland Channel in July were high at the surface, 13.5 to 16.7°C, with the thermocline between 10 and 25 meters. Below 25 meters, temperatures were more uniform. In October, the summer gradients had broken down and temperatures were recorded between 9.23 and 10.69°C at all depths.

Salinity values measured throughout the survey periods were generally uniform from 26.90 to 30.18 °/oo. with the exception of those in October at Stations NC-13 and NC-10A, when values of 18.34 °/oo and 17.70 °/oo were recorded, respectively.

D.O. levels above 50 meters were high at all stations during both survey periods. Typical values were from 5.2 to 10.7 mg/l. Below 50 meters, the lowest value recorded was 4.9 mg/l at Station NC-5A in October.

Colour analysis results from July show colour was undetectable by the analytical method used. In October, colour units from 1 to 7 were centralized around the outfall (Station NC-13) and the adjacent Stations (Stations NC-5A and NC-10A).

Effluent quality results for 1979 supplied by the company are shown below. Toxicity test results were not available.

	Actual	Permitted
BOD_5	47.5 lb/ADT	30 lb/ADT (59,524 lb/Day)
SS	33.4 lb/ADT	13 lb/ADT (26,455 lb/Day) (yearly averages)

3.1.4 Elk Falls, B. C. (Tables 11, 12 and 13). The temperature and salinity profiles recorded during both surveys were very uniform between stations and with depth. The results indicate the water column is extremely well mixed and there appears to be no noticeable effect from the effluent discharge.

The dissolved oxygen profiles were also indicative of a well mixed water column with levels in a range from 5.90 to 7.60 mg/l between 0 and 90 meters.

Colour analysis in November revealed a localization of detectable colour near Station 7, 8 and 9, but colour units were low. During the July survey, colour was not detected in the water column by the analytical method being used. Effluent quality results for 1979 supplied by the company are shown below. Toxicity test results were not available.

	Actual	Permitted
BOD_5	73.5 lb/ADT	50 lb/ADT (95,900 lb/Day)
SS	26.8 lb/ADT	30 lb/ADT (63,930 lb/Day) (yearly averages)

3.2 Trace Metal Analysis in Marine Sediments. Analysis for heavy metals in marine sediments in the vicinity of industrial sites has been routinely done for many years along the B. C. coast. In 1975 new legislation was proclaimed in Canada in the form of the Ocean Dumping Control Act (O.D.C.A.) which prohibits the ocean disposal of certain substances except when contained as trace amounts in other material. Among these prohibited, or Schedule 1 substances, are mercury and mercury compounds and cadmium and cadmium compounds. The inclusion of these heavy metals as prohibited substances is related to their presence in, and toxicity to, living organisms. The levels not to be exceeded as specified in the O.D.C.A. are 0.75 mg/kg for mercury in the solid phase of waste and 0.60 mg/kg for cadmium in the solid phase of waste. The Act does not specify whether or not these levels are determined on a wet or dry weight basis.

A review of the available environmental information and the rationale behind inclusion of these and the other Schedule 1 subtances in the Act is presented in a Report by the 'Scheduled Substances Working Group' (Swiss et al 1980). Available literature cited in this Report suggests that mercury content in sediments free of domestic and industrial wastes would range from 0.015 to 0.17 mg/kg. The natural background level of mercury in Georgia Strait and Howe Sound has been reported to be approximtely 0.1 mg/kg (MacDonald and Wong 1977). Cadmium levels reported for various 'unpolluted' areas around the world ranged from 0.04 to 1.9 mg/kg with a mean of 0.55 mg/kg. Levels of cadmium are quite variable and Perkins et al (1973) report levels of 2.4 to 4.0 mg/kg in an area of Great Britain considered relatively unpolluted. MacDonald reports literature values for mercury and cadmium in natural marine sediments ranging from 0.05 to 3.0 mg/kg for mercury and 2.0 to 5.0 mg/kg for cadmium (Byers and Brinkhurst, editors 1979, Report on Ocean Dumping R and D, Pacific Region 1977-1978). On this basis he suggests that site specific allowances should be made based on the natural background levels in the area.

3.2.1 Powell River, B.C. Several areas in British Columbia have sediments containing levels of mercury and cadmium exceeding those specified in the O.D.C.A. These areas included Victoria Harbour, False Creek,

Vancouver Harbour, and the Squamish Estuary in Howe Sound. The data reported herein supports the inclusion of the Powell River pulpmill area with those mentioned above. In the present study, physical characteristics of the samples were recorded in conjunction with trace metal analysis. (Tables 14, 15 and 15). In February and August particle sizing and total volatile residue analysis were also computed on each sample (Table 18, 19 and 22).

The analysis indicated a localization of elevated levels of the trace metals copper, lead and zinc in the area immediately adjacent to the pulpmill. (Tables 16, 17 and 21). (Discussion of mercury and cadmium follows). One exception was Station MS-20 (Figure 8), sampled in August, where concentrations of mercury, copper and zinc were unusually high. (Hg: 2.10 mg/kg; Cu: 85.0 - 86.3 mg/kg; Zn: 186.0-187.0 mg/kg.) For the remainder of the stations, copper was measured from less than 12.4 to 189 mg/kg, zinc from less than 2.4 to 776.0 mg/kg and lead from less than 9.6 to 97.1 mg/kg.

3.2.1.1 Mercury Levels.

February Survey-Mercury levels exceeded 0.75 mg/kg at 4 of the 14 stations sampled in February (Table 16). There were notably high values adjacent to the floating breakwater (Stations I to O, excluding Station M). The highest value, 9.49 mg/kg was recorded at Station D. Mercury levels previously reported for this area (Nelson 1979) ranged from 0.1 mg/kg to 21.0 mg/kg in core and grab samples collected in November 1978. The unexpectedly high concentrations were found in samples collected in the vicinity of Stations K and L (Figure 6). Levels of mercury of this magnitude, ie 21.0 mg/kg, have been found near the F.M.C. mercury-cell chlor-alkali Plant in Howe Sound (Thompson and McComas 1973); however, have not been duplicated in subsequent sampling trips to the Powell River area.

Grab and Core samples from stations further removed from the pulpmill, ie. Station 1 to 18, indicated that mercury was elevated only at stations 9 and 18 during the February survey (Table 17).

These results indicate that mercury contamination might be restricted to the immediate vicinity of the pulpmill and near the floating breakwater.

August Survey-In August, Stations MS-1 and MS-20 in Malaspina Strait, showed elevated mercury levels only at Stations MS-7 and MS-20 (Table 21). The highest value, 2.10 mg/kg, was recorded at Station MS-20 located approximately 5 kilometres from the pulp mill while Station MS-7 is located directly adjacent to the mill. No reason from the variability in mercury data has been determined nor has the origin of the high concentrations been ascertained.

3.2.1.2 Cadmium Levels.

February Survey-In the first series of surface grab samples in February, cadmium concentration were recorded from 3.08 to 7.20 mg/kg at all Stations except Stations D and N (Table 16). It is possible that the levels at Station D and N may have also exceeded the 0.6 mg/kg specified in the O.D.C.A. as the detection limit was less than or equal to 2.07 mg/kg. In the grab and core samples, elevated cadmium was found at Stations 12, 13, 14, 16 and 18, all of which are in close proximity to the mill area (Table 17).

August Survey-In August, cadmium levels exceeded 0.6 mg/kg at Stations MS-5, MS-7, MS-8 and MS-11 (Table 21). The detection limit of less than or equal to 1.2 mg/kg was slightly lower than in February.

3.2.2 Harmac Pulp Division. The core samples at each site were analyzed for mercury and heavy metals (Table 23), and for particle size and total volatile residues (Table 24).

The analysis indicated a localization of slightly elevated levels of trace metals, copper and zinc, in the surface layers near the outfall (Station NC-13) (Cu: 64.2 mg/kg; Zn: 91.5 mg/kg). For the remainder of the stations, copper was measured from 25.1 to 66.9 mg/kg, zinc from 41.9 to 94.5 mg/kg and lead from less than 9.0 to 35.6 mg/kg.

3.2.2.1 Mercury Levels-Mercury levels were unnaturally high during the July survey at the stations sampled in Northumberland Channel. There is a

possibility there was sample contamination during analysis and therefore the sites will be re-examined during the next survey period.

3.2.2.2 Cadmium Levels-In July, cadmium levels were below the detection limit of less than or equal to 1.2 mg/kg at all stations.

3.2.3 Elk Falls Division. The core samples at each site were analyzed for mercury and heavy metals (Table 25) and for particle size and total volatile residues (Table 26).

3.2.3.1 Mercury Levels-In July, at the four sampling sites in Duncan Bay, mercury levels were recorded from less than 0.175 to 0.194 mg/kg, well below the 0.75 mg/kg limit.

3.2.3.2 Cadmium Levels-Cadmium measured at the four sampling sites in Duncan Bay were all below the detection limit of 1.2 mg/kg.

3.2.4 Osborn Bay. Sediment samples were collected at four sites in Osborn Bay (Figure 11, Table 27). Concentrations of cadmium exceeded the 0.6 mg/kg limit outlined in the O.D.C.A. at Stations 1 and 2; however, as the detection limit is less than 1.24 mg/kg, it is possible that concentrations in the sediments at Stations 3 and 4 were also above that limit. The highest mercury level, 0.340 mg/kg, was found at Station 2.

3.3 Benthic Trawls.

3.3.1 Benthic Trawls: Powell River, B. C. (Appendix I). Benthic trawls were conducted at three locations in the Powell River area in August. The diversity at all three locations was low, and although no organism dominated the trawls, Pandalus borealis was collected in sizeable quantities at Stations PR-2 and PR-3. The ratfish, Hydrolagus colliei was abundant at Stations PR-1 and PR-3. It should be noted that the trawl at Station PR-3 contained large amounts of coarse fibre.

Tissue samples collected from the trawls included Pandalus borealis, P. platyceros, Pandalopsis dispar and Merluccius productus. Concentrations of mercury and cadmium were low in all samples (Table 28). Copper levels were slightly higher in Pandalus borealis at PR-3 with heads than without, possibly because of sediment trapped in the carapace.

3.3.2 Benthic Trawls: Crofton, B. C. (Appendix I). In August, trawls were conducted at three locations in the Crofton area. The sidestripe shrimp, Pandalopsis dispar, was common at all locations. The heart urchin, Brisaster sp., was the most common organism at Station CR-1 (Tow I), CR 2 and CR-3; however, the second trawl at Station CR-1 contained no Brisaster sp. There was notable diversity in the fishes caught at Stations CR-1 (Tow I) and CR-3, although numbers were not high.

In October, trawl locations in Stuart Channel were selected at different sites from the August survey.

The catches at Stations ST-1 and ST-2 were predominantly fish species. At Station ST-1, hake, Merlucius productus, and the slender sole, Lyopsetta exilis were most abundant in the catch. The pink shrimp, Pandalus borealis, were present but numbers were very low. At Station ST-2, the flathead sole, Hippoglossoides elassodon, and the plainfin midshipman, Porichthys notatus, were the most common fish species captured. Shrimp populations appeared to be similar to Station ST-1. A distinct difference was noted in the catches at Stations ST-3 and ST-4. At Station ST-3, large numbers of Brisaster sp. completely dominated the catch. By contrast, the catch at Stations ST-4 was very small with no dominant organism.

Analysis of trace metals in Pandalus borealis and Pandalopsis dispar from Stations CR-1 and CR-2 in August (Table 29) showed cadmium levels were higher in tissues when the entire animal was analyzed (from 0.896 to 1.34 mg/kg) than when just the abdomen was analyzed (below detection limit). Copper levels were sightly higher in shrimps when the entire animal was tested, and mercury levels were low in all tests. Tissue samples were not analyzed during the October survey.

The large trawl catch at Osborn Bay contained a diverse collection of shrimp and fishes. The lemon sole, Parophrys vetulus , the flathead sole, Hippoglossoides elassodon, the plainfin midshipman, Porichthys notatus and the rock sole, Lepidopsetta bilineata comprised the bulk of the catch of Pisces. A number of greenstripe rockfish, Sebastes maliger were also present. The shrimp catch was dominated by the pink shrimp, Pandalus borealis and contained several prawns, Pandalus platyceros.

The trace metal analysis (Table 30) indicated a higher level of copper and cadmium levels in shrimp with heads than without; however, levels of these metals in fish species were reasonably low. Mercury levels were also reasonably low in all species tested.

REFERENCES

Byres, S.C. and R.O. Brinkhurst editors, Report on Ocean Dumping R and D, Pacific Region, Fisheries and Environment Canada, 1977-1978. Pacific Marine Science Report 79-5, 76 pp. (1979).

MacDonald, R.W. and C.S. Wong, The Distribution of Mercury in Howe Sound Sediments, Pacific Marine Science Report 77-22, 51 pp. (1977).

Nelson, H., Pulp Mill Environmental Impact Assessment, MacMillan Bloedel Limited, Powell River Division, Environment Canada, Environmental Protection Service, Regional Program Report 79-14, 43 pp. (1979).

Perkins, E.J., J.R.S. Gilchrist and O.J. Abbot, Trace Metals in Solway Firth Sediments, Marine Pollution Bulletin, 4, pp. 59-61 (1973)

Swiss, J.J., R.F. Addison, D.W. Mcleese and J.F. Payne, Regulated Levels of Schedule I Substances in the Ocean Dumping Control Act - A Review, Government of Canada, Fisheries and Oceans, Ocean Dumping Report 3, 77 pp. (1980).

Sverdrup, H.U., M.W. Johson and R.H.Fleming, The Oceans: Their Physics, Chemistry and General Biology, Prentice-Hall, New York, 1087 pp. (1946).

Gameson, A.L.H., and K.G. Robertson, The Solubility of Oxygen in Pure Water and Seawater, Journal of Applied Chemistry, 5, 502 pp, (1955).

Fisheries/Environmental Protection Service, Laboratory Manual, Dept. of Environment, Fisheries and Marine Service, Pacific Region, 261 pp. (1974).

ACKNOWLEDGEMENTS

The author would like to thank G. Packman (Project Biologist) for directing the studies conducted at Elk Falls and Harmac, B. C.

Thanks to H. Nelson, D. Brothers, N. Holman and D. DeMill for their assistance in the field portion of the work.

The author would also like to acknowledge the assistance of the officers and crew of the CSS VECTOR during the field portions of the survey.

TABLE 1: WATER QUALITY RESULTS - POWELL RIVER, B. C. - FEBRUARY 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
1	0.0	6.82	25.52	7.80	77.21
	2.0	6.81	25.52	7.70	76.30
	5.0	6.87	25.55	7.70	76.31
	10.0	6.91	25.57	7.70	76.40
	25.0	7.19	25.88	7.40	74.09
	50.0	7.25	25.97	7.25	72.74
	100.0	8.90	26.18	4.30	44.95
	290.0	8.74	26.18	4.55	47.39
2	0.0	6.79	25.44	7.70	76.11
	2.0	6.78	25.40	7.80	77.06
	5.0	6.78	25.42	7.75	76.58
	10.0	6.80	25.52	7.75	76.66
	25.0	7.01	25.71	7.55	75.16
	50.0	6.98	25.91	7.30	72.72
	100.0	8.95	26.18	4.50	47.10
3	0.0	6.65	24.31	7.90	77.25
	2.0	6.65	24.32	7.95	77.75
	5.0	6.65	25.40	7.90	77.81
	10.0	6.89	25.67	7.70	76.41
	25.0	7.15	25.79	7.40	73.98
	50.0	7.36	25.99	7.20	72.43
	100.0	8.81	26.17	4.40	45.89
	165.0	9.18	26.17	3.50	36.83
4	0.0	6.75	25.52	7.85	77.56
	2.0	6.74	25.54	7.85	77.56
	5.0	6.77	25.57	7.80	77.13
	10.0	6.79	25.60	3.70	36.62
	25.0	7.17	25.86	7.75	77.54

TABLE 1: WATER QUALITY RESULTS - POWELL RIVER, B. C. - FEBRUARY 1979
Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
5	0.0	6.76	23.48	7.90	77.05
	2.0	6.72	24.32	7.80	76.41
	5.0	6.88	25.58	7.70	76.36
	10.0	6.88	25.62	7.20	71.41
	25.0	7.18	25.81	7.90	79.03
	50.0	7.41	26.04	7.35	74.07
	100.0	8.89	26.17	4.25	44.41
	150.0	7.55	26.17	7.30	73.87
6	0.0	6.64	21.12	8.50	81.42
	2.0	6.79	25.50	7.80	77.14
	5.0	6.81	25.52	7.75	76.68
	10.0	6.98	25.60	7.60	75.46
	25.0	7.08	25.75	7.40	73.82
	50.0	7.31	25.98	7.05	70.85
	70.0	7.35	26.06	6.55	65.91
7	0.0	6.75	25.17	7.80	76.90
	2.0	6.71	25.22	7.90	77.82
	5.0	6.81	25.56	7.70	76.22
	10.0	6.90	25.67	7.65	75.94
	25.0	7.11	25.80	7.35	73.41
	48.0	7.49	25.97	6.65	67.11
8	0.0	6.87	24.30	7.90	77.66
	2.0	6.71	24.32	7.90	77.37
	5.0	6.71	25.35	7.80	76.91
	10.0	6.95	25.65	7.65	76.02
	25.0	7.17	25.80	7.30	73.01
	50.0	7.63	26.04	6.40	64.84
	110.0	8.98	26.17	4.05	42.41

TABLE 1: WATER QUALITY RESULTS - POWELL RIVER, B. C. - FEBRUARY 1979
(Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
9	0.0	7.28	25.84	7.30	73.23
	2.0	7.28	25.84	7.30	73.23
	5.0	7.29	25.84	7.30	73.24
	10.0	7.23	25.88	7.30	72.16
	25.0	7.22	25.91	7.35	73.65
	50.0	7.27	26.03	7.30	73.30
	70.0	7.31	26.01	7.45	74.88
10	0.0	6.87	24.26	8.00	78.64
	2.0	6.86	24.31	8.00	78.65
	5.0	6.94	25.27	7.70	76.31
	10.0	6.99	25.69	7.60	75.62
	25.0	7.31	25.84	6.90	69.26
	50.0	7.53	25.99	6.55	66.17
	70.0	7.93	26.16	5.65	57.71

TABLE 2: WATER QUALITY RESULTS - POWELL RIVER, B. C. - AUGUST 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
1	0.0	15.36	24.39	9.10	108.35
	2.0	13.27	27.51	8.70	101.20
	5.0	13.02	27.68	8.90	103.08
	10.0	11.40	28.13	7.60	85.21
	25.0	9.27	29.27	5.80	62.41
	50.0	8.78	29.97	5.80	61.99
	100.0	7.84	30.16	5.80	60.69
	175.0	8.20	30.41	5.70	60.27
2	0.0	14.68	25.50	8.90	105.24
	2.0	13.04	27.55	8.60	99.56
	5.0	12.52	27.76	8.60	98.60
	10.0	11.11	29.29	7.00	78.07
	25.0	9.19	29.37	5.70	61.27
	50.0	8.67	29.84	5.40	57.52
3	0.0	15.35	26.32	9.10	109.70
	2.0	14.35	27.17	9.10	108.04
	5.0	13.12	27.56	8.60	99.74
	10.0	11.10	28.39	7.10	79.21
	25.0	9.17	29.44	5.70	61.26
	50.0	8.68	29.86	5.80	61.80
	100.0	7.89	30.24	5.70	59.75
	170.0	7.79	30.49	5.50	57.61
4	0.0	15.67	26.93	9.40	114.51
	2.0	14.65	27.12	9.20	109.89
	5.0	13.84	27.34	9.40	110.54
	10.0	10.28	28.72	6.60	72.44
	25.0	8.97	29.31	5.70	60.92
	50.0	8.68	29.88	5.60	59.67
	100.0	7.82	30.35	5.80	60.74
	155.0	7.80	30.49	5.50	57.62

TABLE 2: WATER QUALITY RESULTS - POWELL RIVER, B. C. - AUGUST 1979
(Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
5	0.0	15.77	26.88	8.90	108.61
	2.0	15.57	27.06	8.90	108.29
	5.0	12.72	27.66	8.60	98.95
	10.0	11.40	28.10	7.30	81.83
	25.0	9.02	29.34	5.60	59.94
	50.0	8.63	29.86	5.70	60.66
	100.0	7.88	30.20	6.10	63.91
6	0.0	15.80	20.77	8.90	104.47
	2.0	14.20	26.89	9.10	107.50
	5.0	12.21	27.64	8.30	94.44
	10.0	11.41	28.43	7.50	84.27
	25.0	9.08	29.44	5.70	61.14
	55.0	8.61	29.88	5.60	59.58
7	0.0	15.36	26.84	9.10	110.10
	2.0	14.44	26.93	9.00	106.90
	5.0	13.12	26.31	8.70	100.08
	10.0	11.40	27.94	7.60	85.10
	25.0	9.12	29.36	5.70	61.16
	45.0	8.73	29.81	5.50	58.65
8	0.0	14.76	27.00	9.00	107.67
	2.0	14.71	27.02	9.20	109.95
	5.0	13.95	26.15	8.80	103.59
	10.0	11.71	28.25	7.90	89.26
	25.0	9.22	29.27	5.60	60.20
	50.0	8.74	29.84	5.80	61.87
	100.0	7.82	30.28	5.90	61.75
	115.0	7.74	30.32	5.90	61.66

TABLE 3: WATER QUALITY RESULTS - POWELL RIVER, B. C. - NOVEMBER, 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
1	0.0	9.46	27.19	8.30	88.48
	2.0	9.56	27.24	7.90	84.44
	5.0	10.07	27.52	8.40	91.02
	10.0	9.93	28.39	7.20	78.22
	25.0	9.23	29.42	6.00	64.57
	50.0	9.36	29.25	4.50	48.52
	100.0	8.85	30.37	4.60	49.37
	175.0	8.91	30.58	4.70	50.60
2	0.0	9.30	26.63	8.70	92.07
	2.0	9.91	27.06	8.20	88.27
	5.0	10.21	27.36	8.00	86.88
	10.0	9.63	28.43	7.20	77.70
	25.0	9.45	29.30	6.30	68.09
	50.0	9.18	30.17	4.50	48.62
3	0.0	9.88	22.21	8.40	87.56
	2.0	10.03	27.29	8.20	88.64
	5.0	10.19	27.80	7.80	84.91
	10.0	9.96	28.28	7.10	77.13
	25.0	9.24	29.06	6.00	64.43
	50.0	9.30	30.13	4.60	49.83
	100.0	9.01	30.43	4.60	49.59
	150.0	8.80	30.47	4.50	48.28
4	0.0	9.89	20.01	8.60	88.43
	2.0	9.49	27.00	8.60	91.63
	5.0	10.02	27.25	9.00	97.23
	10.0	10.07	27.91	8.40	91.26
	25.0	9.20	29.27	5.90	63.38
	50.0	9.17	30.38	4.60	49.76
	100.0	8.92	30.43	4.70	50.56
	150.0	8.52	30.55	4.60	49.05

TABLE 3: WATER QUALITY RESULTS - POWELL RIVER, B. C. - NOVEMBER 1979
(Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
5	0.0	10.47	22.60	8.60	91.10
	2.0	9.80	26.77	8.90	95.38
	5.0	10.30	27.49	8.00	87.13
	10.0	10.15	27.99	7.60	82.76
	25.0	9.25	29.07	6.00	64.46
	50.0	9.05	30.31	4.80	51.75
	100.0	8.53	30.37	4.60	49.00
6	0.0	10.70	20.76	8.60	90.50
	2.0	10.07	26.79	8.40	90.60
	5.0	10.25	27.42	8.00	87.00
	10.0	10.19	27.72	7.50	81.60
	25.0	9.33	29.07	6.00	64.57
	50.0	9.29	30.15	4.50	48.74
7	0.0	10.01	25.94	8.40	89.96
	2.0	10.06	26.11	8.30	89.10
	5.0	10.31	27.21	8.10	88.09
	10.0	10.12	27.79	7.50	81.52
	25.0	9.33	29.05	6.10	65.65
	40.0	8.92	29.65	4.50	48.15
8	0.0	10.27	22.65	8.70	91.76
	2.0	10.11	26.59	8.50	91.63
	5.0	10.16	27.60	7.70	83.66
	10.0	10.11	27.85	7.50	81.51
	25.0	9.15	29.22	5.80	62.23
	50.0	8.90	29.94	4.90	52.51
	100.0	8.89	30.35	4.60	49.42

TABLE 4: WATER QUALITY - POWELL RIVER, B. C. - AUGUST & NOVEMBER, 1979
COLOUR ANALYSIS (Colour Units)

DEPTH (meters)	STN 1	STN 2	STN 3	STN 4	STN 5	STN 6	STN 7	STN 8
August								
0	< 5	<5	< 5	< 5	< 5	25	< 5	< 5
2	< 5	<5	< 5	< 5	< 5	< 5	< 5	< 5
5	< 5	<5	< 5	< 5	< 5	< 5	< 5	< 5
10	< 5	<5	< 5	< 5	< 5	< 5	< 5	< 5
November								
0	2	3	5	6	7	6	7	8
2	3	2	2	3	3	3	8	4
5	3	2	3	4	3	6	4	3
10	3	2	3	5	2	3	2	3

TABLE 5: WATER QUALITY RESULTS - CROFTON B. C. - JULY 1971

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
1	0.0	17.16	26.42	7.00	87.56
	2.0	15.83	26.64	6.60	80.51
	5.0	13.99	27.28	5.30	63.51
	10.0	12.89	28.23	4.90	56.80
	25.0	11.62	30.05	5.60	63.90
2	0.0	17.77	26.17	8.00	101.10
	2.0	17.06	26.17	7.60	94.73
	5.0	14.61	26.94	5.30	63.18
	10.0	12.79	28.07	5.30	61.25
	25.0	11.62	28.98	6.00	67.99
	35.0	11.61	29.27	5.40	60.68
3	0.0	18.42	26.00	8.10	103.56
	2.0	18.23	26.02	7.90	100.64
	5.0	14.30	27.19	3.30	39.15
	10.0	12.99	27.94	4.40	51.02
	25.0	11.68	28.96	6.10	69.19
	50.0	10.50	29.52	4.50	49.90
4	0.0	18.68	25.93	8.40	107.88
	2.0	16.95	26.32	7.00	87.14
	7.0	13.55	27.28	4.65	54.33
	22.0	11.82	28.87	5.90	67.10
	37.0	10.92	29.31	5.20	58.14
5	0.0	17.34	26.38	8.90	111.70
	2.0	16.69	26.49	8.70	107.16
	5.0	15.01	27.00	7.90	94.98
	10.0	12.99	28.11	6.40	74.28
	25.0	11.66	28.96	6.15	69.74
	50.0	10.57	29.53	4.65	51.65
	110.0	-	29.63	3.20	-

TABLE 5: WATER QUALITY RESULTS - CROFTON B. C. - JULY 1979
(Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
6	0.0	19.17	25.91	8.40	108.88
	2.0	16.83	26.32	8.40	104.32
	5.0	14.13	27.19	6.50	76.83
	10.0	13.08	27.98	6.90	80.18
	25.0	11.66	29.08	6.10	69.22
	50.0	10.47	29.59	4.50	49.89
	95.0	-	29.61	3.40	-
7	0.0	15.92	26.74	8.60	105.17
	2.0	15.52	26.74	8.50	103.09
	5.0	13.89	27.55	7.20	84.87
	10.0	13.54	27.77	7.20	84.38
	25.0	11.67	28.93	5.70	64.63
	50.0	-	29.52	4.55	-
	180.0	9.62	29.63	3.30	35.89
8	0.0	18.52	26.10	9.00	115.37
	2.0	17.66	26.16	9.20	116.01
	5.0	16.08	26.59	10.30	126.23
	10.0	13.19	27.96	7.30	85.02
	25.0	11.57	29.15	6.00	67.98
9	0.0	19.27	25.45	9.20	119.12
	2.0	16.23	26.02	10.50	128.59
	5.0	14.08	27.24	8.30	98.04
	10.0	13.19	27.89	7.25	84.39
	25.0	11.35	29.06	5.60	63.11
	50.0	10.46	29.52	4.40	48.75
	90.0	10.14	29.61	3.00	33.02

TABLE 6: WATER QUALITY RESULTS - CROFTON B. C. - OCTOBER 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
1	0.0	10.97	27.54	6.10	67.47
	2.0	10.99	27.66	5.80	64.24
	5.0	11.22	28.62	4.30	48.17
	10.0	11.15	28.96	5.20	58.30
	25.0	11.07	29.58	2.80	31.47
2	0.0	11.62	28.13	4.60	51.83
	2.0	11.80	28.30	3.90	44.16
	5.0	11.89	28.39	4.30	48.82
	10.0	11.37	28.94	3.80	42.81
3	0.0	10.93	27.60	6.45	71.32
	2.0	11.04	27.69	6.10	67.65
	5.0	11.18	28.49	5.00	55.92
	10.0	11.08	29.03	5.10	57.12
	25.0	11.06	29.60	2.70	30.34
	45.0	10.95	29.68	3.30	37.01
4	0.0	10.86	27.68	5.60	61.85
	2.0	10.99	27.79	5.60	62.08
	5.0	11.39	28.77	3.80	42.78
	10.0	11.07	29.13	4.70	52.66
	25.0	11.07	29.64	2.30	25.86
	50.0	10.96	29.70	3.30	37.02
5	0.0	10.45	27.37	6.40	69.90
	2.0	10.99	28.52	5.40	60.15
	5.0	11.09	28.98	5.00	55.99
	10.0	11.07	29.19	4.40	49.32
	25.0	10.97	29.62	2.30	25.79
	50.0	10.88	29.74	3.60	40.33
	100.0	10.46	29.95	4.70	52.22
	110.0	10.43	29.98	4.70	52.19

TABLE 6: WATER QUALITY RESULTS - CROFTON B. C. - OCTOBER 1979
Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
6	0.0	10.96	28.05	5.30	58.81
	2.0	11.29	28.81	4.20	47.19
	5.0	11.18	28.98	4.90	54.98
	10.0	10.97	29.17	4.70	52.55
	25.0	11.07	29.60	2.60	29.22
	50.0	10.86	29.74	3.60	40.30
	90.0	10.53	29.91	4.65	51.74
7	0.0	10.72	28.13	6.20	68.46
	2.0	10.85	28.22	6.00	66.49
	5.0	11.10	28.94	5.20	58.22
	10.0	11.11	29.22	4.70	52.74
	25.0	11.09	29.55	3.10	34.84
	50.0	10.87	29.76	4.20	47.04
	100.0	10.57	29.89	4.80	53.45
	180.0	10.39	30.02	4.80	53.27
8	0.0	10.66	27.58	7.10	78.01
	2.0	10.89	28.50	6.30	70.01
	5.0	11.09	29.03	5.60	62.73
	10.0	11.23	29.13	5.10	57.35
	25.0	11.08	29.55	2.40	26.97
	35.0	10.87	29.58	3.10	34.68
9	0.0	10.86	28.03	6.70	74.17
	2.0	10.99	28.03	6.70	74.39
	5.0	11.09	28.66	6.20	69.27
	10.0	10.92	29.28	4.20	46.94
	25.0	11.07	29.60	2.00	22.48
	50.0	10.96	29.72	2.70	30.30
	80.0	10.69	29.83	4.30	47.99

TABLE 7: WATER QUALITY - CROFTON, B. C. - JULY & OCTOBER, 1979
COLOUR ANALYSIS (Colour Units)

DEPTH (meters)	STN 1	STN 2	STN 3	STN 4	STN 5	STN 6	STN 7	STN 8	STN 9
July									
0	14	< 5	7	< 5	<5	5	< 5	<5	< 5
2	22	5	5	5	<5	5	< 5	<5	< 5
5	33	53	28	31(7m)	<5	18	< 5	<5	< 5
10	90	14	47	-	5	< 5	< 5	<5	< 5
October									
0	8	32	7	1	9	2	-	-	-
2	11	46	6	2	11	2	-	-	-
5	15	39	9	31	3	1	-	-	-
10	< 1	17	< 1	1	0	1	-	-	-

TABLE 8: WATER QUALITY RESULTS - NORTHUMBERLAND CHANNEL - JULY, 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
NC-2A	0.0	13.52	27.85	8.80	103.13
	2.0	13.26	27.94	8.50	99.14
	5.0	11.99	28.36	7.30	83.05
	10.0	11.39	28.51	7.00	78.66
	25.0	9.71	29.12	6.20	67.35
	50.0	9.10	29.55	5.90	63.35
	105.0	8.33	30.18	5.70	60.35
NC-5A	0.0	14.34	27.58	9.40	111.89
	2.0	13.83	27.75	9.40	110.82
	5.0	11.85	28.34	7.50	85.05
	10.0	11.29	28.60	6.90	77.42
	25.0	9.57	29.29	6.20	67.20
	50.0	9.03	29.61	5.90	63.29
	110.0	8.29	30.11	5.60	59.22
NC-13	0.0	13.79	27.83	8.80	103.71
	2.0	12.92	27.96	8.40	97.27
	5.0	12.00	28.32	7.50	85.33
	10.0	10.80	28.77	6.60	73.32
	25.0	9.58	29.27	6.10	66.13
	50.0	9.06	29.52	5.90	63.29
	100.0	8.40	29.99	5.60	59.33
NC-10A	0.0	15.36	27.38	10.70	129.90
	2.0	13.73	27.83	9.10	107.12
	5.0	11.19	28.62	7.00	78.37
	10.0	10.89	28.71	6.70	74.56
	25.0	9.53	29.32	6.00	64.98
	40.0	9.19	29.48	5.80	62.39
NC-12A	0.0	16.74	27.51	10.30	128.70
	2.0	13.18	26.92	8.90	102.92
	5.0	11.91	28.34	7.50	85.16
	10.0	10.70	28.79	6.70	74.27
	25.0	9.53	29.31	6.00	64.98
	50.0	9.04	29.61	5.90	63.29

TABLE 9: WATER QUALITY RESULTS - NORTHUMBERLAND CHANNEL - OCTOBER, 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
NC-2A	0.0	9.74	26.90	5.90	63.19
	2.0	9.77	28.71	5.90	63.99
	5.0	9.76	28.98	5.70	61.92
	10.0	9.73	29.13	5.70	61.95
	25.0	9.54	29.41	5.60	60.70
	50.0	9.33	29.55	5.50	59.30
	100.0	9.23	29.79	5.00	53.94
NC-5A	0.0	9.75	26.92	6.50	69.64
	2.0	10.69	28.43	6.00	66.34
	5.0	9.66	28.92	5.65	61.21
	10.0	9.75	29.22	5.60	60.92
	25.0	9.75	29.39	5.50	59.90
	50.0	9.34	29.55	5.50	59.39
	100.0	9.24	29.93	4.90	52.93
NC-13	0.0	9.35	18.34	8.00	80.40
	2.0	9.68	28.13	6.10	65.78
	5.0	9.68	28.92	5.70	61.78
	10.0	9.66	29.22	5.60	60.80
	25.0	9.56	29.41	5.25	56.93
	50.0	9.34	29.57	5.30	57.24
	90.0	9.27	29.76	5.10	55.06
NC-10A	0.0	9.44	17.70	8.40	84.26
	2.0	9.67	27.22	6.30	67.51
	5.0	9.77	28.96	5.70	61.92
	10.0	9.65	29.26	5.50	59.70
	25.0	9.55	29.41	5.20	56.37
	40.0	9.36	29.57	5.20	56.19
NC-12A	0.0	9.76	27.66	6.20	66.76
	2.0	9.79	28.33	6.20	67.11
	5.0	9.78	29.19	5.90	64.21
	10.0	9.66	29.26	5.50	59.72
	25.0	9.56	29.47	5.30	57.49
	50.0	9.24	29.66	5.20	56.07

TABLE 10: WATER QUALITY - NORTHUMBERLAND CHANNEL - JULY & OCTOBER, 1979
COLOUR ANALYSIS (Colour Units)

	DEPTH (meters)	STN NC-2A	STN NC-5A	STN NC-13	STN NC-10A	STN NC-12A
July						
	0	< 5	< 5	<5	< 5	< 5
	2	< 5	< 5	<5	< 5	< 5
	5	< 5	< 5	<5	< 5	< 5
	10	< 5	< 5	<5	< 5	< 5
	25	< 5	< 5	<5	< 5	< 5
October						
	0	< 1	2	7	6	1
	2	< 1	2	2	0	1
	5	1	2	1	< 1	2
	10	< 1	1	2	< 1	1
	25	2	2	6	< 1	1

TABLE 11: WATER QUALITY RESULTS - ELK FALLS, B. C. - AUGUST, 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
DP-2	0.0	11.43	28.60	7.40	83.28
	2.0	11.47	28.59	7.20	81.10
	5.0	11.40	28.60	6.40	71.99
	10.0	11.13	28.77	7.10	79.46
	25.0	10.72	29.10	6.90	76.69
	50.0	9.75	29.46	6.50	70.82
	70.0	-	29.52	6.20	-
DP-3	0.0	11.49	28.25	7.20	80.96
	2.0	11.36	28.32	7.20	80.76
	5.0	11.28	28.62	7.10	79.65
	10.0	11.21	28.59	7.20	80.63
	25.0	10.11	29.31	6.70	73.54
	50.0	9.65	29.50	6.40	69.59
	70.0	9.06	29.61	6.20	66.55
DP-4	0.0	10.84	29.08	7.20	80.23
	2.0	10.83	29.10	7.30	81.34
	5.0	10.86	29.14	7.10	79.18
	10.0	10.88	29.14	7.10	79.21
	25.0	10.66	29.23	7.20	79.99
DP-5	0.0	10.94	29.08	7.10	79.30
	2.0	10.89	29.10	7.10	79.21
	5.0	10.84	29.12	7.00	78.01
	20.0	10.01	29.10	7.00	58.95
	45.0	10.65	29.12	6.90	76.58

TABLE 11: WATER QUALITY RESULTS - ELK FALLS, B. C. - AUGUST, 1979
(Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
DP-6	0.0	11.76	28.25	7.40	83.70
	2.0	11.75	28.32	7.40	83.71
	5.0	11.56	28.49	7.20	81.19
	10.0	11.44	28.41	7.50	84.33
	25.0	11.15	28.72	7.20	80.60
	50.0	9.75	29.40	6.60	71.88
	90.0	8.83	29.61	6.10	65.12
DP-8	0.0	11.75	28.37	7.60	86.01
	2.0	11.72	28.26	7.50	84.76
	5.0	11.52	28.46	7.40	83.38
	10.0	11.43	28.54	7.30	82.12
	25.0	10.73	28.99	7.10	78.86
	50.0	8.87	29.60	6.30	67.32
	60.0	8.67	29.92	5.90	62.87

TABLE 12: WATER QUALITY RESULTS - ELK FALLS, B. C. - NOVEMBER, 1979

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
DP-1	0.0	9.25	29.33	6.10	65.63
	2.0	9.26	29.33	6.20	66.72
	5.0	9.26	29.31	6.20	66.72
	10.0	9.25	29.33	6.10	65.65
	25.0	9.24	29.42	6.10	65.67
	50.0	9.21	29.44	6.10	65.63
	80.0	9.20	29.48	6.00	64.55
DP-2	0.0	9.25	28.41	6.10	65.23
	2.0	9.24	29.39	6.10	65.64
	5.0	9.23	29.41	6.10	65.65
	10.0	9.24	29.43	6.10	65.67
	25.0	9.24	29.42	6.05	65.13
	50.0	9.22	29.48	6.05	65.13
DP-3	0.0	9.28	29.31	6.20	66.75
	2.0	9.26	29.32	6.20	66.73
	5.0	9.27	29.32	6.20	66.74
	10.0	9.27	29.31	6.20	66.74
	25.0	9.27	29.36	6.20	66.76
	50.0	9.24	29.38	6.20	66.73
DP-4	0.0	9.30	29.38	6.20	66.82
	2.0	9.29	29.36	6.20	66.80
	5.0	9.31	29.36	6.20	66.82
	10.0	9.30	29.37	6.20	66.81
	25.0	9.33	29.38	6.15	66.33
DP-5	0.0	9.28	29.34	6.10	65.69
	2.0	9.27	29.34	6.10	65.68
	5.0	9.27	29.35	6.15	66.22
	10.0	9.27	29.34	6.15	66.21
	25.0	9.30	29.36	6.15	66.26
	40.0	9.28	29.36	6.15	66.23

TABLE 12: WATER QUALITY RESULTS - ELK FALLS, B. C. - NOVEMBER, 1979
(Continued)

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (0/00)	DISSOLVED OXYGEN (mg/l)	% SATURATION
P-6	0.0	9.31	29.39	6.20	66.83
	2.0	9.31	29.40	6.20	66.84
	5.0	9.34	29.40	6.20	66.88
	10.0	9.31	29.41	6.10	65.76
	25.0	9.32	29.40	6.15	66.32
	50.0	9.32	29.43	6.20	66.87
DP-7	0.0	9.32	29.41	6.15	66.32
	2.0	9.31	29.42	6.15	66.32
	5.0	9.33	29.40	6.15	66.34
	10.0	9.31	29.40	6.15	66.30
	25.0	9.32	29.41	6.15	66.33
	50.0	9.32	29.41	6.15	66.32
	80.0	9.30	29.42	6.20	66.85
DP-8	0.0	9.30	28.59	6.40	68.61
	2.0	9.30	29.03	6.25	67.20
	5.0	9.32	29.19	6.20	66.76
	10.0	9.31	29.41	6.15	66.30
	25.0	9.30	29.41	6.15	66.29
	50.0	9.29	29.41	6.15	66.28
	80.0	9.30	29.41	6.10	65.75
DP-9	0.0	9.31	29.41	6.15	66.30
	2.0	9.31	29.41	6.10	65.77
	5.0	9.33	29.41	6.15	66.33
	10.0	9.30	29.41	6.15	66.29
	25.0	9.32	*	*	*
	50.0	9.31	29.41	6.15	66.31
	90.0	9.30	29.42	6.15	66.30

* Loss of Sample

TABLE 13: WATER QUALITY - ELK FALLS, B. C. - JULY & NOVEMBER, 1979
COLOUR ANALYSIS (Colour Units)

DEPTH (meters)	STN DP-2	STN DP-3	STN DP-4	STN DP-5	STN DP-6	STN DP-8
July						
0	< 5	<5	<5	< 5	< 5	<5
2	< 5	<5	<5	< 5	< 5	<5
5	< 5	<5	<5	< 5	< 5	<5
10	< 5	<5	<5	< 5	< 5	<5
25	< 5	<5	<5	< 5	< 5	<5

DEPTH (meters)	STN DP-1	STN DP-2	STN DP-3	STN DP-4	STN DP-5	STN DP-6	STN DP-7	STN DP-8	STN DP-9
November									
0	3	0	0	0	0	0	0	2	3
2	0	0	0	0	0	0	0	2	3
5	0	0	0	0	0	0	0	3	2
10	0	0	0	0	0	0	1	4	2
25	0	0	0	0	0	0	0	3	-
40	-	-	-	-	-	-	-	-	-
50	0	0	0	-	-	0	2	4	3
80	0	0	-	-	-	-	2	3	-

TABLE 14: SEDIMENT CHARACTERIZATION-SURFACE GRAB SAMPLES
POWELL RIVER, B. C. - FEBRUARY, 1979

STATION	DEPTH (m)	VISUAL OBSERVATIONS
PR-A	intertidal	not sampled
PR-B	43	90% fine wood chips, 10% charcoal
PR-C	39	70% fine wood chips, 30% charcoal
PR-D	60	5% coarse wood chips, 5% charcoal and yellow crumbly material, 90% fine wood chips
PR-E	36	5% coarse wood chips, 10% charcoal, 85% fine wood chips
PR-F	37	5% coarse wood chips, 5% charcoal, 5% small rocks and gravel, 85% fine wood chips
PR-G	32	5% charcoal, 95% fine wood chips NOTE: The 35 mesh fraction contains "balls" of wood chips that did not break up in the seiving process
PR-H	27	95% fine wood chips, 5% charcoal, wood chip clots
PR-I	14	5% charcoal, 5% medium woodchips, 90% fine wood chips
PR-J	21	95% fine wood chips, 2% medium wood chips, 3% charcoal
PR-K	32	10% large wood chips, 10% charcoal, 80% fine wood chips
PR-L	31	20% large wood chips, 20% charcoal, 60% fine wood chips
PR-M	31	10% large wood chips, 2% charcoal, 88% fine wood chips
PR-N	45	20% large wood chips, "clots" of wood and silt, 2% gravel, 78% fine wood chips
PR-O	44	5% large wood chips, 5% charcoal, 90% fine wood chips

TABLE 15: SEDIMENT CHARACTERIZATION-GRAB & CORE SAMPLES
POWELL RIVER, B. C. - FEBRUARY, 1979

STATION	DEPTH (m)	CORE SAMPLE DEPTH(cm)	VISUAL OBSERVATIONS
PR-1	104	0 - 5	10% large rocks, 5% woodchips, 85% silt.
PR-2	151	0 - 5	10% rocks, 90% silt.
"		bottom	100% "crushable" silt.
PR-3	168	0 - 5	100% "crushable" silt.
"		0 - 5	100% "crushable" silt.
PR-4	162	0 - 5	2% woodchips, 98% silt.
"		bottom	100% silt.
PR-5	150	0 - 5	2% woodchips, 98% silt.
"		10 - 15	100% silt.
"		20 - 25	100% silt.
PR-6	84	0 - 5	100% silt.
SURFACE GRAB SAMPLES			
PR-7	51		5% woodchips, 2% charcoal, 93% silt.
PR-8	100		5% woodchips, 5% charcoal, 5% rocks, 85% silt.
PR-9	132		2% woodchips, 5% small rocks, 93% silt.
PR-10	114		5% small rocks, 5% woodchips, 90% silt.
PR-11	89		5% charcoal, 2% woodchips, 93% silt.
PR-12	62		20% woodchips, 5% charcoal, 2% smallstones, 73% sand and silt.
PR-13	45		5% charcoal, 45% woodchips, 50% sand.
PR-14	82		10% woodchips, 5% charcoal, 85% silt.
PR-15	97		10% woodchips, 5% charcoal.
PR-16	74		10% large woodchips, 5% charcoal, 30% small woodchips, 55% sand.
PR-17	not sampled.		
PR-18	58		10% large woodchips, 10% charcoal, 30% small woodchips, 50% sand.

TABLE 16: TRACE METAL LEVELS IN MARINE SEDIMENTS-GRAB SAMPLES
POWELL RIVER, B. C. - FEBRUARY, 1979
(mg/kg Dry Weight)

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	V
A	not sampled							
B	0.291	3.69	37.0	87.6	291.0	27.9	17.5	63.3
		3.97	39.9	96.6	290.0	29.5	20.2	63.7
		3.57	37.3	87.7	250.0	26.4	<16.5	60.8
		4.00	41.9	94.3	263.0	28.8	21.2	63.3
C	0.940	5.08	38.2	81.5	431.0	24.5	20.1	48.0
		4.64	30.5	84.0	455.0	25.5	<16.4	48.8
D	9.490	< 2.07	73.1	162.0	356.0	25.5	17.2	53.2
		< 2.06	66.6	163.0	374.0	23.0	22.7	52.7
E	3.08	3.08	38.0	80.2	381.0	20.0	<16.4	51.1
		3.31	25.2	79.9	402.0	19.7	<16.3	50.4
F	0.103	3.67	29.4	81.9	447.0	22.3	<16.6	56.1
		4.03	32.6	79.7	431.0	26.3	26.2	61.2
G	0.464	4.81	34.3	85.0	436.0	24.2	18.2	53.3
		4.63	34.2	85.6	437.0	28.9	17.9	51.8
H	1.08	3.15	54.3	107.0	596.0	30.9	21.5	49.7
		4.68	66.8	103.0	585.0	29.5	29.1	52.0
I	1.04	5.85	67.3	118.0	776.0	29.6	25.6	48.1
		5.47	80.6	125.0	777.0	31.8	28.1	47.3
J	1.04	4.97	48.8	81.3	564.0	22.7	17.7	44.1
		4.88	52.3	92.4	557.0	24.1	22.3	45.0
K	1.74	5.68	39.3	110.0	468.0	23.5	20.0	54.3
		5.51	45.9	104.0	464.0	24.9	27.0	54.3
L	0.901	6.46	40.4	100.0	509.0	23.4	18.1	53.8
		5.95	37.4	89.9	499.0	24.2	< 16.3	52.6
M	0.202	6.72	36.9	81.0	379.0	20.5	< 16.6	69.9
		7.20	40.4	77.7	386.0	22.4	24.8	71.9
N	7.74	<2.07	< 16.5	82.4	220.0	25.0	16.8	87.2
		<2.04	< 16.3	79.7	205.0	24.9	19.3	82.7
O	0.974	6.37	26.2	90.0	373.0	22.0	23.5	78.1
		5.68	22.6	82.4	353.0	22.3	< 16.2	75.2

TABLE 17: TRACE METAL LEVELS IN MARINE SEDIMENTS-GRAB AND CORE SAMPLES
POWELL RIVER, B. C. - FEBRUARY, 1979
(mg/kg Dry Weight)

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	V
Core Samples								
PR-1	0.094	< 2.02	<16.1	19.1	36.1	16.4	< 16.1	39.1
"		< 1.99	<15.9	19.1	33.0	15.4	< 15.9	40.4
PR-2 (0-5cm)	0.071	< 2.03	<16.3	13.1	27.8	16.4	< 16.2	51.2
"		< 2.04	<16.2	12.1	26.3	14.6	< 16.3	46.4
PR-2 (bottom)	0.180	< 2.05	<16.4	21.8	42.7	22.8	20.0	58.8
"		< 2.03	<16.2	20.7	40.4	21.6	23.8	57.9
PR-3 (0-5cm)	0.105	< 2.11	<16.8	40.4	74.2	27.1	20.6	69.9
" "		< 2.14	<16.2	40.4	68.5	28.0	21.1	70.5
" "	0.173	< 1.97	<15.7	20.5	40.9	22.0	< 16.0	66.2
" "		< 2.00	<16.0	23.3	39.2	21.6	< 15.7	65.5
PR-4 (0-5cm)	0.143	< 1.98	<15.8	15.7	30.7	14.9	< 15.8	43.8
" "		< 1.95	<15.6	13.6	35.6	15.5	< 15.6	45.1
PR-4 (bottom)	0.112	< 1.98	<15.8	15.8	37.0	21.0	15.9	54.9
" "		< 1.99	<15.9	14.8	35.5	20.2	< 15.9	53.7
PR-5 (0-5cm)	0.062	< 2.03	<16.2	13.6	32.4	12.3	< 16.2	29.2
PR-5 (0-15cm)	0.100	< 2.01	<16.1	12.4	28.9	15.5	< 16.1	42.0
" "		< 2.02	<16.2	13.0	29.8	16.0	< 16.2	42.0
PR-5 (20-25cm)	0.090	< 1.98	<15.9	19.8	36.3	19.7	17.3	44.6
" "		< 1.97	<15.8	17.3	31.8	115.0	72.6	42.8
PR-6 (0-5cm)	0.059	< 1.95	<15.6	12.8	26.0	14.7	<15.6	41.8
" "		< 1.92	<15.4	12.6	24.6	14.1	<15.4	42.5

TABLE 17: (Continued) TRACE METAL LEVELS IN MARINE SEDIMENTS-GRAB AND CORE SAMPLES POWELL RIVER, B. C. - FEBRUARY, 1979 (mg/kg Dry Weight)

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	V
PR-7	0.717	< 2.08	<16.7	17.7	57.1	9.1	< 16.7	26.0
"		< 2.11	<16.8	17.4	57.5	50.0	32.9	26.7
PR-8	0.104	< 2.01	<16.1	14.6	29.1	10.2	< 16.1	18.9
"		< 2.05	<16.4	15.8	31.1	11.2	< 16.4	28.4
PR-9	0.909	< 2.01	<16.1	18.3	34.3	14.3	< 16.1	39.7
"		< 2.08	<16.7	18.0	35.2	13.2	< 16.7	41.0
PR-10	0.668	< 1.99	<15.9	12.5	29.1	11.6	< 15.9	38.6
"		< 1.95	<15.6	13.7	29.1	11.6	< 15.6	35.7
PR-11	0.365	< 2.04	<16.3	16.5	46.6	8.0	< 16.3	23.1
"		< 2.03	<16.3	15.9	45.1	8.6	< 16.3	27.0
PR-12	0.760	3.97	40.2	85.7	405.0	22.2	23.6	70.0
"		3.03	44.6	84.4	372.0	21.4	19.2	70.6
PR-13	0.353	4.93	39.2	80.8	453.0	39.2	31.5	70.9
"		5.02	33.4	83.1	453.0	33.4	35.9	73.3
PR-14	0.090	2.07	<16.2	39.2	67.9	14.3	< 16.2	46.2
"		2.30	<16.3	41.5	62.7	15.6	18.7	46.7
PR-15	0.143	< 1.95	<15.6	29.5	47.4	14.6	< 15.6	52.3
"		< 2.00	<16.0	24.6	48.2	14.5	< 16.0	52.0
PR-16	0.677	4.88	21.6	67.2	181.0	18.8	19.9	52.0
"		5.27	24.6	71.2	178.0	20.1	25.1	52.7
PR-18	1.74	5.55	47.7	108.0	278.0	22.4	< 16.3	64.4

TABLE 18: PARTICLE SIZING AND TOTAL VOLATILE RESIDUES-GRAB & CORE SAMPLES: POWELL RIVER, B. C. - FEBRUARY, 1979

STATION	TVR (mg/g)	35 MESH weight retained	35 MESH percent retained	60 MESH weight retained	60 MESH percent retained	230 MESH weight retained	230 MESH percent retained	<230 MESH weight retained	<230 MESH percent retained
PR-1	45	44.2	62.5	6.2	8.8	16.3	23.1	4.0	5.7
PR-2 (0-5cm)	35	11.3	20.8	0.0	0.0	37.0	68.3	5.9	10.9
PR-2 (bottom)	36	22.8	25.1	12.1	13.3	9.4	10.4	46.4	51.2
PR-3 (0-5cm)	80	4.4	23.0	3.7	19.4	7.9	41.3	3.1	16.2
PR-3 (0-5cm)	32	3.0	10.8	8.3	29.7	14.1	50.5	2.5	9.0
PR-4 (0-5cm)	32	2.3	3.1	5.3	7.0	56.2	75.0	11.1	14.8
PR-4 (bottom)	39	14.3	26.9	4.5	8.5	26.3	49.5	8.0	15.0
PR-5 (0-5cm)	46	4.4	8.3	4.1	7.7	31.4	59.0	13.3	25.0
PR-5 (0-15cm)	37	1.0	1.9	4.3	8.3	34.6	66.7	12.0	23.1
PR-5 (20-25cm)	37	1.2	2.6	4.0	8.7	28.5	61.7	12.2	26.6
PR-6 (0-5cm)	22	7.6	15.5	5.5	11.2	27.5	56.2	8.3	17.0
PR-7	150	11.0	14.2	17.0	22.0	44.4	57.5	4.8	6.2
PR-8	71	14.4	11.4	27.3	21.5	65.1	51.3	20.0	15.8
PR-9	41	3.2	1.8	28.8	16.6	114.8	66.1	27.0	15.5
PR-10	55	6.8	4.0	45.2	26.5	96.0	56.2	22.7	13.3
PR-11	87	3.2	2.9	20.5	18.3	71.9	64.0	20.4	18.2
PR-12	212	13.9	32.6	16.5	38.7	10.4	24.4	1.8	4.2
RP-13	426	4.2	17.6	11.7	49.0	6.5	27.2	1.5	6.2
PR-14	66	44.8	21.3	100.6	47.8	55.8	26.5	9.3	4.4
PR-15	58	12.8	10.5	48.4	39.6	51.4	42.0	9.5	7.8
PR-16	227	10.3	17.3	17.7	29.8	25.3	42.6	6.1	10.3
PR-18	527	3.3	16.9	8.1	41.5	6.4	32.8	1.7	8.7

TABLE 19: PARTICLE SIZING AND TOTAL VOLATILE RESIDUES-GRAB SAMPLES: POWELL RIVER, B. C. - FEBRUARY, 1979

STATION	TVR (mg/g)	35 MESH		60 MESH		230 MESH		< 230 MESH	
		weight retained	percent retained	weight retained	percent retained	weight retained	percent retained	wieght retained	percent retained
PR-A	-	0.8	10.1	2.4	30.4	3.8	48.1	0.9	11.4
PR-B	572	8.1	42.2	5.1	26.6	5.0	26.0	1.0	5.2
PR-C	712	14.8	35.3	14.3	34.1	11.0	26.3	1.8	4.3
PR-D	180	7.3	30.5	8.7	36.4	6.8	28.5	1.1	4.6
PR-E	412	15.7	40.9	14.0	36.5	7.4	19.3	1.3	3.3
PR-F	171	2.1	14.5	6.6	45.5	5.1	35.2	0.7	4.8
PR-G	630	2.9	24.8	5.0	42.7	3.2	27.4	0.6	5.1
PR-H	673	2.3	18.0	5.9	46.0	3.9	30.5	0.7	5.4
PR-I	677	1.9	9.8	8.6	44.3	7.6	39.2	1.3	6.7
PR-J	658	3.4	20.7	6.5	39.6	5.4	32.9	1.1	6.7
PR-K	639	14.7	62.6	5.4	23.0	2.9	12.3	0.5	2.1
PR-L	549	7.6	35.3	6.3	29.3	6.4	29.8	1.2	5.6
PR-M	652	22.8	47.6	13.5	28.2	9.0	18.8	2.6	5.4
PR-N	177	2.6	16.0	7.0	43.2	5.5	34.0	1.1	6.8
PR-O	489	74.5	63.1	22.1	18.7	15.3	13.0	6.0	5.1

TABLE 20: SEDIMENT CHARACTERIZATION - GRAB SAMPLES: POWELL RIVER, B.C., AUGUST 1979

STATION	DEPTH	REMARKS
MS-1	64	Sandy, thin mud layer, wood fragments.
MS-2	147	Sandy, few wood fragments.
MS-3	73	Sandy, few wood fragments.
MS-4	157	Fine mud substrate; reducing sediments (H_2S) at 5-10 cm.
MS-5	61	Fine mud with more wood debris fragments up to 2-5 cm.
MS-6	126	Natural, soft mud; no wood debris.
MS-7	73	Thin layer of fine fibre and sediment overlying coarse sand; wood fragments and sulphur fragments (at 10 cm.); H_2S odor.
MS-8	115	Thin layer of shell fragments, coarse sand; pebbles over natural brown mud.
MS-9	70	Fibre and mud, few bark and wood fragments; slightly reducing; some coarse sand and few pebbles.
MS-10	91	Coarse sand; corraline algae fragments; natural sediment and some fine fibre.
MS-11	44	Predominantly fibre; natural sediment; no reducing.
MS-12	113	Large bark fragments; mud and coarse sand.
MS-13	71	Coarse sand; clean.
MS-14	116	Clean coarse sand; wood debris on surface.
MS-15	155	Clean coarse sand; natural debris on surface.

TABLE 20: SEDIMENT CHARACTERIZATION - GRAB SAMPLES:
(Continued) POWELL RIVER, B.C., AUGUST 1979

STATION	DEPTH	REMARKS
MS-16	249	Clean, natural sediment.
MS-17	260	Clean, natural sediment; soft mud.
MS-18	146	Coarse sand and sediment; cloud sponge fragments, pebbles.
MS-19	305	Clean soft mud; brown surface layer.
MS-20	340	Clean soft mud; brown surface layer.

TABLE 21: TRACE METAL LEVELS IN MARINE SEDIMENTS-GRAB SAMPLES
POWELL RIVER, B. C. - AUGUST, 1979
(mg/kg Dry Weight)

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	V
MS-1	0.171	<1.25	<10.0	13.2	36.9	8.93	< 10.0	25.3
MS-2	0.194	<1.25	< 9.95	15.3	20.4	13.5	< 9.95	34.7
		<1.24	< 9.95	15.6	19.1	14.0	< 9.95	35.0
MS-3	0.286	<1.25	< 9.98	19.2	42.0	9.55	< 9.98	23.2
		<1.23	< 9.85	19.6	42.4	9.90	< 9.85	22.7
MS-4	0.259	<1.23	< 9.88	25.8	38.2	16.4	10.6	31.3
		<1.24	< 9.90	25.2	38.0	16.2	10.0	31.0
MS-5	0.332	6.12	23.8	80.7	277.0	25.0	15.2	60.1
		5.94	23.2	81.7	285.0	25.8	15.0	63.0
MS-6	0.168	<1.25	< 9.98	17.7	25.0	13.0	< 9.98	31.4
		<1.22	< 9.73	18.2	21.9	12.7	< 9.73	31.1
MS-7	0.893	2.49	72.5	189.0	338.0	25.4	19.2	55.6
		2.15	97.1	168.0	317.0	24.5	16.4	51.6
MS-8	0.251	2.43	14.3	36.1	121.0	15.9	<9.8	31.8
		2.59	13.6	43.3	127.0	16.0	<9.9	32.2
MS-9	0.216	<1.22	< 9.78	23.9	30.0	14.9	<9.78	41.1
		<1.20	< 9.62	20.1	36.7	14.7	<9.62	39.1
MS-10	0.179	<1.22	< 9.78	8.35	15.3	8.42	<9.78	24.0
		<1.23	< 9.80	9.28	16.8	8.92	<9.80	25.5

TABLE 21: (Continued) TRACE METAL LEVELS IN MARINE SEDIMENTS-GRAB SAMPLES POWELL RIVER, B. C. - AUGUST, 1979 (mg/kg Dry Weight)

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	V
MS-11	0.296	1.53	11.6	30.2	104.0	12.3	< 9.59	25.1
		1.26	9.61	26.7	83.2	10.7	< 9.43	25.3
MS-12	0.198	< 1.23	<9.88	17.6	29.4	13.9	< 9.88	34.4
		< 1.24	<9.93	17.8	27.5	13.9	< 9.93	33.8
MS-13	0.307	< 1.19	<9.52	8.14	10.1	12.5	< 9.52	41.2
		< 1.24	<9.9	7.61	8.73	11.5	< 9.90	38.4
MS-14	0.187	< 1.2	<9.62	< 1.2	< 2.4	<1.8	< 9.62	6.9
MS-15	0.174	< 1.23	<9.83	< 1.23	< 2.46	<1.84	< 9.83	< 6.14
		< 1.24	<9.90	< 1.24	< 2.48	<1.86	< 9.90	< 6.19
MS-16	0.184	< 1.23	<9.88	< 1.23	< 2.47	<1.85	< 9.88	< 6.17
		< 1.25	<9.98	< 1.25	< 2.49	<1.97	< 9.98	8.0
MS-17	0.190	< 1.23	<9.85	1.35	< 2.46	<1.85	< 9.85	9.59
		< 1.22	<9.78	1.45	< 2.45	<1.83	< 9.78	9.79
MS-18	0.194	< 1.20	<9.64	38.1	55.9	22.6	20.3	59.5
		< 1.24	9.95	43.6	64.6	24.1	20.5	63.7
MS-19	0.202	< 1.22	14.6	75.3	144.0	31.2	31.3	82.5
		< 1.24	16.9	77.1	140.0	31.2	31.3	81.2
MS-20	2.10	< 1.23	21.2	85.0	186.0	39.7	41.1	98.5
		< 1.24	19.9	86.3	187.0	40.2	40.6	103.0

TABLE 22: PARTICLE SIZING AND TOTAL VOLATILE RESIDUES-GRAB SAMPLES, POWELL RIVER, B.C., AUGUST 1979

STATION	TVR (mg/g)	35 MESH		60 MESH		230 MESH		< 230 MESH	
		Wt. Ret.	% Ret.	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.
MS-1	129	3.9	16.9	5.6	24.2	12.4	53.7	1.2	5.2
MS-2	27	2.0	9.8	7.6	37.0	7.7	37.6	3.2	15.6
MS-3	80	2.0	10.4	5.3	27.6	11.0	57.3	0.9	4.7
MS-4	82	0.1	0.9	2.0	17.9	6.4	57.1	2.7	24.1
MS-5	489	0.9	15.5	1.3	22.4	2.0	34.5	1.6	27.6
MS-6	55	0.1	0.6	3.3	19.9	11.4	68.7	1.8	10.8
MS-7	366	7.3	55.7	2.9	22.1	2.2	16.8	0.7	5.3
MS-8	31	6.1	22.3	8.1	29.7	10.8	39.6	2.3	8.4
MS-9	254	1.2	12.9	2.0	21.5	4.1	44.1	2.0	21.5
MS-10	21	14.5	33.2	7.2	16.5	19.8	45.3	2.2	5.0
MS-11	249	0.3	2.8	3.7	3.4	6.0	55.5	0.8	7.4
MS-12	133	9.0	21.2	7.5	17.7	20.4	48.1	5.5	13.0
MS-13	21	2.6	6.8	8.9	23.1	25.8	67.0	1.2	3.1
MS-14	34	1.6	5.2	15.1	49.3	13.0	42.5	0.9	2.9
MS-15	37	2.0	3.8	4.7	9.0	44.8	85.3	1.0	1.9
MS-16	276	0.6	7.7	1.1	14.1	2.8	35.9	3.3	42.3
MS-17	109	0.9	11.3	1.2	15.0	2.6	32.5	3.3	41.2
MS-18	43	2.0	7.8	6.9	27.0	13.5	52.7	3.2	12.5
MS-19	138	4.6	69.7	1.1	16.7	0.8	12.1	0.1	1.5
MS-20	137	0.9	12.9	1.3	18.6	2.2	31.4	2.6	37.1

TABLE 23: TRACE METAL LEVELS IN MARINE SEDIMENTS - CORE SAMPLES
NORTHUMBERLAND CHANNEL - JULY 1979

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	Fe	Mn
C-1 0"	1.85	<1.23	<9.8	44.2	65.2	41.3	36.7	27700	323
		<1.24	<9.95	44.3	67.0	42.0	37.6	27900	324
C-1 10"	1.87	<1.23	<9.8	35.3	52.3	38.8	33.1	27400	353
		<1.22	<9.78	35.1	51.4	37.1	31.2	26700	339
C-2 0"	.254	<1.25	<9.98	53.1	74.6	39.7	34.3	25700	300
		<1.22	<9.76	50.8	72.3	38.4	32.4	25200	295
C-2 10"	.147	<1.24	<9.9	25.1	41.9	31.3	27.5	24200	292
		<1.25	<10.00	26.1	43.3	32.8	29.8	25500	284
C-3 0"	2.40	<1.25	10.6	56.2	72.2	41.8	35.5	29300	343
		<1.23	12.7	51.4	70.0	42.3	36.2	28800	337
C-3 10"	1.84	<1.23	<9.88	44.5	50.2	38.5	31.5	33200	421
		<1.22	<9.78	44.6	49.9	36.2	32.2	32400	401
C-4 0"	.966	<1.23	14.3	55.8	78.1	45.4	36.2	24600	369
		<1.22	14.9	52.6	76.4	45.3	35.6	24300	368
C-4 10"	1.32	<1.19	<9.52	36.4	52.6	39.8	32.1	27100	338
		<1.22	<9.76	35.0	53.6	38.9	32.9	26900	341
C-5 0"	0.366	<1.2	22.5	66.6	94.1	43.7	37.8	24800	308
		<1.25	22.2	66.8	91.2	43.4	36.4	24700	308
C-5 10"	0.241	<1.23	<9.83	37.9	48.7	35.9	26.6	26800	310
		<1.23	<9.8	36.9	47.2	35.2	28.4	25900	297
C-6 0"	0.401	<1.19	26.8	62.5	82.7	59.7	31.3	23800	350
		<1.2	24.3	62.9	81.4	57.0	31.7	23600	344
C-6 10"	0.313	<1.21	<9.71	32.9	46.7	34.2	27.0	23600	270
		<1.19	<9.52	32.7	46.3	32.9	26.0	23200	275

TABLE 23: TRACE METAL LEVELS IN MARINE SEDIMENTS - CORE SAMPLES
(Continued) NORTHUMBERLAND CHANNEL - JULY 1979

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	Fe	Mn
C-7 0"	4.09	<1.24	20.9	62.8	86.5	44.5	31.0	22800	290
		<1.25	14.3	63.3	87.1	44.7	29.2	22800	289
C-7 10"	1.66	<1.21	< 9.66	32.3	48.2	36.3	26.6	24200	288
		<1.23	< 9.85	31.5	47.3	35.3	25.2	23900	294
C-8 0"	2.18	<1.21	18.2	62.5	85.9	43.9	30.1	22800	284
		<1.24	17.4	66.9	85.9	44.1	30.9	23500	296
C-8 10"	1.49	<1.22	< 9.73	33.1	48.1	33.2	26.7	23600	266
		<1.25	<10.00	33.9	49.2	36.5	28.5	24800	300
C-25	0.307	<1.23	32.3	58.3	90.1	57.3	26.6	16100	218
		1.41	35.6	56.1	94.5	56.9	27.6	16200	223
NC-13 0-2"	0.326	<1.23	15.1	64.2	91.5	48.7	31.8	23100	305
NC-13 10-12"	2.44	<1.25	<10.0	34.5	56.1	40.5	30.4	27700	326
		<1.25	< 9.97	35.4	58.2	40.1	31.2	28100	334

TABLE 24: PARTICLE SIZING AND TOTAL VOLATILE RESIDUES - CORE SAMPLES: NORTHUMBERLAND CHANNEL - JULY 1979

		35 MESH		60 MESH		230 MESH		< 230 MESH	
STATION	TVR (mg/g)	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.
C-1 0"	148	0.5	5.2	0.9	9.4	3.1	32.3	5.1	53.1
C-1 10"	68	0.1	0.6	0.4	2.4	6.8	41.7	9.0	55.2
C-2 0"	68	0.2	2.0	0.9	8.9	5.0	49.5	4.0	39.6
C-2 10"	34	0.1	0.4	2.0	7.4	16.6	61.5	8.3	30.7
C-3 0"	27	1.1	8.0	2.4	17.5	6.6	4.8	3.6	26.3
C-3 10"	43	1.8	10.3	3.2	18.3	5.7	32.6	6.8	38.8
C-4 0"	237	3.0	34.9	2.2	25.6	2.1	24.4	1.3	15.1
C-4 10"	71	0.8	3.3	1.9	7.8	7.1	29.2	14.5	59.1
C-5 0"	215	0.4	5.9	1.0	13.9	2.5	34.7	3.3	45.8
C-5 10"	64	0.6	2.7	2.0	9.1	7.2	32.7	12.2	55.5
C-6 0"	61	0.5	2.1	1.5	6.2	7.3	30.0	15.0	61.7
C-6 10"	196	8.5	39.7	2.7	12.6	4.4	20.6	5.8	27.1
C-7 0"	237	2.1	13.5	2.9	18.7	4.5	29.0	6.0	38.7
C-7 10"	68	0.1	0.5	1.1	5.4	5.6	27.6	13.6	66.7
C-8 0"	197	0.4	2.8	1.3	9.1	4.7	32.9	7.9	55.2
C-8 10"	68	0.2	1.0	1.5	7.2	6.4	30.6	12.8	61.2
C-25	120	4.2	27.3	4.5	29.2	5.9	38.3	0.8	5.2
NC-2A 0"	144	0.3	3.2	1.0	10.8	2.9	31.2	5.1	54.8
NC-2A 10"	65	0.2	1.9	0.7	6.5	3.9	36.1	6.0	55.6
NC-5A 0"	157	0.2	2.3	1.0	11.5	2.6	29.9	4.9	56.3
NC-5A 10"	75	0.1	1.5	0.1	1.5	2.3	34.8	4.1	62.1
NC-10A 0"	127	2.3	19.8	3.5	30.2	5.0	43.1	0.8	6.9
NC-12A 0"	36	13.0	47.8	3.8	14.0	9.4	34.6	1.0	3.7
NC-12A 10"	27	0.9	3.1	3.0	10.5	19.2	66.9	5.6	19.5
NC-13 0-2"	184	0.3	3.6	0.8	9.5	2.6	31.0	4.7	56.0
NC-13 10-13"	70	0.1	0.8	1.1	8.3	3.7	27.8	8.4	63.2

TABLE 25: TRACE METAL LEVELS IN MARINE SEDIMENTS - CORE SAMPLES: DUNCAN BAY - JULY 1979

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Ni	Fe	Mn
DB-4	0.194	<1.25	14.1	25.8	41.2	114.0	22.6	<125000	601
		<1.25	12.6	26.1	38.5	114.0	20.5	<125000	593
DB-5	< 0.175	<1.24	<9.95	22.1	37.0	15.3	< 9.95	16600	233
		<1.21	<9.71	20.4	32.4	16.2	< 9.71	16800	234
DB-6	< 0.189	<1.24	<9.9	17.7	34.7	17.1	< 9.9	21000	266
		<1.24	<9.95	16.7	26.5	17.4	< 9.95	19400	245
DB-7	0.194	<1.22	<9.76	62.5	216	37.2	25.1	32500	282
		<1.22	<9.78	66.9	222	39.3	26.8	33800	295

TABLE 26: PARTICLE SIZING AND TOTAL VOLATILE RESIDUES - CORE SAMPLES
DUNCAN BAY - JULY, 1979

STATION	TVR	35 MESH		60 MESH		230 MESH		<230 MESH	
	mg/g	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.	Wt. Ret.	% Ret.
DB-4	7	10.4	17.1	30.2	49.8	20.0	32.9	0.1	0.2
DB-5	167	0.0	27.3	4.2	11.5	20.5	56.0	1.9	5.2
DB-6	39	5.7	8.5	4.2	6.3	56.3	84.0	0.8	1.2
DB-7	254	19.5	38.9	9.9	19.8	19.8	39.5	0.9	1.8

TABLE 27: TRACE METAL LEVELS IN MARINE SEDIMENTS - GRAB SAMPLES
OSBORN BAY - OCTOBER, 1979
(mg/kg Dry Weight)

STATION	Hg	Cd	Pb	Cu	Zn	Cr	Nc	V
1	0.194	1.35	10.5	25.7	68.2	28.5	21.5	55.4
		< 1.24	< 9.93	23.8	68.1	28.4	19.8	56.9
2	0.340	< 1.49	< 9.95	21.3	54.3	23.3	14.8	52.6
		< 1.61	< 10.0	20.4	52.5	23.1	14.6	50.5
3	0.186	< 1.24	< 9.88	18.6	47.2	22.2	14.6	49.8
		< 1.23	< 9.86	17.5	45.1	22.8	12.3	48.1
4	0.144	< 1.22	< 9.78	19.3	34.0	15.6	< 9.78	34.8
		< 1.23	< 9.83	23.7	38.5	16.5	< 9.83	36.6

TABLE 28: TRACE METAL LEVELS IN TISSUE
POWELL RIVER, B.C. - AUGUST 1979
(mg/kg Dry Weight)

STATION/TISSUE	Hg	Cd	Pb	Cu	Zn	Ni	Cr	V
PR-2								
Pandalus borealis (no heads)	0.200	< 0.732	<4.15	55.2	48.3	< 3.91	<0.977	< 4.39
Pandalopsis dispar (no heads)	0.108	< 0.739	<4.19	48.1	36.5	< 3.94	<0.986	< 4.44
Merluccius productus	<0.098	< 0.706	<4.0	10.7	46.6	< 3.77	<0.942	< 4.24
PR-3								
Pandalus borealis (no heads)	0.117	< 0.74	<4.19	47.3	41.1	< 3.94	<0.986	< 4.44
Pandalus borealis (with heads)	0.116	< 0.723	<4.1	114.0	49.9	< 3.86	<0.964	< 4.34
Pandalus platyceros (no heads)	<0.096	< 0.98	<4.17	32.5	34.1	< 3.92	<0.98	< 4.41

TABLE 29: TRACE METAL LEVELS IN TISSUE
CROFTON, B.C.- AUGUST 1979
(mg/kg Dry Weight)

STATION/TISSUE	Hg	Cd	Pb	Cu	Zn	Ni	Cr	V
CR-1								
Pandalopsis dispar (with heads)	< 0.096	0.896	< 4.12	56.9	42.7	< 3.88	< 0.969	< 4.36
Pandalopsis dispar (no heads)	0.099	< 0.727	< 4.12	38.6	37.3	< 3.88	< 0.97	< 4.36
Pandalus borealis (with heads)	0.131	1.06	< 4.17	80.1	76.9	< 3.93	< 0.982	< 4.42
Pandalus borealis (no heads)	0.145	< 0.74	< 4.19	45.4	57.7	< 3.94	< 0.986	< 4.44
CR-2								
Pandalopsis dispar (with heads)	0.102	1.09	< 4.22	68.0	48.2	< 3.97	< 0.993	< 4.47
Pandalopsis dispar (no heads)	0.143	< 0.714	< 4.04	46.2	40.6	< 3.81	< 0.951	< 4.28
Pandalus borealis (with heads)	0.136	1.34	< 4.23	76.7	60.8	< 3.98	< 0.996	< 4.48
Pandalus borealis (no heads)	0.130	< 0.735	< 4.17	44.0	48.7	< 3.92	< 0.98	< 4.41

TABLE 30:

TRACE METAL LEVELS IN TISSUE
OSBORN BAY - OCTOBER 1979
(mg/kg Dry Weight)

STATION/TISSUE	Hg	Cd	Pb	Cu	Zn	Ni	Cr	V
OSBORN BAY								
Pandalus borealis (no heads)	0.254	<0.049	<0.049	43.4	48.8	<3.92	< 0.735	< 2.45
Pandalus borealis (with heads)	0.142	0.648	0.284	102.0	63.3	<3.99	< 0.748	< 2.49
P. platyceros (no heads)	0.259	< 0.049	<0.049	26.5	42.7	<3.93	< 0.736	< 2.45
P. platyceros (with heads)	0.198	0.784	0.137	87.7	61.8	<3.92	< 0.735	< 2.45
Parophrys vetulus (tissue)	0.282	< 0.049	0.837	17.6	19.2	<3.89	< 2.63	< 2.43
Parophrys vetulus (tissue)	0.333	< 0.079	0.448	3.5	24.0	<3.73	< 0.7	< 2.33
Glyptocephalus zachirus (tissue)	0.200	< 0.048	<0.048	2.8	17.8	<3.86	< 0.724	< 2.41
Ophiodon elongatus	0.181	0.692	<0.049	20.0	24.0	<3.95	< 2.08	< 2.47

APPENDIX I
TRAWL DATA

a) POWELL RIVER, B.C.
3 August, 1979

b) CROFTON, B.C.
1 August, 1979

c) CROFTON, B.C.
31 October, 1979

APPENDIX I TRAWL DATA

a) POWELL RIVER, B.C.
3 August 1979

STATION		TIME (PDT)	DEPTH (m)	POSITION
PR-1	Begin Fishing	0913	92	49°52.65'N 124°37.10'W
	Stop Fishing	0923	99	49°53.02'N 124°37.60'W
PR-2	Begin Fishing	1010	133	49°53.95'N 124°41.20'W
	Stop Fishing	1025	131	49°53.6'N 124°41.8'W
PR-3	Begin Fishing	1138	92	49°51.8'N 124°34.75'W
	Stop Fishing	1147	76	49°52.02'N 124°35.30'W

APPENDIX I TRAWL DATA
POWELL RIVER
Station PR-1
79-8-3

SPECIES		COUNT
PORIFERA	Cloud sponge	fragments
ARTHROPODA		
Crustacea	Pandalus platyceros	1
	P. borealis	9
	P. goniurus	10
	P. stenolepis	3
	Crangonidae	10
	Spirontocaris spp.	3
	Munida quadrispina	30
CHORDATA		
Pisces	Hydrolagus colliei	19
	Hydrolagus egg case	noted

APPENDIX I TRAWL DATA
POWELL RIVER
Station PR-2
79-8-3

SPECIES		COUNT
MOLLUSCA		
Gastropoda	Dentaluim sp.	noted
ARTHROPODA		
Crustacea	Pandalus platyceros	1
	P. borealis	226
	P. goniurus	1
	Pandalopsis dispar	37
	Spirontocaris spp.	8
	Sclerocrangon alata	7
	Crangon communis	8
ECHINODERMATA		
Ophuiroidea		noted
Echinoidea	Brisaster sp.	3
Holothuroidea	Molpadia sp.	1
	Chiridota spp.	noted
CHORDATA		
Pisces	Merluccius productus	4
	Hydrolagus colliei	4
	Theragra chalcogramma	1
	Lyconectes aleutensis	2

APPENDIX I TRAWL DATA
POWELL RIVER
Station PR-3
79-8-3

SPECIES		COUNT
MOLLUSCA		
Cephalopoda	*Octopus* sp.	2
ARTHROPODA		
Crustacea	*Pandalus platyceros*	17
	P. borealis	100
	Munida quadrispina	7
	Spirontocaris sp.	4
CHORDATA		
Pisces	*Hydrolagus colliei*	27
	Sebastes elongatus	4
	Ophiodon elongatus	1
	Porichthys notatus	2

NOTE: trawl contained large amounts of coarse fibre.

APPENDIX I TRAWL DATA

b) CROFTON, B.C.

1 August, 1979

STATION		TIME (PDT)	DEPTH (m)	POSITION
CR-1 (I)	Begin Fishing	0912	157	48°54.10'N 123°37.3'W
	Stop Fishing	0930	137	48°54.41'N 123°37.90'W
CR-1 (II)	Begin Fishing	1012	135	48°53.38'N 123°37.3'W
	Stop Fishing	1028	130	48°53.70'N 123°37.82'W
CR-2	Begin Fishing	1112	108	48°53.53'N 123°37.65'W
	Stop Fishing	1124	115	48°53.93'N
CR-3	Begin Fishing	1205	119	48°54.3'N 123°36.5'W
	Stop Fishing	1218	59	48°54.86'N 123°36.55'W

APPENDIX I TRAWL DATA
CROFTON
Station CR-1, Tow I
79-08-01

SPECIES		COUNT	
MOLLUSCA			
Gastropoda	Yoldia thraciaeformis	2	
	Cardiomya sp.	1	
	Gymnosomata	noted	
ANNELIDA			
Polychaeta	Rocinela sp.	1	
	Polynoidae	1	
ARTHROPODA			
Crustacea	Pasiphaea pacifica	noted	
	Pandalus platyceros	1	
	P. jordani	48	200 g.
	P. borealis	3	
	Pandalopsis dispar	650	5700 g.
	Sclerocrangon spp.	18	
	Crangonidae	75	
	Munida quadrispina	1	
	Chionoecetes bairdi	3	330 g.

APPENDIX I TRAWL DATA
CROFTON
Station CR-1, Tow 1
79-08-01
(Continued)

SPECIES		COUNT	
ECHINODERMATA			
Ophiuroidea		noted	
Echinoidea	Strongylocentrotus sp.	1	
	Brisaster sp.	very abundant	
Holothuroidea	Chiridota sp.	noted	
	Unid. holothurian	2	
CHORDATA			
Pisces	Sebastes elongatus	1	320 g.
	Gadus macrocephalus	1	440 g.
	Hydrolagus colliei	1	620 g.
	Theragra chalcogramma	1	
	Lyopsetta exilis	2	
	Cyclopteridae	1	

APPENDIX I TRAWL DATA
CROFTON
Station CR-1, Tow II
79-08-01

SPECIES		COUNT	
CNIDARIA			
Anthozoa	Metridium sp.	3	
ARTHROPODA			
Crustacea	Pandalopsis dispar	550	4700 g.
	Pandalus jordani	10	30 g.
	P. borealis	9	35 g.
	P. platyceros	1	5 g.
	Crangonidae	75	90 g.
	Sclerocrangon sp.	18	
	Pasiphaea pacifica	noted	
	Chionoecetes bairdi	5	1080 g.
	Cancer magister	2	960 g.
	Hyas lyratus	1	
ECHINODERMATA			
Ophuiroidea		4	
Holothuroidea		7	5 g.
CHORDATA			
Pisces	Hydrolagus colliei	1	760 g.

APPENDIX I TRAWL DATA
CROFTON
Station CR-2
79-08-01

SPECIES		COUNT	
MOLLUSCA			
Gastropoda	Yoldia sp.	3	
ARTHROPODA			
Crustacea	Pandalus borealis	36	135 g.
	P. jordani	126	450 g.
	P. goniurus	2	5 g.
	P. platyceros	14	330 g.
	Pandalopsis dispar	300	2440 g.
	Crangonidae	120	200 g.
	Spirontocaris spp.	50	80 g.
	Munida quadrispina	2	
	Chionoecetes bairdi	1	105 g.
ECHINODERMATA			
Echinoidea	Brisaster spp.	very abundant	
Holothuroidea	Molpadia sp.	1	
	Unid holothurians	23	
CHORDATA			
Pisces	Sebastes elongatus	1	230 g.
	Hydrolagus colliei	1	10 g.
	Zoarcidae	3	18 g.

APPENDIX I TRAWL DATA
CROFTON
Station CR-3
79-08-01

SPECIES		COUNT	
MOLLUSCA			
Gastropoda	Acila castrensis	5	
Cephaeopoda	Octopus sp.	1	
ANNELIDA			
Polychaeta		4	
ARTHROPODA			
Crustacea	Pandalopsis dispar	350	3140 g.
	Pandalus hypsinotus	123	38 g.
	P. platyceros	2	20 g.
	Cancer magister	1	440 g.
ECHINODERMATA			
Echinoidea	Brisaster sp.	very abundant	
	Strongylocentrotus sp.	7	
Holothuroidea	Unid holothurians	2	
CHORDATA			
Pisces			
	Gadus macrocephalus	3	3430 g.
	Merluccius productus	2	1290 g.
	Sebastes elongatus	1	220 g.
	Dasycottus setiger	5	
	Porichthys notatus	5	380 g.
	Hippoglossoides elassodon	1	45 g.
	Lycodes diapterus	2	60 g.
	Lycodopsis pacifica	5	130 g.
	Lycodapus sp.	1	

APPENDIX I TRAWL DATA

c) CROFTON, B.C.

31 October, 1979

STATION		TIME (PDT)	DEPTH (m)	POSITION
ST-1 (I)	Begin Fishing	0822	81	48°57.55'N
				123°43.30'W
	Stop Fishing	0833		48°58.03'N
				123°43.67'W
ST-2	Begin Fishing	0903	65	48°59.92'N
				123°43.75'W
	Stop Fishing	0915		49°00.82'N
				123°43.63'W
ST-3	Begin Fishing	1054	121	48°54.08'N
				123°36.21'W
	Stop Fishing	1105		48°54.55'N
				123°36.40'W
ST-4	Begin Fishing	1135	23	48°55.70'N
				123°36.41'W
	Stop Fishing	1148		48°56.20'N
				123°36.60'W
OSBORN BAY	Begin Fishing	1421	52	48°51.85'N
				123°36.8'W
	Stop Fishing	1433	40	48°52.05'N
				123°37.48'W

APPENDIX I TRAWL DATA
STUART CHANNEL
Station ST-1
79-10-31

SPECIES		COUNT
CNIDARIA		
Anthozoa	Metridium sp.	1
MOLLUSCA		
Gastropoda	Polinices draconis	1
Bivalvia	Yoldia scissurata	2
Cephalopoda	Rossia sp.	
ARTHROPODA		
Crustacea	Pandalus borealis	100
	Spirontocaris spp.	noted
	S. sica	20
ECHINODERMATA		
Ophuiroidea		noted
Echinoidea	Brisaster sp.	70
Holothuroidea	Molpadia sp.	3
	Chiridota sp.	noted
	Holothuroidea (unid.)	120
CHORDATA		
Pisces	Lyopsetta exilis	15
	Hippoglossoides elassodon	4
	Parophrys vetulus	1
	Porichthys notatus	9
	Merluccius productus	29
	Theragra chalcogramma	2
	Lycodopsis pacifica	7
	Xeneretmus latifrons	1

APPENDIX I TRAWL DATA
STUART CHANNEL
Station ST-2
79-10-31

SPECIES		COUNT
MOLLUSCA		
Gastropoda	Yoldia thraciaeformis	noted
	Dentalia sp.	3
Cephalopoda	Rossia sp.	noted
NEMERTEA		noted
ARTHROPODA		
Crustacea	Sclerocrangon alata	1
	Pandalus borealis	60
	P. stenolepis	1
	Crangonidae	noted
ECHINODERMATA		
Holothuroidea	Molpadia sp.	1
	Holothuroidea (unid.)	noted
CHORDATA		
Pisces	Porichthys notatus	34
	Merluccius productus	5
	Parophrys vetulus	4
	Hippoglossoides elassodon	31
	Lyopsetta exilis	3
	Lycodopsis pacifica	2
	Theragra chalcogramma	2
	Dasycottus setiger	2
	Xeneretmus latifrons (juv.)	1
	Scorpaenidae (juv.)	1

N.B. Catch contained large numbers of gastropod egg masses.

APPENDIX I TRAWL DATA
STUART CHANNEL
Station ST-3
79-10-31

SPECIES		COUNT
CNIDARIA		
Anthozoa	Metridium sp.	1
MOLLUSCA		
Gastropoda	Yoldia scissurata	2
ANNELIDA		
Polychaeta	Travisia brevis	2
ARTHROPODA		
Crustacea	Pandalopsis dispar	37
	Pandalus jordani	6
	P. borealis	19
	P. montague tridens	5
	Munida quadrispina	noted
	Spirontocaris sica	6
	Crangonidae	20
	Chionocetes bairdi	
ECHINODERMATA		
Echinoidea	Brisaster sp.	dominant > 2000
Holothuroidea		noted
CHORDATA		
Pisces	Lyopsetta exilis	1
	Dasycottus setiger	1

APPENDIX I TRAWL DATA
STUART CHANNEL
Station ST-4
79-10-31

SPECIES		COUNT
MOLLUSCA		
Amphineura		5
Gastropoda	Yoldia scissurata	1
Cephalopoda	Rossia sp.	2
ARTHROPODA		
Crustacea	Pandalus danae	3
	Crangonidae	noted
	Chionocetes bairdi	3
CHORDATA		
Pisces	Theragra chalcogramma	1
	Hippoglossoides elassodon	8
	Parophrys vetulus	8
	Lepidopsetta bilineata	1
	Psettichthys melanostictus	4
	Hexagrammos stelleri (juv.)	1

APPENDIX I TRAWL DATA
CROFTON
STATION OSBORN BAY
79-10-30

SPECIES		COUNT	
CNIDARIA			
Hydrozoa		2	
Anthozoa	Metridium sp.	3	
MOLLUSCA			
Amphineura		1	
Cephalopoda	Gonatus fabricii	1	
	Rossia sp.	12	
ARTHROPODA			
Crustacea	Pandalus platyceros	56	890 g.
	P. borealis	900	2800 g.
	P. danae	14	80 g.
	P. hypsinotus	73	570 g.
	P. goniurus	6	
	P. montague tridens	6	
	P. stenolepis	6	
	Crangonidae	6	
	Spirontocaris sp.	1	
	Cancer magister	3	(♀2 ♂1)
ECHINODERMATA			
Asteroidea	Pseudarcaster sp.	10	
Holothuroidea	Parastichopus spp.	29	

APPENDIX I TRAWL DATA
CROFTON
STATION OSBORN BAY
79-10-30
(Continued)

SPECIES		COUNT	
CHORDATA			
Pisces	Porichthys notatus	36	800 g.
	Sebastes maliger	7	3800 g.
	Agonus acipenserinus	1	
	Ophiodon elongatus (juv.)	4	390 g.
	Nautichthys oculofasciatus	1	
	Radulinus asperellus	2	
	Xeneretmus latifrons	2	
	Chitonotus pugetensis	3	
	Leptocottus armatus	1	
	Microstomus pacificus	2	
	Glyptocephalus zachirus	3	325 g.
	Parophrys vetulus	60	6000 g.
	Hippoglossoides elassodon	55	2000 g.
	Pleuronichthys coenosus	1	250 g.
	Lepidopsetta bilineata	27	1975 g.
	Theragra chalcogramma (juv.)	5	
	Microgadus proximus (juv.)	3	
	Icelinus sp.	1	