ENVIRONMENT CANADA
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ENVIRONMENTAL MONITORING AT PORT MCNEILL, B.C., March 1985: A MARINE RAW SEWAGE OUTFALL

Regional Program Report 87-08

By

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ABSTRACT

The receiving environment around the raw sewage outfall for the town of Port McNeill, B.C. was sampled by Environmental Protection on March 12, 1985. Sediment, water and tissue samples were collected and analysed.

The major impact of the outfall was on the benthic environment. Fecal coliform bacteria were found in sediments at all stations sampled within a 0.5 km radius of the outfall. Copper concentrations were elevated in benthic sediments at the outfall, and in sediments, invertebrate and algal tissue sampled in the adjacent intertidal zone. Photographs from a British Columbia Ministry of Environment and Parks diving inspection report indicate gross contamination of a 120 m diameter zone at the outfall terminus where piles of raw sewage and debris have accumulated.

Water quality parameters of dissolved oxygen, and nutrients (NO_2, NO_3, PO_4) were not significantly altered by the raw sewage discharge. Levels of ammonia sampled from the outfall boil were slightly elevated, but not to levels which would impair marine water quality for salmon or other species of fish.

Keywords: raw sewage, bacterial contamination, degraded benthic zone, marine environmental quality.

RÉSUMÉ

L`environnement récepteur autour de l'émissaire marin déversant les eaux usées non traitées de la ville de Port McNeill, C-B. fut échantillonné par la Protection de l'Environnement le 12 Mars 1985. Des échantillons de sédiment, d'eau et de tissu furent recueillis et analysés.

L'impact majeur de l`émissaire fut sur l`environnement benthique. Les bactéries coliformes fécales ont contaminé les sédiments,à toutes les stations échantillonnées. Les concentrations de cuivre furent élevées dans les sédiments benthiques à l`émissaire, ainsi que dans les sédiments, les tissus d`invertébrés et d`algues échantillonnés dans la zone intertidale adjacente. Des photos de la plongée d`inspection de du ministére de l'environnement et pares indiquent une flagrante contamination d`une zone de 120 mètres de diamètre du terminus de l`émissaire oü des tas d`excréments et de débris se sont accumulés.

Les paramètres de la qualité de l`eau pour l`oxygène dissout et les substances nutritives (NO_2,NO_3,PO_4) ne furent pas modifiés significativement par le déversement d'eaux usées non traitée. Les niveaux d`ammoniac échantillonné dans le plumet de l`émissaire furent élevés, mais pas à des niveaux qui détérioreraient la qualité de l`eau marine pour le saumon et autres espèces de poissons.

mots-clefs: eaux usées non traitées, contamination bactériologique, zone benthique dégradée, qualité de l`environnement marin.

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1 INTRODUCTION

This report presents data collected by Environmental Protection (EP) in the vicinity of the Port McNeill raw sewage outfall on March 12, 1985.

Water, sediment and tissue samples were collected to document the impact of the raw sewage outfall upon the receiving environment. Results will form a baseline to compare with future monitoring data.

1.1 Study Area

Port McNeill (50 35.4 N, 127 0.05 W) is located on north-eastern Vancouver Island about 380 km north of Victoria (Figure 1).

At the time of sampling, sewage from the town (pop. 2,500) underwent no treatment before discharge into McNeill Bay through an outfall at 18 m depth (Figure 1).

Recent underwater photographs (Plates 1 and 2) taken March 19, 1986 at the outfall by the B.C. Ministry of Environment and Parks (BCMOEP) indicated gross contamination of the benthic environment by piles of human excrement and non-degradable plastics/fibres within a 120 m diameter of the outfall: This included a pile of human excrement 1.5 m high and 6 m in diameter at the outfall terminus (BCMOEP 1986).

1.2 Fisheries Resources

Mills Creek, located at the head of McNeill Bay, supports small runs of coho, pink and chum salmon, as does Hyde Creek 5.5 km west of Port McNeill (Birtwell, 1979). Fry of all five salmon species utilize the intertidal foreshore of McNeill Bay, according to Russell (1986) who cited a BCMOEP funded study done in April-May 1984. Salmonid food species (e.g. amphipods, copepods) were also collected from the same area.

Russell (1986) further described a productive subtidal foreshore area of Ledge Point which supports rich eel-grass and kelp beds, with edible crabs, flounders, and rockfish. Kelp was commercially harvested from this area in 1980-81 (B. Rosenberger, DFO: pers. comm.). Groundfish and crab are also fished recreationally around McNeill Bay.

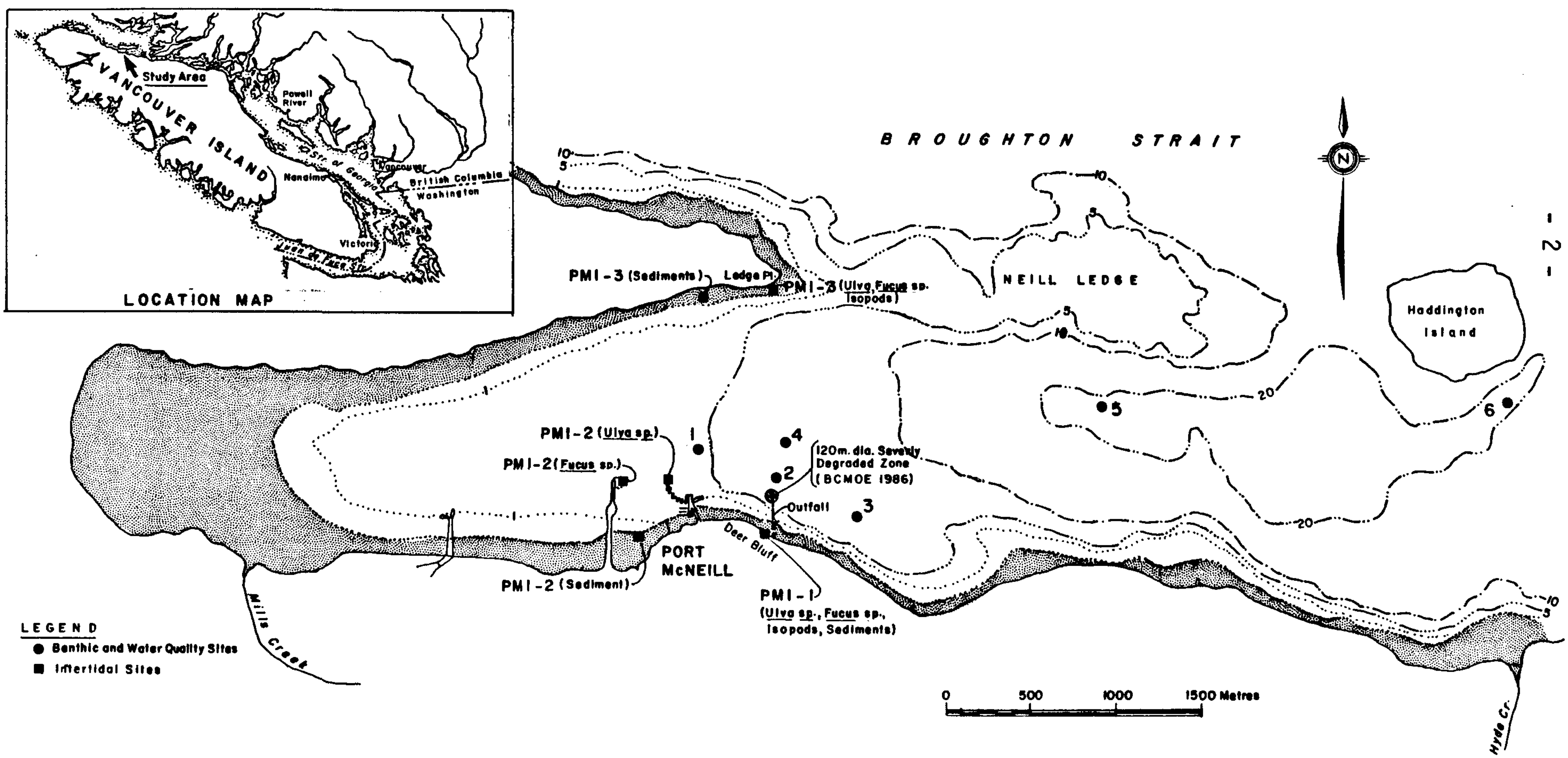
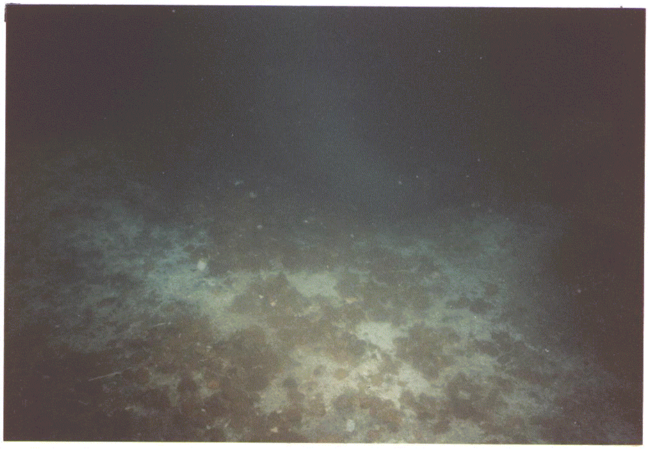


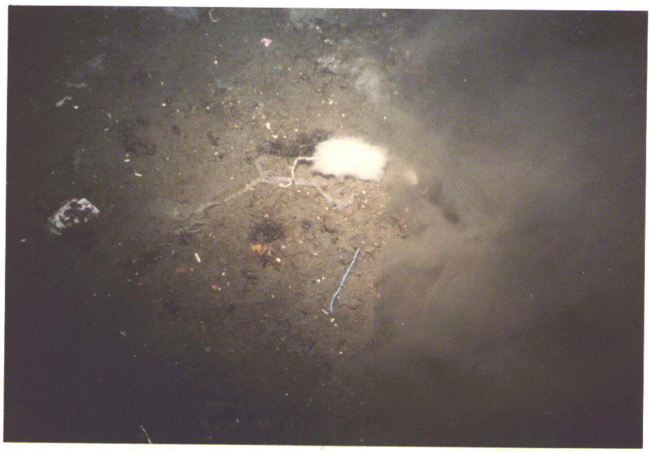
FIGURE 1 LOCATION MAP AND SAMPLING STATIONS - PORT McNEILL - MARCH 12, 1985

PLATE 1



Raw sewage plume and close-up of pile of human waste.

PLATE 2



Assorted bottom debris near end of the outfall.

2 MATERIALS AND METHODS

The area in the vicinity of the outfall (Figure 1) was sampled on March 12, 1985 from the C.S.S. Vector. Stations were located using ship's LORAN-C and radar. The position of each station is listed in Appendix I.

Table 1 shows the types of water and sediment samples taken.

TABLE 1 PORT MCNEILL SAMPLING STATIONS AND SAMPLES TAKEN MARCH 12, 1985

STATION	WATER			SEDIMENTS			BIOTA	
	CTD	DO	NUT	SVR	TM	BACT	O&G	TM
SUBTIDAL								
1	X	X	X	X	X	X	X	
2	X	X	X	X	X	X	X	
3	X	X	X	X	X	X	X	
4	X	X	X	X	X	X	X	
5	X	X	X	X	X		X	
6	X	X	X	X	X		X	
INTERTIDAL								
PMI-1			X	X	X		X	X
PMI-2			X	X	X		X	X
PMI-3			X	X	X		X	X

CTD = Conductivity (Salinity), Temperature, Depth
DO = Dissolved Oxygen
NUT = Nutrients: ammonia, phosphates, nitrate, nitrite
SVR = Sediment Volatile Residue
TM = Trace metals
BACT = Fecal Coliforms
O&G = Oil and Grease
TM = Trace metals

2.1 Water Samples

Water samples were collected at discrete depths using 1.3 litre plastic N.I.O. (National Institute of Oceanography) water bottles. Conductivity, temperature, depth (CTD) profiles were taken using a Plessy Instruments Model 9400 CTD sensor as described by Goyette and Macleod (1984).

2.1.2 Analytical Procedures - Water. Oxygen concentrations were determined in the ship's lab using the azide modification of the Winkler method. The equations of Gameson and Robertson (1955) were used in the calculation of dissolved oxygen saturation. Nutrient samples were immediately frozen and stored (Strickland and Parsons, 1971), until analysis at the West Vancouver EP laboratory using an automated colorimeter (Technicon Auto-analyzer II).

2.2 Sediment Samples

Surface sediment grabs were taken in duplicate at six subtidal stations (Figure 1) using a stainless steel Smith-MacIntyre grab. Three intertidal sites were sampled using a plastic scoop. The top two centimetres at each site were retained for particle size, volatile residue and trace metal analysis. Samples were frozen onboard in plastic bags for later analysis.

Sediment samples for bacterial testing were collected from the grab using pre-sterilized plastic spoons, placed in sterile plastic bags, then stored a cooler prior to analysis at the North Vancouver EP Bacteriology Lab.

2.2.1 Analytical Procedures - Sediment. Frozen sediment samples we analysed by the West Vancouver Environmental Protection Laboratory according to the procedures outlined by Swingle and Davidson (1979). The trace metal samples were freeze-dried and sieved through a 100-mesh (0.15 mm) nylon sieve. They were then digested in a 4:1 nitric-hydrochloric acid mixture and analyed for trace metals using a Perkin-Elmer Inductively-Coupled Argon Plasma (ICAP) Optical Emmission Spectrometer. Low-level cadmium and lead levels were obtained using a Jarrel Ash 850 Atomic Absorption Spectrophotometer (AAS) with a FLA 100 graphite tube furnace. Oil and grease were determined using a soxhlet extraction method with freon as the solvent.

Sediments for particle size were freeze-dried and sieved prior to weighing. Median particle size was determined as the size class where the 50 th percentile weight was located. Wentworth size class divisions were used (Griffiths, 1967).

Sediment volatile residue was determined by obtaining the loss of weight upon ignition at 550 C for 1 hour (Swingle and Davidson, 1979).

2.3 Biota Samples

Algae and isopods were collected by hand from intertidal stations. Samples were immediately frozen and stored in plastic bags. Isopod data represents a pooled sample of 15 individuals. Samples were freeze-dried, then analyzed for metals in the West Vancouver EP lab using the ICAP and AAS methods as described for sediments above.

3 RESULTS AND DISCUSSION

3.1 Water Samples (Table 2, Figure 2)

Water quality data is listed in Table 2. Dissolved oxygen concentration ranged from 8.1-9.0 mg/L (81-90 % saturation). Oxygen levels were not depressed at stations nearer the outfall. Total ammonia was near detection limits at most stations. The maximum concentration of total ammonia, sampled where the effluent reached the surface (outfall boil) NH_3= 0.079 mg/L, was well below the level that would impair marine water quality for salmonids and other marine fish according to Haywood (1983):

MAXIMUM SAFE LEVELS OF TOTAL AMMONIA	SPECIES
1 mg/L	salmonids
2.5 mg/L	other marine fish species

Phosphates were also slightly elevated at the outfall boil but were near background (station 6) levels elsewhere. Concentrations of nitrates (NO_3) were uniformly low throughout the area sampled. Similarly, nitrite was not detected (< 0.005 mg/L) in any sample.

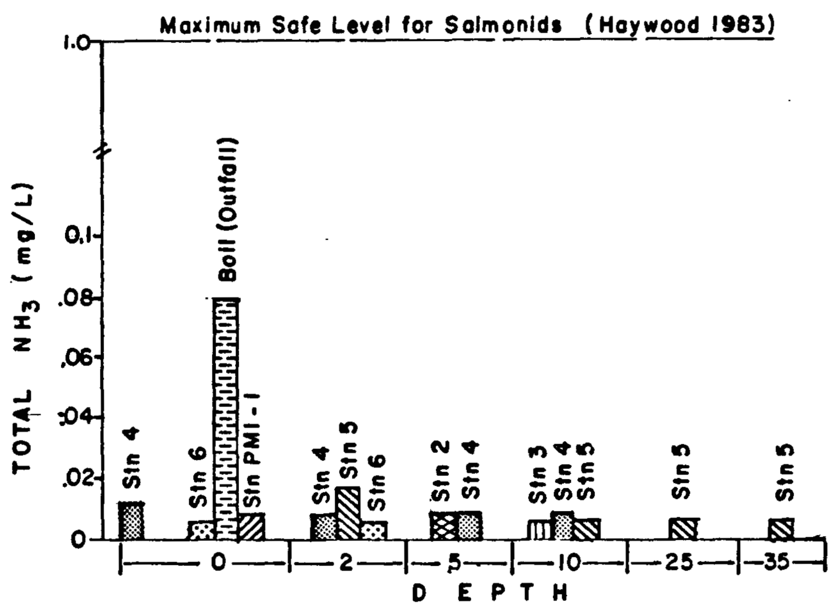


FIGURE 2 AMMONIA LEVELS FROM WATER SAMPLES COLLECTED AT PORT McNEILL - March 12, 1985

TABLE 2 WATER QUALITY RESULTS FROM PORT MCNEILL MARCH 12, 1985

STATION NUMBER	DEPTH	SALINITY	TEMP.	D.O.	SATURATION	(mg/L)				
	(m)	(ppth)	(°C)	(mg/L)	(%)	NH_3	NO_2	NO_3	o-PO_4	t-PO_4
1	0	31.139	7.12	8.7	82	*	*	.27	.058	.062
	2	31.221	7.11	8.7	82	*	*	.29	.058	.065
	5	31.267	7.18	8.7	83	*	*	.25	.054	.061
	10	31.290	7.25	8.5	85	NS	NS	NS	NS	NS
2	0	31.158	7.18	8.6	83	*	*	.24	.054	.062
	2	31.195	7.16	8.5	84	*	*	.29	.059	.062
	5	31.239	7.16	8.5	84	.007	*	.25	.058	.056
	12	31.315	7.20	8.7	83	NS	NS	NS	NS	NS
3	0	31.288	7.23	8.3	87	*	*	.25	.058	.051
	2	31.303	7.21	8.4	86	*	*	.26	.047	.059
	5	31.318	7.21	8.5	85	*	*	.30	.052	.060
	10	31.299	7.21	8.3	87	.007	*	.29	.057	.059
4	0	31.119	7.20	8.7	83	.011	*	.24	.048	.055
	2	31.242	7.23	8.5	85	.007	*	.26	.055	.058
	5	31.279	7.21	8.5	85	.008	*	.26	.054	.056
	10	31.305	7.23	8.4	86	.007	*	.31	.058	.063
5	0	31.274	7.32	8.1	90	*	*	.30	.060	.060
	2	31.282	7.79	8.7	90	.016	*	.29	.053	.062
	5	31.112	7.29	8.2	89	*	*	.27	.057	.057
	10	31.247	7.32	8.1	90	.006	*	.30	.065	.066
	25	31.321	7.23	8.1	89	.005	*	.26	.054	.059
	35	31.318	7.23	8.2	88	.005	*	.29	.057	.057
6 REF. SITE	0	31.213	7.34	8.3	88	.006	*	.26	.052	.057
	2	31.250	7.32	8.2	89	.005	*	.30	.064	.067
	5	31.266	7.30	9.0	81	*	*	.28	.058	.063
	10	31.247	7.32	8.1	90	*	*	.31	.056	.058
	25	31.362	7.29	8.2	89	*	*	.30	.065	.066
OUTFALL BOIL						.079	*	.29	.085	.096
PMI-1 INTERTIDAL						.007	*	.07	.041	.053

* Detection Limit 0.005 mg/L
NS Not Sampled

3.2 Sediment Samples (Tables 3 & 4, Figure 3, Appendix II)

Bacterial testing revealed contaminated sediments at all four stations within McNeill Bay (Table 3). The highest counts came from station 2 nearest the outfall (13,000 fecal coliforms/100 g sediment). Levels of contamination at Port McNeill are 10 to 150 times higher than at Comox where effluent receives secondary treatment (Colodey 1984).

Sediment particle size at Port McNeill ranged from very fine sand (outfall) to coarse shell and gravel at station 6 off Haddington Island, where no sample could be collected in the grab due to the coarse nature of the sediments. Degraded (reducing) sediments were collected 500 m east and west of the outfall from stations 1, 2, 3. These stations also had higher levels of oil and grease than other sites.

Background levels of oil and grease (< 100 mg/kg) were noted at station 5. Of all the intertidal stations, PMI-2 (nearest the outfall) had the highest sediment volatile residue (SVR), silt & clay, and oil & grease, due in part to the rocky nature of the other two intertidal sites. No intertidal impact of the outfall was evident when the sediment characteristics at stations PMI-1 were compared to site PMI-3 across the bay.

TABLE 3 PORT MCNEILL SEDIMENT CHARACTERISTICS MARCH 12, 1985

STATION NUMBER	DEPTH (m)	MEDIAN PARTICLE SIZE* (Wentworth Scale)	SILT & CLAY* (%)	SVR %		OIL & GREASE		BACT
				A	B	C	D	
1	10	fine sand	15.5	4.07	3.71	248	<100	1300
2	18	very fine sand	13.0	2.79	3.29	214	248	13000
3	17	fine sand	12.0	1.77	2.60	400	254	790
4	17	fine sand	8.9	3.05	3.14	125	<100	800
5	40	fine sand with granules	2.5	1.14	2.28	<100	<100	NS
6	38	coarse shell and gravel bottom	------- no sample collected -------					
PMI-1	I	medium sand	2.5	.84	.89	135	<100	NS
PMI-2	I	fine sand with granules	10	3.37	4.39	335	<100	NS
PMI-3	I	fine sand	.2	.85	.78	135	<100	NS

A,B = Replicates samples
C,D = Replicated samples (mg/kg dry wt.)
SVR = Sediment Volatile Residue
BACT = Fecal Coliform Bacteria/100 g sediment

* = Mean of two samples
I = Intertidal
NS = Not Sampled

TABLE 3 (continued)

SEDIMENT CHARACTERISTICS

Station	
1	sandy, slightly reducing, few tube worms
2	sandy, slightly reducing, some tube worms
3	sandy, slightly reducing, tissue paper on sediment surface, some tube worms
4	sandy, not reducing, many tube worms on surface
5	coarse sand and rocks, corals
6	shell, gravel bottom, no sediment sample obtained
PMI-1	rocky, gravel intertidal zone
PMI-2	sandy intertidal zone
PMI-3	rocky intertidal zone

The main impact of the outfall on sediment metal concentrations is evident in the elevated copper levels found at outfall station 2 (Table 4, Figure 3, Appendix II). The maximum copper level found at this station (251 mg/kg) was about 10 times the level found at station 5 two km away. Copper levels at station 5 and elsewhere are similar to the mean copper level of B.C. river sediments (28.8 mg/kg) reported by Johnson (1983). The elevated sediment copper levels at the outfall can be harmful to clams by causing changes in burrowing behaviour (Phelps et al., 1985; Stirling, 1975).

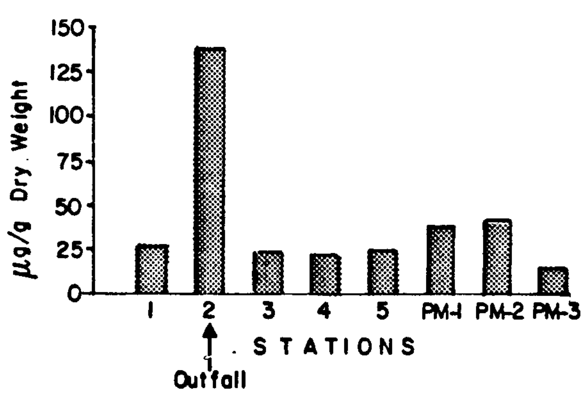


FIGURE 3 SURFACE SEDIMENT COPPER VALUES AT PORT McNEILL - March 12, 1985

Sediment copper levels were also slightly elevated at the nearest intertidal stations (PMI-1, PMI-2: 41.9-38.2 mg/kg).

TABLE 4 MEAN SEDIMENT METAL LEVELS COLLECTED FROM PORT MCNEILL ON MARCH 12, 1985 (ug/g Dry Wt.)

STATION	Al (%)	Cd	Cr	Cu	Fe (%)	Hg	Ni	Pb	Sn	Zn
1	2.09	.18	28.15	27.5	1.97	.139	7.50	<3	<2	31.4
2	1.67	.30	24.30	138	1.72	.108	7.50	<3	<2	26.1
3	1.92	.29	26.90	23.55	1.94	.120	8.50	<3	<2	28.55
4	1.85	.32	26.30	23.00	1.95	.120	8.00	<3	<2	29.30
5	1.85	.16	33.00	24.65	2.90	.200	10.50	<3	<2	33.45
PMI-1	2.02	.10	29.85	38.2	3.13	.095	7.00	<3	<2	27.3
PMI-2	2.23	.19	35.05	41.9	2.80	.105	9.50	<3	<2	41.8
PMI-3	1.87	.14	26.85	15.2	2.85	.072	4.00	<3	<2	43.6

Sediment cadmium was elevated at subtidal stations 2,3,4 (0.29-0.32 ug/g) compared to stations 1 & 5 (0.18-0.16 ug/g).

3.3 Biota Samples (Tables 5 & 6, Figure 4)

Algae have been proposed as useful indicator species for monitoring the conditions of coastal waters (Levine, 1984). For example, green algae (*Ulva* sp.) collected from the Iona sewage jetty had elevated levels of copper in comparison to a reference area (Vermeer and Peakall, 1979). In the present study, copper levels measured in two intertidal algae (*Fucus* sp., *Ulva* sp.) and an isopod crustacean (*Pentidotea wosnesenkii*) were more contaminated at station PMI-1 (nearest the outfall) compared to PMI-3 across the bay (Figure 4, Tables 5 and 6). These organisms accurately indicated the outfall as a copper source.

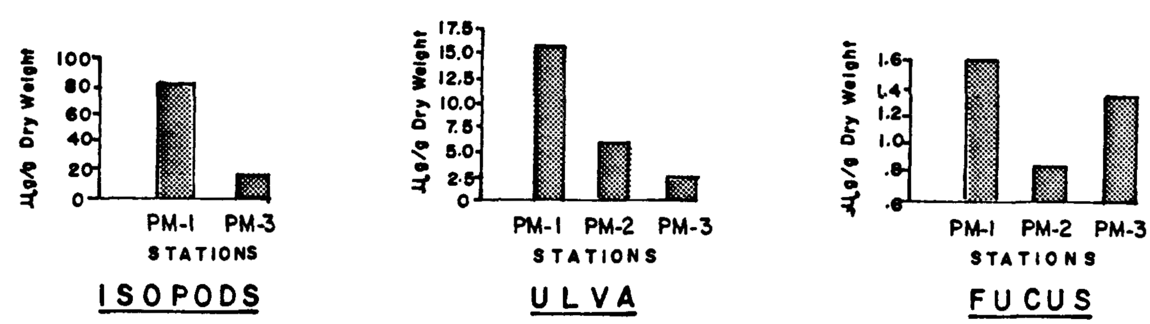


FIGURE 4 COPPER LEVELS IN ISOPODS, *ULVA* AND *FUCUS* FROM PORT McNEILL - March 12, 1985

TABLE 5 MEAN TISSUE METAL LEVELS FROM INTERTIDAL ISOPODS AT PORT MCNEILL MARCH 12, 1985

			METALS (ug/g dry wt.)								
STATION	LOCATION	N	Al (%)	Cd	Cr	Cu	Fe (%)	Hg	Ni	Pb	Zn
PMI-1	at outfall	15	102	.18	.50	80.30	206	.02	<2	.26	73.50
PMI-3	across Bay	15	137	.51	.90	17.10	334	.03	3	.28	77.90

TABLE 6 MEAN TISSUE METAL LEVELS FROM ALGAE AT PORT MCNEILL MARCH 12, 1985

STATION	METALS (ug/g dry wt.)								
	Al (%)	Cd	Cr	Cu	Fe (%)	Hg	Ni	Pb	Zn
ULVA LACTUCA									
PMI-1	301	.75	1.9	17.2	756	.05	8	.33	40.0
PMI-1	208	.68	1.3	14.3	567	.06	6	.31	34.1
MEAN	**254.5**	**.72**	**1.60**	**15.75**	**661.5**	**.06**	**7**	**.32**	**37.05**
PMI-2	43	.42	.6	6.3	178	.04	2	.23	17.7
PMI-2	45	.36	.4	6.0	189	.03	3	.10	16.2
MEAN	**44**	**.39**	**.50**	**6.15**	**183.5**	**.04**	**2.5**	**.17**	**16.95**
PMI-3	24	2.50	<0.4	.9	74.9	.06	3	< 0.08	61.8
PMI-3	176	.34	1.9	3.7	369	.04	4	.35	15.0
MEAN	**100**	**1.42**	**1.90**	**2.30**	**221.95**	**.05**	**3.5**	**.35**	**38.40**
MAX	301	2.50	1.9	17.20	756	.06	8	.35	61.8
STATION	1	3	1	1	1	1,3	1	3	3
FUCUS sp.									
PMI-1	116	2.10	1.1	1.9	261	.02	6	.14	30.5
PMI-1	26	3.40	<0.4	1.3	81.3	.07	4	.10	50.2
MEAN	**71**	**2.75**	**1.1**	**1.6**	**171.15**	**.05**	**5**	**.12**	**40.35**
PMI-2	20	2.60	<0.4	.9	67.8	.10	3	< 0.08	63.0
PMI-2	16	3.00	<0.4	.8	60.3	.04	3	.13	78.6
MEAN	**18**	**2.80**	**<0.4**	**.85**	**64.05**	**.07**	**3**	**.13**	**70.80**
PMI-3	122	4.90	.8	1.3	240	.06	5	.37	35.8
PMI-3	79	3.60	.5	1.4	138	.06	4	.55	32.0
MEAN	**100.5**	**4.25**	**.65**	**1.35**	**189**	**.06**	**4.5**	**.46**	**33.90**
MAX	122	4.90	1.1	1.9	261	.10	6	.55	78.6
STATION	1	3	1	1	1	1,3	1	3	3

CONCLUSIONS AND RECOMMENDATIONS

1. The discharge of raw sewage has caused little or no change in dissolved oxygen or nutrient levels in the waters of McNeill Bay.

2. The main impact of the present discharge is a severely degraded benthic zone in the immediate area of the outfall. Sediments were contaminated with fecal coliform bacteria within a 0.5 km radius of the outfall.

3. Elevated levels of copper exist in sediments at the outfall (up to 10 times higher that background levels), and in sediments, algae and isopods from the adjacent intertidal zone.

4. Further treatment of the effluent, such as fine screening to remove sewage solids, is required to lessen solids loading to the benthic environment.

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APPENDICES

APPENDIX I POSITION OF SAMPLING STATIONS

STATION	LATITUDE NORTH	LONGITUDE WEST
SUBTIDAL STATIONS		
1	50 35 .72	127 5.05
2	50 35 .62	127 4.68
3	50 35 .49	127 4.26
4	50 35 .73	127 4.60
5	50 35 .86	127 3.09
6	50 35 .86	127 1.02
INTERTIDAL STATIONS		
PMI-1	50 35 .48	127 4.70
PMI-2	50 35 .48	127 5.34
PMI-3	50 36 .21	127 4.67

APPENDIX II SEDIMENT METAL LEVELS COLLECTED FROM PORT MCNEILL MARCH 12, 1985

STATION	DEPTH (m)	METALS (ug/g)									
		Al (%)	Cd	Cr	Cu	Fe (%)	Hg	Ni	Pb	Sn	Zn
1	10	2.05	.16	28.5	26.6	2.05	.148	7	<3	<2	31.2
		2.12	.20	27.8	28.4	1.89	.130	8	<3	<2	31.6
	MEAN	**2.09**	**.18**	**28.15**	**27.50**	**1.97**	**.139**	**7.5**	-	-	**31.40**
	CV %	2	16	2	5	6	9	9	-	-	1
	STD	.05	.03	.49	1.27	.11	.01	.71	-	-	.28
2	18	1.55	.33	23.2	251.2	1.62	.120	8	<3	<2	25.2
		1.79	.26	25.4	25.0	1.81	.095	7	<3	<2	26.9
	MEAN	**1.67**	**.30**	**24.30**	**138.10**	**1.72**	**.108**	**7.5**	-	-	**26.05**
	CV %	10	17	6	116	8	16	9	-	-	5
	STD	.17	.05	1.56	159.95	.13	.02	.71	-	-	1.20
3	17	1.82	.31	25.7	22.5	1.86	.114	8	<3	<2	27.2
		2.01	.27	28.1	24.6	2.01	.125	9	<3	<2	29.9
	MEAN	**1.92**	**.29**	**26.90**	**23.55**	**1.94**	**.120**	**8.5**	-	-	**28.55**
	CV %	7	10	6	6	5	7	8	-	-	7
	STD	.13	.03	1.70	1.48	.11	.01	.71	-	-	1.91
4	17	1.89	.31	27.3	24.2	1.99	.137	8	<3	<2	30.6
		1.81	.32	25.3	21.8	1.91	.094	8	<3	<2	28.0
	MEAN	**1.85**	**.32**	**26.30**	**23.00**	**1.95**	**.116**	**8**	-	-	**29.30**
	CV %	3	2	5	7	3	26	0	-	-	6
	STD	.06	.01	1.41	1.70	.06	.03	0	-	-	1.84

CONTINUED...

APPENDIX II (Continued)

STATION	DEPTH (m)	METALS (ug/g)									
		Al (%)	Cd	Cr	Cu	Fe (%)	Hg	Ni	Pb	Sn	Zn
5	40	2.02	.17	35.1	24.8	2.93	.099	11	<3	<2	34.3
		1.67	.15	32.5	24.5	2.86	.308	10	<3	<2	32.6
	MEAN	**1.85**	**.16**	**33.80**	**24.65**	**2.90**	**.204**	**10.5**	-	-	**33.45**
	CV %	13	11	5	1	2	73	7	-	-	4
	STD	.25	.02	1.84	.21	.05	.15	.71	-	-	1.20
PMI-1		2.07	.10	29.8	40.7	2.99	-	7	<3	<2	27.4
		1.96	<0.0	29.9	35.6	3.26	.095	7	<3	<2	27.1
	MEAN	**2.02**	**.10**	**29.85**	**38.15**	**3.13**	**.095**	**7**	-	-	**27.25**
	CV %	4	-	0	9	6	-	0	-	-	1
	STD	.08	-	.07	3.61	.19	-	0	-	-	.21
PMI-2		2.26	.19	35.0	45.9	2.79	.114	10	<3	<2	42.6
		2.19	.18	35.1	37.9	2.81	.095	9	<3	<2	41.0
	MEAN	**2.23**	**.19**	**35.05**	**41.90**	**2.80**	**.105**	**9.5**	-	-	**41.80**
	CV %	2	4	0	14	1	13	7	-	-	3
	STD	.05	.01	.07	5.66	.01	.01	.71	-	-	1.13
PMI-3		1.72	.14	27.5	11.4	2.98	.068	4	<3	<2	44.0
		2.01	<0.08	26.2	19.0	2.72	.076	4	<3	<2	43.2
	MEAN	**1.87**	**.14**	**26.85**	**15.20**	**2.85**	**.072**	**4**	-	-	**43.60**
	CV %	11	-	3	35	6	8	0	-	-	1
	STD	.21	-	.92	5.37	.18	.01	0	-	-	.57