APPENDIX H

PREVIOUS PSDDA CHARACTERIZATION ANALYSES

- 1997 Report for the Bellingham Shipping Terminal Area

- 1998 PSDDA Screening for Portions of the I&J & Whatcom Waterways

- See Also: Testing as part of the 2003 PRDE Report (Appendix A)

STRIPLIN Environmental Associates

PSDDA Sediment Characterization Report

Whatcom International Shipping Terminal
Bellingham, Washington

July 7, 1997

Prepared for:

Port of Bellingham
625 Cornwall Avenue
Bellingham, WA 98225

Prepared by:

Striplin Environmental Associates, Inc.
222 Kenyon St. N.W.
Olympia, WA 98502

PSDDA SEDIMENT CHARACTERIZATION REPORT

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

BT	Bioaccumulation Trigger
DGPS	Differential Global Positioning System
DMMU	Dredged Material Management Unit
HPAH	High Molecular Weight Polycyclic Hydrocarbon
LPAH	Low Molecular Weight Polycyclic Hydrocarbon
MCUL	Minimum Cleanup Level
ML	Maximum Level
MLLW	Mean Lower Low Water
NAD	North American Datum
QA/QC	Quality Assurance/Quality Control
PCB	Polychlorinated Biphenyl
PSEP	Puget Sound Estuary Program
PSDDA	Puget Sound Dredged Disposal Analysis
SAP	Sampling and Analysis Plan
SEA	Striplin Environmental Associates
SL	Screening Level
SQS	Sediment Quality Standard
TBT	Tributyltin
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
WIST	Whatcom International Shipping Terminal

1. INTRODUCTION

The Port of Bellingham is evaluating options for dredging sediments in Whatcom Creek Waterway (Station 29+00 to Station 42+00) to deepen the berth at the Whatcom International Shipping Terminal (WIST), Bellingham, Washington (Figures 1 and 2). The proposed dredging design depth is -35 ft Mean Lower Low Water (MLLW) resulting in the need to dredge 8,700 cubic yards. PSDDA guidance ranks Bellingham Harbor as an area of high concern for sediment chemicals of concern.

In April, 1997, the Port of Bellingham conducted a full sediment characterization in the proposed WIST dredging area to identify suitable dredged material disposal option(s). This report presents the results of this characterization. All sampling and testing was performed in accordance with PSDDA (1989) and other regulatory requirements and the project Sampling and Analysis Plan (SEA 1997, Appendix A).

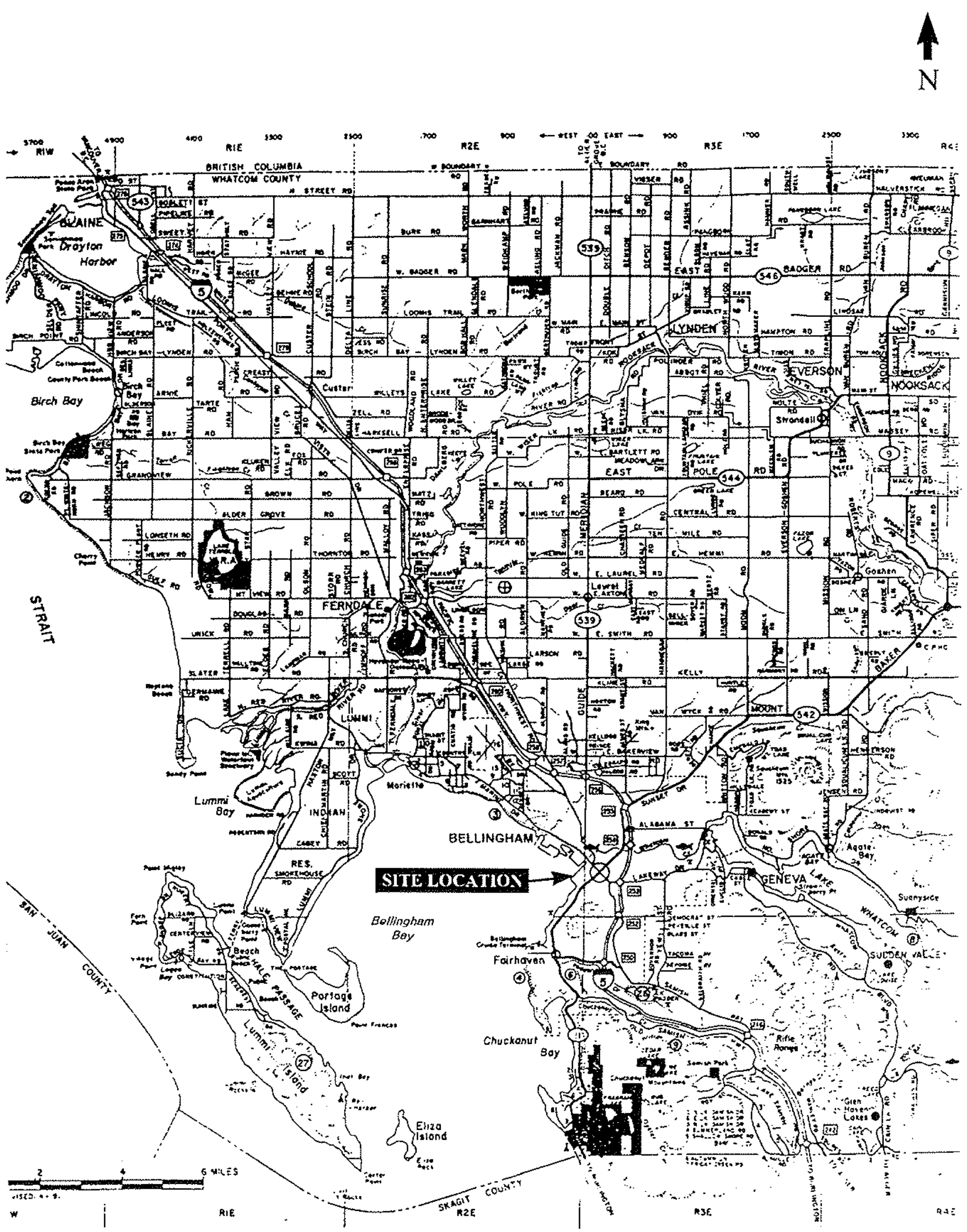

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Figure 1	Vicinity Map	*WIST Sediment Characterization*	
		June 1997	*whatcom1.xar*

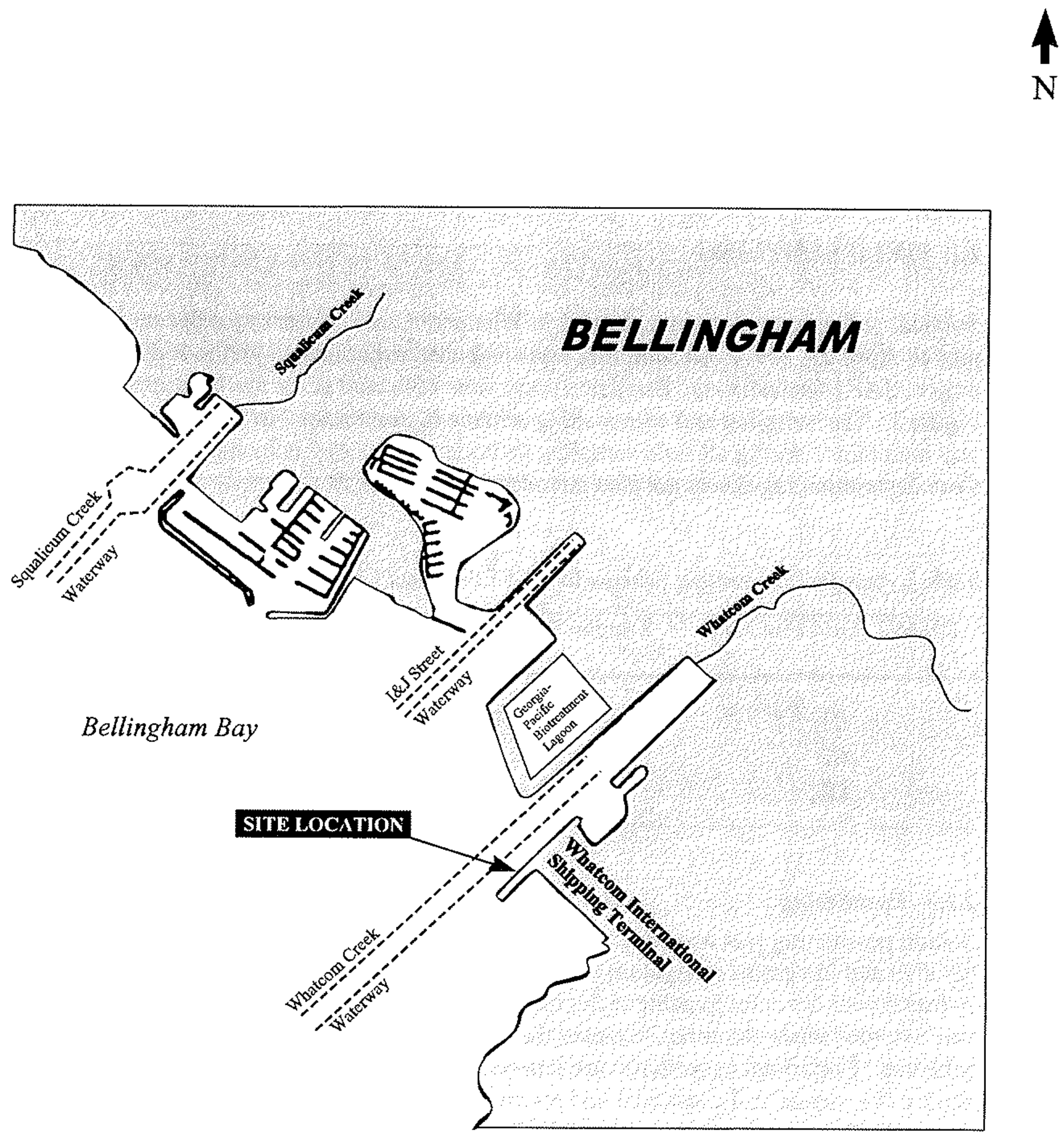

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	Figure 2	Location Map	*WIST Sediment Characterization*
			January 1997 / *whatcom2.xar*

2. METHODS

2.1 FIELD SAMPLING

Subtidal sediment cores were collected in Whatcom Creek Waterway adjacent to the WIST pier on April 21, 1997. All sampling was conducted according to methods described in the project SAP (Appendix A). Duplicate cores were collected at the six locations shown in Figure 3. The sampling and compositing scheme is summarized in Table 1. A field log was maintained during all field sampling activities and a copy is included in Appendix B. Core description log sheets are also included in Appendix B.

Table 1. Sample Compositing Scheme for WIST Sediment Characterization.

DMMU (Grid Unit No.)	Sample ID (Core Section)	DMMU Volume Represented (cubic yards)
C1	1A & 2A	3900
C2	3A & 4A	3900
C3	5A & 6A	3700

2.1.1 Positioning

Station positioning was accomplished using a Differential Global Positioning System (DGPS) and integrated navigation software. The GPS receiver was located at the top of the A-frame over the corer to achieve the most accurate position for each core. A positional fix was recorded when the corer impacted the seafloor. Accuracies of $\pm$2-3 meters were achieved. Horizontal coordinates are reported as latitude and longitude (NAD 83) to the nearest 0.1 second and converted and referenced to Washington Coordinate System (North Zone)/North American Datum 1983 (NAD 83) (Table 2).

Water depth at each core location was measured with a lead line and corrected to MLLW using published tidal elevation data and the existing WIST pier tide gauge. These data were entered on the core description forms (Appendix B).

2.1.2 Core Collection

Cores were collected using the Marine Sampling Services custom-built vibracorer operated by Bill Jaworski off the vessel *R/V Nancy Anne.* Cores were cut at a depth of 4.5 or 5.5 feet and empty tubing was removed to assure that each section was full of sediment. Sediment at the end of each tube section was visually classified for qualitative

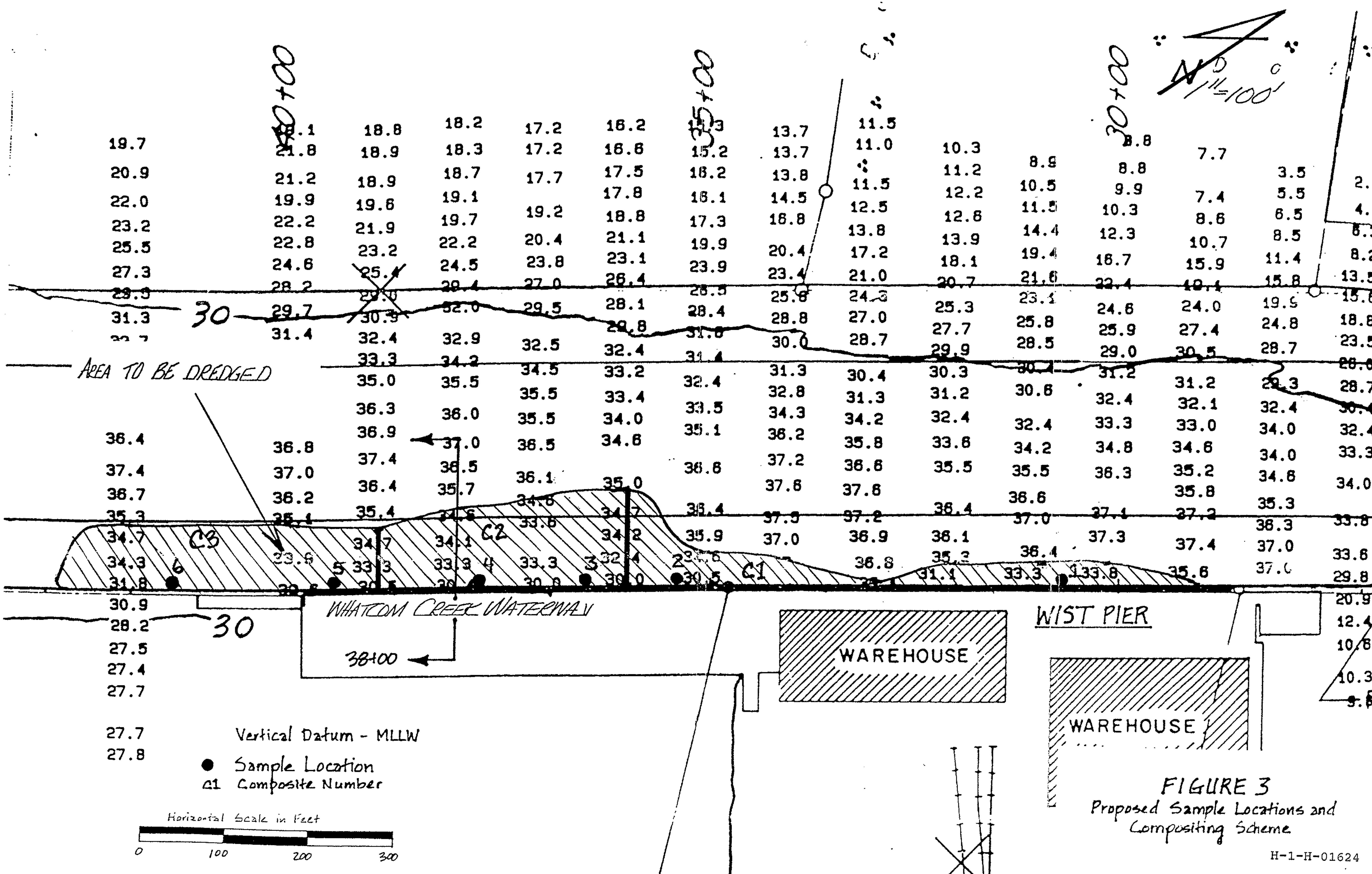

FIGURE 3
Proposed Sample Locations and Compositing Scheme

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Table 2. Station Locations for WIST Sediment Characterization (NAD 83).

	DGPS READOUT[1]		UNIT CONVERSION		COORDINATES	
Station	Latitude	Longitude	Latitude	Longitude	Easting	Northing
1	48 44.7659	122 29.5867	48 44 45.954	122 29 35.202	1239971.56	641269.07
2	48 44.7137	122 29.6644	48 44 42.822	122 29 39.864	1239652.32	640958.47
3	48 44.6984	122 29.6869	48 44 41.904	122 29 41.214	1239559.85	640867.41
4	48 44.6821	122 29.7092	48 44 40.926	122 29 42.552	1239468.05	640770.25
5	48 44.6618	122 29.7400	48 44 39.708	122 29 44.400	1239341.55	640649.51
6	48 44.6366	122 29.7754	48 44 38.196	122 29 46.524	1239195.91	640499.39

[1]Mean of duplicate core positions at each station.

sample characteristics and relevant information recorded on core description forms (Appendix B). The core was labeled and the core ends were covered with aluminum foil, a protective cap and duct tape to prevent leakage. The core sections were stored upright in a container chilled with ice to approximately 4°C.

The cores were transported to an onshore sample processing facility for compositing and subsampling the day after collection. Cores remained in the custody of field sampling personnel during transit between the vessel and processing lab and during processing.

2.1.3 Sample Compositing and Subsampling

Core extrusion and sample processing were completed at an onshore facility the day following core collection. Procedures for collecting sediment samples from the core for chemical and biological testing were as described in the project SAP and are briefly described below.

Core Extrusion. Core sections were extruded onto an aluminum foil-covered stainless steel tray by vibrating the core tube and applying pressure to the end of the core with a plunger. The extruded core was longitudinally split and a description of the core was recorded on core description forms (Appendix B). Discrete subsamples for volatile and sulfides analysis were immediately collected from randomly selected cores. Sulfides samples were preserved with zinc acetate. As discussed in the project SAP, archived bottom samples (representing -35 to -36 ft MLLW) were labeled "Z" preceded by the boring number and stored frozen in case future analysis is required.

Compositing and Subsampling. Following discrete sample collection and sediment descriptions, samples were composited in accordance with the plan described in the project SAP (see Table 1). For subsurface composite samples, equal volumes of sediment were removed from each core section comprising a composite. Samples were collected from the entire length of the representative core section from sediment which had not contacted the core tube. Sediments were placed in a decontaminated stainless steel bowl and thoroughly mixed to a uniform color and texture. Prelabeled jars for chemical, toxicity, and conventional parameter analyses were filled with the homogenized sediment. Each sample container was clearly labeled with the project name, sample/composite identification, type of analysis to be performed, date and time, and initials of person(s) preparing the sample.

Chemical and biological samples were stored on ice or refrigerated at approximately 4°C until delivered to the laboratory. Mercury and archive samples were then stored frozen; all other samples remained at 4°C.

2.1.4 Decontamination

With the exception of new, pre-cleaned core tubes, all sampling equipment was decontaminated prior to use and between composite samples from each dredged material management unit (DMMU) using the following sequential rinses:

- Rinse with tap water
- Scrub with laboratory-grade detergent (i.e., Alconox) solution
- Tap water rinse
- Distilled water rinse
- Rinse with dilute (0.1 Normal) nitric acid
- Distilled water rinse
- Rinse with methanol

The methanol rinse was omitted for volatiles sampling utensils to prevent possible analytical interferences. All decontaminated equipment was wrapped in aluminum foil with the dull side facing the equipment.

Samplers wore disposable gloves during sample processing (i.e., core extrusion and splitting, compositing, and filling sample containers) and changed gloves between DMMU composites to prevent cross contamination.

2.1.5 Sample Transport and Custody

Sediment samples for immediate analysis were transported to the analytical laboratory within 24 hours of collection. Individual sample containers were placed in sealed plastic bags, packed to prevent breakage, and transported on ice in a sealed cooler. The chain-of-custody form was enclosed in a plastic bag and taped to the inside lid of the cooler. Signed and dated chain-of-custody seals were placed on the cooler prior to delivery to the laboratory.

Field personnel retained custody of the cores during collection and processing. Chain-of-custody procedures tracked delivery of samples from the processing facility to the analytical laboratory and were as described in the project SAP. The laboratory maintained chain-of-custody internally to track handling and final disposition of all samples.

Archived samples remained in the custody of field sampling personnel and were stored at the SEA Olympia office. Archived chemistry samples were stored frozen, whereas bioassay samples were stored at 4°C. Sediment for possible physical testing was delivered to RETEC, Inc., Seattle, Washington using specified chain-of-custody procedures.

2.2 CHEMICAL ANALYSIS

All sediment chemical testing was performed by Analytical Resources, Inc. (ARI) of Seattle, Washington. Grain size analyses and interstitial (i.e., porewater) water extraction were performed by Rosa Environmental and Geotechnical Laboratory (REG) of Seattle Washington. Three composite sediment samples (one from each DMMU) were analyzed for the parameters discussed in the following sections. Laboratory testing procedures were conducted in accordance with the project SAP (Appendix A) and relevant PSDDA (1988, 1989) and PSEP (1986, 1989a, 1989b) procedures and protocols.

2.2.1 PSDDA Chemical Testing

Sediment samples were analyzed for the PSDDA chemicals of concern, conventional parameters, and grain size. All parameters, targeted method detection limits and analytical methods are listed in Table 3.

2.2.2 TBT in Interstitial Water

Interstitial water was extracted from the three composite sediment samples using centrifugation and filtration. Although the SAP stated that one randomly selected interstitial water sample would be analyzed for tributyltin (TBT) before proceeding with additional TBT analyses, the laboratory analyzed all three samples and provided these results at no additional cost.

2.2.3 Other Chemical Analyses

Additional chemical analyses, including TCLP metals, TPH and pH, were conducted to provide information for evaluating upland disposal options. These analyses were also conducted by ARI, and analytical methods are listed in Table 3.

Table 3. Chemical preparation and analysis methods and target method detection limits.

PARAMETER	PREP METHOD	ANALYSIS METHOD	SEDIMENT MDL (1)
CONVENTIONALS:			
Total Solids (%)	---	Pg.17 (2)	0.1
Total Volatile Solids(%)	---	Pg.20 (2)	0.1
Total Organic Carbon (%)	---	Pg.23 (2, 3)	0.1
Total Sulfides (mg/kg)	---	Pg.32 (2)	1
Ammonia (mg/kg)	---	Plumb 1981 (4)	1
Grain Size	---	Modified ASTM with Hydrometer	---
METALS (mg/kg):			
Antimony	APNDX D (5)	GFAA (6)	2.5
Arsenic	APNDX D (5)	GFAA (6)	2.5
Cadmium	APNDX D (5)	GFAA (6)	0.3
Copper	APNDX D (5)	ICP (7)	15
Lead	APNDX D (5)	ICP (7)	0.5
Mercury	MER (8)	7471 (8)	0.02
Nickel	APNDX D (5)	ICP (7)	2.5
Silver	APNDX D (5)	GFAA (6)	0.2
Zinc	APNDX D (5)	ICP (7)	15
ORGANICS (ug/kg):			
LPAH			
Naphthalene	3550 (9)	8270 (10)	20
Acenaphthylene	3550 (9)	8270 (10)	20
Acenaphthene	3550 (9)	8270 (10)	20
Fluorene	3550 (9)	8270 (10)	20
Phenanthrene	3550 (9)	8270 (10)	20
Anthracene	3550 (9)	8270 (10)	20
2-Methylnaphthalene	3550 (9)	8270 (10)	20
HPAH			
Fluoranthene	3550 (9)	8270 (10)	20
Pyrene	3550 (9)	8270 (10)	20
Benzo(a)anthracene	3550 (9)	8270 (10)	20
Chrysene	3550 (9)	8270 (10)	20
Benzofluoranthenes	3550 (9)	8270 (10)	20
Benzo(a)pyrene	3550 (9)	8270 (10)	20
Indeno(1,2,3-c,d)pyrene	3550 (9)	8270 (10)	20
Dibenzo(a,h)anthracene	3550 (9)	8270 (10)	20
Benzo(g,h,i)perylene	3550 (9)	8270 (10)	20
CHLORINATED HYDROCARBONS			
1,3-Dichlorobenzene	P&T (12)	8240 (11)	3.2
1,4-Dichlorobenzene	P&T (12)	8240 (11)	3.2
1,2-Dichlorobenzene	P&T (12)	8240 (11)	3.2
1,2,4-Trichlorobenzene	3550 (9)	8270 (10)	6
Hexachlorobenzene (HCB)	3550 (9)	8270 (10)	12

Table 3. Chemical preparation and analysis methods and target method detection limits.

PARAMETER	PREP METHOD	ANALYSIS METHOD	SEDIMENT MDL (1)
PHTHALATES			
Dimethyl phthalate	3550 (9)	8270 (10)	20
Diethyl phthalate	3550 (9)	8270 (10)	20
Di-n-butyl phthalate	3550 (9)	8270 (10)	20
Butyl benzyl phthalate	3550 (9)	8270 (10)	20
Bis(2-ethylhexyl)phthalate	3550 (9)	8270 (10)	20
Di-n-octyl phthalate	3550 (9)	8270 (10)	20
PHENOLS			
Phenol	3550 (9)	8270 (10)	20
2 Methylphenol	3550 (9)	8270 (10)	6
4 Methylphenol	3550 (9)	8270 (10)	20
2,4-Dimethylphenol	3550 (9)	8270 (10)	6
Pentachlorophenol	3550 (9)	8270 (10)	61
MISCELLANEOUS EXTRACTABLES			
Benzyl alcohol	3550 (9)	8270 (10)	6
Benzoic acid	3550 (9)	8270 (10)	100
Dibenzofuran	3550 (9)	8270 (10)	20
Hexachloroethane	3550 (9)	8270 (10)	20
Hexachlorobutadiene	3550 (9)	8270 (10)	20
N-Nitrosodiphenylamine	3550 (9)	8270 (10)	12
VOLATILE ORGANICS			
Trichloroethene	P&T (12)	8240 (11)	3.2
Tetrachloroethene	P&T (12)	8240 (11)	3.2
Ethylbenzene	P&T (12)	8240 (11)	3.2
Total Xylene	P&T (12)	8240 (11)	3.2
PESTICIDES			
Total DDT	---	---	---
p,p'-DDE	3540 (13)	8080 (13)	2.3
p,p'-DDD	3540 (13)	8080 (13)	3.3
p,p'-DDT	3540 (13)	8080 (13)	6.7
Aldrin	3540 (13)	8080 (13)	1.7
Chlordane	3540 (13)	8080 (13)	1.7
Dieldrin	3540 (13)	8080 (13)	2.3
Heptachlor	3540 (13)	8080 (13)	1.7
Lindane	3540 (13)	8080 (13)	1.7
Total PCBs	3540 (13)	8080 (13)	67
OTHER			
TBT in interstitial water (ug/L TBT)	Centrifuge/Filter	PSWQA (14)	0.04
NON-PSDDA PARAMETERS FOR WIST SAMPLING			
TCLP Metals	1311 (15)	6010 (15)	n/a
TPH	n/a	418.1 (16)	n/a
pH	n/a	150.1 (16)	n/a

Table 3. Chemical preparation and analysis methods and target method detection limits.

PARAMETER	PREP METHOD	ANALYSIS METHOD	SEDIMENT MDL (1)

Footnotes

1. Dry Weight Basis.
2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, March, 1986.
3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May, 1993.
4. Procedures For Handling and Chemical Analysis of Sediment and Water Samples, Russell H. Plumb, Jr., EPA/Corps of Engineers, May, 1981.
5. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment and Tissue Samples, Puget Sound Estuary Program, March, 1986.
6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical /Chemical Methods, EPA 1986.
8. Mercury Digestion and Cold Vapor Atomic Absorption (CVAA) Spectrometry - Method 7471, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.
10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
11. GCMS Analysis - Method 8240, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
12. Purge and Trap Extraction and GCMS Analysis - Method 8240, Test Methods for Evaluating Solid Waste Physical/ Chemical Methods, EPA 1986.
13. Soxhlet Extraction and Method 8080, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Puget Sound water, sediment, and tissue samples. Prepared by King County Water Pollution Control Division Environmental Laboratory.
14. Puget Sound Water Quality Authority (PSWQA). 1996. Recommended guidelines for measuring organic compounds in sediment.
15. Extraction/Leaching Method 1310 and Method 6010, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
16. EPA Methods 418.1 and 150.1, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

3. RESULTS

Laboratory data summary sheets describing methods, results, and quality control analyses are provided in Appendix C. As specified in the SAP, the laboratory provided a complete PSDDA QA2 data package and these data are on file at the Port of Bellingham. A data quality evaluation was performed for PSDDA chemicals of concern and results of this evaluation are reported on worksheets contained in Appendix D. The following sections present the results of the data quality evaluation and compare the chemical data to applicable regulatory levels.

3.1 DATA QUALITY SUMMARY

3.1.1 PSDDA Chemical Testing

A data quality evaluation was performed in accordance with PSEP guidance (PSEP 1986) and the PSDDA Abbreviated Data Quality Evaluation (QA 1) for Dredged Material Disposal Projects (PTI 1989) with revisions (PSDDA 1991). Results of this evaluation are reported on worksheets contained in Appendix D. All data were determined to be acceptable. Holding times, detection limits and blank, reference material, analytical replicate analyses, and matrix spike and surrogate recoveries were within PSDDA (1991) recommended warning limits or laboratory control limits with the following exceptions:

- Antimony and mercury exceeded PSDDA action limits for matrix spike recoveries, but certified reference material recoveries were acceptable.
- Acenaphthene exceeded matrix spike control limits, but other laboratory control samples were acceptable. Three additional compounds had matrix spike recoveries less than 50%, but other laboratory control samples (including surrogate recoveries) were acceptable.
- PCB/pesticide surrogate recoveries were below PSDDA warning limits and below control limits in one or more samples. Some pesticide matrix spike recoveries were also below PSDDA warning limits, but were within EPA CLP limits.

3.1.2 TBT in Interstitial Water

Specific protocols and data quality limits for interstitial water extraction and TBT analysis in interstitial water have not yet been established by the PSDDA agencies (Michelsen et al. 1996). Duplicate samples, matrix spike and surrogate recoveries were within the laboratory's control limits. An abbreviated data quality evaluation was performed and summarized using PSDDA QA1 worksheets (Appendix D). One sample (C2) exceeded the requested interstitial water extraction holding time by one day, but the requested holding time is considered to be conservative and this exceedance is not expected to affect the sample result. Slight blank contamination resulted in values being qualified "B", but the level of blank contamination was substantially lower than the PSDDA BT and measured sample concentrations and does not affect interpretation of the results.

3.1.3 Other Chemical Testing

The laboratory provided quality control sample results for the TPH and TCLP analyses. These data are included in the laboratory data package; summary forms are provided in Appendix C, but were not evaluated for this report.

3.2 RESULTS

3.2.1 PSDDA Chemical Results

The sediment chemical data are summarized in Tables 4 and 5. Chemical concentrations reported on a dry weight basis are compared to the PSDDA screening levels (SLs), bioaccumulation trigger levels, and PSDDA maximum levels in Table 4. Chemical concentrations normalized to total organic carbon are compared to Washington State Sediment Management Standards sediment quality standards (SQS) and minimum cleanup levels (MCUL) in Table 5.

The data indicate that sediments adjacent to WIST are composed primarily of sandy-silt or clayey-silt (Table 4). Total organic carbon ranges from 2.6 to 3.6%. The three composite samples analyzed in this characterization each had fourteen to eighteen chemicals of concern that exceeded PSDDA SLs. Chemicals exceeding the SL in all three samples included PAHs, mercury and dibenzofuran. In addition, the composite samples from areas C1 and C2 had 3 and 5 ML exceedances, respectively. The bioaccumulation trigger for mercury was exceeded in all three samples. The bioaccumulation trigger for fluoranthene was exceeded in samples C1 and C2.

In comparison with the SMS sediment criteria, acenaphthene, fluorene, and dibenzofuran in composite samples C1 and/or C2 exceeded the SQS (Table 5). Hexachlorobenzene detection limits in all three samples exceeded the SQS. Mercury concentrations in all three samples exceeded the MCUL.

3.2.2 TBT in Interstitial Water

The TBT concentrations in interstitial water samples ranged from 0.1 to 0.65 ug TBT/L. One sample, C1, exceeded the proposed PSDDA bioaccumulation trigger of 0.15 ug TBT/L (Michelsen et al. 1996).

Table 4. WIST PSDDA Sediment Characterization Data Summary[a].

PARAMETER	PSDDA Screening Level (SL)	PSDDA Bioaccumulation Level (BT)	PSDDA Maximum Level (ML)	WHATCOM WATERWAY C1	WHATCOM WATERWAY C2	WHATCOM WATERWAY C3	
CONVENTIONALS:							
Total Solids (%)	---	---	---	47.9	45.3	47.2	
Total Volatile Solids (%)	---	---	---	11.0	34.0	12.0	
Total Organic Carbon (%)	---	---	---	3.6	3.4	2.6	
Total Sulfides (mg/kg)	---	---	---	2,700	4,000	1,000	
Ammonia (mg-N/kg)	---	---	---	210	300	130	
Grain Size							
% clay	---	---	---	13	26	29	M[b]
% silt	---	---	---	50	38	43	M
% sand	---	---	---	22	20	12	M
% gravel	---	---	---	15	16	16	M
METALS (mg/kg dry weight)							
Antimony	20	146	200	0.13	0.2	0.06	U[c]
Arsenic	57	507	700	7.0	3.5	4.0	
Cadmium	0.96	---	9.6	**1.1**	0.54	0.6	
Copper	81	---	810	67.0	61.5	32.1	
Lead	66	---	660	28	35	14	
Mercury	0.21	1.5	2.1	**6.1**	**2.5**	**2.0**	
Nickel	140	1,022	---	78	86	53	
Silver	1.2	4.6	6.1	0.27	0.14	0.14	
Zinc	160	---	1,600	114	134	64.3	
ORGANICS (ug/kg dry weight)							
LPAH							
Naphthalene	210	---	2,100	200	**940**	84	
Acenaphthylene	64	---	640	25	20 U	20	U
Acenaphthene	63	---	630	**1,300**	**1,400**	**270**	
Fluorene	64	---	640	**980**	**1,100**	**180**	
Phenanthrene	320	---	3,200	**2,600**	**2,900**	**590**	
Anthracene	130	---	1,300	**850**	**970**	**270**	

H-1-H-01633

Table 4. WIST PSDDA Sediment Characterization Data Summary[a].

	PSDDA			WHATCOM WATERWAY					
PARAMETER	Screening Level (SL)	Bioaccumulation Level (BT)	Maximum Level (ML)	C1		C2		C3	
2-Methylnaphthalene	67	---	670	**140**		**240**		49	
Total LPAH	610	---	6,100	**6,095**		**7,550**		**1,443**	
HPAH									
Fluoranthene	630	4,600	6,300	**5,500**		**8,800**		**2,300**	
Pyrene	430	---	7,300	**5,200**		**7,300**		**2,500**	
Benzo(a)anthracene	450	---	4,500	**1,500**		**2,500**		**820**	
Chrysene	670	---	6,700	**2,000**		**3,000**		**1,000**	
Benzofluoranthenes	800	---	8,000	**1,670**		**2,300**		**880**	
Benzo(a)pyrene	680	4,964	6,800	670		**1,000**		360	
Indeno(1,2,3-c,d)pyrene	69	---	5,200	**210**		**300**		**120**	
Dibenzo(a,h)anthracene	120	---	1,200	89		**140**		52	
Benzo(g,h,i)perylene	540	---	5,400	150		260		99	
Total HPAH	1,800	---	51,000	**16,989**		**25,600**		**8,131**	
CHLORINATED HYDROCARBONS									
1,3-Dichlorobenzene	170	1,241	---	1.2	U	1.3	U	1.5	U
1,4-Dichlorobenzene	26	190	260	1.2	U	1.3	U	1.5	U
1,2-Dichlorobenzene	19	37	350	1.2	U	1.3	U	1.5	U
1,2,4-Trichlorobenzene	13	---	64	5.9	U	6.6	U	7.4	U
Hexachlorobenzene (HCB)	23	168	230	20	U	20	U	20	U
PHTHALATES									
Dimethylphthalate	160	1,168	---	20	U	20	U	20	U
Diethylphthalate	97	---	---	20	U	20	U	20	U
Di-n-butylphthalate	1,400	10,220	---	20	U	20	U	20	U
Butylbenzylphthalate	470	---	---	20	U	20	U	20	U
Bis(2-ethylhexyl)phthalate	3,100	13,870	---	130		130		62	
Di-n-octyl phthalate	6,200	---	---	20	U	20	U	20	U
PHENOLS									
Phenol	120	876	1,200	20	U	20	U	20	U
2-Methylphenol	20	---	72	20	U	20	U	20	U

Table 4. WIST PSDDA Sediment Characterization Data Summary[a].

	PSDDA			WHATCOM WATERWAY					
PARAMETER	Screening Level (SL)	Bioaccumulation Level (BT)	Maximum Level (ML)	C1		C2		C3	
4-Methylphenol	120	---	1,200	110		100		47	
2,4-Dimethylphenol	29	---	50	20	U	20	U	20	U
Pentachlorophenol	100	504	690	98	U	98	U	100	U
MISCELLANEOUS EXTRACTABLES									
Benzyl alcohol	25	---	73	20	U	20	U	20	U
Benzoic acid	400	---	690	200	U	200	U	200	U
Dibenzofuran	54	---	540	530		**620**		**120**	
Hexachloroethane	1,400	10,220	14,000	20	U	20	U	20	U
Hexachlorobutadiene	29	212	290	20	U	20	U	20	U
N-Nitrosodiphenylamine	28	161	220	20	U	20	U	20	U
VOLATILE ORGANICS									
Trichloroethene	160	1,168	1,600	1.2	U	1.3	U	1.5	U
Tetrachloroethene	14	102	210	1.2	U	1.3	U	1.5	U
Ethylbenzene	10	27	50	1.2	U	2.6		1.5	U
Total Xylene	12	---	160	2.4	U	8.4		3.0	U
PESTICIDES									
Total DDT	6.9	50	69	2.4	Y[c]	2.2	Y	2.0	U
p,p'-DDE	---	---	---	2.0	U	2.0	U	2.0	U
p,p'-DDD	---	---	---	2.4	Y	2.2	Y	2.0	U
p,p'-DDT	---	---	---	2.0	U	2.0	U	2.0	U
Aldrin	10	37	---	1.1	Y	0.98	U	1.0	U
Chlordane	10	37	---	1.5	Y	1.3	Y	1.0	U
Dieldrin	10	37	---	2.0	U	2.0	U	2.0	U
Heptachlor	10	37	---	0.98	U	0.98	U	1.0	U
Lindane	10	---	---	0.98	U	0.98	U	1.0	U
TOTAL PCBs	130	38[d]	2,500	30		24		40	U
Aroclor 1016				20	U	20	U	20	U
Aroclor 1242				28	Y	20	U	20	U
Aroclor 1248				43	Y	27	Y	26	Y

H-1-H-01635

Table 4. WIST PSDDA Sediment Characterization Data Summary[a].

PARAMETER	PSDDA Screening Level (SL)	PSDDA Bioaccumulation Level (BT)	PSDDA Maximum Level (ML)	WHATCOM WATERWAY C1		C2		C3	
Aroclor 1254				30		24		20	U
Aroclor 1260				20	U	20	U	20	U
Aroclor 1221				39	U	39	U	40	U
Aroclor 1232				41	Y	20	U	20	U
OTHER									
TBT in interstitial water (ug/L TBT)	---	0.15	---	0.65	B[f]	0.10	MB	0.10	B

[a]All units are dry weight based unless otherwise noted.

[b]M=Value is mean of laboratory triplicate.

[c]U=Chemical is undetected and is reported at the detection limit.

[d]Total PCBs BT value in ppm carbon-normalized.

[e]Y=The analyte may be present at or below the listed concentration, but in the opinion of the analyst, confirmation was inadequate.

[f]B=Probable/possible blank contamination.

1 = SL exceedance (single box)
1 = BT exceedance (double box)
1 = ML exceedance (bold shaded box)

H-1-H-01636

Table 5. WIST Sediment Characterization Data Summary Compared to SMS Criteria.

PARAMETER	SEDIMENT MANAGEMENT STANDARDS		WHATCOM WATERWAY		
	SQS	MCUL	C1	C2	C3
CONVENTIONALS:					
Total Solids (%)	---	---	47.9	45.3	47.2
Total Volatile Solids (%)	---	---	11.0	34.0	12.0
Total Organic Carbon (%)	---	---	3.6	3.4	2.6
Total Sulfides (mg/kg)	---	---	2,700	4,000	1,000
Ammonia (mg-N/kg)	---	---	210	300	130
Grain Size					
% clay	---	---	13	26	29 M
% silt	---	---	50	38	43 M
% sand	---	---	22	20	12 M
% gravel	---	---	15	16	16 M
METALS (mg/kg):					
Arsenic	57	93	7.0	3.5	4.0
Cadmium	5.1	6.7	1.1	0.54	0.6
Chromium	260	270	n/a	n/a	n/a
Copper	390	390	67.0	61.5	32.1
Lead	450	530	28	35	14
Mercury	0.41	0.59	**6.1**	**2.5**	**2.0**
Silver	6.1	6.1	0.27	0.14	0.14
Zinc	410	960	114	134	64.3
ORGANICS (ug/kg OC):					
LPAH					
Naphthalene	99	170	5.7	27	3.2
Acenaphthylene	66	66	0.7	0.6 U	0.8 U
Acenaphthene	16	57	**36**	**42**	10
Fluorene	23	79	**27**	**32**	6.9
Phenanthrene	100	480	71	85	22
Anthracene	220	1,200	24	28	10
2-Methylnaphthalene	38	64	3.9	7.1	1.9
Total LPAH	370	780	164	215	53
HPAH					
Fluoranthene	160	1,200	150	260	87
Pyrene	1,000	1,400	140	210	95
Benzo(a)anthracene	110	270	43	72	31
Chrysene	110	460	54	88	39
Benzofluoranthenes	230	450	46	66	34
Benzo(a)pyrene	99	210	19	29	14
Indeno(1,2,3-c,d)pyrene	34	88	5.8	8.9	4.5
Dibenzo(a,h)anthracene	12	33	2.5	4.0	2.0
Benzo(g,h,i)perylene	31	78	4.1	7.6	3.8
Total HPAH	960	5,300	314	486	223

Table 5. WIST Sediment Characterization Data Summary Compared to SMS Criteria.

PARAMETER	SEDIMENT MANAGEMENT STANDARDS		WHATCOM WATERWAY					
	SQS	MCUL	C1		C2		C3	
1,4-Dichlorobenzene	3.1	9	0.5	U	0.6	U	0.8	U
1,2-Dichlorobenzene	2.3	2.3	0.5	U	0.6	U	0.8	U
1,2,4-Trichlorobenzene	0.81	1.8	0.5	U	0.6	U	0.8	U
Hexachlorobenzene (HCB)	0.38	2.3	**0.5**	**U**	**0.6**	**U**	**0.8**	**U**
Dimethylphthalate	53	53	0.5	U	0.6	U	0.8	U
Diethylphthalate	61	110	0.5	U	0.6	U	0.8	U
Di-n-butylphthalate	220	1,700	0.5	U	0.6	U	0.8	U
Butylbenzylphthalate	4.9	64	0.5	U	0.6	U	0.8	U
Bis(2-ethylhexyl)phthalate	47	78	3.5		3.8		2.4	
Di-n-octyl phthalate	58	4,500	0.5	U	0.6	U	0.8	U
Dibenzofuran	15	58	15		**18**		4.6	
Hexachlorobutadiene	3.9	6.2	0.5	U	0.6	U	0.8	U
N-Nitrosodiphenylamine	11	11	0.5	U	0.6	U	0.8	U
Total PCBs	12	65	0.82		0.69		1.5	U
Aroclor 1016			0.55	U	0.57	U	0.77	U
Aroclor 1242			0.77	Y	0.57	U	0.77	U
Aroclor 1248			1.2	Y	0.80	Y	1.0	Y
Aroclor 1254			0.82		0.69		0.77	U
Aroclor 1260			0.55	U	0.57	U	0.77	U
Aroclor 1221			1.1	U	1.1	U	1.5	U
Aroclor 1232			1.1	Y	0.57	U	0.77	U
ORGANICS (ug/kg dry weight)								
Phenol	420	1,200	20	U	20	U	20	U
2-Methylphenol	63	63	20	U	20	U	20	U
4-Methylphenol	670	670	110		100		47	
2,4-Dimethylphenol	29	29	20	U	20	U	20	U
Pentachlorophenol	360	690	98	U	98	U	100	U
Benzyl alcohol	57	73	20	U	20	U	20	U
Benzoic acid	650	650	200	U	200	U	200	U

U=Chemical is undetected and is reported at the detection limit.

M=Value is mean of laboratory triplicate.

Y=The analyte may be present at or below the listed concentration, but in the opinion of the analyst, confirmation was inadequate.

1 = SQS exceedance

1 = MCUL exceedance

3.2.3 Other Chemical Testing Results

Results of additional chemical analyses are summarized in Table 6. These data provide information for evaluating upland disposal options. All TCLP metal concentrations were below levels that would designate the sediment as Dangerous Waste (WAC 173-303). TPH concentrations ranged from 460 to 750 mg/kg.

3.3 BIOLOGICAL TESTING

No biological testing was conducted.

Table 6. Summary of Other Chemical Results.

PARAMETER	Dangerous Waste Criteria (mg/L)	C1	C2	C3
TPH (mg/kg)		510	750	460[a]
pH		7.9	8.0	8.1
TCLP Metals (mg/L)				
Arsenic	5.0	0.1 U	0.1 U	0.1 U
Barium	100.0	0.130	0.114	0.130
Cadmium	1.0	0.004 U	0.004 U	0.004 U
Chromium	5.0	0.01 U	0.01 U	0.01 U
Lead	5.0	0.04 U	0.04 U	0.04 U
Mercury	0.2	0.0001 U	0.0001 U	0.0001 U
Selenium	1.0	0.1	0.1 U	0.1
Silver	5.0	0.006 U	0.006 U	0.006 U

[a]Mean of laboratory triplicate.

4. PSDDA EVALUATION

Sample results indicate that sediments from DMMUs C1 and C2 (Figure 3) contain 3 and 5 chemicals, respectively, at concentrations greater than PSDDA MLs. Mercury and fluoranthene in DMMUs C1 and C2 also exceed the bioaccumulation trigger. PSDDA establishes that if sediments contain one chemical exceeding the ML by more than 100% or two or more chemicals greater than the ML, the sediment will not be considered suitable for unconfined, open-water disposal, even if the sediments pass the routine biological tests (i.e., three toxicity tests plus bioaccumulation tests) (Johns et al. 1997). Sediment with chemical concentrations above the ML may be considered for open-water disposal only if, in addition to passing the routine biological tests, it undergoes further biological tests using specialized test procedures (i.e., Tier IV testing or "dredger's option") (PSDDA 1988). The Port of Bellingham elected not to pursue this option and no additional testing was conducted.

Sample results indicate that sediment from DMMU C3 contains 14 chemicals at concentrations greater than PSDDA SLs. There are no ML exceedances in this DMMU. PSDDA evaluation procedures require that this material undergo standard toxicity testing (i.e., three acute and chronic toxicity tests) to determine if the sediment is suitable for unconfined, open-water disposal. In addition, mercury in the sediment sample from DMMU C3 exceeded the bioaccumulation trigger, and bioaccumulation testing would also be required to determine if the sediment is suitable for unconfined, open-water disposal. At this time, the Port of Bellingham elected not to pursue the unconfined, open-water disposal option and no biological testing was conducted.

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SCREENING-LEVEL PUGET SOUND DREDGED DISPOSAL ANALYSIS
SEDIMENT QUALITY EVALUATION
WHATCOM WATERWAY AREA

Anchor Environmental, L.L.C. and Hart Crowser, Inc.
August 4, 1998

SCREENING-LEVEL PUGET SOUND DREDGED DISPOSAL ANALYSIS
SEDIMENT QUALITY EVALUATION
WHATCOM WATERWAY AREA
BELLINGHAM, WASHINGTON

CONTENTS

TABLES

FIGURES

SCREENING-LEVEL PUGET SOUND DREDGED DISPOSAL ANALYSIS
SEDIMENT QUALITY EVALUATION
WHATCOM WATERWAY AREA
BELLINGHAM, WASHINGTON

L.1 Introduction

A screening-level Puget Sound Dredged Disposal Analysis (PSDDA) sediment quality evaluation was conducted in order to evaluate possible open-water or habitat enhancement/mitigation (subgrade) disposal options for relatively clean sediments previously identified at the head of the Whatcom Waterway and throughout the I&J Street Waterway. This screening-level analysis was not intended to constitute a full characterization for PSDDA dredge material management decisions, but rather to make a qualitative judgement about the likely suitability of material for open-water disposal and/or beneficial reuse.

Various project alternatives for sediment dredging, disposal, and/or beneficial reuse were developed by Georgia-Pacific and the Bellingham Bay Demonstration Pilot Project. These alternatives are more fully described in Section 14. The screening-level analysis presented herein was performed to more accurately address possible open-water and beneficial reuse options for relatively clean sediments present in the I&J Street Waterway and at the head of the Whatcom Waterway.

Specific sampling methods, procedures, and quality control criteria used in this screening-level evaluation are summarized in the Addendum 2 sampling and analysis plan (SAP) (Hart Crowser, 1997).

L.2 Previous Sampling Results

Chemistry and bioassay results from the remedial investigation (RI) sampling activities are described in the Whatcom Waterway RI Report. Key findings of the RI are summarized below:

- Surface sediment chemical analysis and confirmatory bioassay results suggest that the extent of surface sediments exceeding the Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC) minimum cleanup level (MCUL) are restricted to the middle and seaward reaches of the Whatcom Waterway, and to areas immediately adjacent to the mouth of the Whatcom Waterway (see Figure 11-1);
- Compared with the middle and seaward reaches of the Whatcom Waterway, surface sediments at the head of the Whatcom Waterway and

throughout the I&J Street Waterway contained significantly lower mercury concentrations. Mercury and other chemical concentrations within these surface sediments were below MCUL criteria; much of these areas are also below Sediment Quality Standards (SQS) as defined in the SMS;

- Depth profiles of sediment mercury concentrations throughout the Whatcom Waterway site exhibit a distinct subsurface maximum ranging from roughly 2 to 6 feet below the sediment/water interface, depending on location; and

- The only chemicals detected in either surface or subsurface marine sediments in the Whatcom Waterway area exceeding the SQS chemical criteria in one or more samples were as follows (in order of decreasing frequency and magnitude of exeedance relative to the SQS):

  - Mercury;
  - Phenols/Cresols (especially 4-methylphenol and 2,4-methylphenol);
  - Polycyclic Aromatic Hydrocarbons (PAHs);
  - Phthalate Esters (especially bis[2-ethylhexyl]phthalate);
  - Hexachlorobenzene;
  - Dibenzofuran;
  - Benzoic acid;
  - Zinc; and
  - Cadmium.

L.3 Screening-Level PSDDA Characterization Results – July, 1997 Sampling

In July 1997, sediment core samples were collected from two areas within the I&J Street Waterway and from two areas within the Whatcom Waterway (Figure L-1). Four cores were collected from each area (HC-VC-94A through HC-VC-94D; HC-VC-95A through HC-VC-95D; HC-VC-96A through HC-VC-96D; and HC-VC-97A through HC-VC-97D) and were composited into two representative samples. The sediment cores were composited as indicated in Table L-1. Samples designated as "C1" represent the shallower 0- to 4-foot-depth interval composite. Samples designated as "C2" represent the deeper 4 feet to the –25 MLLW elevation composite (also representing an approximate 4-foot interval). As per PSDDA guidelines, native sediments were not composited with overlying contaminated sediments. Sampling and analysis procedures were completed in accordance with PSDDA guidelines (PSDDA, 1998) and the SAP.

During sediment coring, the sampling vessel was anchored into position at each station using a differential Global Positioning system (DGPS). Coordinates for the sampling positions were recorded to an accuracy of within 6 feet at the time of sample collection. Samplers monitored core tube penetration and recovery. Core penetration depths ranged from 9 to 14 feet below mudline. Some compaction of sediments was expected during core tube advancement as a result of the vibracoring technique. Compaction ranged from 0 to 47 percent. Compactions greater than 25 percent were generally not accepted unless difficult coring conditions (e.g., wood, concrete, riprap shoreline, debris) precluded better recovery. The decision criteria for core acceptance was (in order of priority):

- Core to desired penetration depth;
- Sample within 10-foot radius of proposed location; and
- Recover sediment with less than 25 percent compaction.

If field crews encountered difficult coring conditions at a proposed location, subsequent core attempts were advanced in 10-foot radius increments away from the proposed location for improved penetration depth. If compaction was greater than 25 percent, additional core attempts were advanced at the designated location to improve sample recovery. At sampling locations HC-VC-94A, HC-VC-94B, HC-VC-96A, HC-VC-97C, and HC-VC-97D sediment compactions were greater than 25 percent. Several attempts were made to improve sample recovery at these locations, but difficult coring conditions precluded better recovery. The core with the best percent recovery was retained.

After the cores were retrieved and accepted, core tubes were capped, sealed, labeled, and placed upright in a chilled ice-box on the vessel deck. Core logging and sampling took place at the Hart Crowser laboratory facility. Cores were handled in accordance with the SAP. Core extrusion/description logs are at Anchor and are available upon request.

Sample composites were submitted to Multichem Analytical Services, Inc. (MAS) of Renton, Washington for chemical, conventional, and grain size analyses. Analysis results are summarized in Table L-2. Sample composites were submitted to EVS Environment Consultants laboratory of North Vancouver, British Columbia, Canada for bioassay and bioaccumulation testing. Complete laboratory and data validation reports are available from Anchor upon request.

Table L-3 is a summary of the PSDDA SL and ML exceedences for detected data. Method reporting limits for undetected data exceeded the PSDDA SL for 1,2-dichlorobenzene (one sample with an exceedence ratio [ER] of 1 03), 1,2,4-trichlorobenzene (five samples with an average ER of 1.20), and n-nitrosodiphenylamine (seven samples with an average ER of 1.64).

Toxicity tests were conducted on all sediment composite samples. The following sediment toxicity tests were conducted:

- 10-day amphipod mortality bioassay using *Eohaustorius estuarius*;
- 20-day juvenile polychaete growth bioassay using *Neanthes arenaceodentata*; and
- 48-hour sediment larval development test using *Dendraster excentricus.*

Toxicity test results for the sediment composite samples are summarized in Tables L-4 through L-8. Sample composites HC-VC-96-C1, HC-VC-96-C2, and HC-VC-97-C2 exceeded the PSDDA bioassay interpretive criteria ("one-hit" and "two-hit" rules).

Sediment samples that passed the PSDDA bioassay criteria ("one-hit" and "two-hit" rules) and contained chemical concentrations that exceeded the PSDDA bioaccumulation trigger values were subjected to bioaccumulation testing. Twenty-eight day bioaccumulation tests were conducted on sample composites HC-VC-94-C2 and HC-VC-97-C1 using *Macoma nasuta* and *Nereis virens.* Due to insufficient sample volume, animals were exposed to four replicates of each sediment treatment, reference sediment, and native control sediment, except for sample HC-VC-94-C2. Sample HC-VC-94-C2 was set up for one test replicate for *M. nasuta* only, because of insufficient sample volume. Bioaccumulation test results are summarized in Figure L-2 and Tables L-9 and L-10.

Table L-11 presents a summary of the chemistry, bioassay, and bioaccumulation evaluation with respect to PSDDA and SMS interpretive criteria. Two samples contained one chemical (2-methylphenol in Sample HC-VC-95-C1 and 4-methylphenol in Sample HC-VC-97-C1) that exceeded the PSDDA ML and passed the PSDDA bioassay criteria. Because only one chemical exceeded the PSDDA ML in each of the samples, and the chemical concentrations did not exceed the PSDDA ML by more than 100 percent, these sample composites are considered suitable for unconfined open-water disposal (PSDDA 1998). As summarized in Table L-11, sediments in five of the eight sampling areas, including all of the I&J Street Waterway, are likely suitable for open-water disposal or beneficial reuse.

Table L-1. Sediment Compositing Scheme

Sample ID	Depth Interval	Composite ID
HC-VC-94A	0-4.0 ft	HC-VC-94-C1
HC-VC-94B1	0-3.8 ft	
HC-VC-94B2	0-4.1 ft	
HC-VC-94C	0-2.4 ft	
HC-VC-94D	0-3.5 ft	
HC-VC-94A	4.0-6.9 ft	HC-VC-94-C2
HC-VC-94B1	3.8-4.8 ft	
HC-VC-94B2	4.1-8.6 ft	
HC-VC-95A	0-2.7 ft	HC-VC-95-C1
HC-VC-95B	0-1.9 ft	
HC-VC-95C	0-2.7 ft	
HC-VC-95D	0-2.9 ft	
HC-VC-95A	2.7-4.4 ft	HC-VC-95-C2
HC-VC-95B	1.9-4.3 ft	
HC-VC-95C	2.7-5.9 ft	
HC-VC-96A1	0-4.4 ft	HC-VC-96-C1
HC-VC-96A2	0-6.0	
HC-VC-96B	0-1.9 ft	
HC-VC-96C	0-3.8 ft	
HC-VC-96D	0-2.0 ft	
HC-VC-96A1	4.4-12.9 ft	HC-VC-96-C2
HC-VC-96A2	6.0-12.0 ft	
HC-VC-96B	1.9-4.9 ft	
HC-VC-96C	2.0-10.3 ft	
HC-VC-97A	0-5.0 ft	HC-VC-97-C1
HC-VC-97B	0-3.0 ft	
HC-VC-97C	0-3.7 ft	
HC-VC-97D	0-4.9 ft	
HC-VC-97A	5.0-7.0 ft	HC-VC-97-C2
HC-VC-97B	3.0-6.0 ft	
HC-VC-97C	3.7-10.2 ft	
HC-VC-97D	4.9-8.9 ft	

Table L-2. Summary of Sediment Composite Sampling Data for the Screening Level PSDDA Evaluation of Whatcom and I Waterways, Bellingham, WA

Sample ID	HC-VC-94-C1	HC-VC-94-C2	HC-VC-95-C1	HC-VC-95-C2	HC-VC-96-C1	HC-VC-96-C2	HC-VC-97-C1	HC-VC-97-C2	PSDDA SL	PSDDA ML	PSDDA BT	SQS	MCUL
Metals in mg/kg (dry weight)													
Antimony	0.51 UE	0.54 UE	0.42 UE	0.34 UE	0.62 UE	0.95 E	0.62 UE	0.58 UE	150	200	150	—	—
Arsenic	11	11	5.8	4.2	12	22	8.2	7.5	57	700	507.1	57	93
Cadmium	1.1	1.6	0.85 U	0.67 U	3.4	6.1	1.7	2.7	5.1	14	—	5.1	6.7
Chromium	58	62	41	24	79	120	69	74		—	—	260	270
Copper	44	46	39	18	79	140	73	130	390	1300	—	390	390
Lead	15	15	12	4.9	120	290	140	150	450	1200	—	450	530
Mercury	1.3	1.8	0.68	0.15	2.7	4.3	1.8	2.5	0.41	2.3	1.5	0.41	0.59
Nickel	73	76	51	21	63	60	53	50	140	370	370	—	—
Silver	0.22 E	0.25 E	0.19 E	0.071 E	0.8 E	1.5 E	1 E	1.2 E	6.1	8.4	6.1	6.1	6.1
Zinc	83	89	69	37	280	320	190	220	410	3800	—	410	960
Tributyltin in ug/L (in porewater)													
Tributyltin	0.05 U	0.05 U	0.11	0.07 U	0.20	0.05 U	0.19	0.05 U	0.15	—	0.15	—	—
LPAHs in ug/kg (dry weight)													
Naphthalene	43	29 E	160	220	200	180	280	720	2100	2400	—	—	—
Acenaphthylene	30 U	33 U	13 E	17 E	17 E	46 U	23 E	50	560	1300	—	—	—
Acenaphthene	33 U	36 U	20 E	26	130	78	110	340	500	2000	—	—	—
Fluorene	13 E	9 E	45	58	140	120	140	370	540	3600	—	—	—
Phenanthrene	48	31 E	89	89	470	440	460	1200	1500	21000	—	—	—
Anthracene	15 E	10 E	35	37	110	89	150	300	960	13000	—	—	—
2-Methylnaphthalene	21 E	17 E	160	230	120	210	130	330	670	1900	—	—	—
Total LPAHs	140	96	522	677	1187	1117	1293	3310	5200	29000	—	—	—
LPAHs in mg/kg-oc													
Naphthalene	1.9	1.0 E	3.0	4.6	3.4	1.6	4.9	9.5		—	—	99	170
Acenaphthylene	1.3 U	1.1 U	0.24 E	0.35 E	0.29 E	0.42 U	0.40 E	0.66		—	—	66	66
Acenaphthene	1.4 U	1.2 U	0.38 E	0.54	2.2	0.71	1.9	4.5		—	—	16	57
Fluorene	0.56 E	0.31 E	0.85	1.2	2.4	1.1	2.5	4.9		—	—	23	79
Phenanthrene	2.1	1.1 E	1.7	1.9	8.1	4.0	8.1	16		—	—	100	480
Anthracene	0.65 E	0.34 E	0.66	0.77	1.9	0.81	2.6	3.9		—	—	220	1200
2-Methylnaphthalene	0.91 E	0.59 E	3.0	4.8	2.1	1.9	2.3	4.3		—	—	38	64
Total LPAHs	6.1	3.3	9.8	14	20	10	23	44		—	—	370	780
HPAHs in ug/kg (Dry Weight)													
Fluoranthene	66	43	130	90	490	340	670	1000	1700	30000	4600	—	—
Pyrene	71	46 E	120	73	440	360	550	760	2600	16000	—	—	—
Benz(a)anthracene	25 E	46 U	56	25 E	150	120	260	310	1300	5100	—	—	—
Chrysene	32 E	17 E	56	22 E	190	160	360	380	1400	21000	—	—	—
Total benzofluoranthenes	39 E	23 E	49 U	39 U	196	122 E	390	340	3200	9900	—	—	—
Benzo(a)pyrene	21 E	11 E	30 E	13 E	100	67	210	230	1600	3600	3600	—	—
Indeno(1,2,3-cd)pyrene	16 E	9 E	15 E	39 U	58 E	33 E	110	110	600	4400	—	—	—
Dibenz(a,h)anthracene	60 U	66 U	51 U	41 U	75 U	93 U	72 U	70 U	230	1900	—	—	—
Benzo(ghi)perylene	21 E	13 E	20 E	12 E	71 E	41 E	130	130	670	3200	—	—	—
Total HPAHs	291	162	427	235	1695	1243	2680	3260	12000	69000	—	—	—

Table L-2. Cont.

Sample ID	HC-VC-94-C1	HC-VC-94-C2	HC-VC-95-C1	HC-VC-95-C2	HC-VC-96-C1	HC-VC-96-C2	HC-VC-97-C1	HC-VC-97-C2	PSDDA SL	PSDDA ML	PSDDA BT	SQS	MCUL
HPAHs in mg/kg-oc													
Fluoranthene	2.9	1.5	2.5	1.9	8.4	3.1	12	13		—	—	160	1200
Pyrene	3.1	1.6 E	2.3	1.5	7.6	3.3	9.6	10		—	—	1000	1400
Benz(a)anthracene	1.1 E	1.6 U	1.1	0.52 E	2.6	1.1	4.6	4.1		—	—	110	270
Chrysene	1.4 E	0.59 E	1.1	0.46 E	3.3	1.5	6.3	5.0		—	—	110	460
Total benzofluoranthenes	1.7 E	0.79 E	0.92 U	0.81 U	3.4	1.1 E	6.8	4.5		—	—	230	450
Benzo(a)pyrene	0.91 E	0.38 E	0.57 E	0.27 E	1.7	0.61	3.7	3.0		—	—	99	210
Indeno(1,2,3-cd)pyrene	0.70 E	0.31 E	0.28 E	0.81 U	1.0 E	0.30 E	1.9	1.4		—	—	34	88
Dibenz(a,h)anthracene	2.6 U	2.3 U	0.96 U	0.85 U	1.3 U	0.84 U	1.3 U	0.92 U		—	—	12	33
Benzo(ghi)perylene	0.91 E	0.45 E	0.38 E	0.25 E	1.2 E	0.37 E	2.3	1.7		—	—	31	78
Total HPAHs	13	5.6	8.1	4.9	29	11	47	43		—	—	960	5300
Miscellaneous Semivolatiles in ug/kg (dry weight)													
1,2-Dichlorobenzene	36 U	19 U	30 U	24 U	16 E	33 E	12 E	21 U	35	110	37	—	—
1,3-Dichlorobenzene	49 U	53 U	42 U	33 U	61 U	19 E	58 U	57 U	170	—	1241	—	—
1,4-Dichlorobenzene	32 U	35 U	28 U	22 U	12 E	29 E	17 E	21 E	110	120	120	—	—
1,2,4-Trichlorobenzene	30 U	33 U	26 U	20 U	38 U	47 U	36 U	35 U	31	64	—	—	—
Hexachlorobenzene	4.1	5.3	2.3	1.8 U	23	28	13	4.6	22	230	168	—	—
Dibenzofuran	14 E	10 E	88	120	95	52 U	100	220 E	540	1700	—	—	—
Hexachlorobutadiene	2.6 U	2.8 U	2.2 U	1.8 U	3.3 U	4 U	3.1 U	3 U	29	290	212	—	—
Hexachloroethane	37 U	40 U	31 U	25 U	46 U	57 U	43 U	43 U	1400	14000	10220	—	—
N-Nitroso diphenylamine	40 U	43 U	34 U	27 U	50 U	62 U	47 U	46 U	28	130	130	—	—
Benzyl Alcohol	3.9 E	2.8 E	3.5 E	0.93 E	15 E	28 E	55 E	8 E	57	870	—	57	73
Benzoic Acid	100 EB	95 EB	390 B	230 B	370 B	420 B	390 B	260 EB	650	760	—	650	650
Miscellaneous Semivolatiles in mg/kg-oc													
1,2-Dichlorobenzene	1.6 U	0.65 U	0.57 U	0.50 U	0.28 E	0.30 E	0.21 E	0.28 U		—	—	2.3	2.3
1,4-Dichlorobenzene	1.4 U	1.2 U	0.53 U	0.46 U	0.21 E	0.26 E	0.30 E	0.28 E		—	—	3.1	9
1,2,4-Trichlorobenzene	1.3 U	1.1 U	0.49 U	0.42 U	0.65 U	0.43 U	0.63 U	0.46 U		—	—	0.81	1.8
Hexachlorobenzene	0.18	0.18	0.043	0.038 U	0.40	0.25	0.23	0.061		—	—	0.38	2.3
Dibenzofuran	0.61 E	0.34 E	1.7	2.5	1.6	0.47 U	1.8	2.9 E		—	—	15	58
Hexachlorobutadiene	0.11 U	0.097 U	0.042 U	0.038 U	0.057 U	0.036 U	0.054 U	0.039 U		—	—	3.9	6.2
N-Nitroso diphenylamine	1.7 U	1.5 U	0.64 U	0.56 U	0.86 U	0.56 U	0.82 U	0.60 U		—	—	11	11
Phthalates in ug/kg (dry weight)													
Dimethyl phthalate	67 U	73 U	57 U	45 U	83 U	100 U	16 E	78 U	1400	—	1400	—	—
Diethyl phthalate	79 U	9 E	67 U	53 U	11 E	120 U	93 U	91 U	1200	—	—	—	—
Di-n-butyl phthalate	18 EB	22 EB	39 U	31 U	58 U	72 U	52 EB	54 U	5100	—	10220	—	—
Butyl benzyl phthalate	60 U	65 U	51 U	40 U	75 U	93 U	38 U	70 U	970	—	—	—	—
Bis(2-ethylhexyl)phthalate	38 EB	46 EB	360 B	23 EB	460 B	290 B	560 B	130 EB	8300	—	13870	—	—
Di-n-octyl phthalate	56 U	61 U	48 U	38 U	70 U	87 U	67 U	65 U	6200	—	—	—	—
Phthalates in mg/kg-oc													
Dimethyl phthalate	2.9 U	2.5 U	1.1 U	0.94 U	1.4 U	0.91 U	0.28 E	1.0 U		—	—	53	53
Diethyl phthalate	3.4 U	0.31 E	1.3 U	1.1 U	0.19 E	1.1 U	1.6 U	1.2 U		—	—	61	110
Di-n-butyl phthalate	0.78 EB	0.76 EB	0.74 U	0.65 U	1.0 U	0.65 U	0.91 EB	0.71 U		—	—	220	1700
Butyl benzyl phthalate	2.6 U	2.2 U	0.96 U	0.83 U	1.3 U	0.84 U	0.67 U	0.92 U		—	—	4.9	64
Bis(2-ethylhexyl)phthalate	1.7 EB	1.6 EB	6.8 B	0.48 EB	7.9 B	2.6 B	9.8 B	1.7 EB		—	—	47	78
Di-n-octyl phthalate	2.4 U	2.1 U	0.91 U	0.79 U	1.2 U	0.79 U	1.2 U	0.85 U		—	—	58	4500

Table L-2. Cont.

Sample ID	HC-VC-94-C1	HC-VC-94-C2	HC-VC-95-C1	HC-VC-95-C2	HC-VC-96-C1	HC-VC-96-C2	HC-VC-97-C1	HC-VC-97-C2	PSDDA SL	PSDDA ML	PSDDA BT	SQS	MCUL
Phenols in ug/kg (dry weight)													
Phenol	34 B	23 B	160 B	63 B	210 B	230 B	190 B	290 B	420	1200	876	420	1200
2-Methylphenol	12 E	7.4 E	130	74	13 E	31 E	18 E	28 E	63	77	—	63	63
4-Methylphenol	130	78	460	260	4600	12000	3900	7600	670	3600	—	670	670
2,4-Dimethylphenol	14 E	8.4 E	190	120	8 E	46 E	8.8 E	19 E	29	210	—	29	29
Pentachlorophenol	4 E	4.3 E	11 E	5.7 E	29 E	150	37 E	44 E	400	690	504	360	690
Pesticides and PCBs in ug/kg (dry weight)													
4,4-DDD	4 E	14 UE	4.1 E	1.8 UE	28 E	52 E	25 E	61 E		—	—	—	—
4,4-DDE	5.2 UE	14 UE	4.4 UE	1.8 UE	16 UE	25 E	16 UE	15 UE		—	—	—	—
4,4-DDT	5.2 UE	14 UE	4.4 UE	1.8 UE	16 UE	20 UE	16 UE	15 UE		—	—	—	—
Total DDT	5.2 UE	14 UE	4.4 UE	1.8 UE	28 E	77 E	25 E	61 E	6.9	69	50	—	—
Aldrin	2.6 U	2.8 U	2.2 U	1.8 U	3.3	4.9	5.1	3.5	10	—	37	—	—
Alpha Chlordane	2.6 U	2.8 U	2.2 U	1.8 U	3.3 U	4 U	3.1 U	3 U	10	—	37	—	—
Dieldrin	5.2 U	5.7 U	4.4 U	3.5 U	9.5	10	14	20	10	—	37	—	—
Heptachlor	5.2 UE	2.8 UE	4.4 UE	1.8 UE	16 UE	20 UE	16 UE	15 UE	10	—	37	—	—
PCB-1016	52 U	57 U	44 U	35 U	coellution w/1242	coellution w/1242	coellution w/1242	coellution w/1242		—	—	—	—
PCB-1016 + 1242	NA	NA	NA	NA	280	510	200	190		—	—	—	—
PCB-1221	52 U	57 U	44 U	35 U	65 U	81 U	62 U	61 U		—	—	—	—
PCB-1232	52 U	57 U	44 U	35 U	65 U	81 U	62 U	61 U		—	—	—	—
PCB-1242	52 U	57 U	44 U	35 U	coellution w/1242	coellution w/1242	coellution w/1242	coellution w/1242		—	—	—	—
PCB-1248	52 U	57 U	44 U	35 U	65 U	81 U	62 U	61 U		—	—	—	—
PCB-1254	52 U	57 U	44 U	35 U	65 U	81 U	62 U	61 U		—	—	—	—
PCB-1260	52 U	57 U	44 U	35 U	330	510	160	320		—	—	—	—
Total PCBs	52 U	57 U	44 U	35 U	610	1000	360	510	130	3100	—	—	—
PCBs in mg/kg-oc	2.3 U	2 U	0.83 U	0.73 U	11	9.1	6.3	6.7		—	38	12	65
Conventionals													
Ammonia-Nitrogen (mg/kg dry wt)	12	36	8.1	21	100	610	87	260		—	—	—	—
Total Organic Carbon (%dry)	2.3	2.9	5.3	4.8	5.8	11	5.7	7.6		—	—	—	—
pH	8.2	8.4	8.1	8.2	8.2	8.2	8.1	8.1		—	—	—	—
Moisture (%)	47	53	40	24	59	67	57	56		—	—	—	—
Grain Size Summary													
Percent gravel	0	0	2	9	6	1	0	1		—	—	—	—
Percent sand	18	7	55	73	31	29	37	35		—	—	—	—
Percent silt	47	49	25	11	38	42	41	40		—	—	—	—
Percent clay	35	44	18	7	25	28	22	24		—	—	—	—

Table L-3. Detected PSDDA SL and PSDDA ML Exceedences

Sample ID	Analyte	Result	Unit	PSDDA SL	PSDDA SL E-Ratio (1)	PSDDA ML	PSDDA ML E-Ratio (1)
HC-VC-96-C2	Cadmium	6.1	mg/kg	0.41	1.20	14	
HC-VC-94-C1	Mercury	1.3	mg/kg	0.41	3.17	2.3	
HC-VC-94-C2	Mercury	1.8	mg/kg	0.41	4.39	2.3	
HC-VC-95-C1	Mercury	0.68	mg/kg	0.41	1.66	2.3	
HC-VC-96-C1	Mercury	2.7	mg/kg	0.41		2.3	1.17
HC-VC-96-C2	Mercury	4.3	mg/kg	0.41		2.3	1.87
HC-VC-97-C1	Mercury	1.8	mg/kg	0.41	4.39	2.3	
HC-VC-97-C2	Mercury	2.5	mg/kg	0.41		2.3	1.09
HC-VC-96-C1	Tributyltin	0.20	ug/L	0.15	1.33	NA	
HC-VC-97-C1	Tributyltin	0.19	ug/L	0.15	1.27	NA	
HC-VC-96-C1	Hexachlorobenzene	23	ug/kg	22	1.05	230	
HC-VC-96-C2	Hexachlorobenzene	28	ug/kg	22	1.27	230	
HC-VC-95-C1	2-Methylphenol	130	ug/kg	63		77	1.69
HC-VC-95-C2	2-Methylphenol	74	ug/kg	63	1.17	77	
HC-VC-95-C1	2,4-Dimethylphenol	190	ug/kg	29	6.55	210	
HC-VC-95-C2	2,4-Dimethylphenol	120	ug/kg	29	4.14	210	
HC-VC-96-C2	2,4-Dimethylphenol	46 E	ug/kg	29	1.59	210	
HC-VC-96-C1	4-Methylphenol	4600	ug/kg	670		3600	1.28
HC-VC-96-C2	4-Methylphenol	12000	ug/kg	670		3600	3.33
HC-VC-97-C1	4-Methylphenol	3900	ug/kg	670		3600	1.08
HC-VC-97-C2	4-Methylphenol	7600	ug/kg	670		3600	2.11
HC-VC-97-C1	Dieldrin	14	ug/kg	10	1.40	NA	
HC-VC-97-C2	Dieldrin	20	ug/kg	10	2.00	NA	
HC-VC-96-C1	Total DDT	28 E	ug/kg	6.9	4.06	69	
HC-VC-96-C2	Total DDT	77 E	ug/kg	6.9		69	1.12
HC-VC-97-C1	Total DDT	25 E	ug/kg	6.9	3.62	69	
HC-VC-97-C2	Total DDT	31 E	ug/kg	6.9	4.49	69	
HC-VC-96-C1	Total PCBs	610	ug/kg	130	4.69	3100	
HC-VC-96-C2	Total PCBs	1000	ug/kg	130	7.69	3100	
HC-VC-97-C1	Total PCBs	360	ug/kg	130	2.77	3100	
HC-VC-97-C2	Total PCBs	510	ug/kg	130	3.92	3100	

(1) - E-Ratio, or exceedance ratio, of an analyte/compound with respect to a criteria value is calculated by dividing the concentration of the analyte/compound by the criteria.

Table L-4. Summary of Bioassay Results for Controls and Reference Stations and Comparison to Performance Criteria

SAMPLE ID	*Eohaustorius estuaris* MEAN PERCENT MORTALITY[a]	*Dendraster excentricus* MEAN NORMAL SURVIVAL	*Neanthes arenaceodentata* MEAN INDIVIDUAL GROWTH (MIG) RATE (mg/ind/day dry weight)[a]
Negative Control			
Performance Criteria	$M_C < 10\%$	$N_C/I \geq 70\%$	$M_C < 10\%$; MIG $\geq$ 0.38 mg/ind/day
Test Performance	1 ± 2%	81%	0%; 0.57 ± 0.09
Reference Sediment			
Performance Criteria	$M_R - M_C \leq 20\%$	$N_R/N_C \geq 0.65$	$MIG_R/MIG_C \geq 0.8$
HC-CR-10 Performance	3 ± 3%	75%	0.69 ± 0.16
HC-CR-24 Performance	3 ± 4%	80%	0.56 ± 0.11

[a] Mean and standard deviation for five replicate samples

Table L-5. Summary of the Results of the *Eohaustorius estuarius* Bioassays and Comparison to PSDDA Criteria

Station ID	Reference Station[a]	Mean Mortality, %[b]	Significant Difference[c]	One-Hit Rule	Two-Hit Rule
HC-VC-94-C1	HC-CR-10	9 ± 3	No	Pass	Pass
HC-VC-94-C2	HC-CR-10	29 ± 10	Yes	Pass	Pass
HC-VC-95-C1	HC-CR-24	2 ± 3	No	Pass	Pass
HC-VC-95-C2	HC-CR-24	5 ± 4	No	Pass	Pass
HC-VC-96-C1	HC-CR-24	5 ± 4	No	Pass	Pass
HC-VC-96-C2	HC-CR-24	26 ± 13	Yes	Pass	Pass
HC-VC-97-C1	HC-CR-24	5 ± 4	No	Pass	Pass
HC-VC-97-C2	HC-CR-24	39 ± 18	Yes	**Fail**	**Fail**

[a] Corresponding reference station with similar grain size.
[b] Mean and standard deviation for five replicate samples.
[c] Statistically significant increases in percent mortality compared to reference as determined by a t-Test (normally distributed data) or Mann-Whitney Test (M-W: nonparametric data) at the $\alpha = 0.05$ level.

Table L-6. Summary of the Results of the *Dendraster excentricus* Bioassays and Comparison to PSDDA Criteria

STATION ID	REFERENCE STATION[A]	MEAN NORMAL SURVIVAL, %[B]	SIGNIFICANT DIFFERENCE[C]	ONE-HIT RULE	TWO-HIT RULE
HC-VC-94-C1	HC-CR-10	113.8 ± 5.3	No	Pass	Pass
HC-VC-94-C2	HC-CR-10	63.4 ± 14.1	Yes	Pass	Pass
HC-VC-95-C1	HC-CR-24	80.4 ± 6.1	Yes	Pass	Pass
HC-VC-95-C2	HC-CR-24	108.4 ± 9.3	No	Pass	Pass
HC-VC-96-C1	HC-CR-24	0.4 ± 0.5	Yes	**Fail**	**Fail**
HC-VC-96-C2	HC-CR-24	0	Yes	**Fail**	**Fail**
HC-VC-97-C1	HC-CR-24	83.0 ± 11.4	No	Pass	Pass
HC-VC-97-C2	HC-CR-24	0	Yes	**Fail**	**Fail**

a Corresponding reference station with similar grain size.

b Mean and standard deviation for five replicate samples.

c Statistically significant decreases in percent normal survival compared to reference as determined by a t-test (normally distributed data) or Mann-Whitney Test (M-W: nonparametric data) at the $\alpha = 0.05$ level.

Table L-7. Summary of the Results of the *Neanthes arenaceodentata* Bioassays and Comparison to PSDDA Criteria

Station ID	Reference Station[a]	Mean Individual Growth Rate, mg/ind/day dry wt[b]	Significant Difference[c]	One-Hit Rule	Two-hit Rule
HC-VC-94-C1	HC-CR-10	0.61 ± 0.04	Yes	Pass	Pass
HC-VC-94-C2	HC-CR-10	0.71 ± 0.06	No	Pass	Pass
HC-VC-95-C1	HC-CR-24	0.59 ± 0.08	No	Pass	Pass
HC-VC-95-C2	HC-CR-24	0.67 ± 0.11	No	Pass	Pass
HC-VC-96-C1	HC-CR-24	0.00	Yes	**Fail**	**Fail**
HC-VC-96-C2	HC-CR-24	0.00	Yes	**Fail**	**Fail**
HC-VC-97-C1	HC-CR-24	0.45 ± 0.16	No	Pass	Pass
HC-VC-97-C2	HC-CR-24	0.00	Yes	**Fail**	**Fail**

NOTE: SQS - Sediment Quality Standards
MCUL - Minimum Cleanup Level

[a] Corresponding reference station with similar grain size.
[b] Mean and standard deviation for five replicate samples.
[c] Statistically significant decreases in growth relative to reference as determined by a t-test (normally distributed data) or Mann-Whitney Test (M-W: nonparametric data) at the $\alpha = 0.05$ level.

Table L-8. Comparison of Bioassay Results and Sediment Biological Effects Interpretive Criteria

Station ID	*E. estuaris* One-Hit	*E. estuaris* Two-Hit	*D. excentricus* One-Hit	*D. excentricus* Two-Hit	*N. arenaceodentata* One-Hit	*N. arenaceodentata* Two-Hit	PSDDA "One-hit Rule"	PSDDA "Two-hit Rule"
HC-VC-94-C1	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
HC-VC-94-C2	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
HC-VC-95-C1	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
HC-VC-95-C2	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
HC-VC-96-C1	Pass	Pass	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**
HC-VC-96-C2	Pass	Pass	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**
HC-VC-97-C1	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
HC-VC-97-C2	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**	**Fail**

Table L-9. Whatcom Waterway Bioaccumulation Mercury Concentrations

Sample ID	Hg (mg/kg wet weight)	
	N. virens	*M. nasuta*
Negative control	0.019	0.019
Negative control	0.014	0.014
Negative control	0.013	0.021
Negative control	0.016	0.045
HC-CR-10	0.017	0.017
HC-CR-10	0.011	0.021
HC-CR-10	0.009	0.016
HC-CR-10	0.011	0.019
HC-CR-24	0.015	0.015
HC-CR-24	0.019	0.023
HC-CR-24	0.018	0.015
HC-CR-24	0.018	0.017
HC-VC-97-C1	0.014	0.05
HC-VC-97-C1	0.01	0.029
HC-VC-97-C1	0.011	0.019
HC-VC-97-C1	0.015	0.022
HC-VC-94-C2	NA	0.03
Background	0.018	0.023
Day 0	0.009	0.024

NOTE: NA - Insufficient sample volume

Table L-10. Whatcom Waterway Mean Mercury Concentrations (mg/kg wet weight)

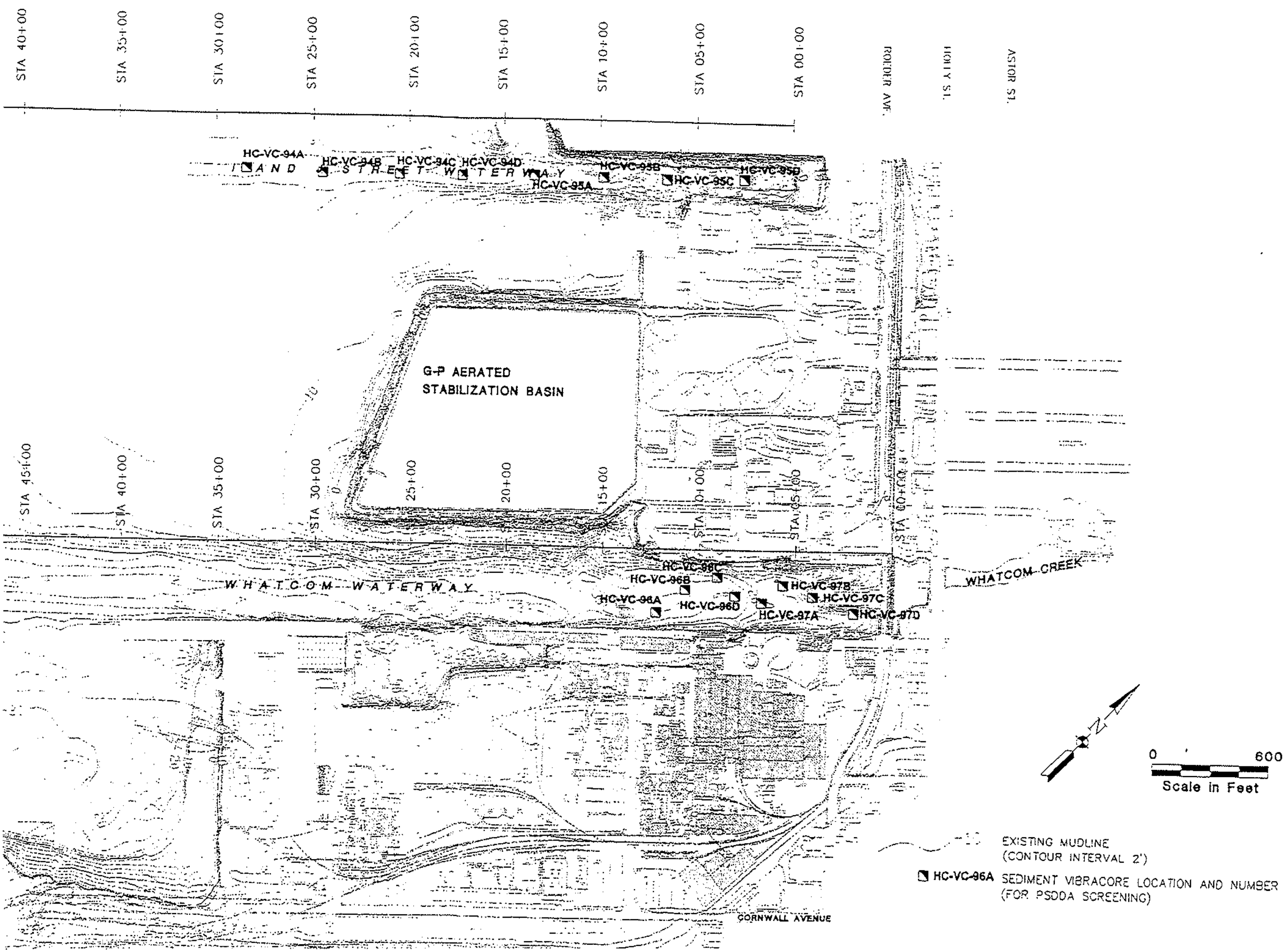
	N. virens		*M. nasuta*	
Sample ID	Mean	Standard Deviation	Mean	Standard Deviation
Negative Control	0.0155	0.00265	0.0248	0.01382
HC-CR-10	0.0120	0.00346	0.0183	0.00222
HC-CR-24	0.0175	0.00173	0.0175	0.00379
HC-VC-97-C1	0.0125	0.00238	0.0300	0.01398
HC-VC-94-C2	NA	NA	0.0300	NA

NOTE: NA - Insufficient sample volume

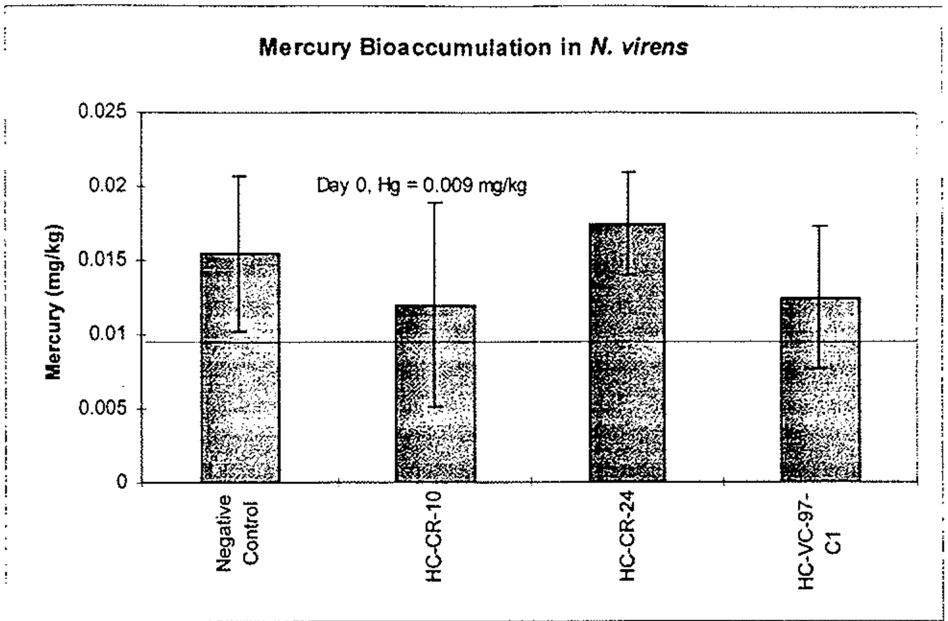
Table L-11. PSSDA Analysis Summary

Sample ID	Chemical Exceedences					Confirmatory Biological Testing		Potential Disposal Options	
	PSDDA SL Exceedances	PSDDA ML Exceedances	PSDDA BT Exceedances	SQS Exceedances	MCUL Exceedances	PSDDA Bioassay	Mercury Concentration Less Than Bioaccumulation Action Level (1)	Potentially Suitable for Unconfined Open-Water Disposal	Potentially Suitable for Beneficial Reuse
HC-VC-94-C1	Mercury; 1,2-Dichlorobenzene; N-Nitrosodiphenylamine	None	None	Mercury; 1,2,4-Trichlorobenzene (ER 1.61)	Mercury	Pass	NA	Yes	Yes
HC-VC-94-C2	Mercury; 1,2,4-Trichlorobenzene; N-Nitrosodiphenylamine; Total DDT	None	Mercury	Mercury; 1,2,4-Trichlorobenzene (ER 1.40)	Mercury	Pass	Yes	Yes	Yes
HC-VC-95-C1	Mercury; 2-Methylphenol; 2,4-Dimethylphenol; N-Nitrosodiphenylamine	2-Methylphenol	None	Mercury; 2-Methylphenol; 2,4-Dimethylphenol	Mercury; 2-Methylphenol; 2,4-Dimethylphenol	Pass (2)	NA	Yes	Yes
HC-VC-95-C2	2-Methylphenol; 2,4-Dimethylphenol	None	None	2-Methylphenol; 2,4-Dimethylphenol	2-Methylphenol; 2,4-Dimethylphenol	Pass	NA	Yes	Yes
HC-VC-96-C1	Mercury; Tributyltin; 4-Methylphenol; 1,2,4-Trichlorobenzene; Hexachlorobenzene; N-Nitrosodiphenylamine; Heptachlor; Total DDT; Total PCBs	Mercury; 4-Methylphenol	Mercury; Tributyltin	Mercury; Hexachlorobenzene (ER 1.04); 4-Methylphenol	Mercury; 4-Methylphenol	Fail	NA	No	No
HC-VC-96-C2	Cadmium; Mercury; 1,2,4-Trichlorobenzene; Hexachlorobenzene; 4-Methylphenol; 2,4-Dimethylphenol; N-Nitrosodiphenylamine; Heptachlor; Total DDT; Total PCBs	Mercury; 4-Methylphenol; Total DDT	Mercury; Total DDT	Cadmium; Mercury; 4-Methylphenol; 2,4-Dimethylphenol	Mercury; 4-Methylphenol; 2,4-Dimethylphenol	Fail	NA	No	No
HC-VC-97-C1	Mercury; Tributyltin; 1,2,4-Trichlorobenzene; 4-Methylphenol; N-Nitrosodiphenylamine; Dieldrin; Heptachlor; Total DDT; Total PCBs	4-Methylphenol	Mercury; Tributyltin	Mercury; 4-Methylphenol	Mercury; 4-Methylphenol	Pass (2)	Yes	Yes	Yes
HC-VC-97-C2	Mercury; 1,2,4-Trichlorobenzene; 4-Methylphenol; N-Nitrosodiphenylamine; Dieldrin; Heptachlor; Total DDT; Total PCBs	Mercury; 4-Methylphenol	Mercury	Mercury; 4-Methylphenol	Mercury; 4-Methylphenol	Fail	NA	No	No

(1) - FDA action level of 1.0 mg/kg mercury in tissue (wet weight).
(2) - Although one chemical exceeds the PSDDA ML, the chemical does not exceed the ML by more than 100 percent.



STA 40+00
STA 35+00
STA 30+00
STA 25+00
STA 20+00
STA 15+00
STA 10+00
STA 05+00
STA 00+00
ROEDER AVE.
HOLLY ST.
ASTOR ST.
HC-VC-94A
HC-VC-94B
HC-VC-94C
HC-VC-94D
I AND STREET WATERWAY
HC-VC-95A
HC-VC-95B
HC-VC-95C
HC-VC-95D
G-P AERATED
STABILIZATION BASIN
STA 45+00
STA 40+00
STA 35+00
STA 30+00
25+00
20+00
15+00
STA 10+00
STA 05+00
STA 00+00
WHATCOM WATERWAY
WHATCOM CREEK
HC-VC-96A
HC-VC-96B
HC-VC-96C
HC-VC-96D
HC-VC-97A
HC-VC-97B
HC-VC-97C
HC-VC-97D
CORNWALL AVENUE
N
0
600
Scale in Feet
EXISTING MUDLINE
(CONTOUR INTERVAL 2')
HC-VC-96A SEDIMENT VIBRACORE LOCATION AND NUMBER
(FOR PSDDA SCREENING)



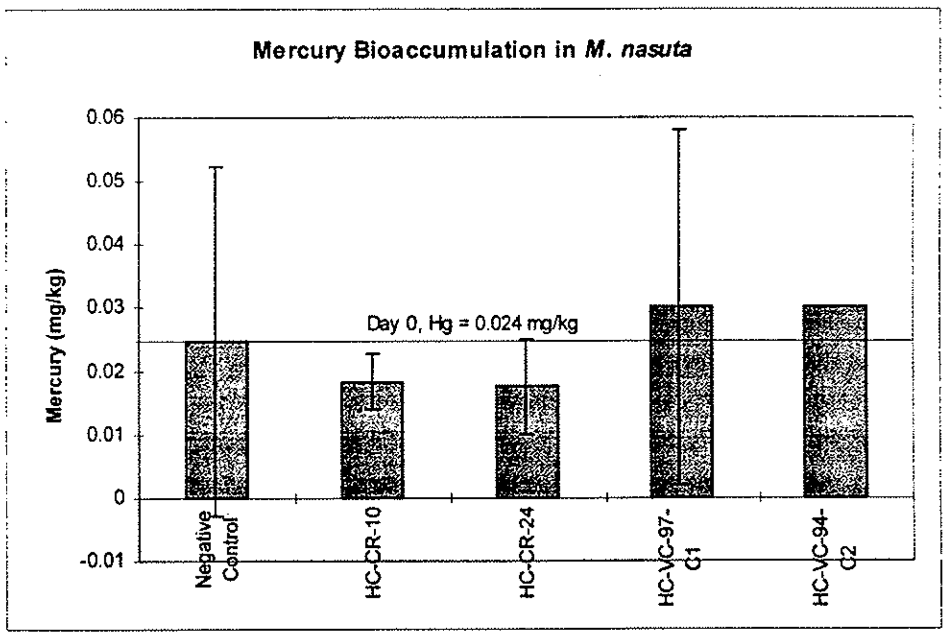


Figure L-2. Mercury Bioaccumulation in N. Virens and M. Nasuta