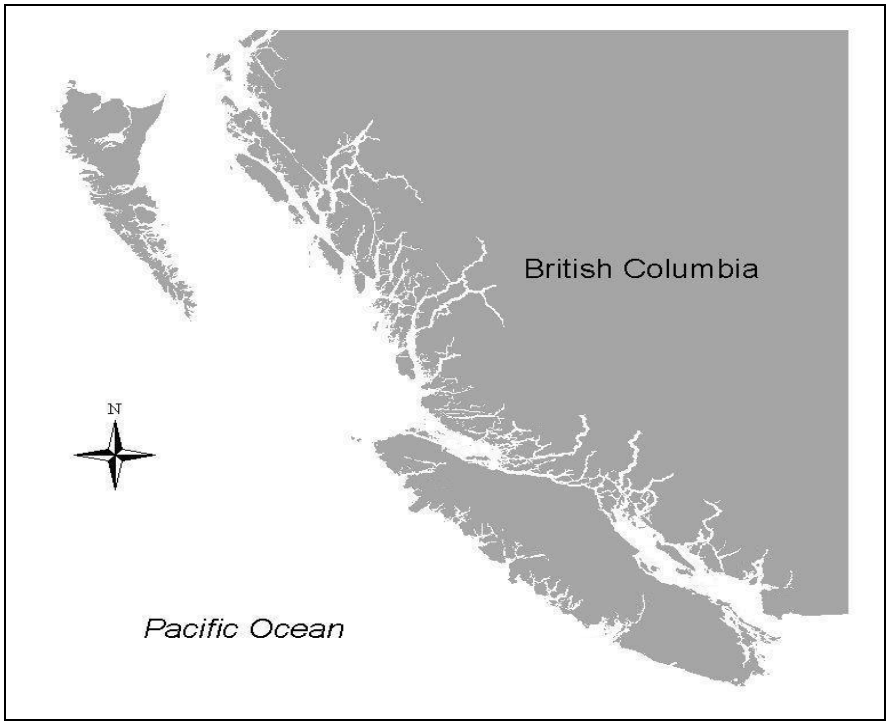
Environment Canada
Environnement Canada

DISPOSAL AT SEA ACTIVITIES SUMMARY

2000

PACIFIC AND YUKON REGION



Regional Program Report No.06-03

By:

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ABSTRACT

Environment Canada's administration of disposal at sea activities undertaken in the Pacific and Yukon Region from 01 January 2000 to 31 December 2000 is summarized in this report. Disposal at sea sites in this region are used primarily for the disposal of dredged and excavated spoils. This report includes information on ten disposal sites that were used in 2000 and seven disposal site monitoring programs.

This report is a continuation of a series of reports documenting disposal at sea activities from 1975 to 1999 and includes Ward and Sullivan (1980), Sullivan (1987), Kim and Sullivan (1993), Kim et al. (1997), Sullivan et al. (1997), Schnider and Sullivan (1997a), Schnider and Sullivan (1997b), Kim et al. (1999), Sullivan et al. (1999), and Sullivan et al. (2006a). To obtain copies of these reports and other disposal at sea information please visit our website at http://www.pyr.ec.gc.ca/disposal_at_sea/index_e.htm.

RÉSUMÉ

Ce rapport résume les activités d'administration des dépôts en mer exécutées par Environnement Canada, Région du Pacifique et du Yukon, entre le 1er janvier 2000 et le 31 décembre 2000. Il porte plus spécifiquement sur les activités visant dix sites de dépôt ayant été utilisés au cours de l'année 2000, ainsi que sur sept programmes de surveillance afférents. Ces sites de dépôt servent principalement à l'élimination des matériaux de dragage et d'excavation.

Ce rapport fait partie d'une série de comptes rendus sur les activités de dépôt en mer concernant la période comprise entre 1975 et 1999: Ward et Sullivan (1980), Sullivan (1987), Kim et Sullivan (1993), Kim et coll. (1997), Sullivan et coll. (1997), Schnider et Sullivan (1997a), Schnider et Sullivan (1997b), Kim et coll. (1999), Sullivan et coll. (1999), et Sullivan et al. (2006a). Pour obtenir une copie de ces rapports et pour toute autre information concernant les activités de dépôt en mer, consultez notre site web : http://www.pyr.ec.gc.ca/disposal_at_sea/index_f.htm.

ACKNOWLEDGMENTS

The authors wish to thank numerous co-op students from Simon Fraser University for their input in the preparation of the report series, and the master and crew of the CCGS VECTOR for their assistance in the field portion of the monitoring surveys.

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1.0 INTRODUCTION

Environment Canada administers the requirements for disposal at sea under authority of the *Canadian Environmental Protection Act, 1999* (CEPA 1999), Part 7, Division 3. Disposal at sea is regulated according to the terms and conditions in permits issued by Environment Canada. To ensure compliance with the conditions of the permit, inspections are routinely conducted by Environment Canada, Enforcement and Emergencies Division.

This report describes all disposal at sea activities conducted in 2000 in the Pacific and Yukon Region. There are 36 designated disposal sites in British Columbia, 27 of which are located in southern British Columbia (Figure 1). In 2000, ten of these disposal sites were used and seven were monitored (Table 1).

2.0 ADMINISTRATION

2.1 APPLICATION AND REVIEW PROCESS

Under the authority of CEPA 1999 material destined for disposal at sea or loaded for the purpose of disposal at sea requires a permit. Maintenance dredging activities involving less than 4 000 cubic metres of approved dredged material, or excavation projects involving approved undisturbed native till may be carried out under the terms and conditions of a multi-site disposal at sea permit. New dredging projects, maintenance dredging activities involving volumes in excess of 4 000 cubic metres and unique excavation projects require a site-specific permit. Permits are valid for a one year period. Information on the application and permitting process can be obtained from Environment Canada, 201–401 Burrard Street, Vancouver, British Columbia, V6C 3S5 or online at: http://www.pyr.ec.gc.ca/disposal_at_sea/index_e.htm. Figure 2 shows a schematic of the complete permitting process.

Permit applications are reviewed by Environment Canada with advice from the Regional Ocean Disposal Advisory Committee (RODAC). This committee has representation from Environment Canada, Fisheries and Oceans Canada (DFO) and British Columbia Ministry of Environment. Following the application review process, only material which has been rigorously tested and found to meet the criteria outlined in the Disposal at Sea Regulations (2001) and the Interim Contaminant Testing Guidelines for Disposal at Sea (ICTG), Pacific and Yukon Region (Appendix I), is approved for disposal at sea.

The public can voice their concerns regarding disposal at sea projects throughout the application review and permitting process. Public advisory of all disposal at sea permit applications is made through a Notice of Intent published by the applicant in a newspaper in the area of the proposed disposal at sea activity. As part of Environment Canada's responsibility to conduct an environmental assessment of each project under the *Canadian Environmental Assessment Act*, a Notice of Commencement for all environmental assessments is posted on the Canadian Environmental Assessment Registry (CEAR). The public has a 15 day period to communicate comments or concerns to the CEAR, Suite 320 - Sinclair Centre, 757 West Hastings Street, Vancouver, British Columbia, V6C 1A1, or on the CEAR website:

http://www.ceaa-acee.gc.ca/050/index_e.cfm. Prior to issuance, all disposal at sea permits and amendments are published in the Canada Gazette (http://canadagazette.gc.ca) and subject to a 30 day public review period.

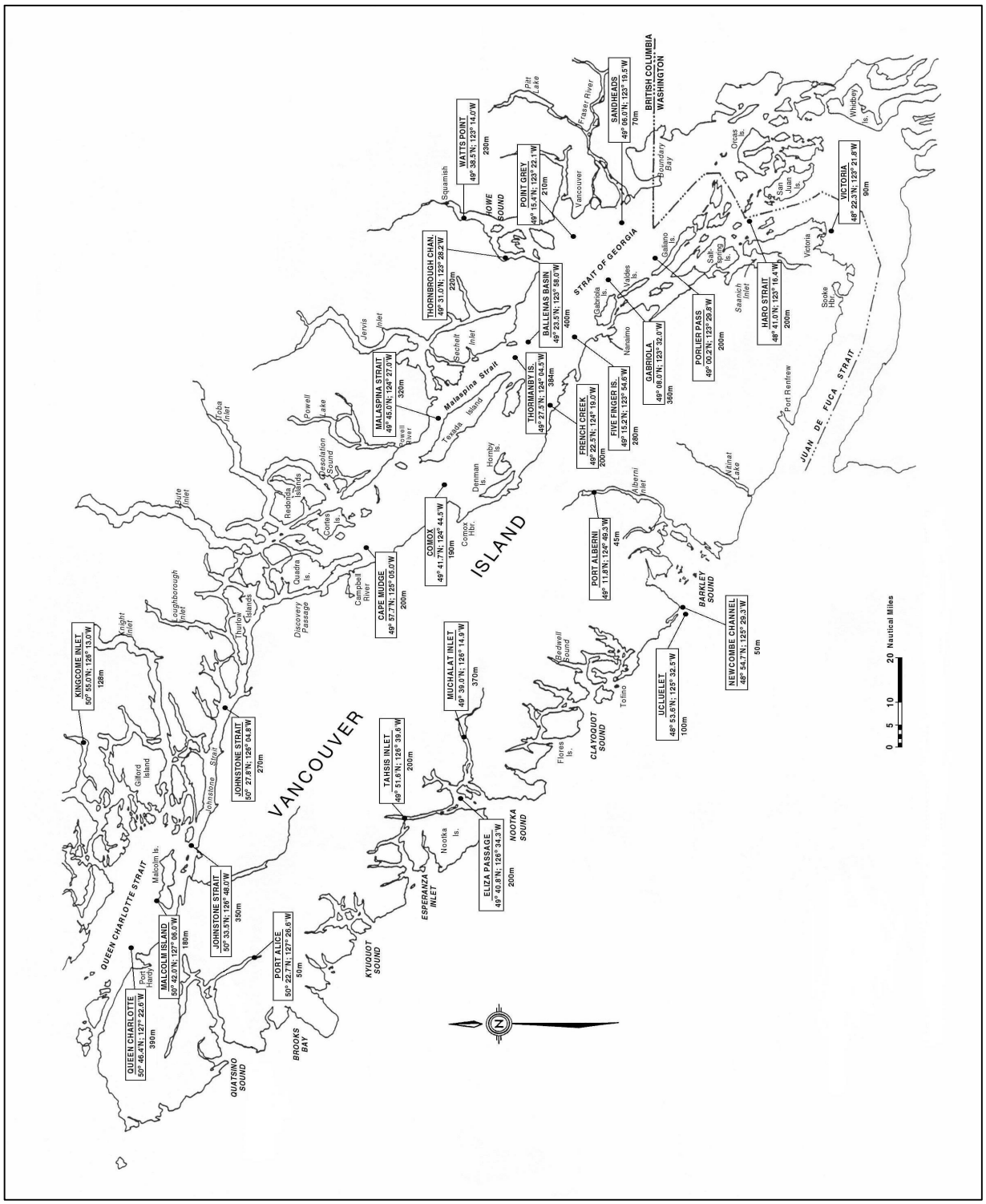

Figure 1. Designated disposal at sea sites in southern British Columbia.

Table 1. Disposal at sea sites used and monitored in 2000.

Disposal Site	Depth (m)	Co-ordinates	Volume Disposed in 2000
* Point Grey	210	49°15.40'N; 123°22.10'W	324,102 m^3
* Sand Heads	70	49°06.00'N; 123°19.50'W	295,982 m^3
* Comox (Cape Lazo)	190	49°41.70'N; 124°44.50'W	17,000 m^3
* Malaspina Strait	320	49°45.00'N; 124°27.00'W	15,746 m^3
Johnstone Strait - Hickey Point	270	50°27.80'N; 126°04.80'W	13,257 m^3
Thornbrough Channel	220	49°31.00'N; 123°28.30'W	10,500 m^3
Five Finger Island	280	49°15.20'N; 123°54.60'W	8,018 m^3
* Porlier Pass	200	49°00.20'N; 123°29.80'W	6,344 m^3
Johnstone Strait - Hanson Island	350	50°33.50'N; 126°48.00'W	6,237 m^3
Thormanby Island	384	49°27.50'N; 124°04.50'W	4,000 m^3
* Cape Mudge	200	49°57.70'N; 125°05.00'W	0 m^3
* Watts Point	230	49°38.50'N; 123°14.10'W	0 m^3
		Total:	701,186 m^3

* Monitoring studies were conducted at these disposal sites in 2000.

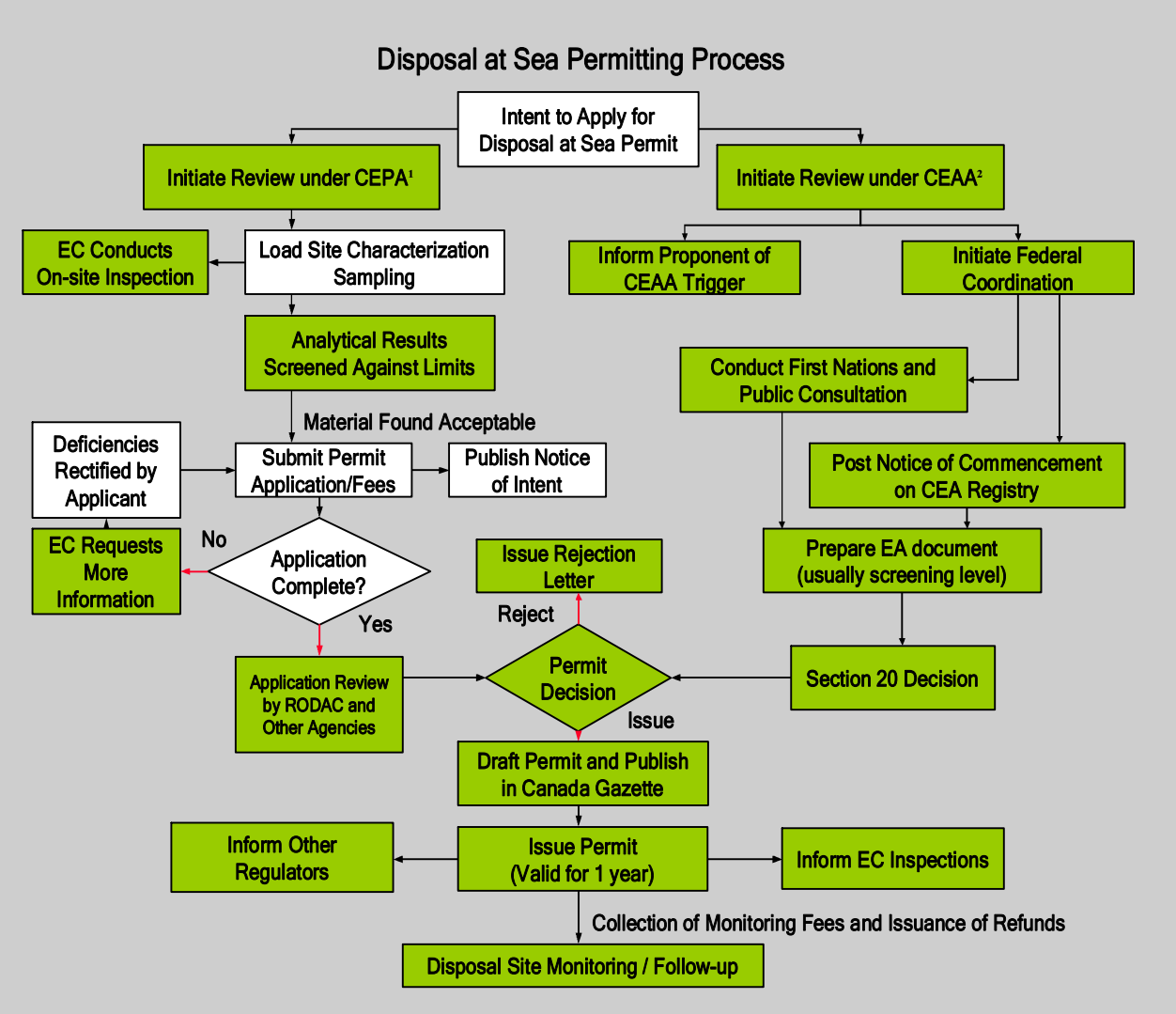

Figure 2. Disposal at sea permitting process.

1. CEPA 1999 – *Canadian Environmental Protection Act, 1999*
2. CEAA – *Canadian Environmental Assessment Act*

2.2 DISPOSAL AT SEA RESTRICTIONS

Disposal at sea is permitted only within the government designated disposal sites and only if the material to be disposed of is listed under CEPA 1999 Schedule 5:

1. Dredged material.
2. Fish waste or other organic matter that comes from industrial fish processing operations.
3. Ships, aircraft, platforms or other structures from which all material that can create floating debris or other marine pollution has been removed to the maximum extent possible if, in the case of disposal, those substances would not pose a serious obstacle to the fishing or navigation after being disposed of.
4. Inert, inorganic geological matter.
5. Uncontaminated organic matter of natural origin.
6. Bulky substances that are primarily composed of iron, steel, concrete or other similar matter that does not have a significant adverse effect, other than a physical effect, on the sea or the seabed, if those substances:

    a) are in locations where disposal or incineration at sea is the only practicable manner of disposing of or thermally destroying the substances; and
    b) in the case of disposal, would not pose a serious obstacle to fishing or navigation after being disposed of.

A permit to dispose of these materials can be obtained only if they meet the conditions listed in Schedule 6 of CEPA 1999 which states that if any feasible options such as re-using, recycling or an alternative form of disposal exist, then disposal at sea is not an option.

Under Schedule 6, Parts 9 and 10, materials mentioned in Schedule 5 may not be allowed for disposal at sea if they exceed the following screening criteria. If the disposal material contains these substances below the following limits, then it is considered below the lower level and will be considered for disposal at sea.

Lower Level of the National Action List

1. Cadmium and its compounds	0.6 mg/kg (dry weight)
2. Mercury and its compounds	0.75 mg/kg (dry weight)
3. Total Polycyclic Aromatic Hydrocarbons (PAHs)	2500 µg/kg (dry weight)
4. Total polychlorinated biphenyls (PCBs)	100 µg/kg (dry weight)
5. Persistent plastics and other persistent synthetic materials (in a suitably comminuted form)	4% by volume

If the disposal material has higher concentrations than these, then it can be tested to see if it meets the upper level criteria. To determine the upper level criteria, a minimum of three marine biological tests for sediment are required. They include:

- one acute lethality test; and
- two sub-lethal tests; or
- one sub-lethal and one bioaccumulation test.

Material that passes all three tests is considered below the lower level and can be considered for disposal at sea. If it passes the acute lethality test but fails one sub-lethal or one bioaccumulation test, then it is below the upper level but above the lower level and will require a more detailed assessment. However, if it fails the acute test or fails the other two tests then it exceeds the upper level and will not be permitted for disposal at sea.

In order to protect fisheries resources, spawning areas, and juvenile and adult migratory areas, the Department of Fisheries and Oceans (DFO) requires that dredging and/or ocean disposal activities be conducted within time frames specified by district Habitat Management Units. Proponents are directed to contact the appropriate DFO units prior to commencing any projects for timing restrictions relevant to the area of proposed activities. For example, Fraser River Environmental Management Program (FREMP) Dredge Management Guidelines for operations within navigation channels specify periods when clamshell or suction dredging is allowed. Dredging outside navigation channels is reviewed on a site-specific basis.

2.3 COMPLIANCE AND ENFORCEMENT

Environment Canada conducts pre-load inspections to verify sampling program design and sample collection as required. Enforcement of the terms and conditions of permits under CEPA 1999, Part 10 is the responsibility of Environment Canada Enforcement Officers. CEPA inspectors routinely conduct compliance and surveillance inspections of dredging/loading and disposal operations. Vessel Traffic Management Centres monitor disposal sites to ensure disposal activities occur within the authorized locations. Any contravention of permit conditions is dealt with under authority of CEPA 1999, Part 7, Division 3 or Section 36 (3) of the *Fisheries Act*.

3.0 DISPOSAL SITE MONITORING

Disposal site monitoring procedures are outlined in the Interim Monitoring Guidelines for Ocean Disposal (1999). Physical monitoring is the first stage of the monitoring approach. Of key importance is the collection of information to determine the area of deposition, delineation of the disposal site boundaries, the accumulation of material within the boundaries, and evidence of sediment transport off the disposal site.

Chemical assessment of a disposal site involves measuring chemical concentrations of sediment from within the disposal site boundary and from one or more nearby reference stations. Using the reference site results as a comparison, Environment Canada can determine whether disposal activities are significantly altering the chemical make-up of sediment within the disposal site.

Biological testing is focused primarily on laboratory toxicity testing and benthic community studies. Biological testing protocols were completed in 1992 and continue to be evaluated for use in disposal site assessment. In addition, Environment Canada has published a guidance document entitled "*Guidance Document on the Collection and Preparation of Sediment for Physiochemical Characterisation and Biological Testing* (1994)".

All available information from physical, chemical and biological monitoring is considered in the overall assessment of a disposal site.

4.0 DISPOSAL AT SEA ACTIVITIES

4.1 NUMBER OF PERMITS

In 2000, 22 disposal at sea permit applications were received and 20 permits were issued (Table 2): 18 for dredged material and two for excavated material.

Under multi-site permits for dredged and excavated materials, 79 projects were assessed and approved in 2000. Sixty-two approvals were issued for maintenance dredging projects involving less than 4 000 cubic metres of material throughout the Lower Mainland, Vancouver Island and coastal British Columbia. Seventeen approvals were issued for excavation projects in the Lower Mainland area.

Table 2. Number of permits issued in the Pacific and Yukon Region - 1987 to 2000.

Permit Type	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dredge	33	41	28	25	23	20	21	18	20	15	14	23	10	18
Excavation	2	5	5	4	4	5	3	2	4	6	6	6	3	2
Vessel	0	0	1	0	2	2	0	0	1	2	1	1	0	0
Others	2	2	2	2	1	0	1	0	0	0	0	0	0	0
Total	37	48	36	31	30	27	25	20	25	23	21	30	13	20

4.2 VOLUME OF MATERIAL DISPOSED OF AT SEA

In 2000, approximately 700 000 cubic metres of material was disposed of at various disposal sites in the Pacific and Yukon Region. The Point Grey and Sand Heads disposal sites received approximately 88% of all materials.

Dredged material accounted for approximately 80% of the material sent to disposal sites while excavation projects in the Lower Mainland accounted for the remaining 20%.

In 2000, approximately 241 000 cubic metres of sand from the Fraser River channel maintenance dredging was ocean disposed of at the Sand Heads disposal site. This is greatly reduced from 1999's figures of 641 000 cubic metres, largely due to sand recovery and sales to construction projects.

4.3 MONITORING

Routine monitoring of ocean disposal sites is carried out by Environment Canada to assess physical, chemical and biological effects of disposal operations. At each designated disposal site, a grid of sediment sampling stations has been established to allow repetitive surveys.

Environment Canada undertook two monitoring surveys in 2000. During May and November, seven designated disposal sites were monitored: Malaspina Strait, Point Grey, Cape Mudge, Comox (Cape Lazo), Porlier Pass, Sand Heads and Watts Point. All sediments collected were analysed for trace metals and particle size distribution. Sediment samples collected at Cape Mudge were analysed for concentrations of total polycyclic aromatic hydrocarbon (PAH) and total organic carbon (TOC). Sediment samples collected at the Malaspina Strait and Point Grey disposal sites were tested for additional substances: ammonia, sulphide, acid volatile sulphides (AVS), and simultaneously extractable metals (SEM).

Biological tests are conducted to determine and monitor effects of ocean disposed sediments on the receiving environment. Biological testing is focused primarily on sediment toxicity testing of two types: acute lethality and sub-lethal tests. Sediment samples from the Malaspina Strait disposal site were subject to one acute lethality test, a 10 day amphipod survival test using the marine amphipods *Eohaustorius washingtonianus, Eohaustorius estuarius,* and *Rhepoxynius abronius* and two sub-lethal tests including Echinoid Fertilization using *Dendraster excentricus* and the solid phase Microtox® test.

In October 2000, video images of Malaspina Strait, Cape Mudge and Watts Point disposal sites were recorded using a remotely operated submersible, known as the Remotely Operated Platform for Ocean Science (ROPOS II), owned by DFO and operated by the Canadian Scientific Submersible Facility. Predetermined transect lines were followed across the disposal site to examine bottom conditions and evidence of ocean disposal activities. Discussion of the physical monitoring conducted at these three sites is presented in Section 5.0.

5.0 DISPOSAL SITE ACTIVITY SUMMARY

The total quantity of materials found under disposal headings in the following sections is the total quantity disposed of under permit/approval since 1976. Information on specific permits and approvals in 2000 at each disposal site can be found in the disposal site summaries located in Appendix II.

5.1 POINT GREY

Disposal Site:	Point Grey
Co-ordinates:	49°15.40'N; 123°22.10'W
Depth:	210 metres
Total Quantity Disposed Since 1976:	9 738 613 cubic metres + 390 tonnes

Comments

DFO requests that the Fraser River Estuary Management Program (FREMP) Dredge Management Guidelines be applied to any dredging project, subject to approval by the appropriate Habitat Management Unit.

Load Site Information

177 602 cubic metres of dredged material was sent to the Point Grey disposal site in 2000. This material resulted from maintenance dredging operations at various locations in Vancouver Harbour and the Fraser River. An additional 146 500 cubic metres of excavated native till from the Greater Vancouver Regional District was also taken to the disposal site. Specific load site information is listed in Appendix II.

Monitoring Information

In May 2000 surface sediment samples were collected from 41 stations on the disposal site and the surrounding area (Figure 3). The samples were analysed for trace metal concentrations, total polycyclic aromatic hydrocarbons (PAH), total organic carbon (TOC), and particle size distribution. Results are presented in Table 3. No chemical concentrations exceeded the screening limits outlined in the ICTG except for the total polycyclic aromatic hydrocarbons (PAH) at stations 40 and 41.

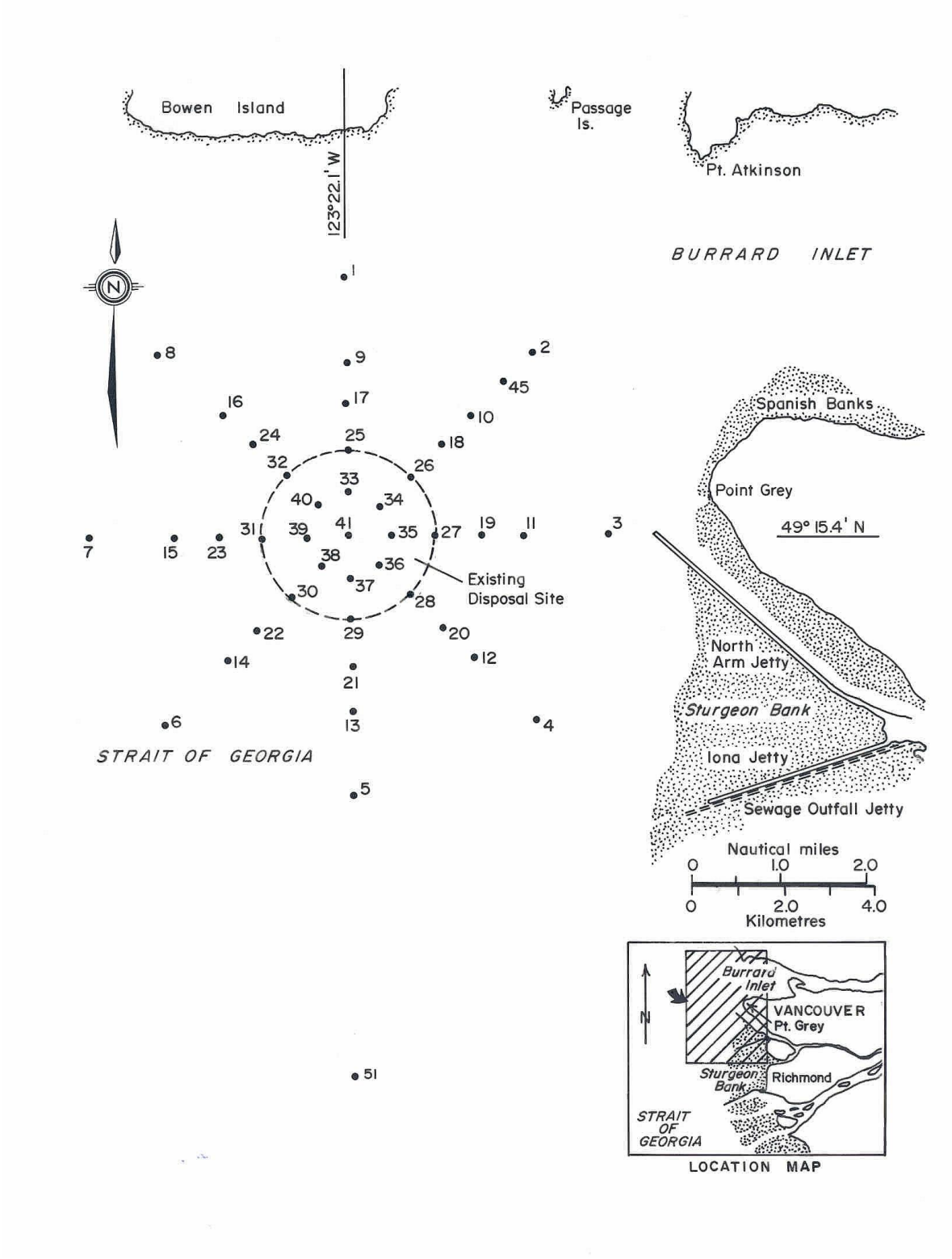

Figure 3. Point Grey disposal site sediment sampling stations.

Table 3. Point Grey sediment chemistry and particle size data – May 2000.

	Sediment Chemistry[1]							% Particle Size			
Station	**Cd**	**Hg**	**Cu**	**Pb**	**Zn**	**PAH**	**TOC**	**Gravel**	**Sand**	**Silt**	**Clay**
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	> 2.0mm	2 - 0.063 mm	0.063 - 0.004 mm	< 0.004mm
1	0.09	0.075	42.2	36	105	0.53	1.16	0.4	4.3	47.1	48.1
2	0.18	0.101	52.2	38	114	0.38	0.98	0.2	1.2	54.1	44.4
3	0.13	0.058	35.0	22	83	0.30	0.61	0.3	33.3	50.7	15.8
4	0.09	0.054	43.9	29	107	0.30	1.06	0.2	0.8	55.7	43.2
5	0.11	0.078	40.0	31	103	0.38	1.11	2.8	1.2	52.4	43.6
6	-0.04	0.077	40.7	26	105	0.46	1.29	0.1	0.6	48.7	50.5
7	-0.04	0.093	43.5	35	112	0.60	1.28	0.3	0.6	43.8	55.4
8	0.11	0.089	46.6	27	111	0.89	1.15	0.5	1.4	39.1	59.1
9	0.13	0.069	37.6	30	100	0.80	1.14	0.2	11.1	45.1	43.5
10	0.15	0.098	47.9	34	112	0.43	1.04	0.2	5.7	48.7	45.5
11	0.09	0.080	45.7	28	109	0.34	1.04	2.0	2.8	51.8	43.5
12	0.04	0.081	40.2	32	104	0.35	1.21	0.1	0.0	52.3	47.5
13	0.04	0.080	39.6	22	103	0.38	1.07	5.5	0.4	49.6	44.5
14	-0.04	0.077	40.0	29	106	0.44	1.33	1.6	0.8	47.7	50.0
15	0.05	0.084	43.6	30	111	0.77	1.15	0.2	5.0	42.2	52.6
16	0.13	0.096	46.2	34	109	0.63	1.09	0.3	3.7	40.4	55.5
17	0.10	0.089	34.9	21	95	0.62	1.39	0.6	16.4	42.5	40.5
18	0.15	0.085	42.9	35	109	0.42	1.21	0.4	4.7	48.2	46.7
19	0.08	0.073	42.1	27	104	0.36	1.17	0.3	2.3	49.9	47.6
20	-0.04	0.079	39.6	31	103	0.38	1.03	0.1	1.4	50.9	47.6
21	0.10	0.081	41.0	27	105	0.38	1.12	0.8	2.6	47.9	48.7
22	0.04	0.078	39.4	27	106	0.39	1.08	0.7	10.9	45.6	42.8
23	-0.04	0.096	40.2	25	102	0.55	1.18	1.1	12.9	37.9	48.1
24	0.09	0.160	43.1	27	107	0.58	1.27	0.1	9.8	39.8	50.3
25	0.17	0.062	33.4	27	86	0.82	1.31	3.0	32.7	33.8	30.5
26	0.12	0.068	36.3	31	94	0.52	1.07	5.5	32.1	34.9	27.5
27	0.08	0.066	36.3	25	94	0.43	1.04	3.1	23.4	41.4	32.1
28	0.04	0.074	39.0	22	103	0.38	1.09	0.1	8.3	48.0	43.6
29	0.10	0.069	37.7	28	100	0.38	1.08	0.9	11.9	47.8	39.5
30	0.05	0.061	39.1	25	93	0.61	1.34	1.6	17.6	41.3	39.5
31	0.05	0.058	33.5	27	85	0.42	1.05	1.3	33.7	35.2	29.8
32	0.12	0.068	36.1	18	92	0.47	1.85	1.3	26.0	36.7	36.0
33	0.08	0.052	31.6	23	80	0.49	1.93	4.8	45.0	29.0	21.2
34	0.10	0.059	32.3	25	84	0.54	1.48	1.2	42.2	32.4	24.1
35	0.12	0.047	31.4	28	80	0.69	1.3	3.1	58.5	24.1	14.3
36	0.05	0.062	33.8	22	90	0.60	1.8	1.2	25.8	43.1	29.9
37	0.17	0.061	31.1	20	83	0.47	1.08	2.3	28.2	40.0	29.4
38	0.12	0.055	32.4	16	84	0.41	1.35	2.1	35.7	34.9	27.4
39	0.10	0.061	35.6	22	92	0.49	1.56	1.3	41.6	34.3	22.9
40	0.26	0.060	33.8	23	98	*4.30	1.48	3.1	36.0	30.4	30.4
41	0.17	0.080	32.3	19	84	*3.30	1.16	10.8	42.3	27.2	19.7

[1] Total metals results are expressed in dry weight.
* Indicates sample exceeded ICTG limit.
Negative numbers represent values below detection limit.

5.2 SAND HEADS

Disposal Site:	Sand Heads
Co-ordinates:	49°06.00'N; 123°19.50'W
Depth:	70 metres
Total Quantity Disposed Since 1976:	11 814 283 cubic metres

Comments

The Fraser River Environmental Management Program (FREMP) Dredge Management Guidelines apply to all projects. In general, these guidelines state that for the Lower Fraser River there is no dredging (clamshell or suction) between March 1 and June 15 of volumes greater than 4 000 cubic metres. In addition, no suction dredging is allowed in water less than five metres depth at low tide between June 15 and July 15.

The DFO Habitat Management Unit in New Westminster, British Columbia should be contacted for specific timing restrictions on dredging.

Load Site Information

Only clean sand, silt and gravel (no wood waste) are approved for disposal at the Sand Heads disposal site. In 2000, 295 982 cubic meters of dredged material was disposed of at Sand Heads, most as a result of Fraser River channel maintenance projects by the Fraser River Port Authority. Other material sent to Sand Heads typically results from maintenance dredging at load ramps for construction aggregate facilities on the Fraser River. Specific load site information is listed in Appendix II.

Monitoring Information

In May 2000 surface sediment samples were collected from 6 stations at the Sand Heads disposal site (Figure 4). The samples were analysed for trace metal concentrations, total polycyclic aromatic hydrocarbons (PAH), total organic carbon (TOC), and particle size distribution. No chemical concentrations exceeded the screening limits outlined in the ICTG. Results are presented in Table 4.

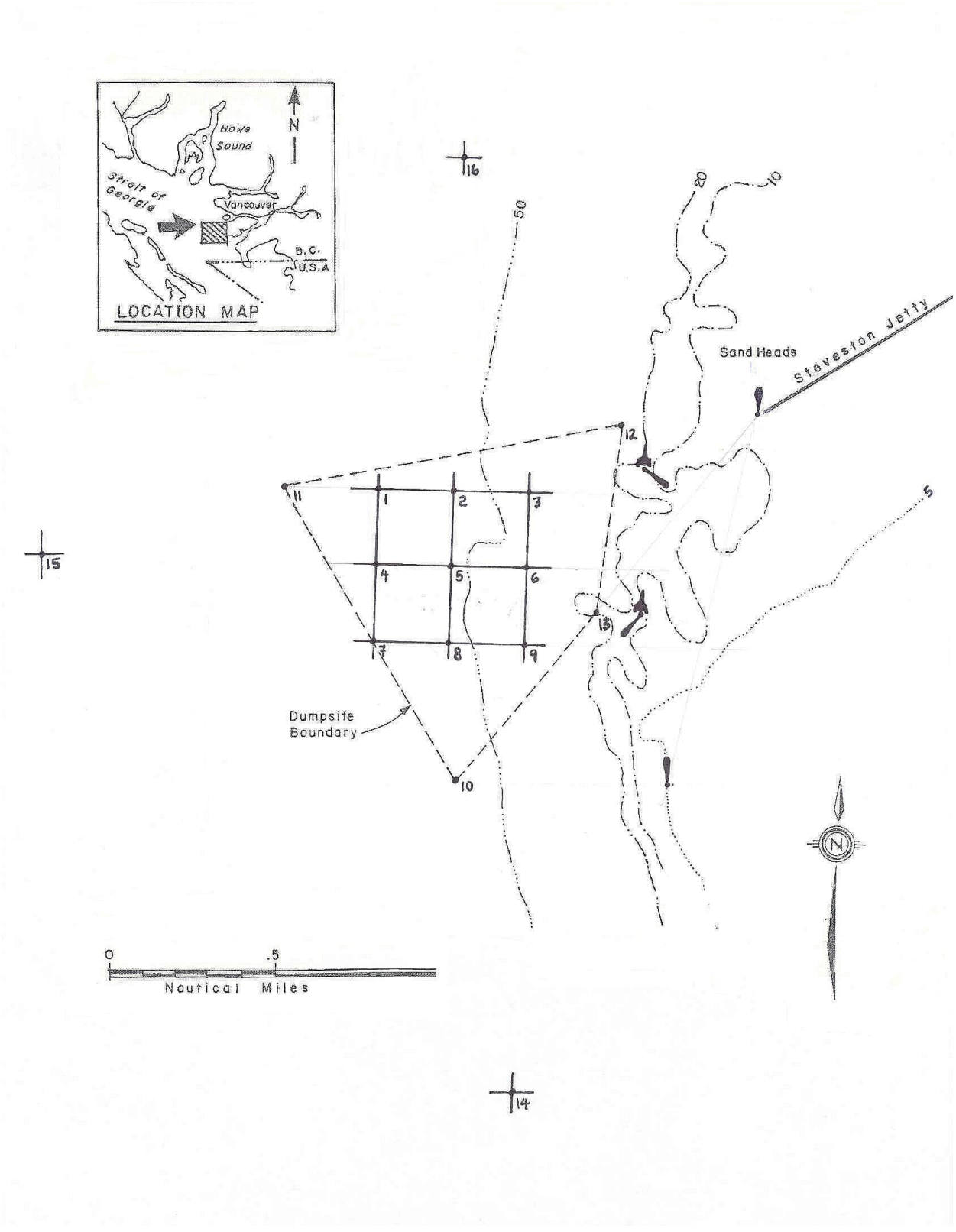

Figure 4: Sand Heads disposal site sediment sampling stations.

Table 4. Sand Heads sediment chemistry and particle size data – May 2000.

Station	Sediment Chemistry[1]							% Particle Size			
	Cd	Hg	Cu	Pb	Zn	PAH	TOC	Gravel	Sand	Silt	Clay
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	> 2.0mm	2 - 0.063mm	0.063 - 0.004mm	< 0.004mm
1	0.15	0.080	28.0	19	78	0.12	0.53	0.0	33.2	51.8	15.0
2	0.15	0.049	25.8	28	74	0.04	0.27	0.1	87.9	8.7	3.3
3	0.12	0.042	27.5	31	72	0.43	0.49	0.1	85.1	10.9	4.0
6	0.15	0.046	31.4	30	77	0.24	0.68	0.3	47.2	41.1	11.4
11	0.13	0.051	30.2	23	84	0.19	0.65	0.0	27.3	54.4	18.3
15	0.14	0.056	30.3	20	84	0.17	0.76	0.1	18.3	59.5	22.1

[1] Total metals results are expressed in dry weight.

5.3 COMOX (CAPE LAZO)

Disposal Site:	Comox (Cape Lazo)
Co-ordinates:	49°41.70'N; 124°44.50'W
Depth:	190 metres
Total Quantity Disposed Since 1976:	62 633 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 17 000 cubic metres of material was disposed of at the Comox disposal site. This material originated from maintenance dredge activities in Courtenay River and Comox Harbour, British Columbia. Specific load site information is listed in Appendix II.

Monitoring Information

In May 2000 surface sediment samples were collected from 10 stations on the disposal site and the surrounding area (Figure 5). The samples were analysed for trace metal concentrations, total polycyclic aromatic hydrocarbons (PAH), total organic carbon (TOC), and particle size distribution. Results are presented in Table 5. No chemical concentrations exceeded the screening limits outlined in the ICTG.

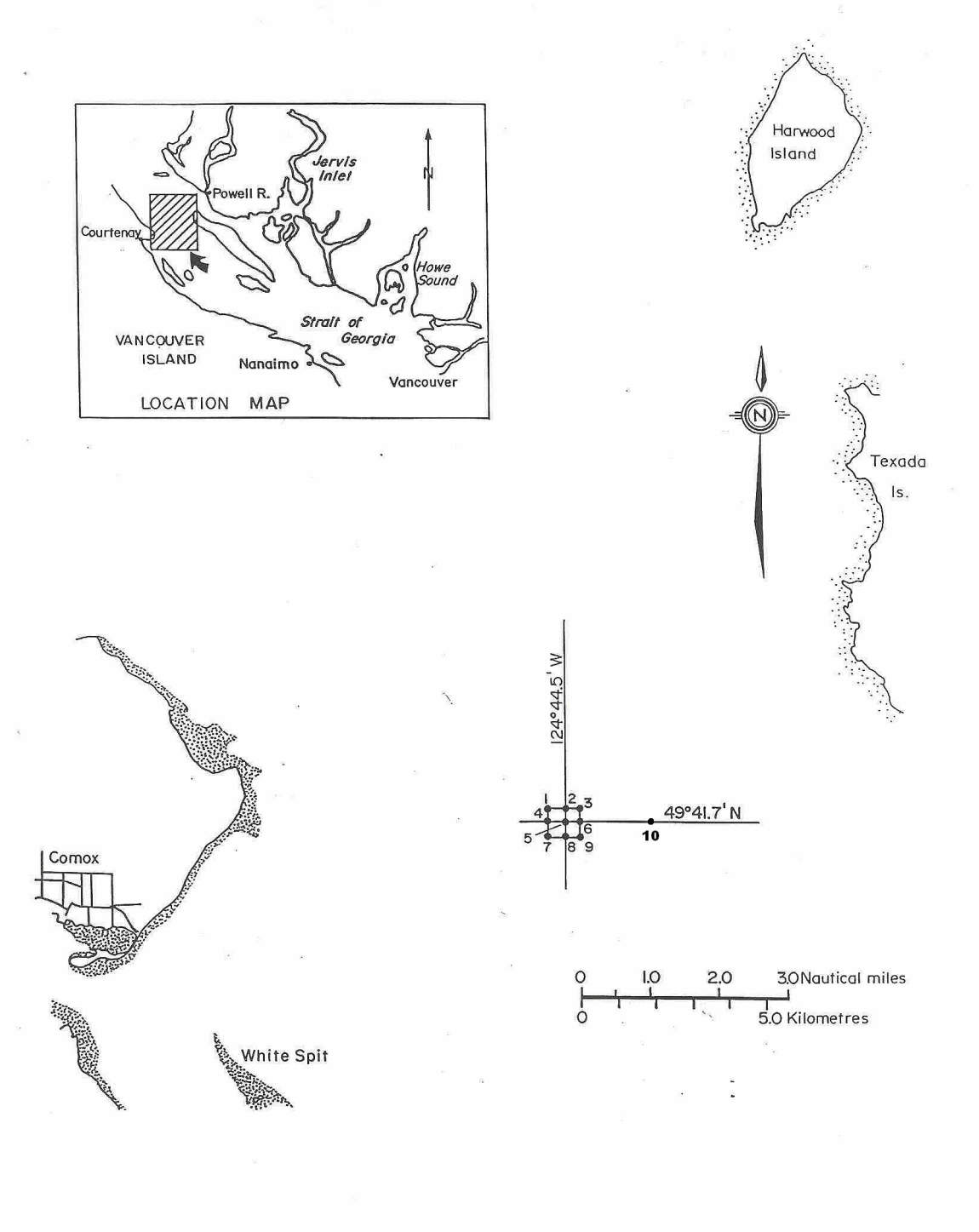

Figure 5: Comox (Cape Lazo) disposal site sediment sampling stations.

Table 5. Comox (Cape Lazo) sediment chemistry and particle size data – May 2000.

	Sediment Chemistry[1]							% Particle Size			
Station	**Cd**	**Hg**	**Cu**	**Pb**	**Zn**	**PAH**	**TOC**	**Gravel**	**Sand**	**Silt**	**Clay**
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	> 2.0mm	2 - 0.063mm	0.063 - 0.004mm	< 0.004mm
1	0.10	0.070	53.4	26	85	0.44	1.16	0.3	28.8	36.5	34.4
2	0.14	0.078	50.3	15	80	0.42	1.46	0.3	23.9	33.6	37.1
3	0.15	0.065	52.0	18	86	0.38	1.34	0.3	24.1	31.7	41.9
4	0.08	0.061	46.3	18	76	0.42	1.16	0.0	34.4	33.8	30.9
5	0.05	0.072	53.3	21	83	0.39	3.32	0.0	32.7	29.7	32.5
6	0.14	0.073	52.3	21	82	0.49	1.51	0.3	23.7	37.0	38.9
7	0.11	0.048	31.6	10	57	0.29	1.05	0.7	60.6	15.4	22.3
8	0.18	0.062	41.8	18	71	0.66	1.46	0.6	30.3	36.4	32.7
9	0.22	0.066	50.3	22	79	0.40	1.32	0.3	24.3	39.2	36.2
10	0.14	0.080	61.1	28	94	0.47	1.42	0.9	15.7	30.7	52.7

[1] Total metals results are expressed in dry weight.

5.4 MALASPINA STRAIT

Disposal Site:	Malaspina Strait
Co-ordinates:	49°45.00'; 124°26.95'W
Depth:	320 metres
Total Quantity Disposed Since 1976:	577 216 cubic metres + 6 000 tonnes

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 15 746 cubic metres of material resulting from maintenance dredging activities outside the Stillwater Bay Dry Land Sort and at the MacMillan Bloedel (Pacifica Papers) mill in Powell River, British Columbia, was sent to the Malaspina Strait disposal site. Specific load site information is listed in Appendix II.

Monitoring Information

In May 2000 surface sediment samples were collected from 13 stations on the disposal site and the surrounding area (Figure 6). In addition, a composite sample was collected from each station. All samples were analysed for trace metal concentrations, total polycyclic aromatic hydrocarbons (PAH), total organic carbon (TOC), and particle size distribution. Total polycyclic aromatic hydrocarbons exceeded the screening limits outlined in the ICTG at station 3 and composite 9 and cadmium levels exceeded the limits at multiple stations (Table 6).

The composite samples collected were also tested for additional substances: ammonia, sulphide, acid volatile sulphides (AVS), and simultaneously extractable metals (SEM). Results are presented in Table 7. Further tests were performed for acute toxicity to monitor the effects of ocean disposed sediments on the receiving environment, using the marine amphipods *Eohaustorius washingtonianus, Eohaustorius estuarius* and *Rhepoxynius abronius*. These sediment samples were also analysed using the echinoid test and the solid phase Microtox® test (Table 8).

In November 2000, ROPOS II was deployed at the Malaspina Strait disposal site. As part of a physical monitoring program, the remotely operated vehicle (ROV) is used to observe the benthic condition of the disposal site and surrounding area. In addition, information on the area of deposition of materials and physical characteristics of sediment in and around the disposal site boundary can be gathered from the ROPOS video. Predetermined track lines were plotted over the disposal site and continuous video images were recorded. Computer-captured still images (transferred to slide and CD ROM) were also collected (Appendix III).

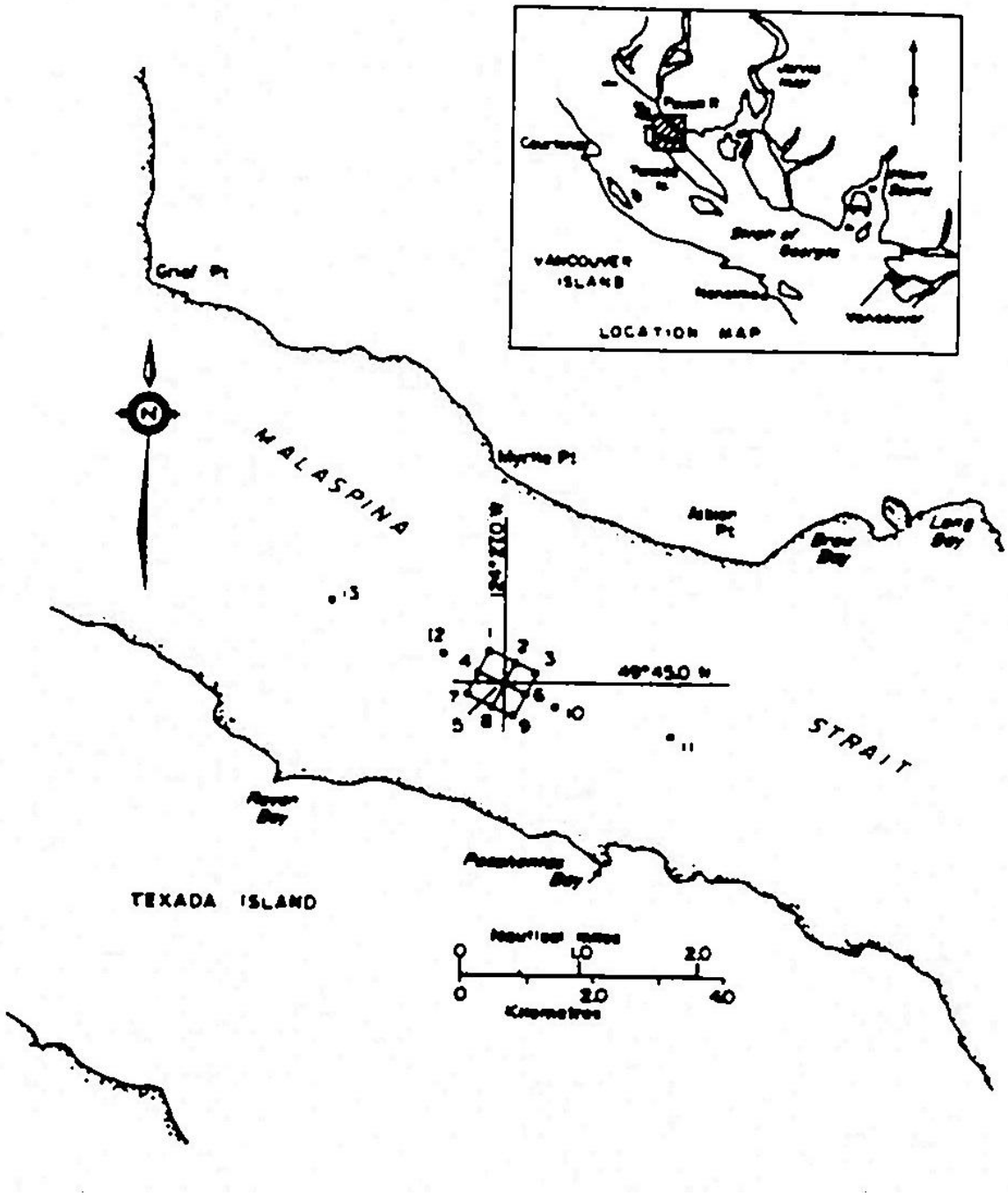

Figure 6. Malaspina Strait disposal site sediment sampling stations.

Table 6. Malaspina Strait sediment chemistry and particle size data – May 2000.

Station	Sediment Chemistry[1]							% Particle Size			
	Cd	Hg	Cu	Pb	Zn	PAH	TOC	Gravel	Sand	Silt	Clay
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	> 2.0mm	2 - 0.063mm	0.063 - 0.004mm	< 0.004mm
1	0.59	0.135	80.8	43	183	1.10	3036	1.5	8.2	22.5	67.8
2	*0.66	0.113	84.9	38	170	0.95	4.32	4.7	7.0	19.4	69.0
3	*0.61	0.117	75.0	37	167	*2.70	5.24	6.9	16.1	18.4	58.6
4	0.50	0.044	91.5	29	134	0.64	6.26	11.3	27.0	28.9	32.8
5	*0.65	0.100	80.9	37	164	0.99	8.84	11.8	22.1	13.3	46.8
6	0.60	0.084	85.3	0	0	1.10	8.47	15.3	16.6	24.2	43.9
7	0.53	0.084	87.4	29	154	0.94	4.73	11.9	18.9	28.9	40.4
8	0.58	0.073	83.8	28	149	0.97	2.18	7.8	23.2	31.1	38.0
9	0.57	0.098	76.5	35	149	1.00	4.74	10.3	16.4	25.7	47.7
13	*0.63	0.143	82.9	40	196	1.20	3.61	0.5	3.3	25.8	70.5
Composite 1	*0.67	0.159	82.9	45	202	1.30	4.12	4.7	7.0	19.4	69.0
Composite 2	*0.75	0.159	83.9	44	212	1.50	3.53	4.0	9.7	19.7	66.7
Composite 3	*0.64	0.122	79.4	42	186	1.90	5.70	15.1	15.3	17.0	52.6
Composite 4	0.50	0.044	91.5	29	134	0.96	10.20	15.3	26.7	22.2	35.8
Composite 5	*0.62	0.098	79.2	31	161	1.30	11.60	19.4	15.8	20.8	44.0
Composite 6	*0.61	0.110	80.7	36	167	1.40	9.21	15.4	19.4	20.6	44.7
Composite 7	0.54	0.087	84.4	32	152	1.00	8.17	11.7	19.7	27.0	41.6
Composite 8	*0.61	0.074	88.2	34	148	1.50	8.47	12.6	26.6	28.2	32.5
Composite 9	*0.69	0.113	79.0	37	178	*3.00	11.00	16.1	21.7	19.8	42.4
Composite 13	*0.72	0.143	84.8	41	202	1.30	2.84	0.8	1.5	27.7	70.0

[1] Total metals results are expressed in dry weight.
* Indicates sample exceeded ICTG limit.

Table 7. Malaspina Strait additional substances data – May 2000.

Station	Sulphide	Ammonia	Eh	AVS	SEM	AVS/SEM
	mg S/g	mg NH3-/g	mV	umol/g dry weight	umol/g dry weight	
Composite 1	82.3 ± 14.9	17.7 ± 0.1	-86 ± 1	17.2	0.61	28.197
Composite 2	80.7 ± 18	26.4 ± 1.1	-88 ± 2	15.8	0.67	23.582
Composite 3	150 ± 21.8	33.4 ± 0.7	-147 ± 1	12.5	1.45	8.621
Composite 4	67.3 ± 6.9	15.2 ± 0.9	-154 ± 1	17.6	1.51	11.656
Composite 5	161 ± 4.9	56.8 ± 0.6	-182 ± 2	17.8	1.29	13.798
Composite 6	132 ± 7.6	42.3 ± 0.9	-140 ± 2	17.2	1.12	15.357
Composite 7	101 ± 14.5	35.8 ± 0.5	-167 ± 2	17.8	1.29	13.798
Composite 8	98.4 ± 17.6	24.3 ± 0.5	-86 ± 2	17.2	1.12	15.357
Composite 9	140 ± 4	21.5 ± 0.9	-148 ± 1	21	1.42	14.789
Composite 13	28.5 ± 1	12.3 ± 0.1	-58 ± 1	5.7	2.1	2.714

Table 8. Malaspina Strait toxicity test results – May 2000.

Station	Amphipod E. washingtonianus % survival	Amphipod R. abronius % survival	Amphipod E. estuarius % survival	Echinoid D. excentricus % survival	Microtox®+ solid phase IC50 % effect
Composite 1	* 58 ± 10.4	66 ± 2.2	63 ± 11.0	90 ± 2.0	0.077
Composite 2	* 51 ± 14.3	82 ± 8.4	69 ± 10.2	* 0 ± 0.6	0.085
Composite 3	* 62 ± 21.4	85 ± 5.0	85 ± 5.0	* 0 ± 0.6	0.053
Composite 4	* 63 ± 12.5	72 ± 17.9	85 ± 7.1	86 ± 2.5	0.029
Composite 5	76 ± 12.9	83 ± 6.7	76 ± 9.6	77 ± 3.1	0.040
Composite 6	72 ± 13.0	83 ± 5.7	81 ± 6.5	90 ± 5.0	0.037
Composite 7	81 ± 15.6	83 ± 12.0	72 ± 14.0	70 ± 4.0	0.021
Composite 8	86 ± 6.5	91 ± 5.5	88 ± 9.1	80 ± 3.8	0.015
Composite 9	85 ± 11.2	74 ± 11.9	85 ± 3.5	83 ± 3.0	0.044
Composite 13	* 52 ± 21.4	86 ± 15.2	* 59 ± 2.2	93 ± 1.7	0.180

*Toxic response.

+ Microtox® results have been moisture corrected.

5.5 JOHNSTONE STRAIT (HICKEY POINT)

Disposal Site:	Johnstone Strait - Hickey Point
Co-ordinates:	50°27.80'N; 126°04.80'W
Depth:	270 metres
Total Quantity Disposed Since 1976:	176 694 cubic metres + 40 tonnes

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 13 257 cubic metres of dredged material was disposed of at the Hickey Point disposal site. This material originated from forest industry operations in Eve River and Kelsey Bay, British Columbia. Specific load site information is listed in Appendix II.

Monitoring Information

This site was last monitored in 1998.

5.6 THORNBROUGH CHANNEL

Disposal Site:	Thornbrough Channel
Co-ordinates:	49°31.00'N; 123°28.30'W
Depth:	220 metres
Total Quantity Disposed Since 1976:	93 861 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, maintenance dredging at forest industry operations in Howe Sound, British Columbia, resulted in 10 500 cubic metres of material being sent to the Thornbrough Channel disposal site. Specific load site information is listed in Appendix II.

Monitoring Information

This site was last monitored in 1996.

5.7 FIVE FINGER ISLAND

Disposal Site:	Five Finger Island
Co-ordinates:	49°15.20'N; 123°54.60'W
Depth:	280 metres
Total Quantity Disposed Since 1976:	229 112 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 8 018 cubic metres of material resulting from forest industry operations in Nanaimo and Ladysmith, British Columbia, was sent to the Five Finger Island disposal site. Specific load site information is listed in Appendix II.

Monitoring Information

This site was last monitored in 1999.

5.8 PORLIER PASS

Disposal Site:	Porlier Pass
Co-ordinates:	49°00.20'N; 123°29.80'W
Depth:	200 metres
Total Quantity Disposed Since 1976:	187 769 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 6 344 cubic meters of dredged material was disposed of at the Porlier Pass disposal site resulting from maintenance dredging activities at forest industry operations in Chemainus and Ladysmith, British Columbia. Specific load site information is listed in Appendix II.

Monitoring Information

In May 2000, surface sediment samples were collected from 16 stations on the disposal site (Figure 7). The samples were analysed for trace metal concentrations, total polycyclic aromatic hydrocarbons (PAH), total organic carbon (TOC), and particle size distribution (Table 9). No chemical concentrations exceeded the screening limits outlined in the ICTG.

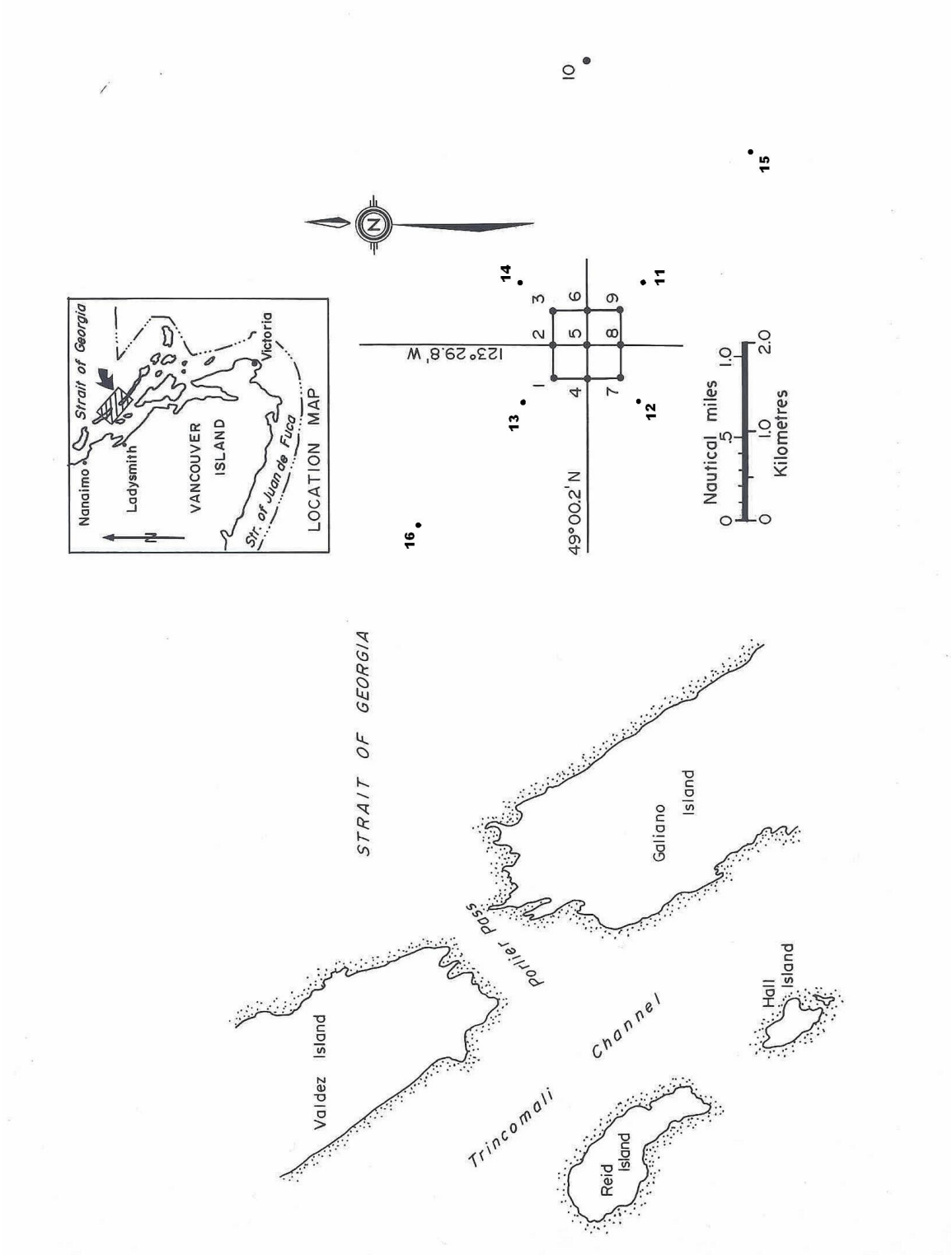

Figure 7: Porlier Pass disposal site sediment sampling stations.

Table 9. Porlier Pass sediment chemistry and particle size data – May 2000.

Station	Sediment Chemistry[1]							% Particle Size			
	Cd	Hg	Cu	Pb	Zn	PAH	TOC	Gravel	Sand	Silt	Clay
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	> 2.0mm	2 - 0.063mm	0.063 - 0.004mm	< 0.004mm
1	0.16	0.080	42.0	38	131	0.74	3.37	3.7	6.8	43.9	45.6
2	0.15	0.080	40.6	33	118	0.55	4.52	201.0	10.7	43.5	43.7
3	0.14	0.083	42.3	35	111	0.31	0.8	2.2	12.4	42.5	42.9
4	0.13	0.084	42.3	40	120	0.49	1.55	0.5	4.7	46.2	48.5
5	0.23	0.085	43.0	38	129	0.44	1.27	7.4	7.5	43.3	41.9
6	0.14	0.082	41.0	29	115	0.41	1.38	2.6	7.8	44.4	45.1
7	0.15	0.086	43.9	40	119	0.40	1.11	0.3	3.9	46.2	49.5
8	0.17	0.080	40.3	38	113	0.40	1.62	9.1	4.6	43.0	43.2
9	0.13	0.083	40.6	36	115	0.43	1.11	1.7	2.8	47.5	48.0
10	0.12	0.082	40.9	34	110	0.24	0.84	0.1	11.3	46.2	42.4
11	0.15	0.084	39.1	40	115	0.39	1.08	0.5	4.2	48.2	47.1
12	0.15	0.090	40.5	33	118	0.35	1.00	0.1	2.5	46.1	51.3
13	0.14	0.090	41.7	33	120	0.36	1.43	1.4	2.9	46.9	48.8
14	0.14	0.084	40.6	36	112	0.38	1.31	6.6	9.5	42.4	41.6
15	0.13	0.089	39.1	29	112	0.27	1.07	0.0	2.5	40.9	46.6
16	0.10	0.088	43.9	30	124	0.36	0.89	0.0	0.9	46.0	53.1

[1] Total metals results are expressed in dry weight.

5.9 JOHNSTONE STRAIT (HANSON ISLAND)

Disposal site:	Johnstone Strait - Hanson Island
Co-ordinates:	50°33.50'N; 126°48.00'W
Depth:	350 metres
Total Quantity Disposed Since 1976:	208 893 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 6 237 cubic metres of dredged material originating from forest industries in Port McNeill and Beaver Cove, British Columbia, was disposed of at the Hanson Island disposal site. Specific load site information is listed in Appendix II.

Monitoring Information

This site was last monitored in 1998.

5.10 THORMANBY ISLAND

Disposal Site:	Thormanby Island
Co-ordinates:	49°27.50'N; 124°04.50'W
Depth:	384 metres
Total Quantity Disposed Since 1976:	13 585 cubic metres

Comments

The DFO Habitat Management Unit in Nanaimo, British Columbia (South Coast Division) should be contacted for specific timing restrictions on dredging.

Load Site Information

In 2000, 4 000 cubic metres of dredged material was disposed of as a result of maintenance dredging in Secret Cove, British Columbia. Specific load site information is listed in Appendix II.

Monitoring Information

This site was last monitored in 1997.

5.11 CAPE MUDGE

Disposal Site:	Cape Mudge
Co-ordinates:	49°57.70'N; 125°05.00'W
Depth:	200 metres
Total Quantity Disposed Since 1976:	155 773 cubic metres

Comments

This site was last used in 1999. DFO generally prohibits dredging/loading activities during the period December 1 to March 15 in the Campbell River area to protect salmon stocks and to minimise disruption of the local sport fishery.

The DFO Habitat Management Unit in Nanaimo, British Columbia (south Coast Division) should be contacted for specific timing restrictions on dredging.

Monitoring Information

In May 2000 surface sediment samples were collected from 10 stations on the disposal site and the surrounding area (Figure 8). The samples were analysed for trace metal concentrations, total polycyclic aromatic hydrocarbons (PAH), total organic carbon (TOC), and particle size distribution. None of the samples exceeded the screening limits outlined in the ICTG. Results are presented in Table 10.

In November 2000, ROPOS II was deployed at the Cape Mudge disposal site. As part of a physical monitoring program, the remotely operated vehicle (ROV) is used to observe the benthic condition of the disposal site and surrounding area. In addition, information on the area of deposition of materials and physical characteristics of sediment in and around the disposal site boundary can be gathered from the ROPOS video. Predetermined track lines were plotted over the disposal site and continuous video images were recorded. Computer-captured still images (transferred to slide and CD ROM) were also collected. A selection of these images is presented in Appendix III.

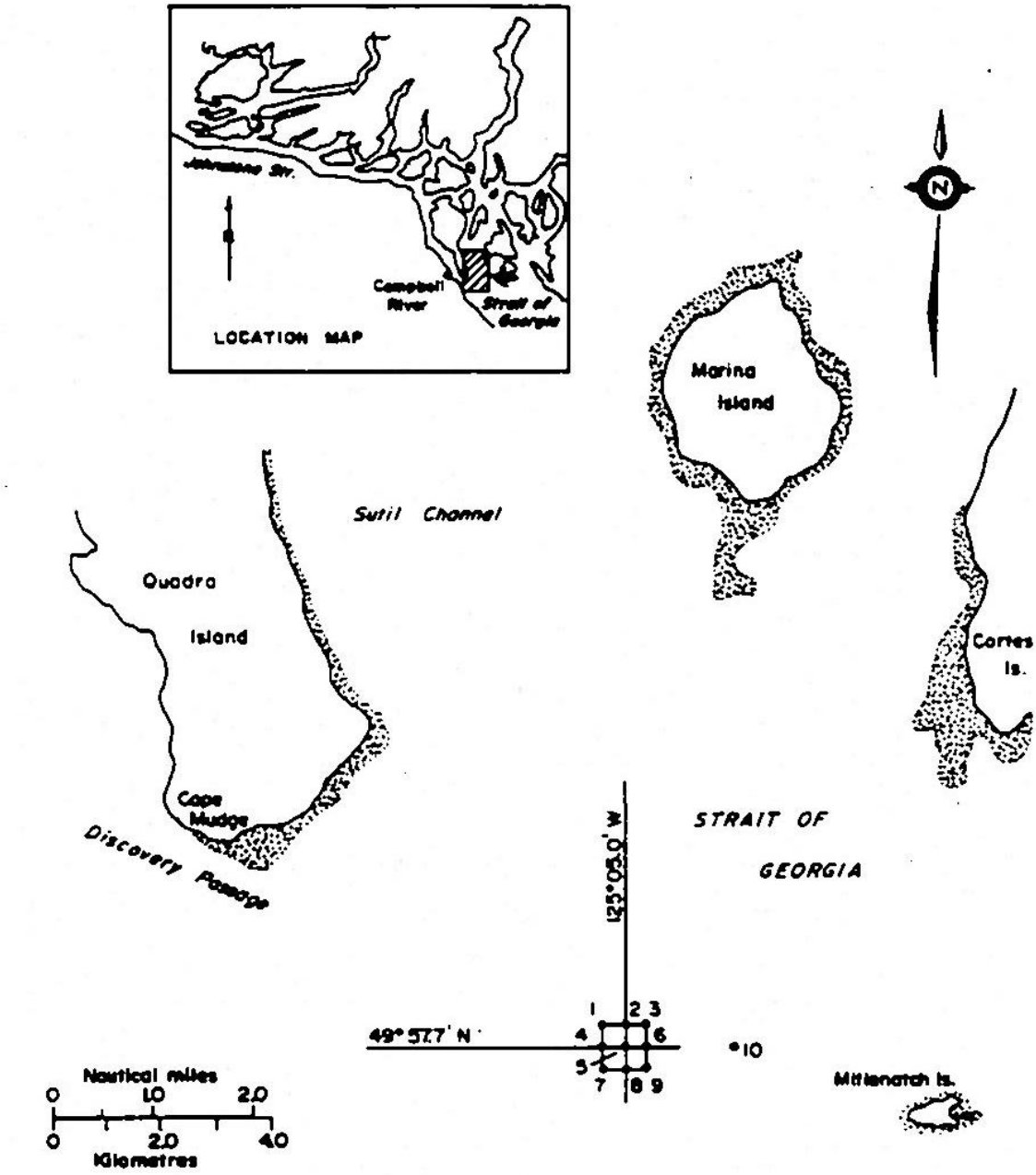

Figure 8. Cape Mudge disposal site sediment sampling stations.

Table 10. Cape Mudge sediment chemistry and particle size data – May 2000.

Station	Sediment Chemistry[1]							% Particle Size			
	Cd	Hg	Cu	Pb	Zn	PAH	TOC	Gravel	Sand	Silt	Clay
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	> 2.0mm	2 - 0.063mm	0.063 - 0.004mm	< 0.004mm
1	0.11	0.036	30.4	15	57	0.18	1.46	0.8	81.4	5.5	9.3
2	0.15	0.063	44.6	25	77	0.36	1.58	0.4	65.8	10.8	20.1
3	0.22	0.091	68.8	27	102	0.65	2.35	0.4	24.4	24.6	48.6
4	0.10	0.042	36.3	18	61	0.19	1.54	0.5	76.0	7.3	12.2
5	0.07	0.057	40.9	18	71	0.25	1.40	0.7	75.9	5.3	12.1
6	0.25	0.093	70.4	21	109	0.76	1.83	0.5	33.8	19.2	39.5
7	0.20	0.045	38.0	19	67	0.19	1.22	0.3	72.1	7.6	14.1
8	0.15	0.058	45.4	22	77	0.27	1.62	0.4	73.6	8.0	16.0
9	0.16	0.076	54.3	24	89	0.34	1.57	0.7	62.9	11.3	24.1
10	-0.04	0.033	24.8	17	54	0.17	0.59	0.3	76.2	8.0	15.5

[1] Total metals results are expressed in dry weight.
Negative numbers represent values below detection limit.

5.12 WATTS POINT

Disposal Site:	Watts Point
Co-ordinates:	49°38.50'N; 123°14.10'W
Depth:	230 metres
Total Quantity Disposed Since 1976:	487 116 cubic metres

Comments

This disposal site was last used in 1997. Dredging is prohibited from April 01 to June 01 of any year in order to protect juvenile salmonids migrating downstream in Mill Creek. The DFO Habitat Management Unit in New Westminster, British Columbia should be contacted for specific timing restrictions on dredging.

Monitoring Information

No sediment samples were collected from Watts Point in 2000.

In November 2000, ROPOS II was deployed at the Watts Point disposal site (Figure 9). As part of a physical monitoring program, the remotely operated vehicle (ROV) is used to observe the benthic condition of the disposal site and surrounding area. In addition, information on the area of deposition of materials and physical characteristics of sediment in and around the disposal site boundary can be gathered from the ROPOS video. Predetermined track lines were plotted over the disposal site and continuous video images were recorded. Computer-captured still images (transferred to slide and CD ROM) were also collected. A selection of these images is presented in Appendix III.

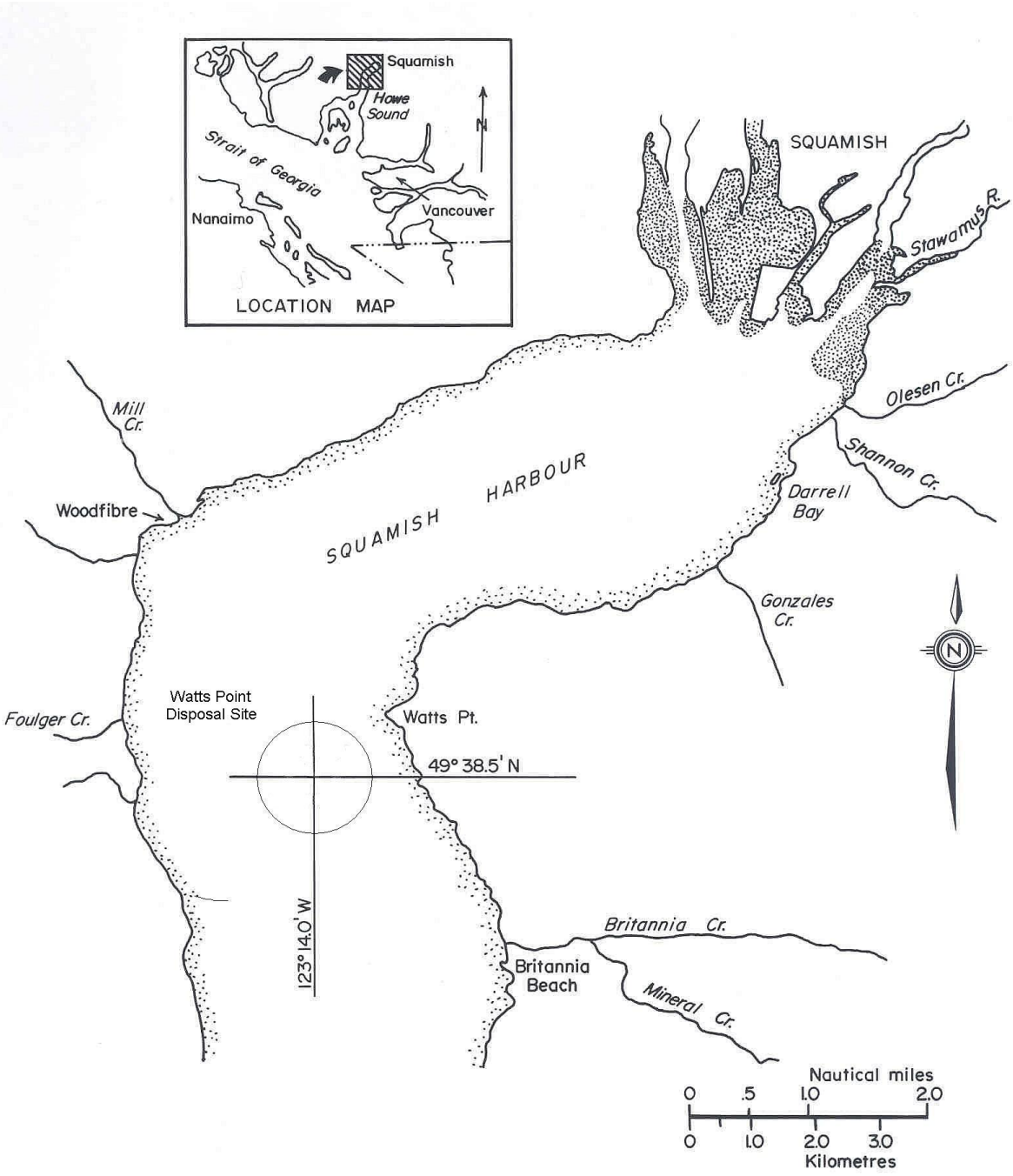

Figure 9: Watts Point disposal site location map.

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APPENDICES

APPENDIX I

Interim Contaminant Testing Guidelines for Disposal at Sea Pacific and Yukon Region (2005 August)

INTERIM CONTAMINANT TESTING GUIDELINES FOR DISPOSAL AT SEA PACIFIC AND YUKON REGION

In response to growing concern over the biological implications of contaminants in marine sediments along the Canadian coastline, Environment Canada (EC), Pacific and Yukon Region, in consultation with the Regional Ocean Disposal Advisory Committee, has developed the following guidelines for sampling, analysis and reporting associated with proposed disposal at sea activities.

Under Schedule 6 (Assessment of Waste or Other Matter) of the *Canadian Environmental Protection Act, 1999* (CEPA 1999), EC and permit applicants must consider the availability of practical alternate disposal options. To satisfy this requirement, the applicant must provide a written record of the decision-making process used in selecting disposal at sea as the alternative of choice for disposal of materials. Disposal at sea is only permitted for materials where it is the environmentally preferable and practical alternative.

To assess the potential for environmental impacts of disposal at sea, EC requires chemical analyses to be performed on any material where there is a lack of chemical data, or a reason to believe that contaminants such as selected trace metals or organics are present. Guidance for the number of samples required may be obtained through Environment Canada's Regional Disposal at Sea offices. A proposed sampling program should be developed by the applicant, based on information provided in the following tables, and submitted to the appropriate Regional Office for approval prior to commencement of loading or disposal activities.

Materials found to contain substances of concern at or higher than the regulated or guideline concentrations identified in the following tables, may be considered for disposal at sea under CEPA 1999, Schedule 6. A substance may be considered for disposal at sea if tests show that it can be disposed of so as not to cause acute or chronic effects on marine organisms or human health, whether or not arising from their bioaccumulation in marine organisms. A tiered assessment approach using biological testing is used for this determination. Disposal at sea options such as capping, containment and side-casting will be considered by EC, but their acceptance will be conditional on compliance with Schedule 6.

SAMPLING AND ANALYSIS REQUIREMENTS

The following pages identify the minimum sampling and analytical requirements for dredged and excavated materials based on the size of the project, as well as rejection/screening limits currently used by EC. Sampling requirements will be tailored on a site specific basis at the discretion of EC, and analysis of other parameters may be requested when EC has reason to believe that other contaminants are present.

MINIMUM REQUIREMENTS FOR DREDGED MATERIAL

Sampling Requirements

The following are the minimum sampling requirements for disposal of dredged material. Additional guidance may be obtained from the *Users Guide to the Application Form for Ocean Disposal* (Report EPS 1/MA/1, 1995) available from Regional Disposal at Sea offices. Projects involving disposal of less than 4 000 cubic metres of material resulting from maintenance dredging are eligible for disposal under a valid general permit (Pacific and Yukon Region).

Parentheses indicate the number of composite samples to be analyzed initially for dioxins/furans, if requested by EC.

Table 1. Minimum sampling requirements for dredged material.

Project Quantity	Permit Type	# of Samples	Type of Sampling
0 - 4 000 m^3	General	3 (1)	Surface sampling prior to loading.
0 - 10 000 m^3	Site-Specific	6 (1)	Surface sampling prior to loading.
10 001 - 30 000 m^3	Site-Specific	5 (1) 4 (1)	Surface sampling prior to loading. Sampling to depth prior to loading.
		OR	
10 001 - 30 000 m^3	Site-Specific	9 (2)	Surface sampling prior to loading.
30 001 - 60 000 m^3	Site-Specific	5 (2) 5 (2)	Surface sampling prior to loading. Sampling to depth prior to loading.
> 60 000 m^3	Site-Specific	Sampling requirements will be determined on a project specific basis.	

Should the site history reveal cause for environmental concern, an increased number of samples and/or analysis of additional metals and/or organics may be requested.

Analysis Requirements

Details of minimum analytical requirements may be obtained through Environment Canada's Regional Disposal at Sea offices.

Table 2. Minimum analysis requirements for dredged material.

	Parameter	Limit of Detection
Trace Metals	Mercury	0.2 µg/g
	Cadmium	0.2 µg/g
Organics	PAH	0.1 µg/g
Other	Total Organic Carbon	
	Particle Size	

For Polycyclic Aromatic Hydrocarbons (PAH's), the analytical methodology and quality assurance protocol must conform to that outlined in the 'Interim Quality Assurance Guidelines for Determination of Polycyclic Aromatic Hydrocarbons in Marine Sediments for Ocean Disposal', a copy of which is available from EC.

For dioxin/furan, the analytical methodology and quality assurance protocol must conform to that outlined in the 'Internal Quality Assurance Requirements for Analysis of Dioxins in Environmental Samples', a copy of which is available from EC.

The analysis results are to be reported on a dry weight basis with detection limits less than or equal to those stated above. The precision of the test method should be indicated by reporting analyses on five replicate sub-samples on 10% of the trace metal samples, and two replicate sub-samples on 20% of the organics samples, with a minimum of one replicated sample. Sub-sampling should be done following homogenizing but prior to digestion of the sample and the replicates should not be run consecutively. The accuracy of the test method should be indicated by reporting the results of certified reference materials analyzed at the same time as the test samples.

MINIMUM REQUIREMENTS FOR EXCAVATION MATERIAL

Sampling Requirements

The following are the minimum sampling requirements for disposal of excavated material. Additional guidance may be obtained from the *Users Guide to the Application Form for Ocean Disposal* (Report EPS 1/MA/1, 1995), which is available through Environment Canada's Regional Disposal at Sea offices.

Projects involving disposal at sea of undisturbed native till may be completed under a valid general excavation permit (Pacific and Yukon Region). For other excavated materials, a site specific permit will be required.

Table 3. Minimum sampling requirements for excavated material.

Project Quantity	# of Samples	Type of Sampling
0 - 10 000 m^3	6	Composite of surface native till to 1 metre depth.
10 001 - 30 000 m^3	9	Composite of surface native till to 1 metre depth.
30 001 - 60 000 m^3	12	Composite of surface native till to 1 metre depth.
> 60 000 m^3	Number of samples to be determined on a project specific basis.	

Should the site history reveal cause for environmental concern, an increased number of samples and/or analysis of additional metals and/or organics may be requested.

Analysis Requirements

Details of minimum analytical requirements may be obtained through Environment Canada's Regional Disposal at Sea Offices.

Table 4. Minimum analysis requirements for excavated material.

	Parameter	Limit of Detection
Trace Metals	Mercury	0.2 µg/g
	Cadmium	0.2 µg/g
Organics	PAH	0.1 µg/g
Other	Total Organic Carbon	
	Particle Size	

For PAH's, the analytical methodology and quality assurance protocol must conform to that outlined in the 'Interim Quality Assurance Guidelines for Determination of Polycyclic Aromatic Hydrocarbons in Marine Sediments for Ocean Disposal', a copy of which is available from EC.

For dioxin/furan, the analytical methodology and quality assurance protocol must conform to that outlined in the 'Internal Quality Assurance Requirements for Analysis of Dioxins in Environmental Samples', a copy of which is available from EC.

The analysis results are to be reported on a dry weight basis with detection limits less than or equal to those stated above. The precision of the test method should be indicated by reporting sub-samples on 20% of the organics samples, with a minimum of one replicated sample. Sub-sampling should be done following homogenizing but prior to digestion of the sample and the replicates should not be run consecutively. The accuracy of the test method should be indicated by reporting the results of certified reference materials analyzed at the same time as the test samples.

REJECTION/SCREENING LIMITS

Material found to exceed the following regulated and guideline limits will not be considered for disposal at sea unless tests show it can be disposed of at sea within the criteria established under Schedule 6, CEPA 1999.

Environment Canada may impose more stringent limits if the site history indicates cause for environmental concern.

Table 5. Rejection/screening limits for disposal at sea.

Parameter	Rejection/Screening Limit
Cadmium	0.6 μg/g dry weight
Mercury	0.75 μg/g dry weight
Chlorophenols (PCP) (penta and tetra isomers)	1.0 μg/g dry weight
Polychlorinated biphenyls (PCB)	0.1 μg/g dry weight
Total PAH	2.5 μg/g dry weight
Dioxin/Furan	"Quantifiable" 2,3,7,8 TCDD

STEPS REQUIRED FOR COLLECTING SAMPLES AND SUBMITTING ANALYTICAL DATA

The applicant is required to prepare the following information to be included with the proposed sampling program:

1) A location map for the dredge or excavation site with the street address of the proposed dredge/excavation site;
2) A site map showing the proposed dredge or excavation site relative to known landmarks and/or streets;
3) A list of any known possible contaminant input sources in the vicinity of the proposed works;
4) A written record of the decision making process used in selecting disposal at sea as the preferred disposal option, explaining why other disposal methods are not being used;
5) A site use history for the site from which the material approved for disposal at sea will originate; and
6) A proposed sampling plan of the site showing the proposed sampling locations and a list of proposed analyses. The proposed sampling plan should be developed based on information presented in this document and the *Users Guide to the Application Form for Ocean Disposal*. Assistance in designing a sampling program can be provided by Environment Canada. **The sampling program must be approved prior to taking the samples.**

The information identified above should be sent to EC. If the project does not qualify for completion under the terms and conditions of a general permit, this information should be submitted with a completed Disposal at Sea Application. For information on how to apply, please contact EC.

If the project qualifies for completion under a general disposal at sea permit, this information must be submitted to EC with a covering letter describing the proposed activities in detail and the proposed schedule for the work. Upon completion of the sampling and analyses program, the test data, together with all QA/QC data as identified in the foregoing information, must be sent to EC.

No work may proceed under a general permit until written approval for the specific site has been received from EC and a copy of the approval letter is posted at the work site.

For further information on this document, or any other matter relating to the Disposal at Sea Program, please visit the Pacific and Yukon Region Disposal at Sea website at http://www.pyr.ec.gc.ca/disposal_at_sea/index_e.htm or send an email to OceanDisposal@ec.gc.ca.

GENERAL GUIDE TO SOIL AND SEDIMENT SAMPLE COLLECTION

Containers for the samples should be obtained from the laboratory contracted to conduct the required analyses. Avoid unnecessary contact with clean glassware and utensils. A clean stainless steel or teflon spoon or scoop is ideal for transferring samples. Handle containers by the outsides only. Do not touch the inside of the jar, or teflon (or foil) liners, and use spoons or scoops by the handles only. When removing a foil or teflon liner and lid from a jar, remove as one piece and put down on a piece of foil or other clean surface while filling the jar.

If using a grab sampler, remove the water from the surface of the grab, taking care not to disturb the contents if possible. Use the clean scoop to remove a portion of the sediment from the middle of the sampler down to the depth of the material caught in the grab. The material in the sample jar should be representative of the material to be loaded for disposal at sea.

Alternatively, the sample may be taken by removing the lid, holding the jar by the sides and scooping the sample from the sediment without the use of other utensils. The threads of the jar may then be wiped with a paper towel before replacing the lid. Do not fill the jar more than about 3/4 full, allowing plenty of room for mixing/stirring and expansion during freezing. When the sample is in the jar, replace the teflon/foil liner and lid, and label the jar with project identification, sampling site number and sampling date.

To clean the sampling spoon or grab in between samples, wipe with a paper towel to remove any solids, then rinse with water. Clean the tray in this manner as required.

If three samples are required for analysis, three small jars of sediment should be taken for <u>each</u> sampling station, for a total of nine jars. The three jars per sample will be composited by the analytical lab by taking equal aliquots of sample from each jar for a single analysis of most parameters of concern. The samples may be further composited for other testing as required but would otherwise be maintained as discrete samples.

Keep the samples in a refrigerator or on ice for short term storage (1-2 days); freeze the sample as soon as possible or store over dry ice for long term storage. The laboratory responsible for the analyses should be asked to freeze the samples after removal of sufficient material to complete the required analyses. These samples should remain frozen until the permit, or approval under a general permit, has been issued by EC.

APPENDIX II

Disposal Site Summaries

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site Point Grey
Latitude 49°15.40′N
Longitude 123°22.10′W
Depth (m) 210

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3216	FR-DELTA CEDAR	10-Jan-00	750 m3
Dredge	3216	FR-DELTA CEDAR	14-Jan-00	1,500 m3
Dredge	3216	FR-FRASER PULP CHIP	17-Jan-00	1,200 m3
Dredge	3216	FRNA-TERMINAL SAWMILL	17-Feb-00	2,500 m3
Dredge	3216	FRNA-RICHMOND PLYWOOD	11-Mar-00	2,500 m3
Dredge	3216	FRNA-GOLDWOOD IND	28-Apr-00	2,500 m3
Dredge	3216	FRNA-RICHMOND PLYWOOD	06-May-00	1,200 m3
Dredge	3217	FRNA-MB-NW	22-Feb-00	1,500 m3
Dredge	3217	FRNA-MB-NW	31-Mar-00	750 m3
Dredge	3217	FRNA-MB-CANADIAN WHITE PINE	01-Apr-00	1,100 m3
Dredge	3217	FRNA-MB-NW	02-May-00	3,000 m3
Dredge	3219	FRNA-WEST COAST CELLUFIBRE - EAST	20-Mar-00	1,500 m3
Dredge	3219	FRNA-WEST COAST CELLUFIBRE - WEST	20-Mar-00	1,000 m3
Dredge	3219	FR-MCKENZIE MILLS	01-May-00	600 m3
Dredge	3229	FR-CANRON DOCK	10-Feb-00	850 m3
Dredge	3229	FR-STELLA-JONES	10-Feb-00	4,428 m3
Dredge	3230	VAN HBR	17-May-00	225 m3
Dredge	3236	FR-CANOE PASS	18-Nov-00	400 m3
Dredge	3236	FR-CANOE PASS	25-Nov-00	700 m3
Dredge	3237	FR-CIPA LUMBER	25-Mar-00	1,500 m3
Dredge	3237	FR-CIPA LUMBER	19-Aug-00	1,500 m3
Dredge	3237	FR-CIPA LUMBER	25-Nov-00	1,500 m3
Dredge	3239	FR-DELTA CEDAR	11-Mar-00	700 m3
Dredge	3239	FR-DELTA CEDAR	28-May-00	700 m3
Dredge	3239	FR-DELTA CEDAR	17-Jul-00	5,900 m3
Dredge	3239	FR-DELTA CEDAR	01-Oct-00	700 m3
Dredge	3239	FR-DELTA CEDAR	10-Dec-00	700 m3
Dredge	3240	FR-ACORN-PRIMEX	12-Feb-00	2,500 m3
Dredge	3240	FR-ACORN-PRIMEX	19-Aug-00	2,500 m3
Dredge	3243	FRNA-SILVERTREE SAWMILLS	24-Jul-00	5,250 m3
Dredge	3243	FRNA-SILVERTREE SAWMILLS	21-Aug-00	6,000 m3
Dredge	3243	FRNA-SILVERTREE SAWMILLS	09-Sep-00	800 m3
Dredge	3244	FRNA-RICHMOND PLYWOOD	22-Jul-00	2,000 m3
Dredge	3244	FRNA-WESTERN WHITEWOOD	23-Aug-00	1,500 m3
Dredge	3244	FRNA-TERMINAL FOREST PRODUCTS -	26-Aug-00	2,000 m3
Dredge	3244	FR-HAMMOND CEDAR	07-Oct-00	4,000 m3
Dredge	3244	FR-MCKENZIE MILLS	07-Oct-00	3,000 m3

Dredge	3244	FRNA-SCOTT PAPER LTD	20-Oct-00	1,500 m3
Dredge	3244	FR-FRASER PULP CHIP	30-Oct-00	2,030 m3
Dredge	3244	FRNA-MAINLAND SAWMILL	09-Nov-00	4,000 m3
Dredge	3244	FR-MILL & TIMBER	10-Nov-00	4,000 m3
Dredge	3244	FR-BARNSTON ISLAND-GVRD	24-Nov-00	1,500 m3
Dredge	3244	FR-TILBURY CEMENT	06-Dec-00	4,000 m3
Dredge	3244	FR-FRASER MILLS BUNDLE CRANE	18-Dec-00	4,000 m3
Dredge	3244	FRNA-CONAG-RICHMOND	30-Dec-00	2,250 m3
Dredge	3244	FRNA-CONAG-DUCK ISLAND	30-Dec-00	750 m3
Dredge	3246	FRNA-MB-CANADIAN WHITE PINE	24-Jul-00	12,500 m3
Dredge	3246	FRNA-MB-NW	08-Aug-00	8,500 m3
Dredge	3246	FRNA-MB-NW	27-Dec-00	4,000 m3
Dredge	3247	FR-S&R SAWMILLS	06-Sep-00	48,910 m3
Dredge	3249	FR-PACIFIC CUSTOM LOG SORT	01-Aug-00	2,639 m3
Dredge	3249	FR-TEAL CEDAR	01-Nov-00	3,070 m3
Dredge	3251	FRNA-WEST COAST CELLUFIBRE - WEST	24-Aug-00	1,500 m3
Dredge	3251	FRNA-WEST COAST CELLUFIBRE - EAST	24-Aug-00	1,500 m3
			Total Dredge Quantity:	**177,602 m3**

Excavation	3225	LOWER MAINLAND-BEL	01-Jan-00	0 m3
Excavation	3225	LOWER MAINLAND-BEL	01-Feb-00	7,852 m3
Excavation	3225	LOWER MAINLAND-BEL	02-Mar-00	5,071 m3
Excavation	3225	LOWER MAINLAND-BEL	03-Mar-00	1,644 m3
Excavation	3225	LOWER MAINLAND-BEL	06-Mar-00	4,488 m3
Excavation	3225	LOWER MAINLAND-BEL	11-Mar-00	2,166 m3
Excavation	3225	LOWER MAINLAND-BEL	03-Apr-00	469 m3
Excavation	3225	LOWER MAINLAND-BEL	04-Apr-00	209 m3
Excavation	3225	LOWER MAINLAND-BEL	06-Apr-00	2,139 m3
Excavation	3225	LOWER MAINLAND-BEL	01-May-00	7,400 m3
Excavation	3225	LOWER MAINLAND-BEL	05-May-00	2,977 m3
Excavation	3225	LOWER MAINLAND-BEL	10-May-00	1,210 m3
Excavation	3225	LOWER MAINLAND-BEL	01-Jun-00	2,470 m3
Excavation	3225	LOWER MAINLAND-BEL	01-Jun-00	2,238 m3
Excavation	3225	LOWER MAINLAND-BEL	08-Jun-00	1,762 m3
Excavation	3248	LOWER MAINLAND-BEL	04-Jul-00	7,007 m3
Excavation	3248	LOWER MAINLAND-BEL	06-Jul-00	52 m3
Excavation	3248	LOWER MAINLAND-BEL	14-Jul-00	1,118 m3
Excavation	3248	LOWER MAINLAND-BEL	01-Aug-00	1,476 m3
Excavation	3248	LOWER MAINLAND-BEL	11-Aug-00	2,522 m3
Excavation	3248	LOWER MAINLAND-BEL	26-Aug-00	468 m3
Excavation	3248	LOWER MAINLAND-BEL	05-Sep-00	6,110 m3
Excavation	3248	LOWER MAINLAND-BEL	06-Sep-00	2,607 m3
Excavation	3248	LOWER MAINLAND-BEL	07-Sep-00	780 m3
Excavation	3248	LOWER MAINLAND-BEL	25-Sep-00	3,315 m3
Excavation	3248	LOWER MAINLAND-BEL	02-Oct-00	3,595 m3

Excavation	3248	LOWER MAINLAND-BEL	02-Oct-00	3,439	m3
Excavation	3248	LOWER MAINLAND-BEL	04-Oct-00	1,118	m3
Excavation	3248	LOWER MAINLAND-BEL	04-Oct-00	572	m3
Excavation	3248	LOWER MAINLAND-BEL	14-Oct-00	6,182	m3
Excavation	3248	LOWER MAINLAND-BEL	18-Oct-00	7,963	m3
Excavation	3248	LOWER MAINLAND-BEL	19-Oct-00	1,625	m3
Excavation	3248	LOWER MAINLAND-BEL	01-Nov-00	9,250	m3
Excavation	3248	LOWER MAINLAND-BEL	01-Nov-00	15,139	m3
Excavation	3248	LOWER MAINLAND-BEL	04-Nov-00	436	m3
Excavation	3248	LOWER MAINLAND-BEL	17-Nov-00	3,855	m3
Excavation	3248	LOWER MAINLAND-BEL	22-Nov-00	3,263	m3
Excavation	3248	LOWER MAINLAND-BEL	01-Dec-00	22,518	m3
			Total Excavation Quantity:	**146,500**	**m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site Sand Heads
Latitude 49°06.00′N
Longitude 123°19.50′W
Depth (m) 70

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3216	FR-SEASPAN COASTAL	10-Jan-00	2,500 m3
Dredge	3216	FRNA-RICHMOND LANDFILL RAMP	14-Jan-00	1,200 m3
Dredge	3216	FR-TOEWS BROS	17-Apr-00	3,000 m3
Dredge	3216	FR-COAST MOUNTAIN HARDWOODS	06-May-00	2,600 m3
Dredge	3227	FR-LADNER-PWC	19-Jun-00	11,000 m3
Dredge	3227	FR-DEAS SLOUGH	04-Jul-00	6,000 m3
Dredge	3229	FR-RITCHIE BROTHERS	17-Feb-00	2,805 m3
Dredge	3229	CRESCENT BEACH MARINA	03-Mar-00	4,310 m3
Dredge	3229	FR-NOBLE CUSTOM CUTTING	17-Mar-00	3,973 m3
Dredge	3240	FR-ACORN-PRIMEX	14-Feb-00	6,500 m3
Dredge	3244	FR-BARNSTON ISLAND-GVRD	24-Oct-00	3,000 m3
Dredge	3244	FR-CONAG-SURREY	27-Dec-00	4,000 m3
Dredge	3249	FR-RIVTOW-BARGE RAMP	10-Oct-00	3,994 m3
Dredge	3250	FR-MAINTENANCE	12-Jul-00	27,000 m3
Dredge	3250	FR-MAINTENANCE	12-Sep-00	143,120 m3
Dredge	3250	FR-MAINTENANCE	12-Sep-00	1,250 m3
Dredge	3250	FR-MAINTENANCE	26-Sep-00	27,400 m3
Dredge	3250	FR-MAINTENANCE	26-Sep-00	22,210 m3
Dredge	3250	FR-MAINTENANCE	27-Sep-00	20,120 m3
			Total Dredge Quantity:	**295,982 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site Comox (Cape Lazo)
Latitude 49°41.70′N
Longitude 124°44.50′W
Depth (m) 190

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3240	VAN IS-PRIMEX-FIELD SAWMILLS	03-Aug-00	10,000 m3
Dredge	3244	VAN IS-COMOX BAY MARINA	11-Aug-00	4,000 m3
Dredge	3244	VAN IS-COMOX TIMBER	12-Aug-00	3,000 m3
			Total Dredge Quantity:	**17,000 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site	Malaspina Strait
Latitude	49°45.00′N
Longitude	124°26.95′W
Depth (m)	320

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3232	POWELL RIVER	07-Feb-00	2,035 m3
Dredge	3232	POWELL RIVER	29-Aug-00	6,226 m3
Dredge	3232	POWELL RIVER	09-Sep-00	7,485 m3
			Total Dredge Quantity:	**15,746 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site	Johnstone Strait-Hickey Point
Latitude	50°27.80′N
Longitude	126°04.80′W
Depth (m)	270

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3235	VAN IS-EVE RIVER	04-Jan-00	3,524 m3
Dredge	3238	VAN IS-KELSEY BAY-MB	29-Jan-00	9,733 m3
			Total Dredge Quantity:	**13,257 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site Thornbrough Channel
Latitude 49°31.00′N
Longitude 123°28.30′W
Depth (m) 220

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3216	HOWE SD-AVALON	09-Feb-00	4,000 m3
Dredge	3216	HOWE SD-TERMINAL FORESTS	12-Feb-00	2,500 m3
Dredge	3244	HOWE SD-AVALON	19-Jun-00	4,000 m3
			Total Dredge Quantity:	**10,500 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site Five Finger Island
Latitude 49°15.20′N
Longitude 123°54.60′W
Depth (m) 280

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3226	VAN IS-HARMAC	25-Jan-00	1,530 m3
Dredge	3245	VAN IS-LADYSMITH-DOMANS	04-Jul-00	505 m3
Dredge	3245	VAN IS-DOMANS-DUKE PT-SAWMILL	05-Jul-00	1,580 m3
Dredge	3245	VAN IS-DOMANS-DUKE PT-LOG	10-Jul-00	2,005 m3
Dredge	3245	BULL PASSAGE-LASQUETI ISLAND	20-Jul-00	22 m3
Dredge	3245	POINT UPWOOD - TEXADA ISLAND	20-Jul-00	15 m3
Dredge	3245	FALSE NARROWS-GABRIOLA ISLAND	20-Jul-00	9 m3
Dredge	3252	VAN IS-COASTLAND WOOD IND	15-Aug-00	2,352 m3
			Total Dredge Quantity:	**8,018 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site	Porlier Pass
Latitude	49°00.20′N
Longitude	123°29.80′W
Depth (m)	200

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3236	VAN IS-CHEMAINUS-SAWMILL	24-Jul-00	3,505 m3
Dredge	3236	VAN IS-CHEMAINUS-MB-DRYSORT	28-Jul-00	2,115 m3
Dredge	3245	VAN IS-LADYSMITH-DOMANS	01-Jul-00	724 m3
			Total Dredge Quantity:	**6,344 m3**

Disposal Site History Report

For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site Johnstone Strait-Hanson Island
Latitude 50°33.50′N
Longitude 126°48.00′W
Depth (m) 350

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3235	VAN IS-PORT MCNEILL-WESTERN	07-Jan-00	3,886 m3
Dredge	3235	VAN IS-PORT MCNEILL-MB	11-Jan-00	1,237 m3
Dredge	3235	VAN IS-BEAVER COVE-CANFOR	12-Jan-00	1,114 m3
			Total Dredge Quantity:	**6,237 m3**

Disposal Site History Report

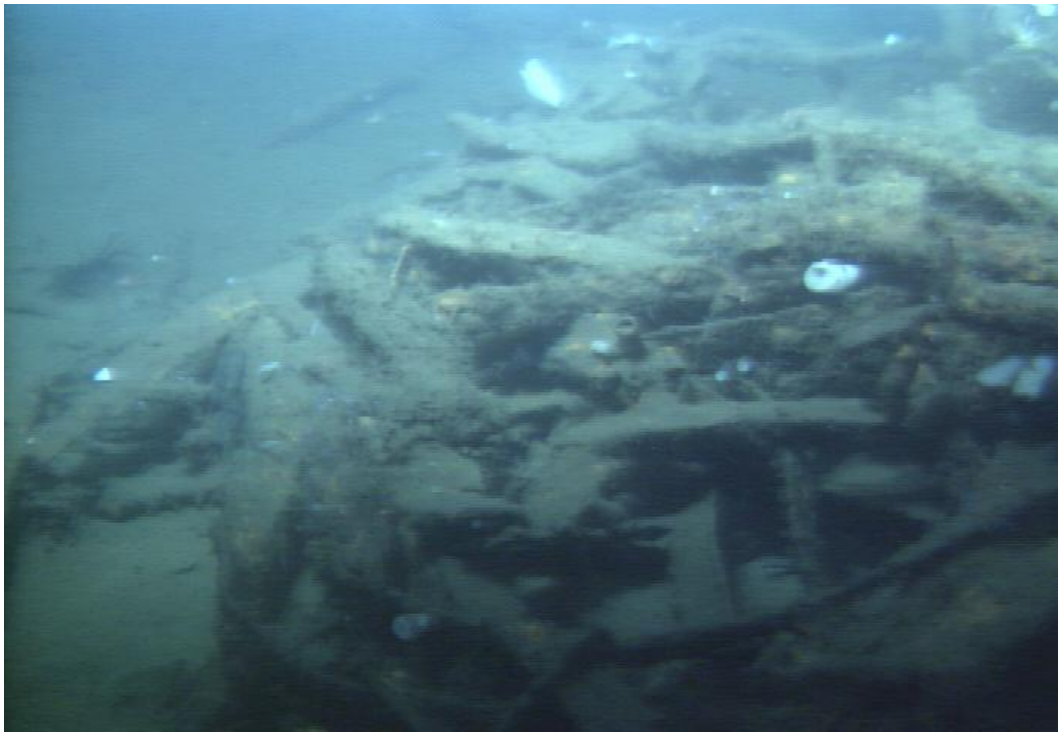
For Disposal Activities Between 2000/01/01 and 2000/12/31

Disposal Site	Thormanby Island
Latitude	49°27.50′N
Longitude	124°04.50′W
Depth (m)	384

Permit Type	Permit	Load Site	Dump Start Date	Quantity
Dredge	3216	SECRET COVE - LOT 6	31-Jan-00	4,000 m3
			Total Dredge Quantity:	**4,000 m3**

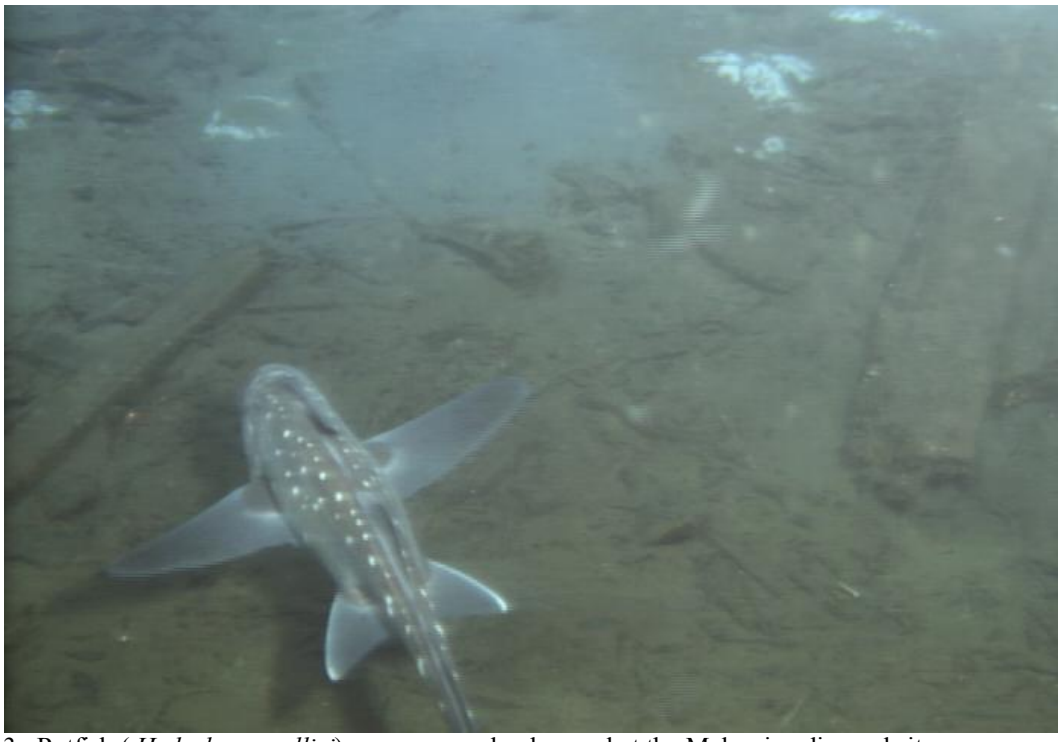
APPENDIX III

Images Obtained by ROPOS II



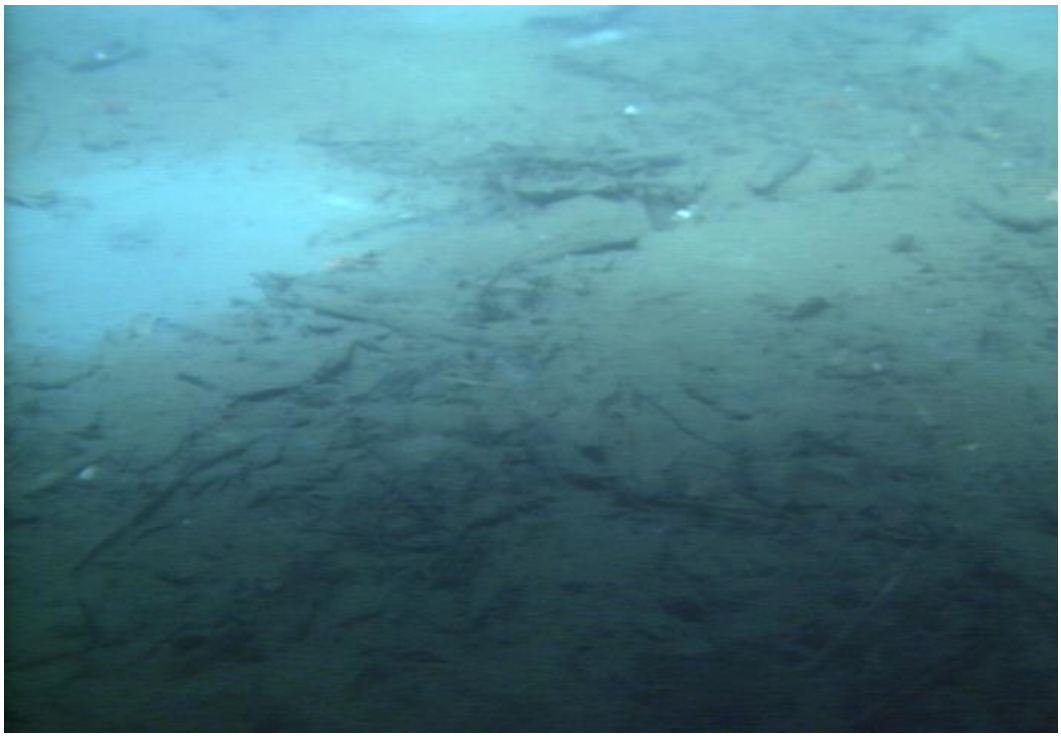
1. Wood waste debris at the Malaspina Strait disposal site

2. Prawns (*Pandalus platyceros)* use wood waste debris as habitat within the disposal site.

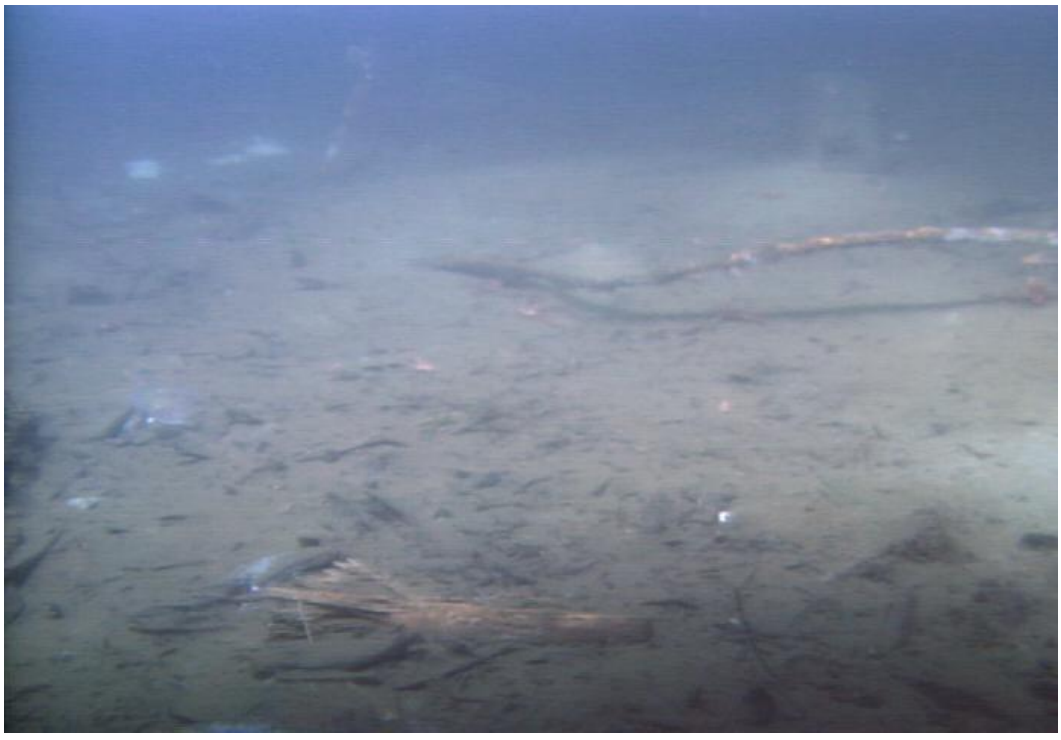


3. Ratfish (*Hydrolagus colliei*) are commonly observed at the Malaspina disposal site.

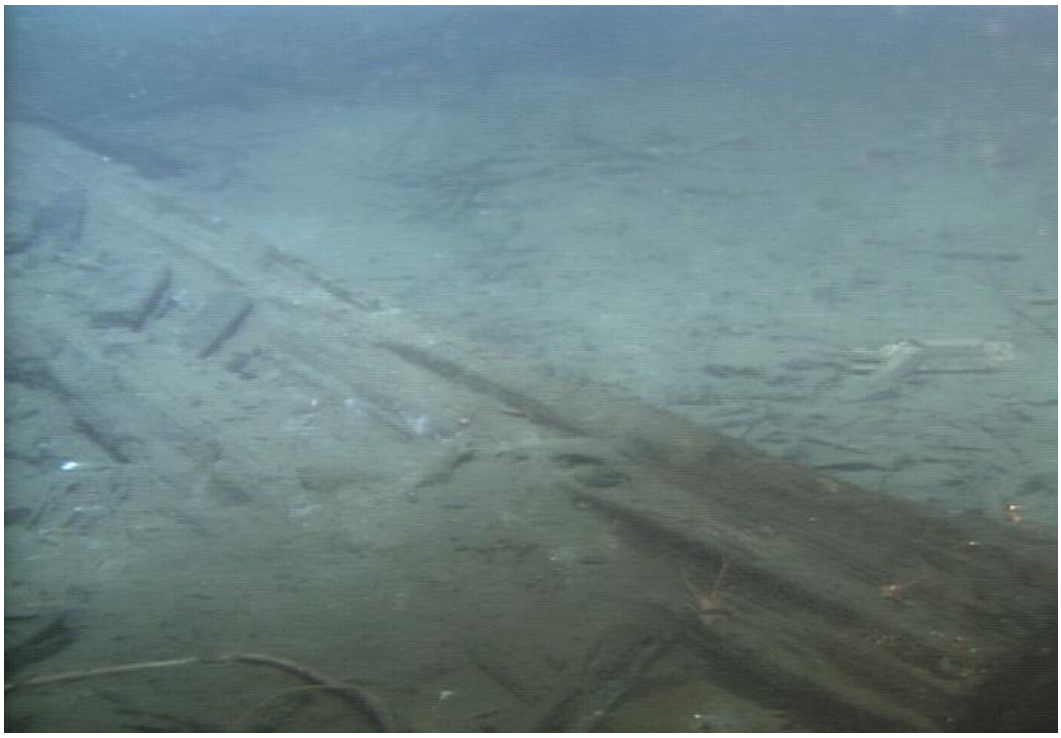
4. Wood waste debris provides valuable habitat for marine life such as squat lobsters (*Munida quadrispina)*.



5. Wood waste debris at the Cape Mudge disposal site.



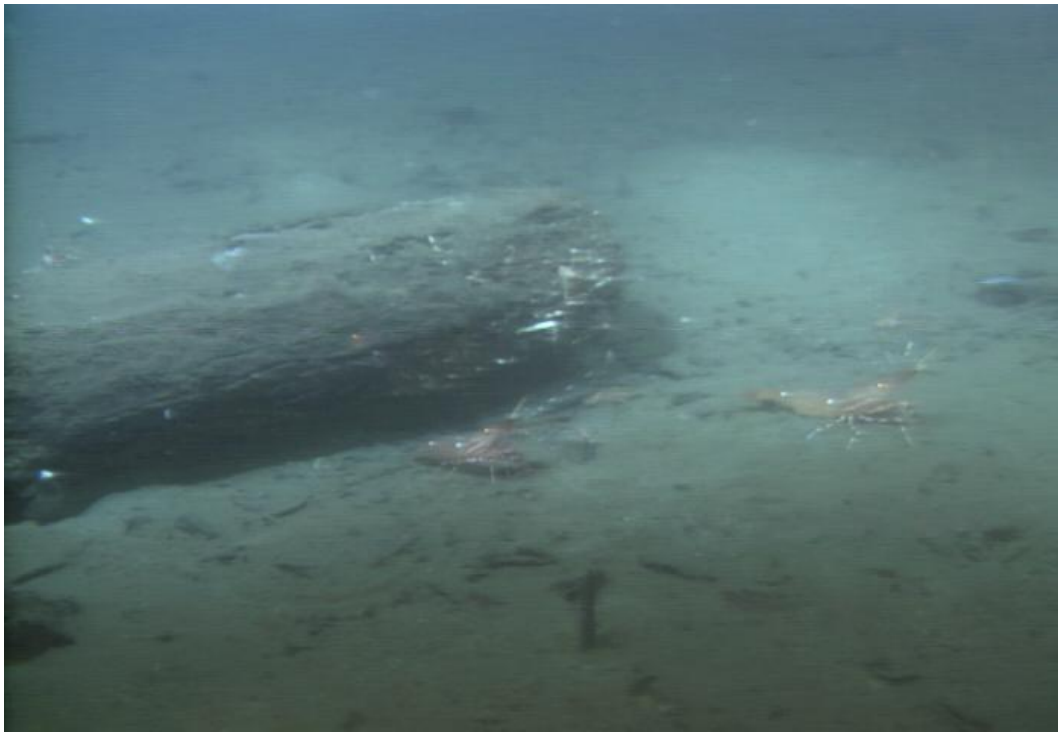
6. Wood waste debris at the Cape Mudge disposal site.



7. Wood waste debris at the Watts Point disposal site.

8. Shellfish are attracted to the wood waste debris at the Watts Point disposal site.

9. Rockfish (*Sebastes sp.)* passing through the Watts Point disposal site.



10. Prawns (*Pandalus platyceros*) use wood waste debris as habitat.