DREDGED MATERIAL MANAGEMENT PROGRAM

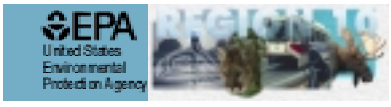
Puget Sound Dredged Disposal Analysis
Grays Harbor/Willapa Bay Evaluation Procedures
Lower Columbia River Evaluation Framework (Washington)

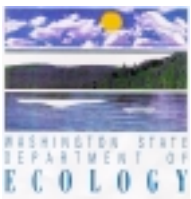
BIENNIAL REPORT

Dredging Years 2002/2003

PREPARED BY THE DMMP AGENCIES

WASHINGTON STATE DEPARTMENT OF
Natural Resources





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AET	Apparent Effects Threshold
BT	Bioaccumulation Trigger
COC	Chemical of Concern
CWA	Clean Water Act
CY	Cubic Yard
DAIS	Dredged Analysis Information System
DL	Detection Limit
DMMO	Dredged Material Management Office
DMMU	Dredged Material Management Unit
DNR	Washington Department of Natural Resources
DY	Dredging Year
EPA	Environmental Protection Agency
EPTA	Evaluation Procedures Technical Appendix
FC	Full Characterization
GIS	Geographic Information System
HPA	Hydraulic Project Approval
HPAH	High-molecular-weight PAH
LPAH	Low-molecular-weight PAH
ML	Maximum Level
MPR	Management Plan Report
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and Maintenance
PAH	Polynuclear Aromatic Hydrocarbon
PC	Partial Characterization
PCBs	Polychlorinated Biphenyls
PPB	Parts Per Billion
PPM	Parts Per Million
PSDDA	Puget Sound Dredged Disposal Analysis
PSEP	Puget Sound Estuary Program
PSNS	Puget Sound Naval Shipyard
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SDM	Suitability Determination
SMARM	Sediment Management Annual Review Meeting
SMS	Sediment Management Standards
SL	Screening Level
TOC	Total Organic Carbon
USACE	US Army Corps of Engineers
UCOWD	Unconfined Open Water Disposal
WDFW	Washington Department of Fish and Wildlife

CHAPTER 1 - INTRODUCTION

The Dredged Material Management Program (DMMP) represents an interagency approach to the management of dredged material in the State of Washington. Three separate, but closely related, dredged material programs exist under the DMMP: the Puget Sound Dredged Disposal Analysis (PSDDA), Grays Harbor and Willapa Bay, and the Lower Columbia River programs. The four cooperating agencies ("agencies") are: U.S. Army Corps of Engineers, Seattle District (Corps); U.S. Environmental Protection Agency, Region 10 (EPA); Washington Department of Ecology (Ecology); and Washington Department of Natural Resources (DNR). This chapter summarizes Dredged Material Management Program (DMMP) activities for Dredging Years 2002 and 2003.

The DMMP applies dredging evaluation guidelines to federal and permitted projects in Washington State, including Lake Washington, Puget Sound, Grays Harbor and Willapa Bay, and the Lower Columbia River. A dredging year includes all projects evaluated between June 16 of a given year and June 15 of the following year (DY02 = June 16, 2001 - June 15, 2002; DY03 = June 16, 2002 - June 15, 2003). Tables related to project-specific ranking, sampling, testing, and suitability determinations are presented in Chapter 2. Chapter 3 presents an overall assessment of sampling and testing activities and data, and details unusual circumstances or the application of best professional judgment by the agencies.

During DY02/03 there were 27 projects that completed the DMMP process (**Tables 1-1a** and **1-1b**). Most projects were full characterizations (FC) of a project area intended to assess suitability of the proposed dredged material for open water disposal. The typical completion action by the DMMP is a suitability determination memorandum (SDM) that summarizes the results of the FC and provides an official determination on suitability for open water disposal. Other DMMP actions include volume revisions (when the project volume changes subsequent to characterization), frequency or recency determinations, and other project-specific actions that document a DMMP decision on open-water disposal.

Of the projects listed in **Tables 1-1a** and **1-1b**, 8 had DMMP actions completed by June 15, 2002 and are considered DY02 projects. Nineteen projects had DMMP actions completed by June 15, 2003 and are considered DY03 projects. Puget Sound project locations for DY02 and DY03 are plotted in **Figure 1-1**. Projects located in Grays Harbor and Willapa Bay are shown in **Figure 1-2**.

Several characterizations during the DY02/03 biennium were for large, complex projects that proceeded through more than one round of sampling and/or testing and that span more than one dredging year. Those are discussed more fully in **Appendix A**. Any project that has resulted in an SDM or other completion action since June 15, 2003 is considered a DY 2004 project and is not considered in this report.

Table 1-1a. DY02 DMMP Evaluation Activities. These include all projects that concluded with an action by the DMMP between 6/15/01-6/14/02**.**

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	Ranking Determination DY	SAP Review DY	Suitability Determination DY
Glacier Northwest, Ready-Mix Facility	FC	PSDDA	4,900	1998[1]	2001	2002
Grays Harbor, Port of, Terminals 1, 2, 3 and 4	FC	GH/WB	132,841	1995[1,2]	2001	2002
Oak Harbor Municipal Pier	FC	PSDDA	144,500	1998[1]	2000	2002
Seattle, Port of, East Waterway Stage I	RD	PSDDA	27,000	1998[1]	1998	2002
Seattle, Port of, East Waterway, Stage II	RD	PSDDA	19,500	1998[1]	1998/1999	2002
Tacoma, Port of, Pierce County Terminal	FC	PSDDA	2,100,000	1998[1]	2001	2002
US Navy, Puget Sound Naval Shipyard, Phase I and II	BU	PSDDA	160,120	1998[1]	1998/1999	2002
Weyerhaeuser, Bay City Dock	FD/VR	GH/WB	20,000	1995[3,4]	1999	2002

DMMP Actions

FC = Full Characterization
PC = Partial Characterization
RD = Recency Determination
ED = Exclusion Determination
FD = Frequency Determination
VR = Volume Revision
BU = Beneficial Use

Disposal Jurisdictions

GH/WB = Grays Harbor/Willapa Bay
PSDDA = Puget Sound Dredged Disposal Analysis
CR = Columbia River

[1] Ranking source: Dredged material evaluation procedures and disposal site management, Grays Harbor and Willapa Bay, June 1995
[2] Ranking source: PSDDA Users Manual, 1st edition, 1998
[3] Ranking source: Dredged material evaluation procedures and disposal site management, Grays Harbor and Willapa Bay, June 1995
[4] Ranking source: PSDDA Users Manual, 1st edition, 1998

Table 1-1b. DY03 DMMP Evaluation Activities. These include all projects that concluded with an action by the DMMP between 6/15/02-6/14/03**.**

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	Ranking Determination DY	SAP Review DY	Suitability Determination DY
Bridgehaven Marina	FC	PSDDA	4,000	2000[1]	2003	2003
Delta Marine Industries	FC	PSDDA	7,000	2000[1]	2002	2003
Glacier Northwest	FC	PSDDA	10,000	2000[1]	2002	2003
Haug Channel	FC	PSDDA	10,000	2000	2001	2003
Grays Harbor, Port of, Terminal 2	VR	GH/WB	35,000	1995	na	na
Manke Lumber	RD	PSDDA	482,000	1998	na	2003
Olympia Yacht Club	FC	PSDDA	49,340	2000[4]	2002	2003
Sandy Hook Yacht Club	ED/BU	PSDDA	26,210	2000	2002	2003
Seattle, Port of, East Waterway, Terminal 18, Stage 1A	FC	PSDDA	28,100	2000[4]	2002	2003
Tyee Yacht Club	FC/BU	PSDDA	2,300	2001	2003	2003
Tacoma, Port of, Pierce County Terminal, Cutback Addendum	FC	PSDDA	205,060	2000[4]	2003	2003
Toke Point Entrance Channel	RD/FD	GH/WB	19,000	1995[3]	na	2003
USACE, Grays Harbor	FC	GH/WB	1,860,000	1995[3]	2002	2003
USACE, Swinomish	FC	PSDDA	120,000	2000[4]	2002	2003
US Coast Guard, Pier 36	RD	PSDDA	11,580	2002	2002	2003
US Coast Guard, Pier 36	FC	PSDDA	23,200	2000[4]	2001	2003
US Coast Guard, Pier 36	RD	PSDDA	12,800	2003	na	2003
US Fish and Wildlife Service, Protection Island	ED/BU	PSDDA	4,000	2000[4]	2002	2003
Weyerhaeuser, Mt. Coffin Channel	ED/FC	CR	1,100,000	1998	2002	2003

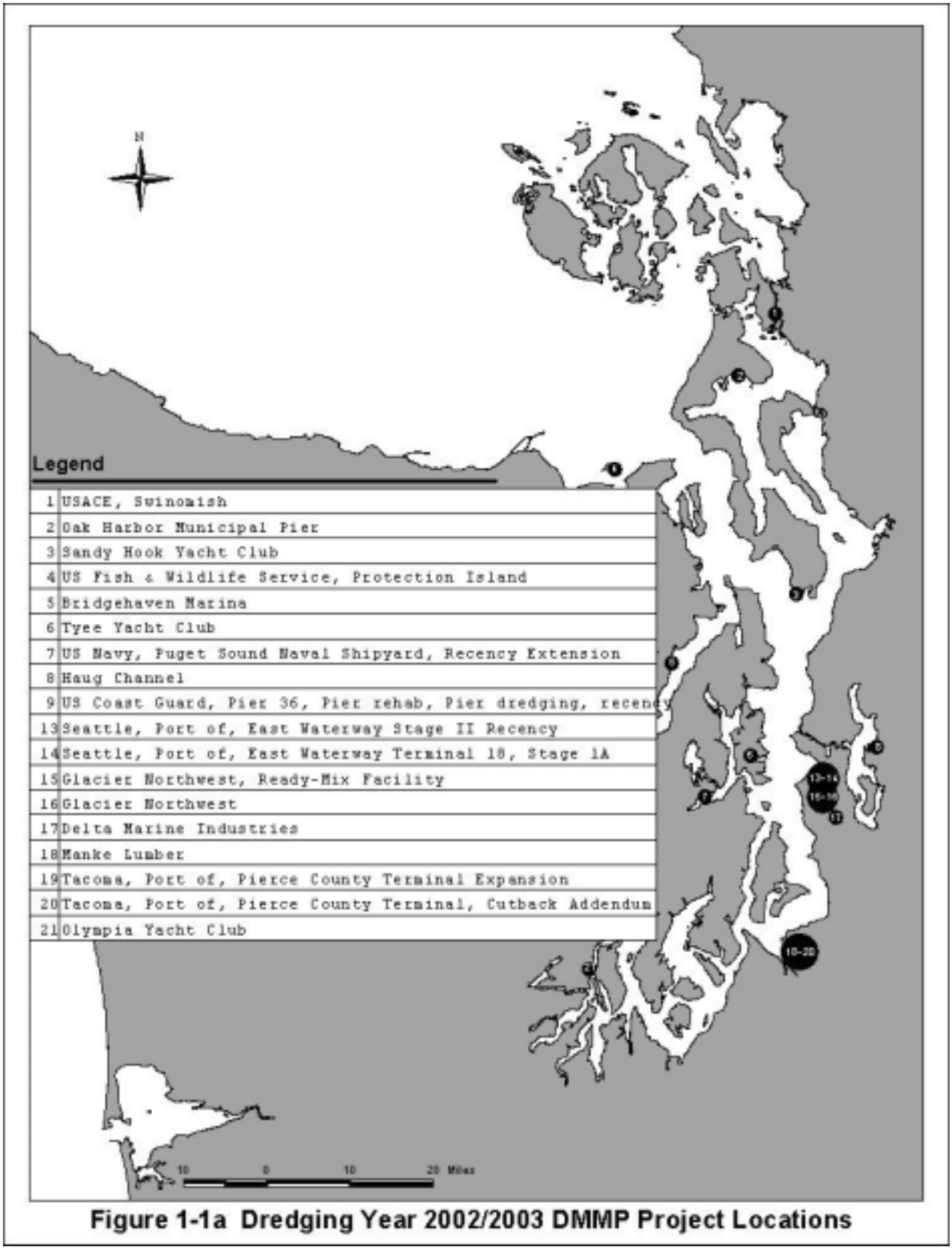

Figure 1-1a Dredging Year 2002/2003 DMMP Project Locations

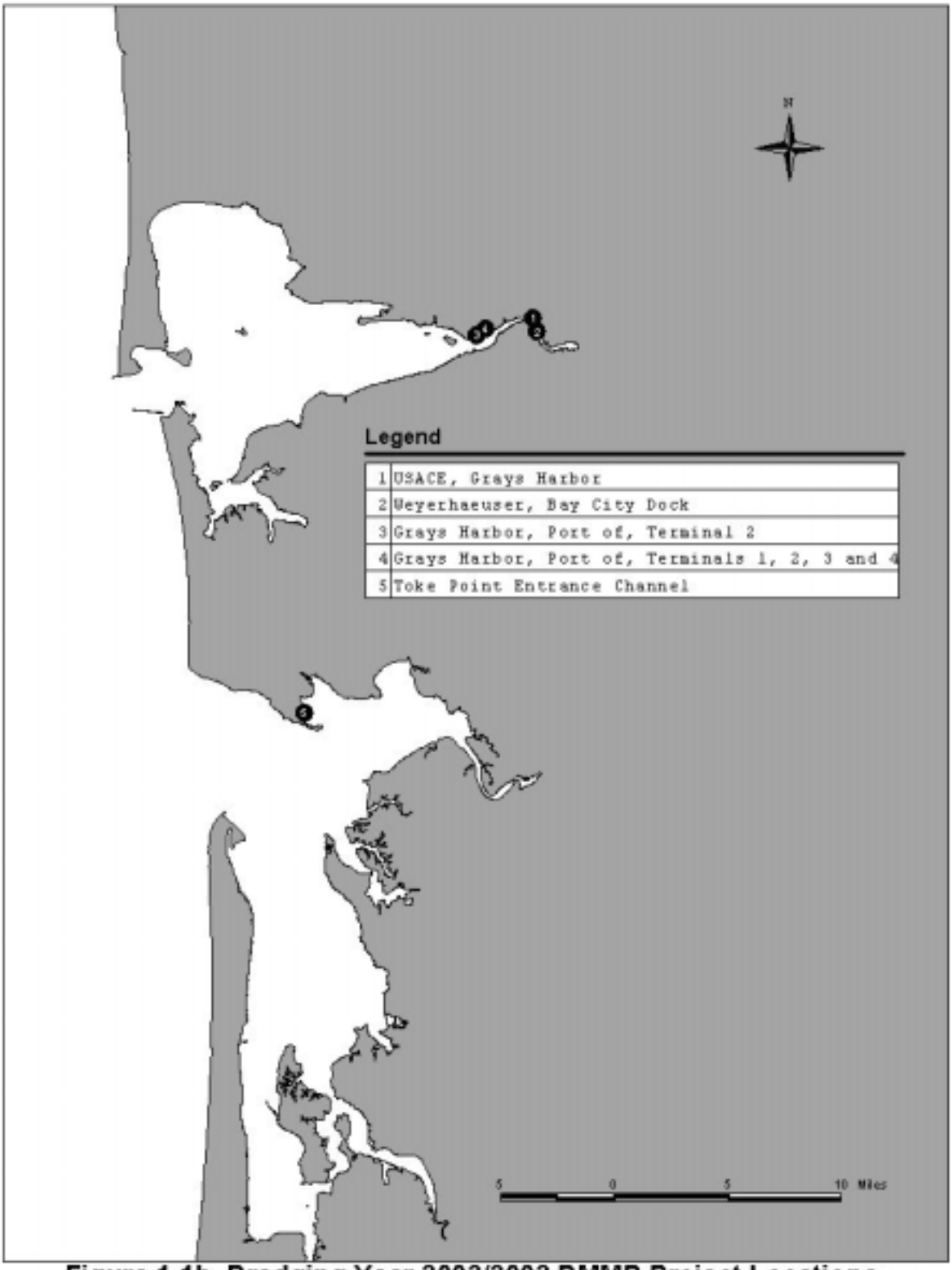

Figure 1-1b Dredging Year 2002/2003 DMMP Project Locations

CHAPTER 2 - DY02/03 PROJECTS

2.1 RANKING

Each jurisdiction under the DMMP has specific guidance that explains requirements for evaluating dredged material for open-water disposal. Sampling and analysis requirements under the PSDDA program are fully explained in the 1988 Phase I Evaluation Procedures Technical Appendix (EPTA) and the 2000 PSDDA Users Manual. Sampling and analysis requirements in Grays Harbor and Willapa Bay are explained in the Dredged Material Evaluation Procedures and Disposal Site Management Manual, Grays Harbor and Willapa Bay, Washington (GHDMEP). Sampling and analysis requirements for projects occurring within the Columbia River are found in the November 1998 Dredged Material Evaluation Framework – Lower Columbia River Management Area.[1] The PSDDA Users Manual and the Dredged Material Evaluation Framework can be accessed via the Internet from the Corp's Dredged Material Management Office home page, at http://www.nws.usace.army.mil (click on "Dredge Material Management"). A revised Users Manual combining both Puget Sound and Grays Harbor sampling and analysis requirements will be added to the same web site in 2004. The Dredged Material Evaluation Framework is being revised as part of the Regional Sediment Evaluation Team efforts. A draft of a revised regional sediment evaluation framework will be completed by October 2004.

Under the jurisdictional specific guidelines summarized above, the initial appraisal of a proposed dredging project requires a careful examination of all existing sediment quality data within the dredging area. An initial area ranking is based on a "reason to believe" that chemicals of concern may or may not be present in the project area. The agencies have established ranks for general areas within each jurisdiction (e.g., Elliott Bay/PSDDA) and activities (e.g., marinas) based on historical data or awareness of active sources of contamination. In the absence of project-specific data, representatives of the agencies apply an initial ranking based on guidance contained in the jurisdictional specific documents (PSDDA Users Manual, Chapter 3; Grays Harbor/Willapa Bay Users Manual, Chapter 7; Dredged Material Evaluation Framework, Chapter 5).

All three jurisdictional areas allow for a reconsideration of the initial ranking if the historical data at the site are adequate, or if the applicant conducts a partial characterization (PC) as described within each Users Manual to survey sediments in the project area for specific chemicals of concern. If the PC chemistry data support a lower ranking, sampling and analysis requirements for surface and subsurface sediments may be reduced during the full characterization (FC), commensurate with the revised ranking requirements. Chemicals of concern may also be eliminated for analysis during the FC, based on the PC data. **Tables 2-1a** and **2-1b** contain the initial and full characterization rankings of all DY02/03 projects. The "initial rank" was taken from the respective jurisdictional guidance rankings that were in effect at the time of project initiation. The "full characterization" rank was the rank actually used in the full characterization of project sediments.

None of the four DY02 full characterizations and one of the eleven DY03 FCs (Tyee Yacht Club)) had rankings adjusted based on presentation of additional data. In the one case the ranking was adjusted downward. It should be noted that the DMMP does not track projects that have had

[1] Henceforth referred to as the Dredged Material Evaluation Framework

downranking requests denied based on insufficient "reason to believe" or inadequate data supporting the request.

Table 2-1a. DY02 Project Rankings.

PROJECT	Disposal Jurisdiction	Location	Water body	Initial Rank	Final Rank
Glacier Northwest, Ready-Mix Facility	PSDDA	Seattle	Duwamish River	H	H
Grays Harbor, Port of, Terminals 1, 2, 3 and 4	GH/WB	Aberdeen	Grays Harbor	L/LM	L/LM
Oak Harbor Municipal Pier	PSDDA	Seattle	Puget Sound	LM	LM
Seattle, Port of, East Waterway Stage I	PSDDA	Seattle	Duwamish River	H	H
Tacoma, Port of, Pierce County Terminal	PSDDA	Tacoma	Blair Waterway	L	L
US Navy, Puget Sound Naval Shipyard, Phase I and II	PSDDA	Bremerton	Sinclair Inlet	H	H
Weyerhaeuser, Bay City Dock	GH/WB	Aberdeen	Chehalis River	LM	LM

L = Low
LM = Low/Moderate
M = Moderate
H = High

Table 2-1b. DY03 Project Rankings.

PROJECT	Disposal Jurisdiction	Location	Water body	Initial Rank	Final Rank
Bridgehaven Marina	PSDDA	Hood Canal	Hood Canal	LM	LM
Delta Marine Industries	PSDDA	Seattle	Duwamish River	H	H
Glacier Northwest	PSDDA	Seattle	Duwamish River	H	H
Haug Channel	PSDDA	Seattle	Lake Washington	M	M
Grays Harbor, Port of, Terminal 2	GH/WB	Aberdeen	Grays Harbor	LM	LM
Manke Lumber	PSDDA	Tacoma	Hylebos Waterway	H	H
Olympia Yacht Club	PSDDA	Island Home	Hood Canal	LM	LM
Sandy Hook Yacht Club	PSDDA	Whidbey Island	Puget Sound	L	L
Seattle, Port of, East Waterway, Terminal 18, Stage 1A	PSDDA	Seattle	Duwamish River	H	H
Tyee Yacht Club	PSDDA	Bainbridge Island	Eagle Harbor	M	LM
Tacoma, Port of, Pierce County Terminal, Cutback Addendum	PSDDA	Tacoma	Blair Waterway	L	L
Toke Point Entrance Channel	GH/WB	Toke Point	Willapa Bay	L/M	L/M
USACE, Grays Harbor	GH/WB	Aberdeen	Grays Harbor	L	L
USACE, Swinomish	PSDDA	Swinomish Channel	Swinomish Channel	L	L
US Coast Guard, Pier 36	PSDDA	Seattle	Elliott Bay	H	H
US Coast Guard, Pier 36, Recency	PSDDA	Seattle	Elliott Bay	H	H
US Coast Guard, Pier 36, Alpha Pier	PSDDA	Seattle	Elliott Bay	H	H
US Fish and Wildlife Service, Protection Island	PSDDA	Port Angeles	St of Juan de Fuca	LM	LM
Weyerhaeuser, Mt. Coffin Channel	CR	Longview	Columbia River	LM	LM

2.2 SAMPLING AND ANALYSIS PLANS

Approved sampling and analysis plans (SAPs) are required before applicants collect sediment samples for either a PC or FC. The applicant or dredging consultant receives guidance in SAP development[2] based on the ranking that has been assigned to the proposed project. A conceptual dredging plan and representative sampling plan are established in close coordination with the Corps of Engineers Dredged Material Management Office (DMMO). Protocols for station positioning, decontamination, field sampling, sample compositing, chemical analysis, biological testing, QA/QC and data submittal are all included in the sampling and analysis plan. Once completed, DMMO coordinates review and approval of the plan with the DMMP agencies.

Tables 2-2a and **2-2b** contain data related to sampling plans approved for DY02/03 projects. Application of jurisdictionally specific sampling and analysis requirements resulted in the number of field samples and dredged material management units (DMMUs) formulated for each of the projects. Descriptions of those projects for which no testing was required, or for which best professional judgment was applied, are discussed in the project descriptions in **Appendix A**.

Table 2-2a. DY02 Projects - Approved Sampling Plans. Includes information from any SAP submitted that resulted in a DMMP action in DY02. SAPs were not necessarily reviewed in DY02.

PROJECT	Rank	Total Volume (cy)	Surface Volume (cy)	Number of Surface Samples	Number of Surface DMMUs	Subsurface Volume (cy)	Number of Sub-surface Samples	Number of Sub-surface DMMUs
Glacier Northwest, Ready-Mix Facility	H	4,900	4,900	4	2	0	0	0
Grays Harbor, Port of, Terminals 1, 2, 3 and 4	L/LM	132,841	132,841	19	5	0	0	0
Oak Harbor Municipal Pier	LM	144,500	1,700	8	2	142,800	8	2
Tacoma, Port of, Pierce County Terminal	L	2,074,102	115,593	16	4	1,958,509	21	5

[2] Templates for large project and small project sampling and analysis plan development are contained on the Seattle District Dredged Material Management Office homepage at the following address: http://www.nws.usace.army.mil/.

Table 2-2b. DY03 Projects - Approved Sampling Plans. Includes information from any SAP submitted that resulted in a DMMP action in DY03. SAPs were not necessarily reviewed in DY03**.**

PROJECT	Rank	Total Volume (cy)	Surface Volume (cy)	Number of Surface Samples	Number of Surface DMMUs	Sub-Surface Volume (cy)	Number of Sub-surface Samples	Number of Sub-surface DMMUs
Bridgehaven Marina	LM	4,000	4,000	3	1	0	0	0
Delta Marine Industries	H	7,000	4,000	8	2	3,000	5	1
Glacier Northwest	H	10,000	10,000	9	3	0	0	0
Haug Channel	M	10,000	10,000	5	1	0	0	0
Olympia Yacht Club	LM	7,600	7,600	3	1	0	0	0
Sandy Hook Yacht Club	L	26,210	26,210	8	2	0	0	0
Seattle, Port of, East Waterway, Term. 18, Stage 1A (Rounds 1 and 2)	H	28,100	28,100	18 (R1) 11 (R2)	6 (R1) 2 (R2)	0	0	0
Tyee Yacht Club	LM	2,300	2,300	3	1	0	0	0
Tacoma, Port of, Pierce County Terminal, Cutback Addendum	L/M	205,060	9,800	2	1	19,600	8	8
USACE, Grays Harbor	L	600,000	600,000	80	10	0	0	0
USACE, Swinomish	L	120,000	120,000	16	2	0	0	0
US Coast Guard, Pier 36 (recency confirmation)	H	11,580	11,580	10	3	0	0	0
US Coast Guard, Pier 36 (Alpha Berth)	H	23,200	6,700	4	2	16,500	8	4
US Fish and Wildlife Service, Protection Island	LM	4,000	4,000	2	2	0	0	0
Weyerhaeuser, Mt. Coffin Channel	LM	200,000	200,000	9	3	0	0	0

2.3 SAMPLING

Tables 2-3a and **2-3b** contain data related to sampling efforts during DY02/03. Two general requirements existing within all three jurisdictions are to sample to the depth of dredging (including overdepth)[3], and to provide positioning data to a minimum precision of one-tenth of a second, latitude and longitude. A variety of positioning techniques were used to provide the required precision. Great emphasis is placed on positioning in order to provide high-quality data. Precise positioning is important to provide repeatability in sampling and to provide data that can be utilized in a geographical information system (GIS).

For the majority of the projects listed in the tables, the maximum sediment depths correspond to both the actual length of the deepest boring as well as to the maximum depth of the dredging prism, including overdepth. In high-ranked areas there is an additional requirement to provide an archived sample from the one-foot of sediment beyond the dredging prism ("Z" sample). This additional depth is not reflected in the table.

TABLE 2-3a. DY02 Project Sampling. Grain sizes given are averages from all samples for a given project.

PROJECT	GRAIN SIZE PERCENTAGES				SAMPLING EQUIPMENT	MAX. SAMPLE DEPTH (FT)	MEAN SAMPLE DEPTH (FT)
	GRAVEL > 2 mm	SAND .063 - 2mm	SILT .004 - .063 mm	CLAY < .004 mm			
Glacier Northwest, Ready-Mix Facility	37.4	38.5	17.1	7.0	vibracore	15.9	13.0
Grays Harbor, Port of, Terminals 1, 2, 3 and 4	0.76	21.8	56.5	21.0	Power-grab sampler	12.0	1.6
Oak Harbor Municipal Pier	0.5	72.0	16.5	11.0	vibracore	15.1	11
Tacoma, Port of, Pierce County Terminal	3.0	69	27.7	7.8	Upland drill rig + Grab samples	68	16

[3] This requirement is less stringent in Grays Harbor/Willapa Bay in areas with high shoaling rates, which have been previously characterized to the limits of the dredging prism, and for areas generally meeting either Section 404 or Section 103 exclusionary criteria. In these cases sampling of the surface layer with a vanVeen grab is generally allowed.

TABLE 2-3b. DY03 Project Sampling. Grain sizes given are averages from all samples for a given project.

PROJECT	GRAIN SIZE PERCENTAGES				SAMPLING EQUIPMENT	MAX. SAMPLE DEPTH (FT)	MEAN SAMPLE DEPTH (FT)
	GRAVEL > 2 mm	SAND .063 - 2mm	SILT .004 - .063mm	CLAY < .004 mm			
Bridgehaven Marina	0.62	34.14	49.6	16.1	Gravity core	4	4
Delta Marine Industries	2.00	41.88	47.8	11.03	vibracorer	6	4.2
Glacier Northwest Cement Terminal	0.60	11.4	67.8	19.9	vibracorer	8	3.8
Haug Channel	0.1	10.9	55.0	34.0	Hand corer	7	3.5
Olympia Yacht Club	23.3	47.7	18.3	10.6	Gravity corer	8	3.8
Sandy Hook Yacht Club	2.7	95.6	0.8	0.8	Push corer	3	3
Seattle, Port of, East Waterway, Term. 18, Stage 1A (Rounds 1 and 2)	4.24	54.78	26.52	14.42	vibracorer	5.4	3.8
Tyee Yacht Club	9.5	78.0	8.0	4.4	vibracorer	4	4
Tacoma, Port of, Pierce County Terminal, Cutback Addendum	13.95	43.0	33.25	8.2	Upland drill rig	12	12
USACE, Grays Harbor	0.1	53.64	33.16	14.1	Grab sampler	1	1
USACE, Swinomish	1.85	82.7	7.35	2.15	Grab sampler	1	1
US Coast Guard, Pier 36 (recency confirmation)	2.06	65.3	25.7	6.9	vibracorer	4	4
US Coast Guard, Pier 36 (Alpha Berth)	4.95	63.7	25.18	8.7	vibracorer	35	21
US Fish and Wildlife Service, Protection Island	46.05	52.5	1.45	0	Grab sampler	1	1
Weyerhaeuser, Mt. Coffin Channel	1.0	82.36	14.86	1.6	Ponar grab sampler	1	1

2.4 CHEMICAL TESTING

Chemical testing was conducted for 6 full characterizations in DY02 and 13 projects in DY03. In DY03 three projects (Sandy Hook Yacht Club, US Fish and Wildlife Service, Protection Island and Weyerhaeuser Mt. Coffin Channel) met guidelines for site-specific exclusion from chemical testing under PSDDA and DMEF jurisdictional guidelines. All projects had site-specific exclusions from testing were excluded based on the coarse-grained nature of the sediments. For four projects (Grays Harbor Terminal 2, Manke Lumber US coast Guard Pier 36 and Toke Point Entrance channel) the agencies reaffirmed the frequency or recency determination for the proposed dredged material.

In general, the QA/QC for projects undergoing chemical testing was acceptable by the DMMP agencies for regulatory decision-making. A complete listing of DMMP sediment guideline value exceedances for DY02/03 is included in **Appendix C**.

2.5 BIOLOGICAL TESTING

A total of 8 projects required acute bioassay testing (**Tables 2-4a** and **2-4b**) during the biennium. Two of these projects underwent biological testing in DY02. Six projects also underwent biological testing in DY03. Al lDY02 projects exclusively used tiered testing, performing biological tests on only those DMMUs that had exceedances of SLs. Four DY03 projects utilized concurrent testing

DMMP regulatory use of the saline Microtox® test has been suspended since DY94 for regulatory decision-making. This suspension remains in force pending commitment of agency resources to effectively evaluate the continued use of this test, or a suitable replacement test, within each dredging/disposal jurisdiction.

Table 2-4a. DY02 Biological Testing Summary. Summary of bioassay tests performed for DY02 projects.

PROJECT	Number of biological analyses		Number of analyses failing bioassays	Bioassay tests conducted			Control sediment location	Reference sediment location
	tiered testing	concurrent testing		Amphipod	Sediment Larval	*Neanthes* 20-day Growth		
Glacier Northwest, Ready-Mix Facility	1	0	0	Ee	Mg	Na	West Beach, Whidbey Island	Carr Inlet
Tacoma, Port of, Pierce County Terminal	3	0	3	Ee	Me	Na	West Beach, Whidbey Island	West Beach, Whidbey Island

Aa = *Ampelisca abdita*
De = *Dendraster excentricus*
Ee = *Eohaustorius estuarius*
Me = *Mytilus eduliss*
Mg = *Mytilus galloprovincialus*
Na = *Neanthes arenaceodenta*
Ra = *Rhepoxynius abronius*
Sp = *Strongylocentrotus purpuratus*

Table 2-4b. DY03 Biological Testing Summary. Summary of bioassay tests performed for DY03 projects.

PROJECT	Number of biological analyses		Number of analyses failing bioassays	Bioassays Conducted			Control Sediment Location	Reference Sediment Location
	Undergoing tiered testing	Undergoing concurrent testing		Amphipod	Sediment Larval	20-day Growth		
Delta Marine Industries	2	0	0	Aa	Mg	Na	LaJolla California	Carr Inlet
Glacier Northwest	0	3	1	Ee	Mg	Na	Yaquina Bay, Oregon	Carr Inlet and Holmes harbor
Seattle, Port of, East Waterway, Term. 18, Stage 1A (Rounds 1 and 2)	0	3	1	Ee	Ng	Na	West Beach, Whidbey Is.	Carr Inlet
US Coast Guard, Pier 36 Recency	0	3	2	Ee	Mg	Ma	West Beach, Whidbey Is.	Carr Inlet
US Coast Guard, Pier 36 (Alpha Berth)	3	0	0	Ra	De	Na	West Beach, Whidbey Is.	Carr Inlet
USACE Grays Harbor	0	2	0	Ee	Mg	Na	Yaquina Bay, Oregon	Grays Harbor GHS7

Aa = *Ampelisca abdita*
De = *Dendraster excentricus*
Ee = *Eohaustorius estuarius*
Me = *Mytilus eduliss*
Mg = *Mytilus galloprovincialus*
Na = *Neanthes arenaceodenta*
Ra = *Rhepoxynius abronius*
Sp = *Strongylocentrotus purpuratus*

2.6 BIOACCUMULATION TESTING

No DY02 projects were required to pass bioaccumulation testing prior to being found suitable for open water disposal. One DY03 project, Port of Seattle, East Waterway Terminal 18, Stage 1A) required bioaccumulation testing. Two DMMUs were tested for TBT, subjected to 45-day exposures and not failures were recorded. The project specific bioaccumulation testing conducted during DY02/03 is discussed in detail in Appendix A.

2.7 SUITABILITY DETERMINATIONS

A suitability determination outlines the evaluation procedures used in the characterization of project sediments, summarizes chemical and biological testing data and associated QA/QC issues, and documents the interpretation of testing results. The suitability determinations is a technical memorandum, drafted by the Corps' DMMO and signed by DMMP representatives from the Corps of Engineers, Environmental Protection Agency, Department of Ecology and Department of Natural Resources. The suitability determination documents the suitability of proposed dredged sediments for open-water disposal at either one of the eight PSDDA sites, or two estuarine and one ocean sites in both Grays Harbor and Willapa Bay, or at appropriate in water sites in the Columbia River. It does not, however, constitute final project approval by the agencies. Comprehensive agency comments on the overall project are provided through the regulatory public notice and review process.

Tables 2-5a and **2-5b** contain information taken from the suitability determinations or other completion actions for each of the projects that completed their DMMP review during DY02 and DY03, respectively.

For the projects receiving suitability determinations in DY02, less than 1 percent of the total volume (2% of total number of DMMUs) was found unsuitable for unconfined-open-water disposal under relevant DMMP evaluation guidelines. For DY03, 2% of the total volume (27% of the total number of DMMUs) was found unsuitable for unconfined open-water disposal. The amount of unsuitable material varied considerably by project and location, with considerable portions of unsuitable material coming from the high-use areas of both the Ports of Seattle and Tacoma.

Table 2-5a. DY02 Suitability Determinations

PROJECT	Rank	Total Volume (cy)	No. of chemical analyses	No. of bioassay analyses	No. of bioaccum analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed DMMP Disposal Site
Glacier Northwest, Ready-Mix Facility	H	4,900	2	1	0	0	0	2	4900	Elliott Bay
Grays Harbor, Port of, Terminals 1, 2, 3 and 4	L/LM	132,841	5	0	0	0	0	5	132,841	Pt. Chehalis or South Jetty
Oak Harbor Municipal Pier	LM	144,500	4	0	0	0	0	4	144,500	Rosario Strait
Seattle, Port of, East Waterway, Stage II	H	19,500 (101,270)	16	16	4	0	0	16	19,500 (101,270)	Elliott Bay
Tacoma, Port of, Pierce County Terminal	L	2,100,000	29	3	0	9	69,593	20	2,004,509	Commencement Bay
Weyerhaeuser, Bay City Dock	LM	20,000	0	0	0	0	0	0	0	Pt. Chehalis or South Jetty

Table 2-5b. DY03 Suitability Determinations

PROJECT	Rank	Total Volume (cy)	No. of chemical analyses	No. of bioassay analyses	No. of bioaccum analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed DMMP Disposal Site
Bridgehaven Marina	LM	4,000	1	0	0	0	0	1	4,000	Elliott Bay
Delta Marine Industries	H	7,000	3	2	0	0	0	3	7,000	Elliott Bay
Glacier Northwest	H	10,000	3	3	0	2	6,670	1	3,250	Elliott Bay
Haug Channel	M	10,000	1	0	0	1	10,000	0	0	Elliott Bay
Olympia Yacht Club	LM	7,600	1	0	0	0	0	1	7,600	Anderson Island
Sandy Hook Yacht Club	E	26,210	0	0	0	0	0	all	26,210	BU
Seattle, Port of, East Waterway, Terminal 18, Stage 1A	H	28,100	6	3	2	3	10,300	3	17,800	Elliott Bay
Tyee Yacht Club	LM	2,300	1	0	0	0	0	1	2,300	BU
Tacoma, Port of, Pierce County Terminal, Cutback Addendum	L; M	205,060	10	0	0	4	14,700	6	190,360	Commencement Bay
USACE, Grays Harbor	L	1,860,000	10	2	0	0	0	10	1,860,000	Pt. Chehalis or South Jetty
USACE, Swinomish	L	120,000	2	0	0	0	0	2	120,000	Rosario Strait or Beneficial Use
US Coast Guard, Pier 36, Recency	H	11,580	3	3	0	2	7,700	1	3,880	Elliott Bay
US Coast Guard, Pier 36, Alpha Pier	H	23,200	6	3	0	3	10,400	3	12,800	Elliott Bay
US Fish and Wildlife Service, Protection Island	LM	4,000	0	0	0	0	0	2	4,000	BU
Weyerhaeuser, Mt. Coffin Channel	LM	200,000	0	0	0	0	0	3	200,000	Columbia River

CHAPTER 3 - SUMMARY AND ASSESSMENT OF DY02/03 DATA

3.1 SUMMARY OF CHEMICAL TESTING RESULTS.

Table 3-1 and **Appendix C** summarize the chemical testing results from DY 2002 and DY 2003. A total of 37 of the 58 DMMP COCs had screening levels exceeded for at least one project. These included both detected exceedances (32 COCs) and detection limit exceedances (7 COCs). Six COCs had detected concentrations above the BT; two COCs were undetected above the BT. Ten chemicals were detected above the ML, whereas three were undetected above the ML. **Table 3-2** highlights those chemicals that had detected concentrations exceeding SL, BT and ML most often. Also included are those chemicals for which the detection limit exceeded the SL, BT, or ML.

From **Table 3-2** it can be seen that the chemicals most often detected above SL and BT included mercury, TBT, Fluoranthene, DDT, and total PCBs. Only TBT, DDT, and PCBs were quantitated above BT in three or more projects. The chemicals for which detection limits were most often exceeded included Hexachlorobenzene, Pentachlorophenol, Benzyl Alcohol, Hexachlorobutadiene, and N-Nitrosodiphenylamine. Detection limit exceedances were generally inconsequential, because other detected SL exceedances generally triggered biological testing. There were no instances where detection limit exceedances of SLs triggered biological testing without co-occurring exceedances of at list one other detected chemical over SL (**Appendix C**). Concurrent biological testing was conducted for four projects including the East Waterway Terminal 18 Stage 1A recency retesting, the U.S. Coast Guard Pier 36 Slip dredging recency retesting, the Glacier Northwest Cement terminal and the USACE maintenance dredging in Grays Harbor.

During the two-year period covered by this report five projects were evaluated for beneficial uses disposal alternatives. A portion of the material (21,799 cy) previously characterized as suitable but not dredged for the U.S. Navy Puget Sound Naval Shipyard Project from the Turning Basin was re-evaluated as suitable for use as capping material to remediate surface contamination identified on State-Owned-Aquatic-Land within CERCLA Operable Unit-B at the Pit-CAD site in Sinclair Inlet. The federal maintenance dredging of the Swinomish River included a portion that was used to provide a cap for mercury-contaminated sediments at the Georgia Pacific Log Pond in Bellingham Bay. A third project, at the Sandy Hook Yacht Club, involved nourishing the adjacent beach with sandy/gravel dredged from the berthing areas. A fourth project involved beach nourishment at the U.S. Fish and Wildlife Service Protection Island National Wildlife Refuge with material dredged from the entrance channel. A fifth project, Tyee Yacht Club, was evaluated for beneficial placement as a cap at the Pacific Sound Resources CERCLA site. Also, DY02 federal maintenance dredging of the lower Snohomish River by the Corps of Engineers on material characterized in DY01 resulted in 47,422 cy of the operations and maintenance material being placed on Jetty Island to renourish the eroding wetland habitat.

Table 3-1. DY02/03 Chemical Testing Summary. Total projects = 19; total # of DMMU = 84.

CHEMICAL OF CONCERN	# of DMMU D > SL	# of Projects D > SL	# of DMMU D > BT	# of Projects D > BT	# of DMMU D > ML	# of Projects D > ML	# of DMMU U > SL	# of Projects U > SL	# of DMMU U > BT	# of Projects U > BT	# of DMMU U > ML	# of Projects U > ML
METALS & ORGANOMETALS												
Arsenic	2	2										
Lead [1]	1	1										
Mercury	4	2	1	1	1	1						
Zinc [1]	2	2										
TBT ion (porewater) [2]	6	3	6	3								
LPAH												
Acenaphthene [1]	4	3										
Acenaphthylene [1]	2	1										
Fluorene [1]	3	2										
Phenanthrene [1]	3	2										
Anthracene [1]	3	2										
2-Methylnaphthalene [1]	1	1										
Total LPAHs [1]	3	2										
HPAH												
Fluoranthene	3	2	1	1								
Pyrene [1]	5	2			1	1						
Benzo(a)anthracene [1]	2	1										
Benzofluoranthenes (b+k) [1]	2	1										
Chrysene [1]	2	1										
Benzo(a)pyrene	2	1	2	1	2	1						
Indeno(1,2,3-c,d)pyrene [1]	2	1										
Dibenzo(a,h)anthracene [1]	2	1										
Benzo(g,h,I)perylene [1]	2	1										
Total HPAHs [1]	3	2			1	1						
CHLORINATED HYDROCARBONS												
1,2,4-Trichlorobenzene [1]	1	1			1	1						
Hexachlorobenzene (HCB)							4	2				
PHENOLS												
4-Methylphenol [1]	1	1										
2,4-Dimethylphenol [1]	4	2			1	1	3	1				
Pentachlorophenol							4	2	1	1	1	1
MISCELANEOUS EXTRACTABLES												
Benzyl alcohol [1]							4	2				
Benzoic acid [1]	1	1			1	1	3	1				
Hexachlorobutadiene							4	2			1	1
N-Nitrosodiphenylamine							4	2	1	1	1	1
VOLATILE ORGANICS												
Ethylbenzene	1	1			1	1						
Total Xylene (total of o,m,p)	1	1			1	1						
PESTICIDES AND PCBs												
Total DDT	21	7	5	3	1	1						
alpha-Chlordane [2]	1	1										
Dieldrin [2]	1	1										
Total PCBs	24	6	5	3								

D = Detected U = Undetected SL = Screening Level BT = Bioaccumulation Trigger ML = Maximum Level
[1] = No BT exists [2] = No ML exists [3] = No BT or ML exists

Table 3-2. DY 02/03 DMMP Guideline Value Exceedances.

CHEMICAL OF CONCERN	Detected Chemicals exceeding SL in at least 3 Projects	Detected Chemicals exceeding BT in one Project	Detected Chemicals exceeding ML in one Project	Chemicals exceeding SL Detection Limits in at least 2 Projects	Chemicals exceeding BT Detection Limits in one Project	Chemicals exceeding ML Detection Limits in one Project
Mercury		X	X			
TBT (porewater)	X	X				
Acenaphthene	X					
Fluoranthene		X				
Pyrene			X			
Benzo(a)pyrene		X	X			
Total HPAHs			X			
1,2,4-Trichlorobenzene			X			
Hexachlorobenzene				X		
2,4-Dimethylphenol			X			
Pentachlorophenol			X	X	X	X
Benzoic acid			X			
Benzyl Alcohol				X		
Hexachlorobutadiene				X		X
N-Nitrosodiphenylamine				X	X	X
Ethylbenzene			X			
Total Xylene			X			
Total DDT	X	X	X			
Total PCBs	X	X				

3.2 BIOLOGICAL TESTING.

Biological testing was conducted on 8 of the 19 projects undergoing chemical testing during DY02/03. **Table 3-3** shows the number of times each of the three bioassays was conducted and the number of hits recorded for each bioassay for non-dispersive and dispersive site disposal. The table shows that all three bioassays in the test suite recorded hits, with the amphipod bioassay registering the most hits (2H + 1H) in 7 out of 21 bioassays (33.3%). The number of total hits recorded for the sediment larval bioassay was 3 hits (14.3%), with one of the hits ensuing from a best professional judgment determination (QA/QC failure) resulting from the failure of the reference sediment to meet the performance standard. The *Neanthes* growth bioassay recorded only a single two-hit response (4.7%) out of the 21 DMMUs evaluated. All the hits recorded were for the nondispersive site evaluations, with no hits noted for the two analyses utilizing the dispersive site guidelines.

Table 3-3. DY 02/03 Bioassay "Hit" Summary.

BIOASSAY	Number of DMMUs Tested		Number of Hits Under the "Two-Hit Rule"		Number of Hits Under the "Single-Hit Rule"		Total Hits (2H + 1H)
	ND	D	ND	D	ND	D	
Amphipod	19	2	4	0	3	0	7
Sediment Larval	19	2	0	0	2	0	3*
***Neanthes* Growth**	19	2	1	0	0	0	1

ND = non-dispersive site interpretation guidelines
D = dispersive site interpretation guidelines
* = also includes one QA/QC failure

3.3 BIOACCUMULATION TESTING.

During the two-year period covered by this report, only two DMMUs from a single project (East Waterway Terminal 18, Stage 1A) required bioaccumulation testing for TBT. They were subject to 45-day exposures, and no failures were recorded. The project specific bioaccumulation testing conducted during DY02/03 is discussed in detail in **Appendix A**.

3.4 COST ANALYSIS

Total Costs. Total sampling and testing costs are generally related to the size of the project and the rank. Larger projects have lower unit costs than smaller projects due to economy of scale. Area rank influences costs by requiring larger numbers of analyses (DMMU) relative to lower ranked projects. **Figure 3-1** shows the relationship of average total cost per cubic yard to the total volume tested for all PSDDA projects submitting data from DY90 to DY01. The regression of these two variables resulted in a significant ($p<0.001$) correlation and regression equation noted in **Figure 3-1**, which can be used to estimate testing cost given the project size.

Testing Costs. Chemical testing costs are generally the most straightforward and readily discernible costs. Analytical laboratories performing DMMP analyses will provide quotes on unit costs. Average unit chemical testing costs (including QA/QC) for the past ten years are depicted in **Figure 3-2** as a function of the number of analyses for the standard suite of chemicals and for the cost for the standard suite plus special chemicals such as dioxin and tributyltin. The scatter plot depicted shows that as the number of analyses increases beyond three the unit costs drop sharply and steadily decrease for the most part to a low of around $1,200 to $1,500 per analysis. Projects with one or two analyses are especially costly, as the QA/QC costs cannot be distributed over several samples.

Evaluating bioassay costs shows that the unit costs generally relate well to the total number of analyses, as shown in **Figure 3-3**. There is a tremendous range in unit costs for projects with only one analysis, whereas the variability in unit costs drops sharply with additional analyses.

Bioaccumulation testing costs were analyzed for two dredging projects during DY00/01. The USACE/Port of Seattle East Waterway Stage II dredging project conducted 25 bioaccumulation tests (TBT, PCBs, Fluoranthene, total DDT) with an average bioaccumulation cost of $17,953/DMMU. The second project was the USACE Olympia Harbor Characterization Project, which conducted two bioaccumulation tests (TBT) at an average cost of $18,663/DMMU.

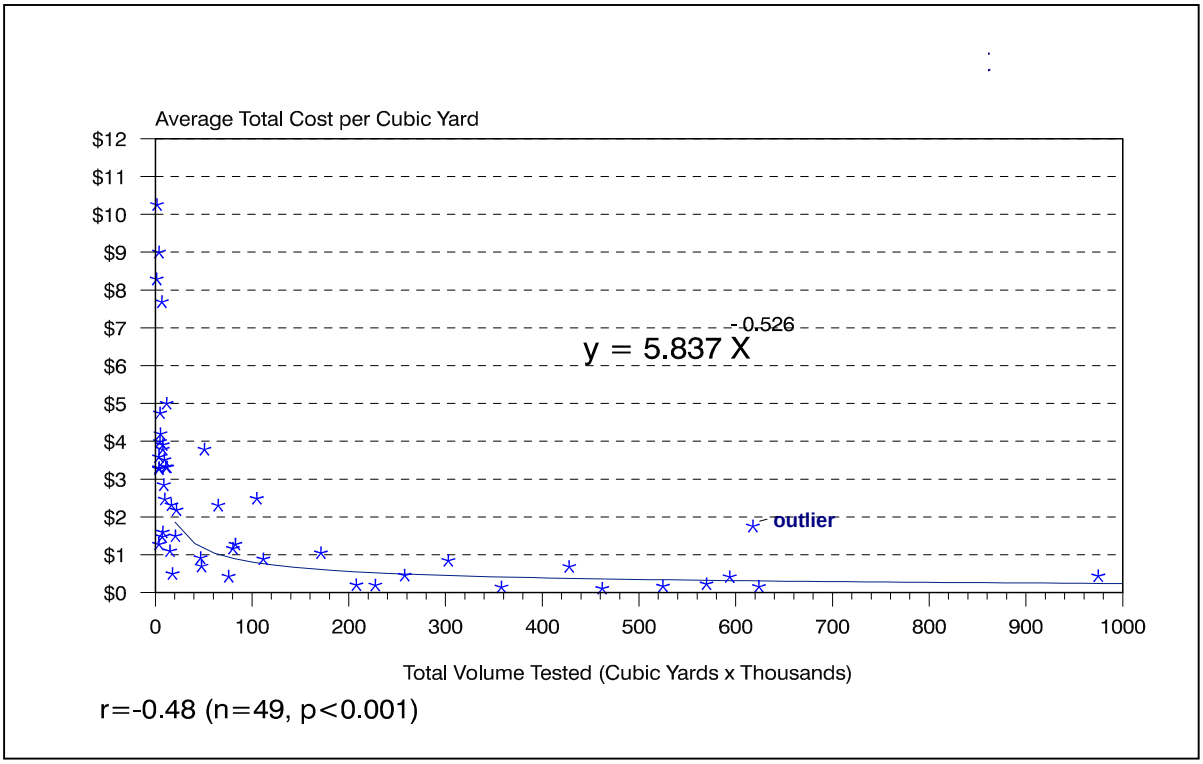

Figure 3-1. Project Size versus Unit Testing Cost

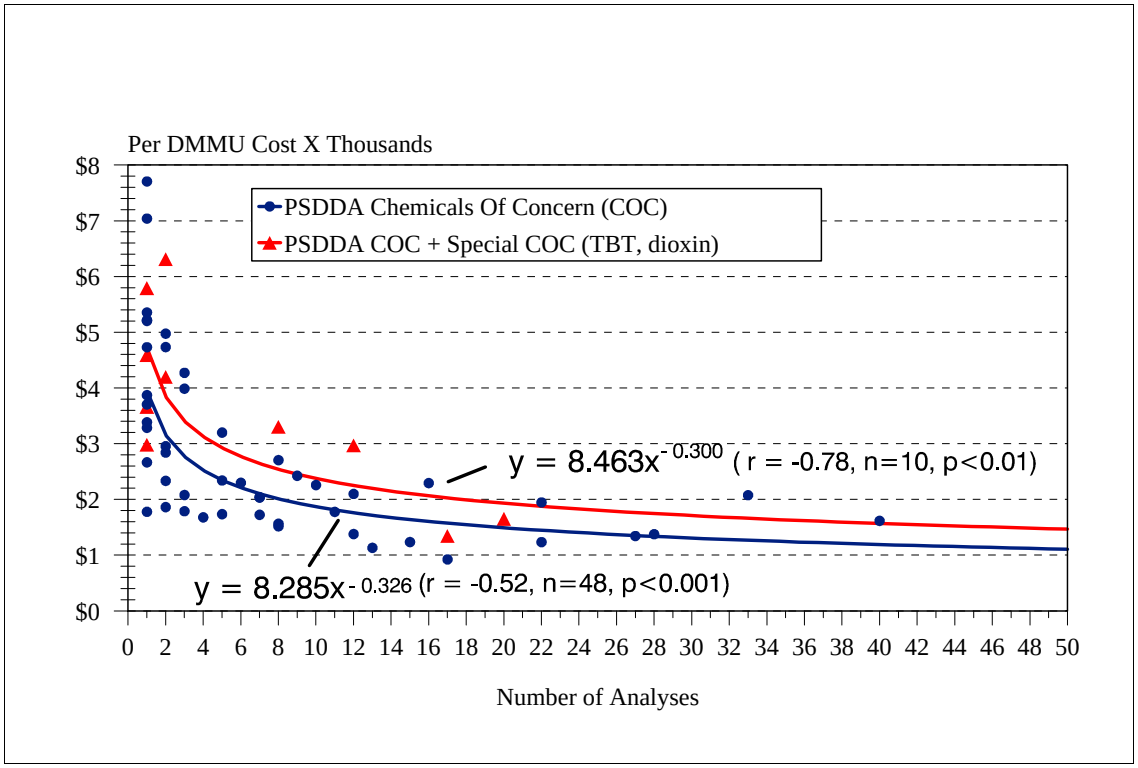

Figure 3-2. Chemistry Unit Cost

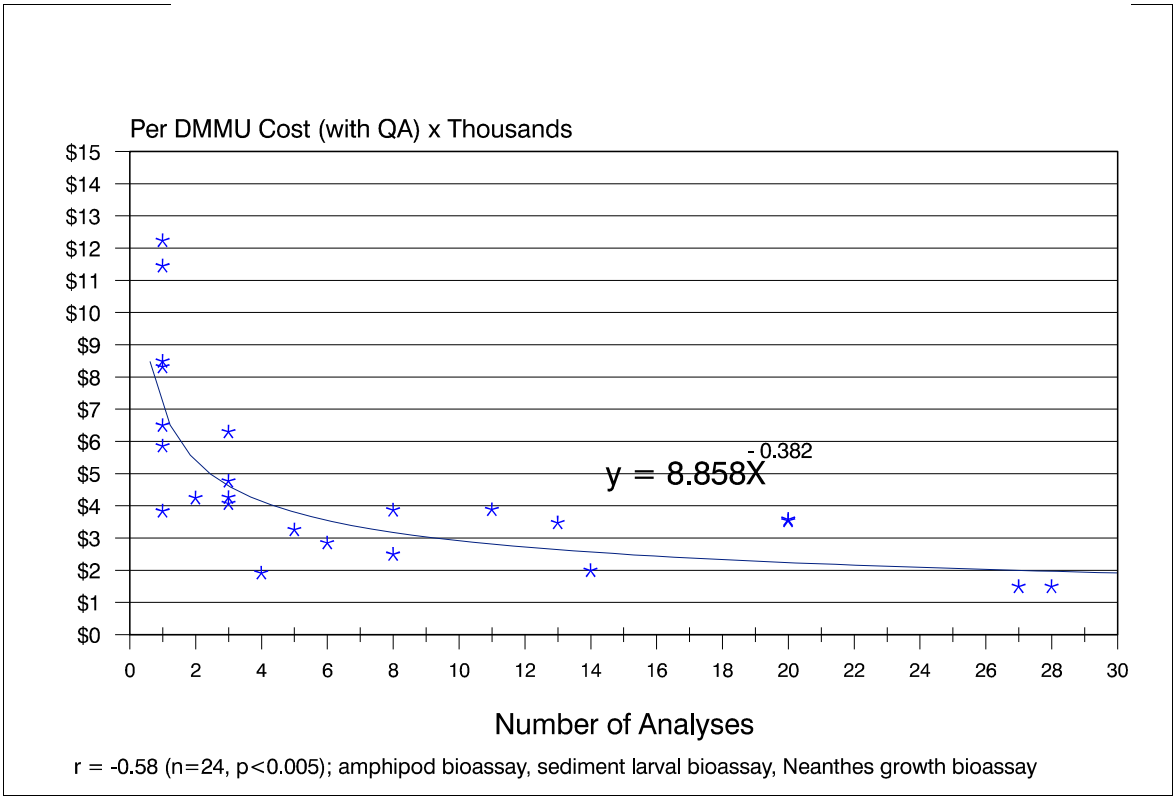

Figure 3-3. Bioassay Suite Unit Cost Analysis

3.5 REGULATORY PROCESSING

Regulatory Framework. For the majority of dredging projects, DMMP sediment sampling and testing are a part of the regulatory requirements under Section 404 of the Clean Water Act, or under Section 103 of the Marine Protection, Research and Sanctuaries Act. For those dredging projects requiring sampling and testing, the regulatory process consists of a sequence of steps that must be taken before obtaining a permit. The majority of permit actions involve 404 jurisdiction, but the steps are similar for 103 actions. These are as follows:

(1) Prepare and submit application for permit.

(2) Prepare sampling and analysis plan (SAP) for characterization of proposed dredged material.

(3) Receive approval of SAP from DMMP agencies.

(4) Perform sampling and chemical/biological analysis and submit testing results.

(5) Receive suitability determination for open-water disposal from DMMP agencies.

(6) Complete application details required for issuance of public notice.

(7) Corps prepares and issues public notice.

(8) Corps transmits review comments to applicant after 30-day public comment period.

(9) Applicant provides Corps with responses to public comments.

(10) Corps completes public interest review, 404(b)1 evaluation, NEPA documentation and issues permit decision.

The average time requirements for steps 3 through 5 are included in Figure 1-5a, which was constructed using data from processing activities occurring in DY02/03

Permit Preparation and Submittal. An application (JARPA, or Joint Aquatic Resources Permit Application) for a Corps of Engineers Section 10/404 permit for dredging and dredged material disposal is usually submitted before any DMMP processing takes place. An application number and Regulatory Branch Project Manager are assigned when an application is submitted and the Dredged Material Management Office begins review of information relevant to the proposed dredging. Permit preparation is part of the regulatory process, but completely within the control of the permit applicant, so is not included in the analysis of processing time.

(1) Sampling and Analysis Plan Development. A sediment sampling and analysis plan must be developed and submitted to the DMMP agencies for review prior to commencement of field sampling. The time required for SAP development is highly variable and almost completely within control of the dredging applicant. In many cases a permit application is submitted at the same time as a draft SAP, while in other cases a permit application is submitted long before development of a SAP begins.

(2) Sampling and Analysis Plan Approval. Once a sediment SAP has been submitted, the DMMO coordinates review with the other DMMP agencies: EPA, DNR and Ecology. An approval letter, which includes DMMP agency comments and recommends modifications to the SAP, is then sent to the applicant. Once the applicant, via telephone, letter or e-mail, has accepted these comments and modifications sampling and analysis may proceed. It is the goal of the DMMO to complete the review of SAPs within three weeks. During DY 02/03 the average time from the submittal of the final SAP for a project to SAP approval was 22 days.

(3) Sampling and Analysis. During this phase, field sampling and chemical/ biological analysis are completed following the protocols established in the approved SAP. Data are compiled and submitted in a hard copy report. A Corps contractor enters these data into the Dredged Analysis Information System. Sampling, testing and reporting consume a substantial portion of the DMMP Process time budget, averaging 159 days during DY 02/03. This is one of the project phases with the highest degrees of variability, with sampling and analysis taking anywhere from 51 to 508 days during this 2 year time period. Factors influencing the time required for this phase include weather, sampling difficulties, laboratory capacity and turn-around, QA problems arising during chemical and biological testing, and report compilation

time. Those projects that include bioassay or bioaccumulation testing usually are those with the longer turn-around times.

(4) Data Review. Once a full set of chemical/biological testing data is submitted along with the sampling report, the DMMO conducts a data review with the other DMMP agencies. The result of this review is the signing, by DMMP agency representatives, of a Memorandum for Record documenting the determination reached on the suitability/unsuitability of each of the dredged material management units defined in the approved SAP. The goal of the DMMO is to complete this review within three weeks of data submittal, though several projects during this biennium required a much longer review time that skewed the average up to over two months. In DY02/03, the average time required was 64 days. In many cases, this review was much shorter; time needed during this biennium ranged from 1 day to 240 days, with most projects in the middle of that range. The longest reviews usually involve complications such as a change in dredge volume or especially large or complex data sets.

(5) Complete Permit Application. Once the suitability determination has been signed, the DMMO submits a copy to the Corps Regulatory Branch project manager who then prepares to issue a public notice. However, if project details have not been fully developed by this time, or if project plans are modified subsequent to the suitability determination, new drawings or other information may be required of the applicant prior to the preparation of the public notice. In other cases, the applicant may not have yet obtained a shoreline development permit and a decision may be made to wait to go out to public notice until the local shoreline jurisdiction has issued a permit.

(6) Prepare and Issue Public Notice. By regulation, the Regulatory Branch must issue a public notice within fifteen days of the completion of the permit application.

(7) Public Comment Period and Transmittal of Review Comments. A DMMP project typically undergoes a 30-day public comment period. Comments received during this period are collated by the Corps Regulatory project manager and are transmitted to the applicant for response.

(8) Applicant Responds to Review Comments. The permit applicant is responsible for providing written responses to public review comments to the Corps before the Regulatory Branch project manager can complete a public interest review.

(9) Corps Completes Public Interest Review and Makes Permit Decision. The public interest review, including a Section 404(b)(1) alternatives analysis and NEPA evaluation, is completed and documented after the permit applicant provides responses to review comments. The Corps project manager prepares a permit decision upon completion of the public interest review.

This stage of the process may be very time consuming. Dredging and DMMP processing are often only part of complex projects. Other elements may be involved, such as wetland fills, eelgrass bed impacts or Endangered Species Act issues. The addition of several species to the list of threatened and endangered species in Western Washington has led to a substantial backlog in permit review and approval.

To improve regulatory response time, the Department of Ecology recommends that applicants seek a hydraulic project approval (HPA) from the Department of Fish and Wildlife, and resolve other problems as early as possible in the permit process.

DMMP Processing Time. The entire DMMP dredged material evaluation process, as depicted in **Figure 3-4**, includes final sampling and analysis plan review and approval, field sampling and analysis, data review and completion of the suitability determination. The average time required for the DMMP dredged material evaluation process was 242 days (ranging from 89 to 493 days) in DY02/03, with the majority of that time taken up by sampling, testing, and data report preparation by the applicant. Note that Figure 3-1 shows the average time required for each of the three phases of the dredged material evaluation process, the sum of which does not equal the mean time for the entire process.

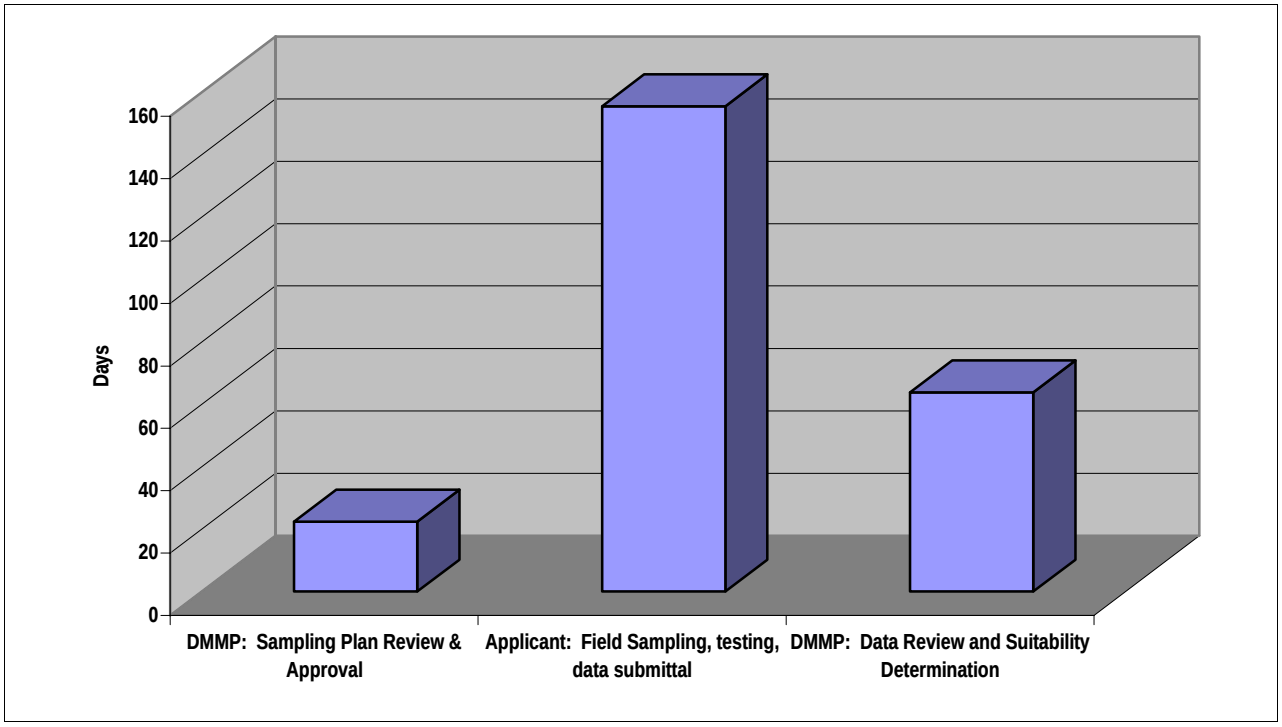

Figure 3-4. DMMP Processing Time (means for DY 02/03 Projects in days)

CHAPTER 4 – DISPOSAL SITE USE AND MONITORING

4.1 DISPOSAL ACTIVITY AND SITE USE

The Washington State Department of Natural Resources (DNR) issues site-use authorizations to project proponents electing to dispose of suitable dredged material at PSDDA and Grays Harbor/Willapa Bay (GH/WB) designated disposal sites. These authorizations are issued for sediments that are 1) suitable for unconfined open-water disposal as determined by the Dredged Material Management Program (DMMP) evaluation process, and 2) associated with dredging projects which have received all required regulatory permits (e.g., CWA 401/404 permits). This section of the report describes the PSDDA and GH/WB disposal activity for Dredging Years 2002 and 2003 (i.e., June 16, 2001 through June 15, 2002, and June 16, 2002 through June 15, 2003). This information is discussed by dredging year and individual disposal site.

Dredging Year 2002 (June 16, 2001 through June 15, 2002). In DY02, a total of 176,571 cubic yards (cy) of dredged material were deposited at 2 PSDDA sites, while the Corps of Engineers placed 47,422 cy at 1 beneficial use site project at Jetty Island. The Corps of Engineers also placed 143,055 cy of material at its Snohomish River upstream upland landfill site. Of the three PSDDA sites utilized in DY02, Elliott Bay received the bulk of the material with 131,152 cy from five projects, whereas Port Gardner was second with disposal of 45,419 cy from 2 projects. During DY02 the Commencement Bay disposal site was shut down, while the DMMP agencies evaluated the presence of material outside the boundaries of the site. This is discussed further in Section B.

In Grays Harbor a total of 564,011 cy were disposed at the 2 estuarine disposal sites and 68,812 cy was disposed at the Southwest ocean disposal site, whereas a total of 453,660 cy were placed at 2 beneficial uses sites. Half Moon Bay received 878,441 cy of federal maintenance dredged material, while 75,219 cy was disposed at the South Beach beneficial use site. No disposal occurred in Willapa Bay during DY02. The volumes disposed are graphically presented in **Figures 4-1** and **4-2**, and are summarized in **Tables 4-1** and **4-2**.

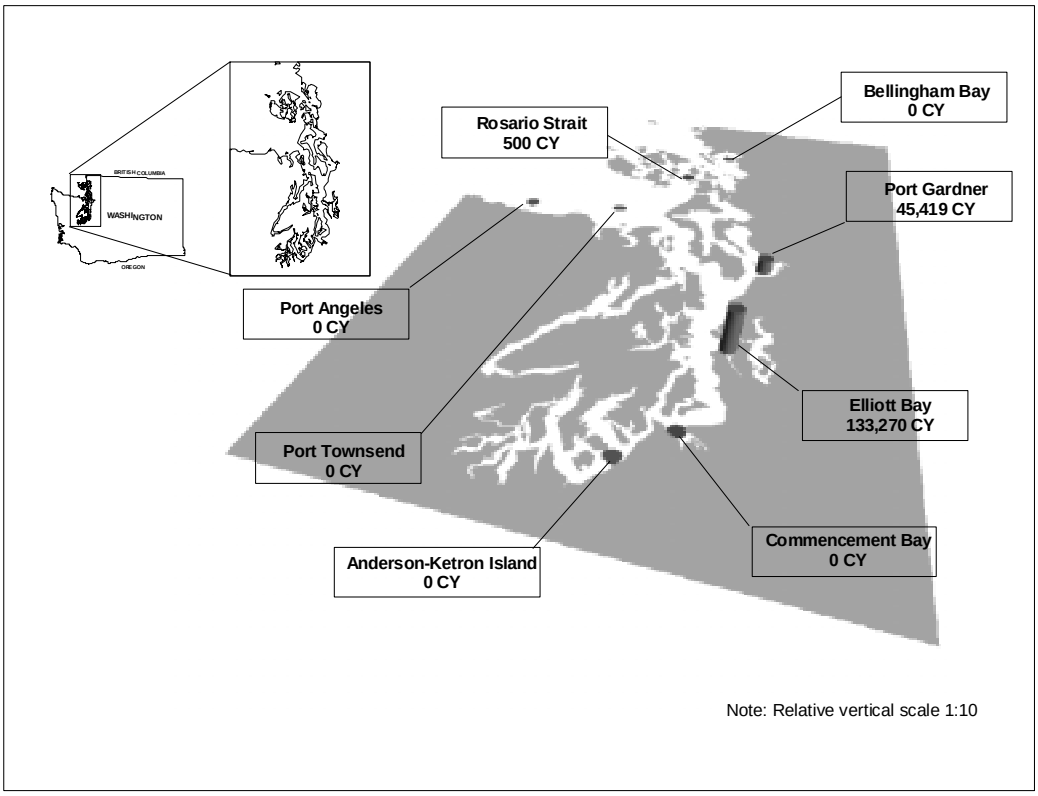

Figure 4-1. DY 2002 Disposal Volumes in Puget Sound

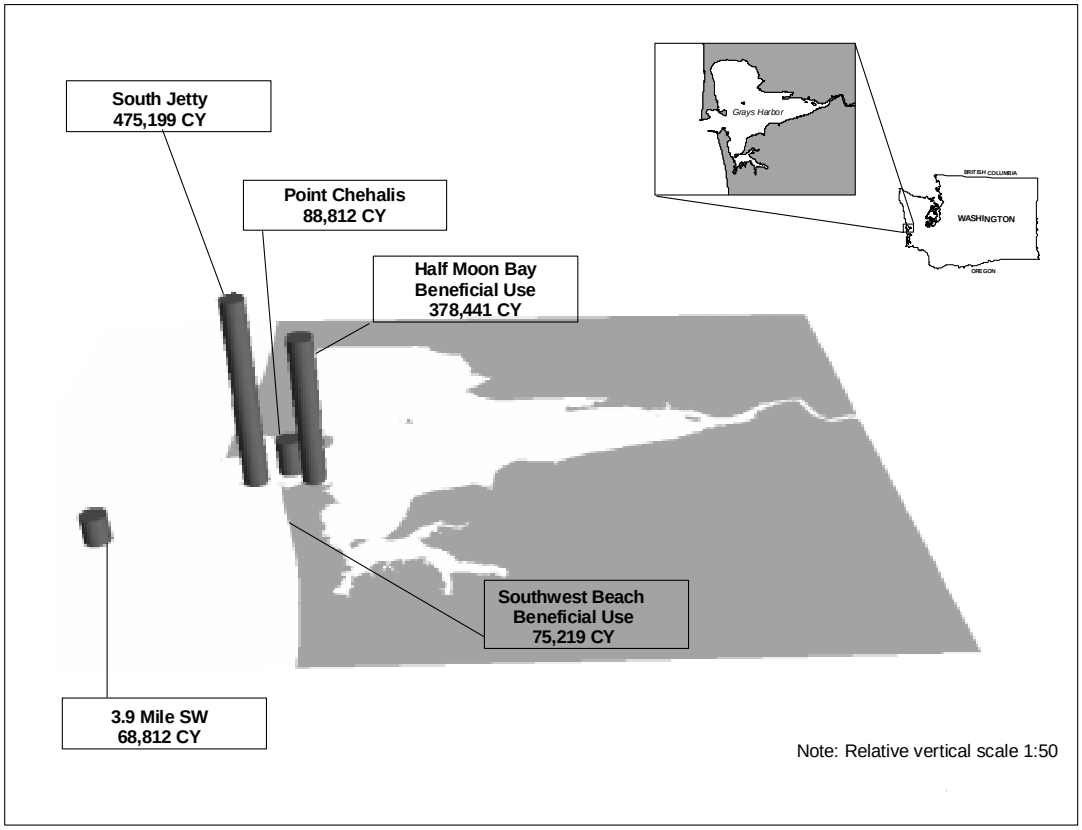

Figure 4-2. DY 2002 Disposal Volumes for Grays Harbor

Table 4-1. Disposal Site Activity Summary, DY02

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Elliott Bay	PSDDA	5	131,152
Port Gardner	PSDDA	2	45,419
Jetty Island-BU	PSDDA BU	1	47,422
Upland – Snohomish R.	PSDDA Upland	1	143,055
South Jetty	Grays Harbor	1	475,199
South West-Ocean	Grays Harbor	1	68,812
Point Chehalis	Grays Harbor	2	88,812
Half Moon Bay-BU	Grays Harbor	1	378,441
Southwest Beach-BU	Grays Harbor	1	75,219
All Sites within Jurisdiction	PSDDA sites PSDDA BU PSDDA Upland	8 1 1	176,571 47,422 143,055
	Grays Harbor Estuarine sites Grays Harbor Ocean site Grays Harbor BU	2 1 1	564,011 68,812 453,660
	Willapa Bay sites	0	0

Table 4-2. Summary of Disposal Activity by Jurisdiction and Site, DY02

Site	Proponent	Dredging Contractor	Disposal Volume (cy)	# Barge Loads	Off Site	Disposal Dates
EB	Weyerhaeuser	Wilder	10,021	9	No	Jan 02
EB	POS, Terminal 30	General	18,269	13	No	Jan-Feb 02
EB	POS, Pier 66	General	1,400	1	No	Feb 02
EB	Glacier NW	General	4,939	7	No	Feb 02
EB	Corps Maintenance, Duwamish R.	American	96,523	49	No	Jan-Feb 02
PG	Shelter Bay Community	American	500	1	No	Jan 02
PG	Everett Marina	American	44,919	83	No	Oct 01-Feb 02
UD	Corps Maintenance, Snohomish R.	Manson	143,055	Pipeline	No	Jan 02
BU-JI	Corps Maintenance, Snohomish R.	Manson	47,422	Pipeline	No	Jan 02
SJ	Corps Maintenance, Grays Harbor	Dutra	475,199	205	No	Sep-Oct 01
SW-Ocean	Corps Maintenance, Grays Harbor	Corps	68,812	13	No	May 02
PC	Weyerhaeuser, Bay City	Dutra	20,000	5	No	Jan-Feb 02
PC	Corps Maintenance, Grays Harbor	Corps & Dutra	1,296,173	176	No	Nov-Jan 02, May 02
BU-HMB	Corps Maintenance, Grays Harbor	Corps & Dutra	378,441	429	No	May 02
BU-SWB	Corps Maintenance, Grays Harbor	Corps	75,219	14	No	May 02

Legend: EB = Elliott Bay Site; PG = Port Gardner Site; UD = Upland disposal; BU-JI = Jetty Island -Beneficial Uses; SJ = South Jetty Site; SW-Ocean = Southwest Ocean Site; PC = Point Chehalis Site; BU-HMB = Half Moon Bay-Beneficial Uses; BU-SWB = Southwest Beach-Beneficial Uses

Dredging Year 2003 (June 16, 2002 through June 15, 2003). In DY03, a total of 748,898 cubic yards (cy) of dredged material were deposited at 2 PSDDA sites. Disposal occurred at only two of the eight PSDDA sites during DY03, with the bulk of the material (710,675 cy) being placed at the Commencement Bay disposal site, principally from the Port of Tacoma's Pierce County Terminal Development Project. The Port of Skagit County disposed 38,223 cy at the Rosario Strait disposal site.

In Grays Harbor 910,654 cy were disposed at the 2 estuarine disposal sites and 12,301 cy disposed at the Southwest ocean site. A total of 454,494 cy were placed at 2 beneficial uses sites, with 329,106 cy going to the Half Moon Bay site, and 125,388 cy going to the Southwest-Beach beneficial use site. Willapa Bay had a total of 155,267 cy disposed at two estuarine disposal sites, with 82,357 cy going to the Goose Point site, and 72,910 cy going to the Cape Shoalwater nearshore disposal site. The volumes disposed are graphically presented in **Figures 4-3** and **4-4**, and are summarized in **Tables 4-3** and **4-4**.

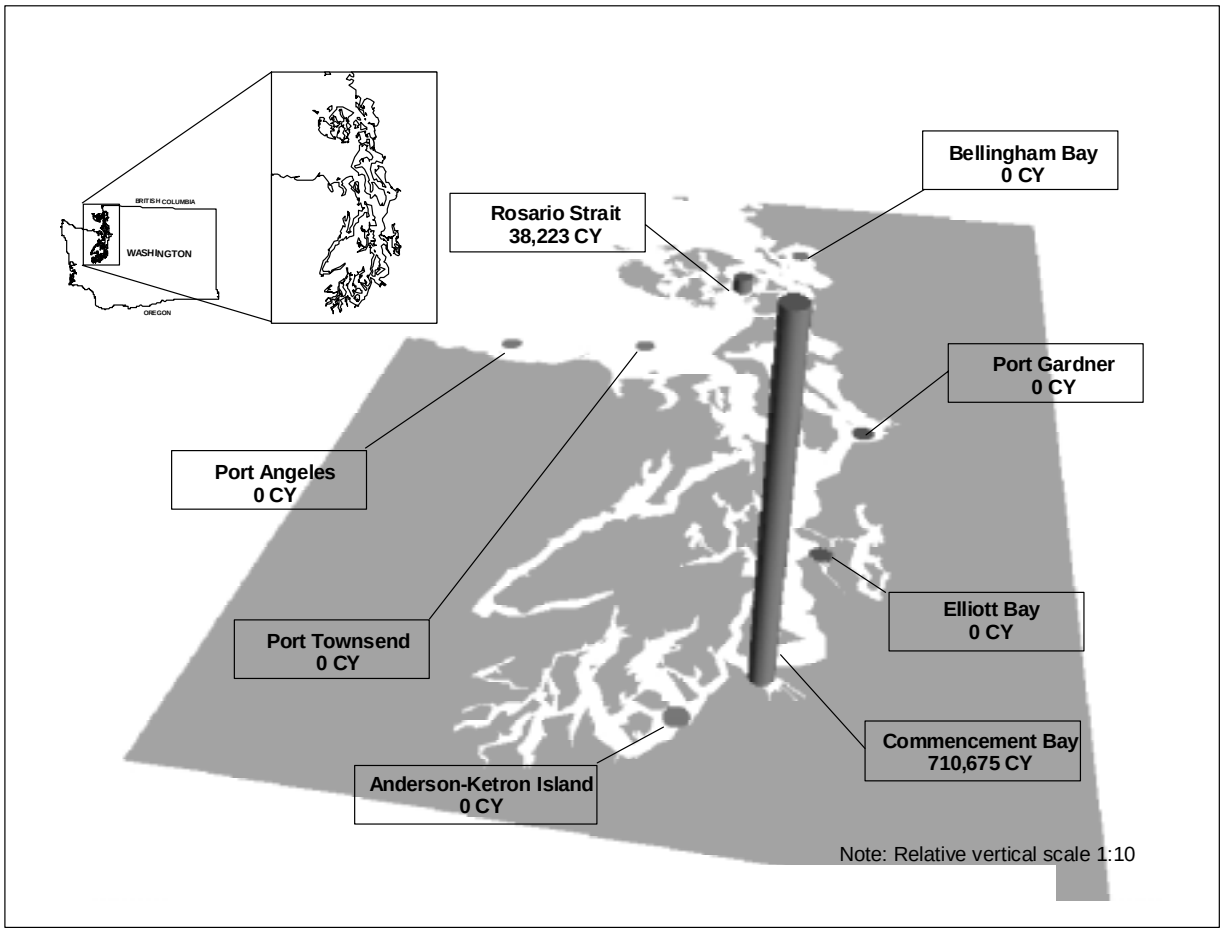

Figure 4-3. DY 2003 Disposal Volumes in Puget Sound

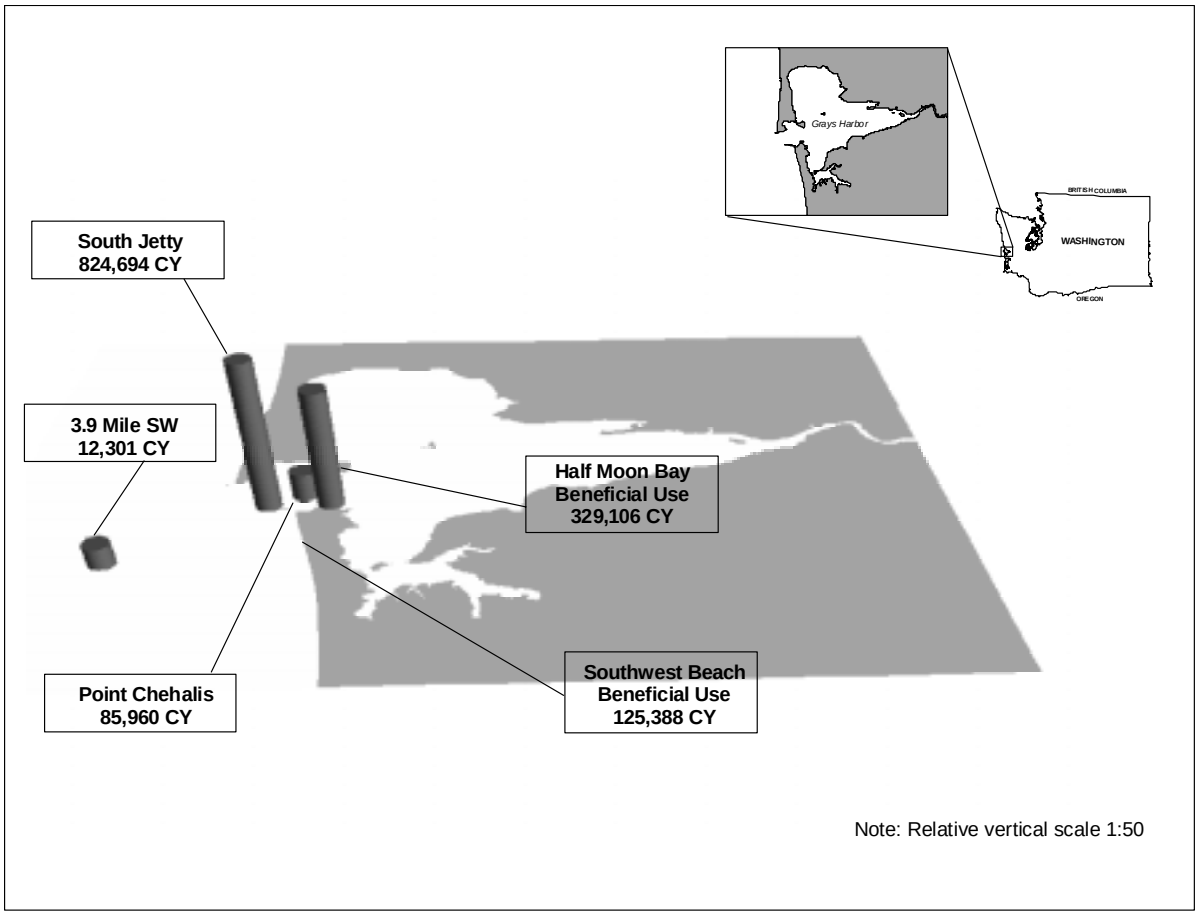

Figure 4-4. DY 2003 Disposal Volumes for Grays Harbor

Table 4-3. Disposal Site Activity Summary, DY03

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Commencement Bay	PSDDA	5	710,675
Rosario Strait	PSDDA	1	38,223
Point Chehalis	Grays Harbor	2	85,960
South Jetty	Grays Harbor	1	824,694
Half Moon Bay-BU	Grays Harbor	1	329,106
South Beach-BU	Grays Harbor	1	125,388
South West-Ocean	Grays Harbor	1	12,301
Goose Point	Willapa Bay	1	82,357
Cape Shoalwater	Willapa Bay	1	72,910
All Sites within Jurisdiction	PSDDA sites	6	748,898
	Grays Harbor Estuarine sites	1	910,654
	Grays Harbor Ocean site	1	12,301
	Grays Harbor BU	1	137,689
	Willapa Bay sites	2	155,267

Table 4-4. Summary of Disposal Activity by Jurisdiction and Site, DY03

Site	Proponent	Dredging Contractor	Disposal Volume (cy)	# Barge Loads	Off Site	Disposal Dates
CB	Port of Tacoma, Sitcum	Manson	232,979	91	No	Sep 02-Feb 03
CB	Port of Tacoma, PCT Project	General	374,075	198	No	Oct 02-Jan 03
CB	Glenn Springs Holding	Miller	64,745	44	No	Nov-Dec 02
CB	Manke Lumber Company	Manke	23,000	46	No	Jan-Feb 03
CB	WA Department of Transportation	TNC	15,876	10	No	Mar-Apr 03
RS	Port of Skagit County	American	38,224	40	No	Oct 02-Feb 03
PC	Port of Grays Harbor	Manson	60,556	25	No	Feb 03
PC	Port of Grays Harbor	Manson	25,404	9	No	Feb 03
PC	Corps O&M, Grays Harbor	Manson	355,139	138	No	Nov 02 & May 03
SJ	Corps O&M, Grays Harbor	Manson	824,694	357	No	Oct 02 – Feb 03
BU-HMB	Corps O&M, Grays Harbor	Manson	329,106	289	No	May 03
BU-SWB	Corps O&M, Grays Harbor	Corps	125,388	36	No	May 03
SW-Ocean	Corps O&M, Grays Harbor	Corps	12,301	3	No	May 03
GP	Corps O&M, Willapa Bay	American	82,357	76	No	Jun – Sep 02
CS	Corps O&M, Willapa Bay	American	72,910	46	No	Jun – Jul 02

Legend: CB = Commencement Bay; RS = Rosario Strait; PC = Point Chehalis; SJ = South Jetty; BU-HMB = Half Moon Bay; BU-SWB = Southwest Beach renourishment; SW-Ocean = Southwest Ocean site; GP = Goose Point; CS = Cape Shoalwater.

4.2 POST-DISPOSAL SITE MONITORING (2001 – 2003)

Overview: Environmental monitoring is the primary tool utilized in the management of PSDDA non-dispersive disposal sites. The main objective of post-disposal site monitoring is to determine whether the disposal of dredged material has adversely affected the disposal site environment. Environmental monitoring includes physical, chemical, and biological assessment of the sediments and biological resources in, and adjacent to, the disposal site being monitored. The PSDDA monitoring program is designed to compare the post-disposal monitoring results to "baseline" values. Baseline Values for key environmental parameters, such as sediment chemistry, toxicity, and benthic community structure, were determined for each PSDDA site and the associated benchmark stations prior to the first use of the sites to serve as an environmental baseline for later comparisons as a reference (PTI, 1988, 1989). The DMMP agencies now evaluate site chemistry changes over time using a time-trend analysis approach. The new analysis technique was first used in 1996 to evaluate post-disposal monitoring data from Commencement Bay.

Post-disposal site monitoring surveys described below collect data to answer three major questions. Full PSDDA monitoring was designed to collect data to answer the three questions and six testable hypotheses (**Table 4-5**). The PSDDA monitoring plan is now designed to work in a tiered framework, with a partial monitoring event addressing questions 1 and 2 and testing the first four hypotheses. Question 3 is only addressed if either of the first two questions, or one or more of the four testable hypotheses is rejected.

The Seattle District, U.S. Army Corps of Engineers is responsible for physical monitoring at all eight disposal sites, and DNR is responsible for chemical and biological monitoring at the five PSDDA non-dispersive disposal sites. This environmental monitoring is conducted at irregular intervals based on the documented pattern of disposal site-use occurring since the previous monitoring survey. This pattern encompasses several important factors, such as volume and characteristics (e.g., physical characteristics and sediment quality) of the material disposed at a given site, the nature and recency of previous site monitoring data, and site-specific environmental concerns. Each spring, DMMP technical staff members review the previous year's disposal activity records, and determine, by consensus, which site(s), if any, will be monitored, and at what intensity.

Based upon this review, the DMMP agencies determined that a full monitoring event was required at the Commencement Bay disposal site in 2001[4], a tiered-full monitoring event would be required at the Elliott Bay disposal site in 2002, and a full monitoring would be required at the Commencement Bay disposal site in 2003.

[4] The DMMP summary of the 2001 monitoring results at the Commencement Bay disposal site were not discussed in the 2002 Biennial Report, but were reviewed and discussed at the 2002 SMARM, and will be briefly summarized here.

Table 4-5. The DMMP Monitoring Framework

Questions	Hypothesis	Monitoring Variable	Interpretive Guideline	Action Item when exceeded*
No.1 Does the deposited dredged material stay onsite?	1. Dredged material remains within the site boundary?	Sediment Profile Imagery (SPI) Onsite & Offsite	Dredged material > 3 cm at the perimeter stations	Further assessment is required to determine full extent of dredged material deposit.
	2. Chemical concentrations do not measurably increase over time due to dredged material disposal at offsite stations.	Sediment Chemistry Offsite	Washington State Sediment Quality Standards and Temporal Analysis	Post-disposal benchmark station chemistry is analyzed and compared with appropriate baseline benchmark station data.
No. 2 Are the biological effects conditions for site management exceeded at the site due to dredged material disposal?	3. Sediment chemical concentrations at the onsite monitoring stations do not exceed the chemical concentrations associated with PSDDA Site Condition II guidelines due to dredged material disposal	Sediment Chemistry Onsite	Onsite chemical concentrations are compared to DMMP maximum levels.	PSDDA agencies may seek adjustments of disposal guidelines and compare post-disposal benchmark chemistry with appropriate baseline benchmark station data.
	4. Sediment toxicity at the onsite stations does not exceed the PSDDA Site Condition II biological response guidelines due to dredged material disposal.	Sediment Bioassays Onsite	DMMP Bioassay Guidelines (Section 401 Water Quality Certification)	Benchmark station bioassays are performed (if archived after monitoring) and compared with baseline benchmark bioassay data.
No. 3 Are unacceptable adverse effects due to dredged material disposal occurring to biological resources offsite?	5. No significant increase due to dredged material disposal has occurred in the chemical body burden of benthic infaunal species collected down current of the disposal site	Tissue Chemistry Transect	Guideline values Metals: 3x baseline conc. Organics: 5x baseline conc.	Compare post-disposal benchmark tissue chemistry with baseline benchmark tissue chemistry data.
	6. No significant decrease due to dredged material disposal has occurred in the abundance of dominant benthic infaunal species collected down current of the disposal site.	Infaunal Community Structure Transect	Guideline values Abundance of major taxa < ½ baseline macrobenthic infaunal abundances	Compare post-disposal benchmark benthic data with baseline benchmark data.

***** To determine if observed changes in chemical conditions or infaunal benthos are due to dredged material disposal, data from the benchmark stations are evaluated. The DMMP deliberations use best professional judgment.

Full Monitoring at the Commencement Bay Disposal Site (2001). The Commencement Bay disposal site was previously monitored in 1998 (SPI physical mapping only), 1996 (Tiered-Partial) and 1995 (Tiered-Full). A brief summary of disposal activity at the Commencement Bay site since the last partial monitoring event in the 1996 follows. No dredged material was disposed during DY97, whereas a cumulative total of 683,540 cy was disposed during DY98, 140,761 cy was disposed during DY99, 893,776 cy was disposed during DY00, and 265,867 cy was disposed during DY01, resulting in a cumulative total volume (DY97-DY01) of 1,993,944 cy of disposed dredged material during this five year period. Between 1997 and 2000, the DMMP agencies agreed to forego monitoring in part based on previous monitoring results for the non-dispersive sites meeting the site management objectives, and use funds to conduct research by Battelle North West that was tied to the management of the disposal sites. The studies conducted by Battelle focused on the sensitivity of the amphipod, *Leptocheirus plumulosus* relative to TBT contamination and provided a comparative evaluation of its potential use as an alternative test species to evaluate dredged material. The 2001 monitoring results from Commencement Bay were previously summarized and discussed at the 2002 SMARM (http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/SMARM__2002_minutes.pdf, see SMARM minutes pages 9-10, 14-16, 55-68, and 92-100). A brief summary of these results follows focusing on the monitoring and follow-up investigations conducted to answer the three monitoring questions and six testable hypotheses highlighted in **Table 4-5**.

Commencement Bay Monitoring Results (2001). Figure 4-5 shows the fixed and floating chemical and biological stations occupied during the 2001 full monitoring exercise. Mapping of the disposal site and adjacent areas was conducted with the Sediment Profile Imagery (SPI) camera system, which provides a vertical profile Image of the top 20 cm of the sediment surface, and differentiates the dredged material footprint. The survey indicated that the dredged material footprint extended outside the disposal site boundary and exceeded the 3 cm site management trigger at the perimeter line, which resulted in **hypothesis No. 1** being rejected (**Figure 4-6**). The footprint showed that the dredged material outside the boundary largely extended to the northwest and southwest.

The DMMP agencies responded to this revelation by adding additional floating stations for chemistry and benthic infaunal characterization to further assess the offsite material and potential impacts extending outside the disposal site. These stations were designed to further assess monitoring question 3, and **hypotheses 5 and 6**, as to whether unacceptable adverse impacts attributable to dredged material were occurring to biological resources offsite.

Chemical analyses conducted showed there were no statistically measurable increases in chemicals measured at the perimeter stations, nor were there any elevated chemicals in the offsite dredged material footprint (all chemicals < SL and SQS). Therefore, **hypothesis No. 2** was not rejected. Evaluation of chemistry concentrations at the onsite stations (**hypothesis No. 3**) and the toxicity of the onsite material relative to the site condition II biological effects response guidelines (**hypothesis No. 4**), showed no elevated chemistry or apparent toxicity. Therefore, both **hypotheses No. 3 and 4** were not rejected.

Because a relatively large area outside the disposal site boundary was documented as being dredged material, the DMMP agencies implemented a 90-day site closure through DNR in August 2001, pending the completion of a full investigation of the effects of the offsite material. The

studies necessitated extending the closure. The site was eventually re-opened in July 2002 after all additional site investigations and modeling studies were completed, and after the DMMP agencies provided assurances to Pierce County Shoreline Board on the management actions adopted by the DMMP agencies, which included close monitoring of all disposal activity at the Commencement Bay disposal site.

Monitoring Question 3 was evaluated to assess whether unacceptable adverse effects were occurring to biological resources offsite attributable to dredged material. To address this question in part, body burdens were assessed in the sea cucumber, *Molpadia intermedia* at transect stations. These analyses showed that mercury, copper, and antimony and phenol exceeded guideline values, which resulted in **hypothesis No. 5** being rejected. This necessitated the analysis of benchmark tissue samples to evaluate whether the observed increases in these chemicals was an area wide affect or was restricted to the dredged material disposal at the site.

An evaluation of onsite, perimeter and additional floating stations located within the offsite dredged material footprint showed that all chemicals were quantitated below the PSDDA SL and SMS SQS guidelines. Additionally, an evaluation of chemistry at the perimeter stations using the Chemical Tracking Software showed that there was no statistically significant increase in chemical concentrations over time. All bioassays conducted passed the non-dispersive disposal site interpretation guidelines. Analysis of chemical body burdens in *Molpadia intermedia* tissue at transect stations and benchmark stations indicated that the disposal site was not responsible for statistical significant increases in chemical body burdens relative to the guideline values. The data analyzed at benchmark stations indicate that the increases appear to be related to regional area wide changes rather than dredged material disposal. Analysis of benthic infaunal data collected at transect stations and benchmark stations indicate that observed changes in bivalve molluscan abundance at transect stations is more likely attributable to regional broad-scale changes in the surface sediment texture rather than to dredged material disposal. Benchmark stations confirmed sediment texture changes consistent with this hypothesis. Therefore, **hypothesis No. 6** is not rejected.

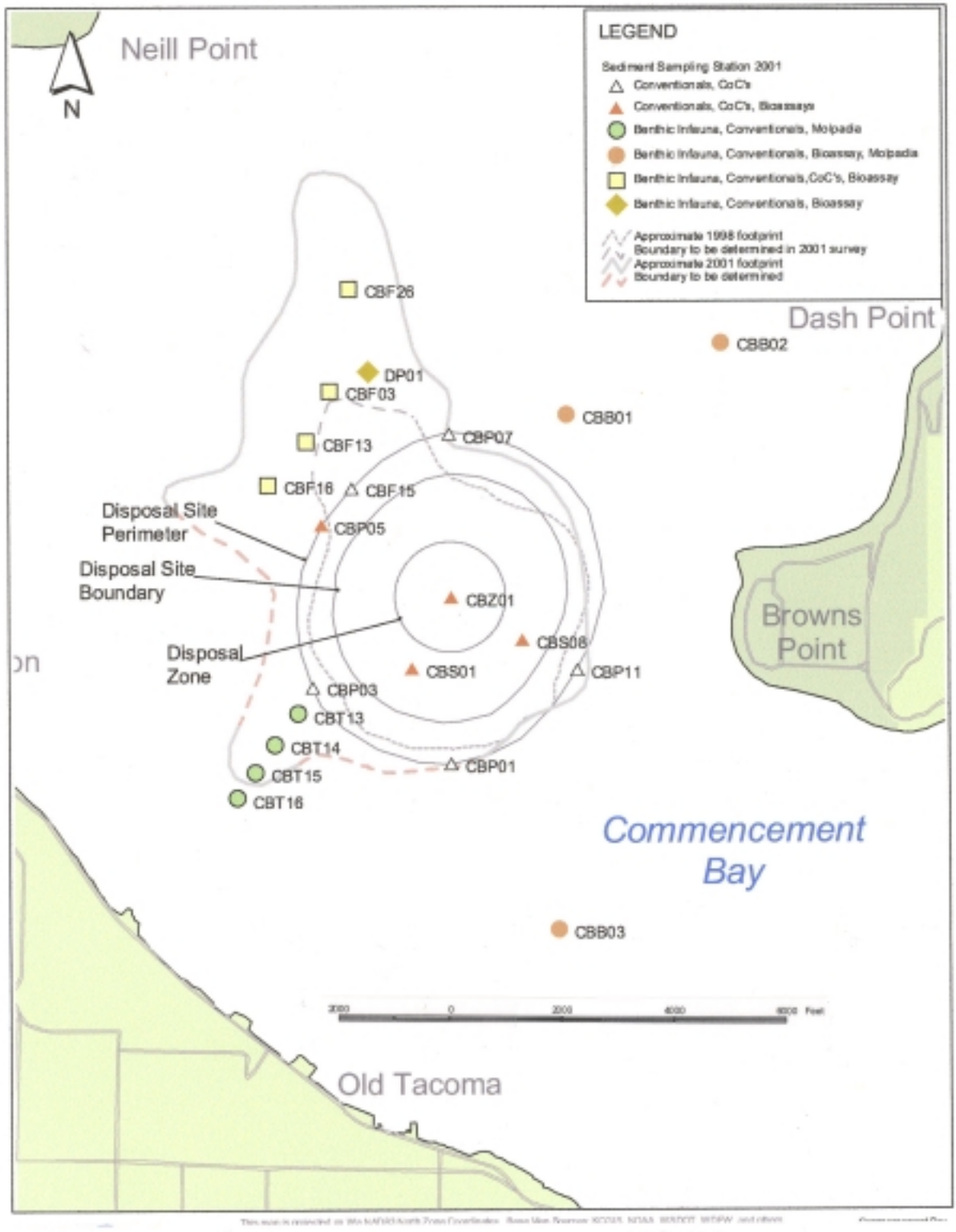

Figure 4-5. Commencement Bay 2001 Monitoring Sediment Sampling Stations

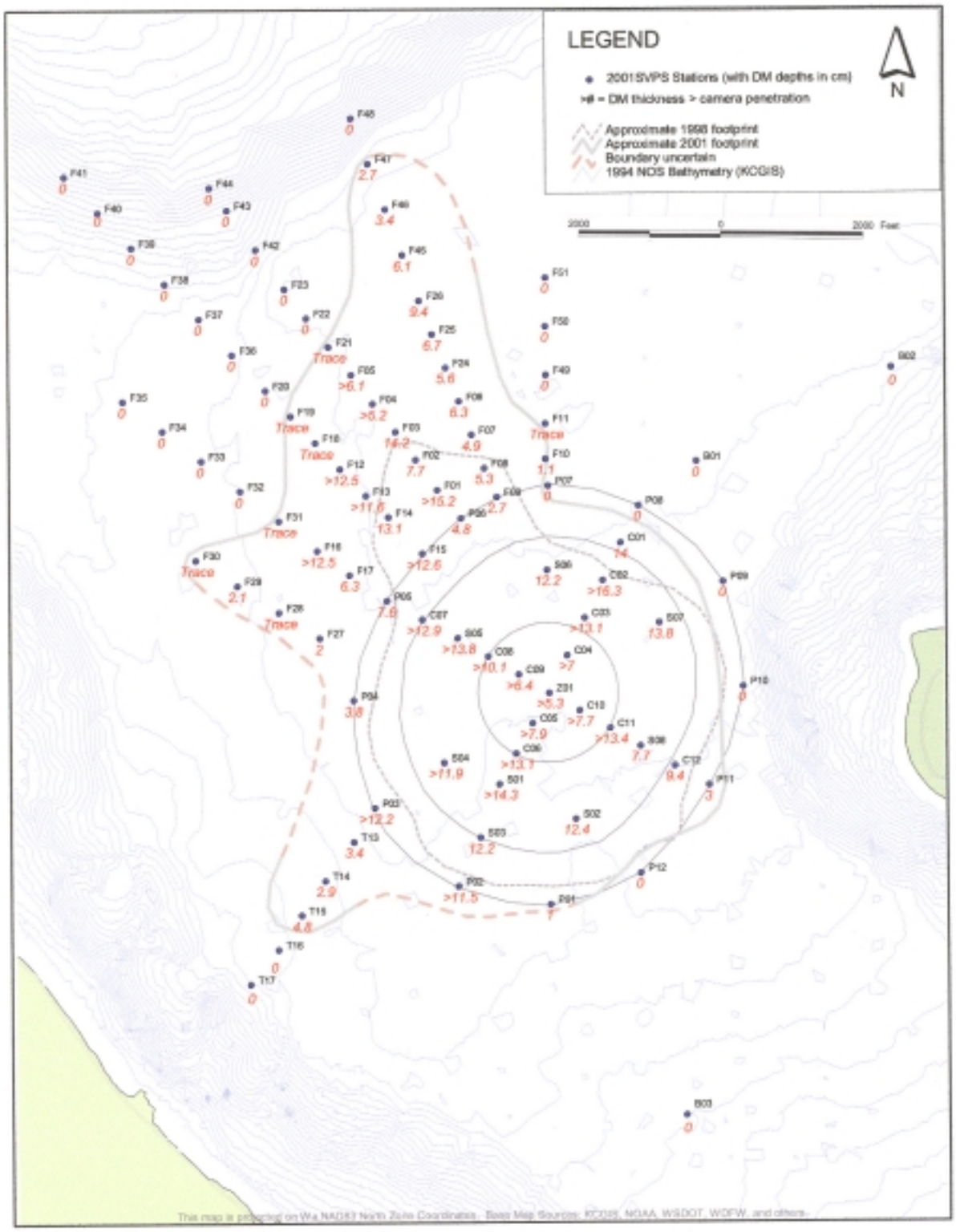

Figure 4-6. Dredged Material Distribution and Thickness (cm) at the Commencement Bay site in 2001

Tiered-Partial Monitoring at the Elliott Bay Disposal Site (2002). The Elliott Bay disposal site was previously monitored in 2000 (Full), 1992 (Full), and 1990 (Partial). A cumulative volume of 690,610 cubic yards (2001: 557,340 cy; 2002: 133,270 cy) of dredged material was disposed at the Elliott Bay disposal site since the 2000 monitoring event. The DMMP agencies determined that given the volume of material disposed a full monitoring event would be required. The DMMP agencies also elected to evaluate bioaccumulative chemicals of concern recently proposed for DMMP implementation. **Figure 4-7** shows the chemical and biological sampling stations occupied during the 2002 partial monitoring exercise.

Elliott Bay Monitoring Results (2002). The SPI survey mapped the dredged material footprint and showed that the footprint was distributed well within the boundary of the disposal site and perimeter line (**Figure 4-8**). Therefore, **hypothesis No. 1** relating to Question 1 was not rejected. Analysis of perimeter stations showed that there were no exceedances of Washington State SQS, which concluded that **hypothesis No. 2** of Question 1 was also not rejected. Time trend analyses of chemical data using the CTS software concluded that there were no measurable increases in chemical concentrations over time attributable to dredged material disposal. Monitoring data collected to address Question 2 and **hypotheses No. 3 and 4**, led to the conclusion that both hypotheses were not rejected. The onsite chemistry Site Condition II guideline (all chemicals < ML) was not exceeded. Moreover, the onsite bioassays stations, met the site Condition II interpretation guidelines. Onsite Station Z scored a hit under the two-hit rule for the bivalve sediment larval bioassay, but there was no other corroborating hit from either the *Neanthes* growth bioassay, or the amphipod bioassay.

Monitoring data were assessed relative to answering question 3: Are unacceptable adverse effects due to dredged material disposal occurring to biological resources offsite? The *Molpadia intermedia* tissue concentrations at transect stations were compared with the guidelines established with the 2000 monitoring results, and showed that their were no guideline exceedances. Therefore, **hypothesis No. 5** was not rejected. Evaluation of benthic infaunal results at transect stations indicated that two of the three transect stations had significant decreases in molluscan abundance, therefore, **hypothesis No. 6** was tentatively rejected, pending further examination of the benthic data. The DMMP agencies examined the species composition of the dominant molluscan species at all three transect stations, and found that *Axinopsida serricata* was the dominant species at all three stations, during 1992 and 2000, and at two of the three stations during 2002. This species is a widely recognized opportunistic species with documented wide shifts in abundance attributable to variable recruitment, interspecies competition, and predation (Nichols, 1985). The DMMP agencies accepted this explanation as the likely reason for the observed decrease in molluscan abundance, and therefore did not attribute the decreases to dredged material disposal. Therefore, **hypothesis No. 6** is not rejected.

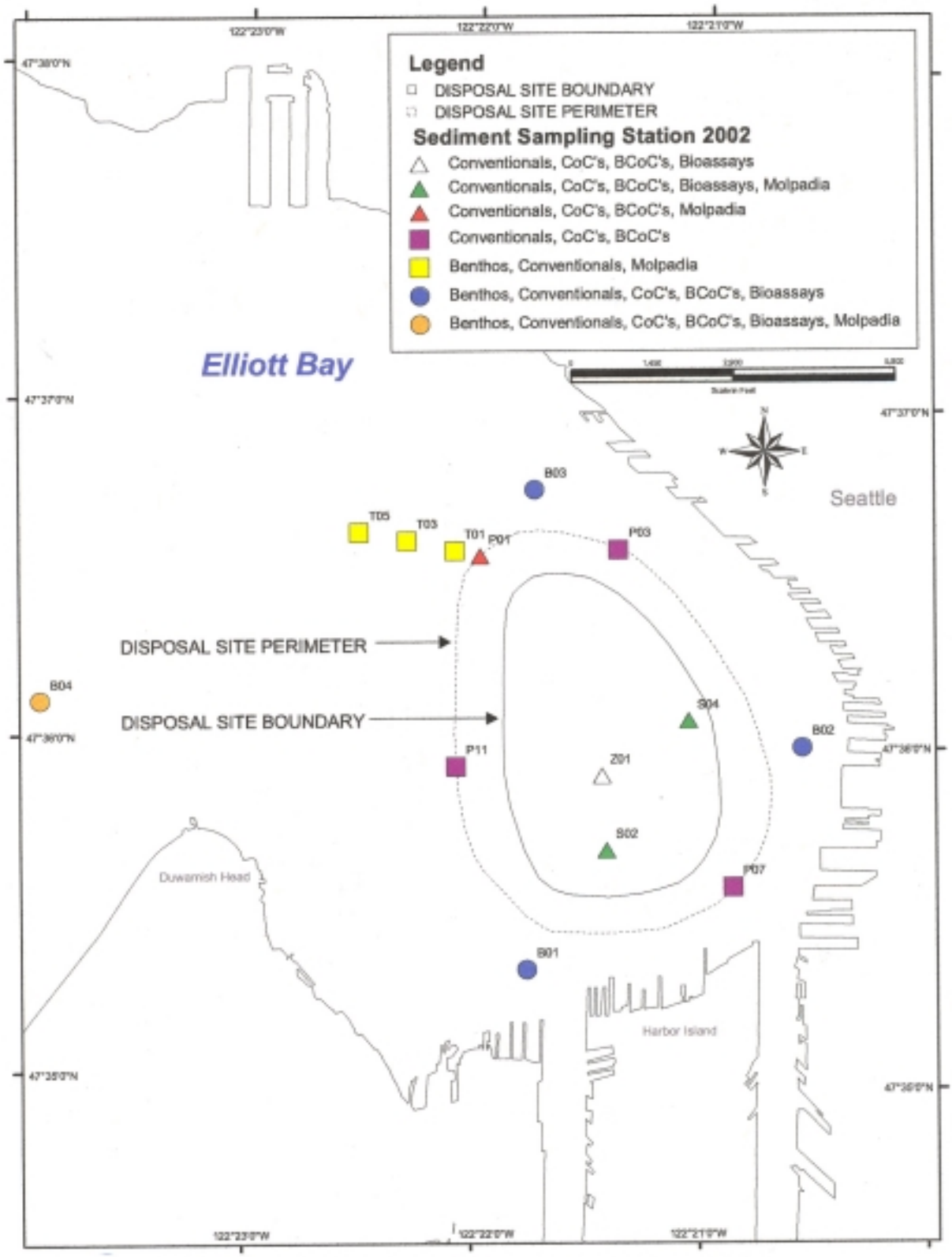

Figure 4-7. Elliott Bay 2002 Monitoring Sediment Sampling Stations

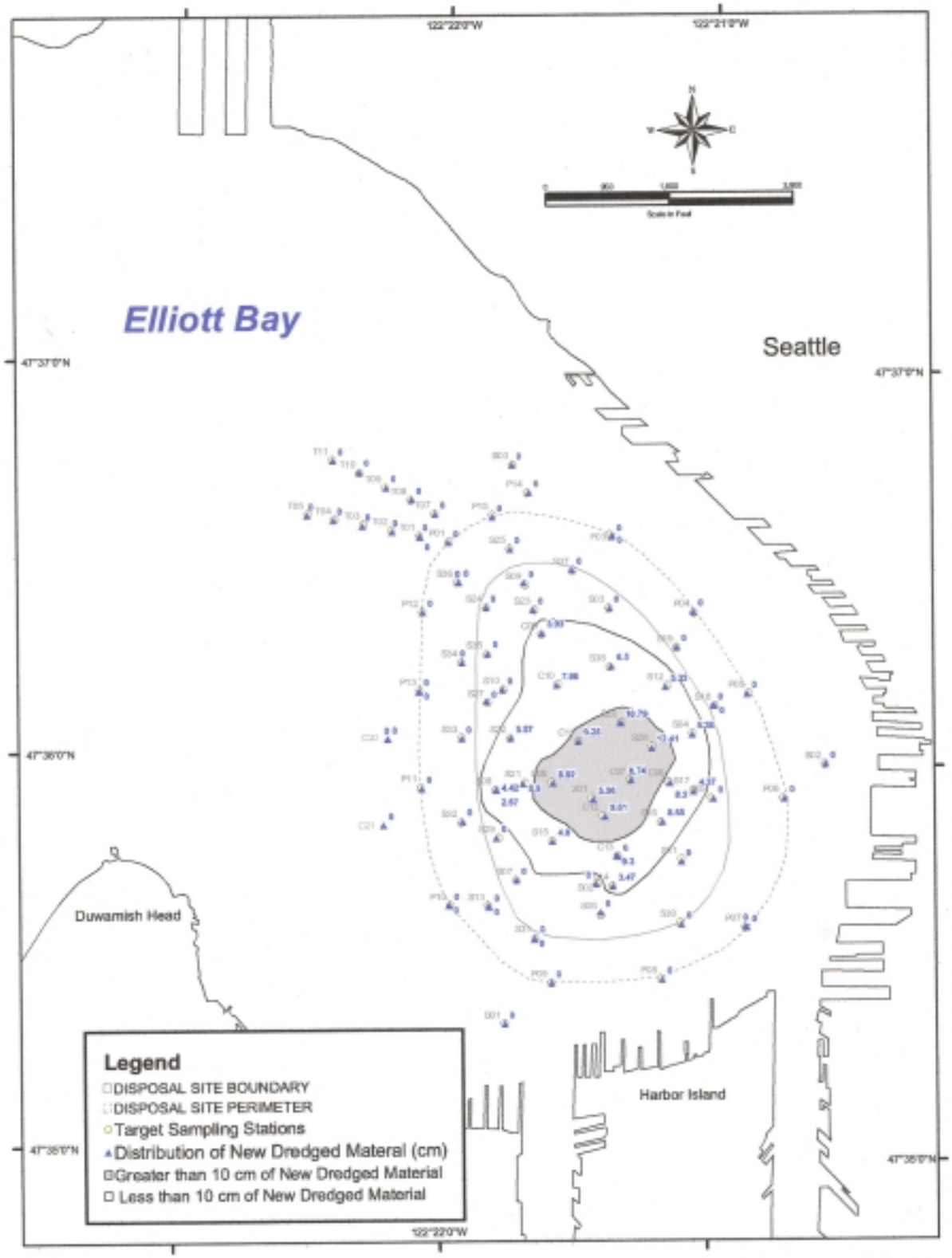

Figure 4-8. Dredged Material Distribution and Thickness (cm) at the Elliott Bay site in 2002

Tiered-Full Monitoring at the Commencement Bay Disposal Site (2003). The Commencement Bay disposal site as noted earlier was previously monitored in 2001 (Full), 1998 (SPI Physical survey only), 1996 (Tiered-Partial), and 1995 (Tiered-Full). The site was closed during DY02 while the DMMP agencies examined the 2001 monitoring data evaluating the offsite dredged material impacts, and evaluated future management options. The site was reopened in DY03 and 710,675 cubic yards was disposed during that period. A tiered-full monitoring effort was conducted between June 25 and July 10, 2003. **Figure 4-9** shows the chemical and biological sampling stations occupied during the 2003 disposal site full monitoring exercise.

Commencement Bay Monitoring Results (2003). The SPI survey map showed that the dredged material footprint extended outside the disposal site perimeter, in general similar to that observed in 2001, but not extending as far north (**Figure 4-10**). Therefore, **hypothesis No. 1** was rejected. The results also indicate that the amount of dredged material accumulating outside the boundary of the disposal site has not been significant since 2001. A comparison of the perimeter station chemistry to the Washington State SQS indicated exceedances for 1,2,4-trichlorobenzene, butylbenzylphthalate, bis(2-ethyl)phthalate, and phenol, although, for 1,2,4-trochlorobenzene, it was undetected and all SQS exceedances were attributable to detection limit exceedances. A statistical time-trend analysis using the Chemical Tracking System software, and this analysis concluded that globally there were no statistically significant increases in COCs at the perimeter stations since 1988 baseline. However, the metal silver showed a statistically significant increase over time at the perimeter stations. For LPAHs and HPAHs, the CTS trend analysis showed a statistically significant decrease in this group of chemicals over time at the perimeter stations. The chemical Phenol also showed a statistically significant increase over time, that actually slightly exceeded the SL and SQS at two of the perimeter stations (CBP01 and CBP03). Because **hypothesis No. 2** was tentatively rejected for phthalates and phenol, benchmark chemistry stations are currently being examined to determine if the changes observed at the disposal site are attributable to area wide trends or are a direct result of disposal at the site.

Evaluation of onsite and perimeter chemistry stations indicated that there were no maximum level (ML) exceedances. Therefore, the site condition II chemical management guidelines was not exceeded and **hypothesis No. 3** is not rejected. Likewise, onsite stations met the Site Condition II biological effects response guideline for PSDDA bioassays. Therefore, **hypothesis No. 4** is not rejected.

Evaluation in chemical body burdens in the sea cucumber, *Molpadia intermedia*, indicated that cadmium was measured at concentrations that were significantly higher than previously reported and exceeded the 1995 guideline values (0.0765 mg/kg) averaging 0.14 mg/kg. Therefore, **hypothesis No. 5** is tentatively rejected, pending analysis of benchmark tissue samples for Cadmium. These analyses are ongoing.

Evaluation of benthic infaunal abundances at transect stations showed significant increases in the abundances of infaunal organisms compared to the 2001 full monitoring event. Molluscan abundances increased from 48.48% at station CBT16 to over 400% at station CBT13. Crustacean abundance increased from 29.8% at CBT16 to 78.6% at CBT14. The data showed that the abundance found during the 2003 survey was 50% greater than that found in the 2001 survey and greater than the 1995 sampling survey. Therefore, **hypothesis No. 6** is not rejected.

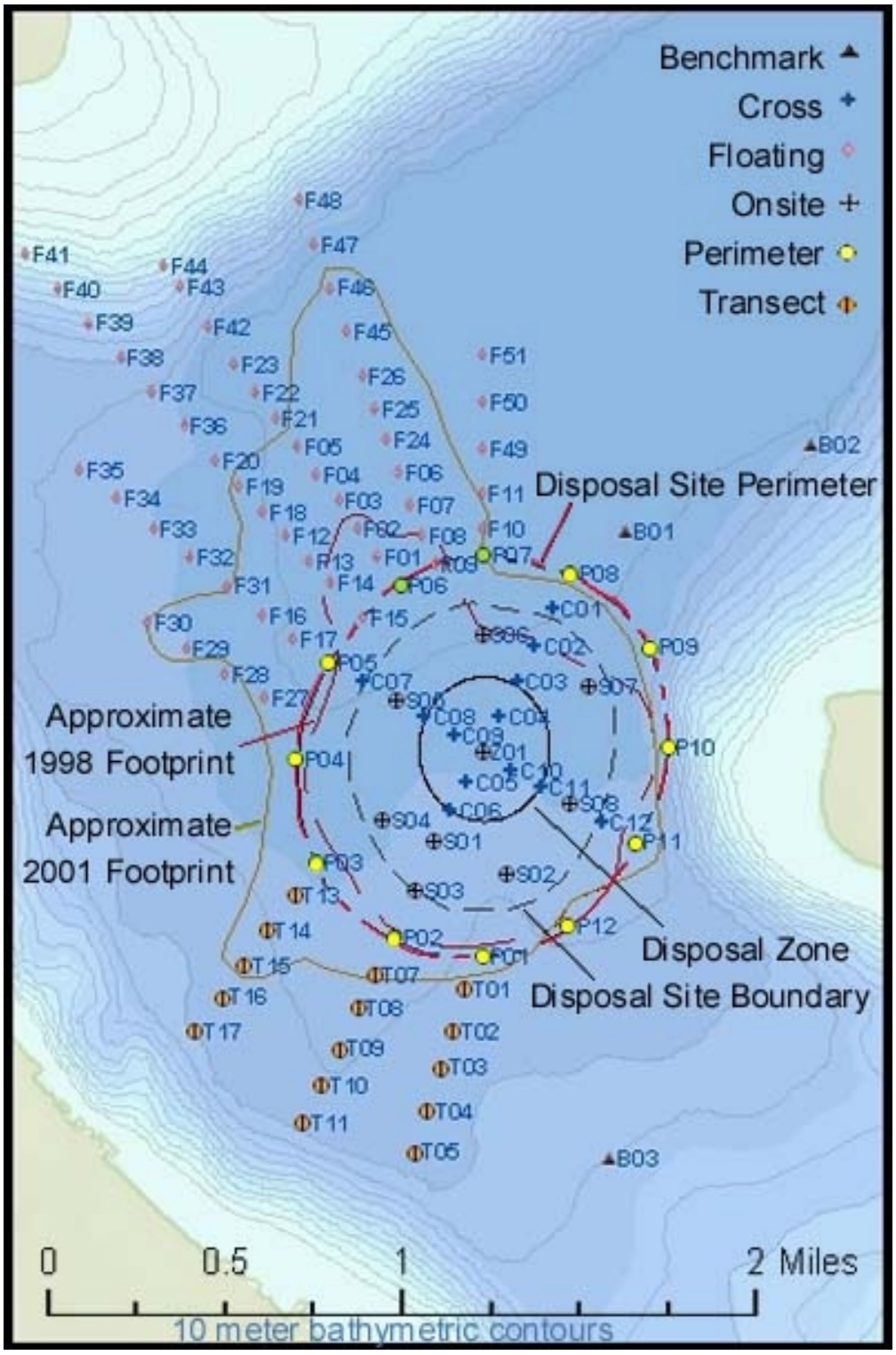

Figure 4-9. Commencement Bay 2003 Monitoring Sediment Sampling Stations

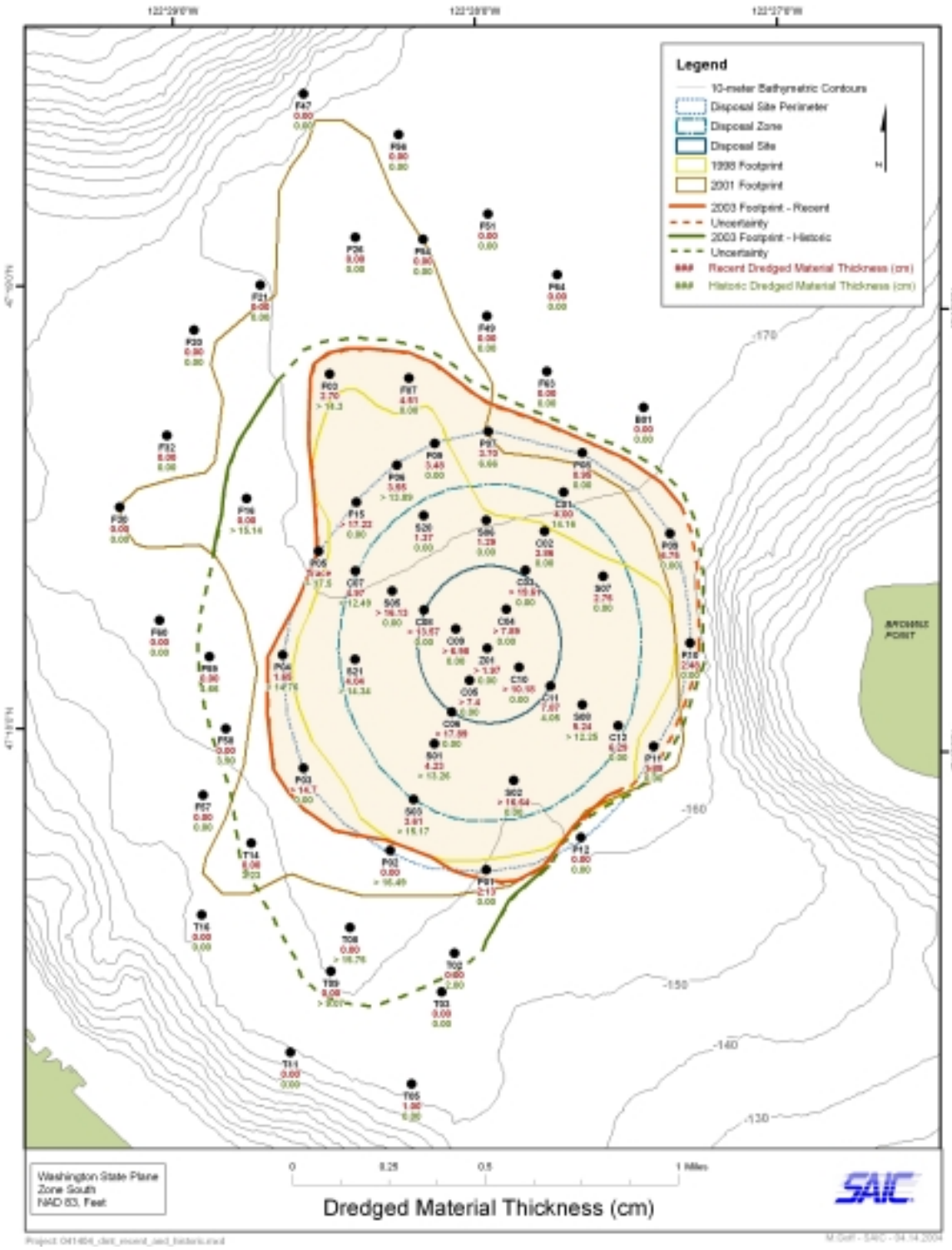

Figure 4-10. Dredged Material Distribution/Thickness (cm) at the Commencement Bay site in 2003

4.3 SUMMARY: DMMP DISPOSAL SITE USE AND MONITORING FREQUENCY

The cumulative dredged material volumes disposed at each Puget Sound site and Grays Harbor/Willapa Bay site since program implementation are depicted in **Figures 4-11** and **4-12** and **Table 2-6.** All eight PSDDA sites have been used, and the two estuarine sites in Grays Harbor and Willapa Bay have also been utilized. Fifteen-year summaries of site use for the PSDDA sites general show that site capacities appear to be sufficient to last at least 20 years (**Table 4-7**, **Figure 4-11**).

However, the Commencement bay site use has significantly accelerated during the past six years and has averaged 540,835 cy/year since 1998 (excluding 2002 when the site was shut down). At that rate of site use this site will exceed the estimated 9,000,000 cy site capacity threshold within ten years at the present rate of disposal site use. Therefore, the DMMP agencies are initiating a NEPA/SEPA review of the Commencement bay site to evaluate future site use projections relative to the existing site. It will also consider expanding the site boundaries, or selecting a new site, or closing down the existing site. The DMMP agencies expect to convene an interagency workgroup during 2004 to discuss the various alternatives being contemplated and solicit input on alternatives being contemplated to address the future disposal needs in Commencement bay and vicinity.

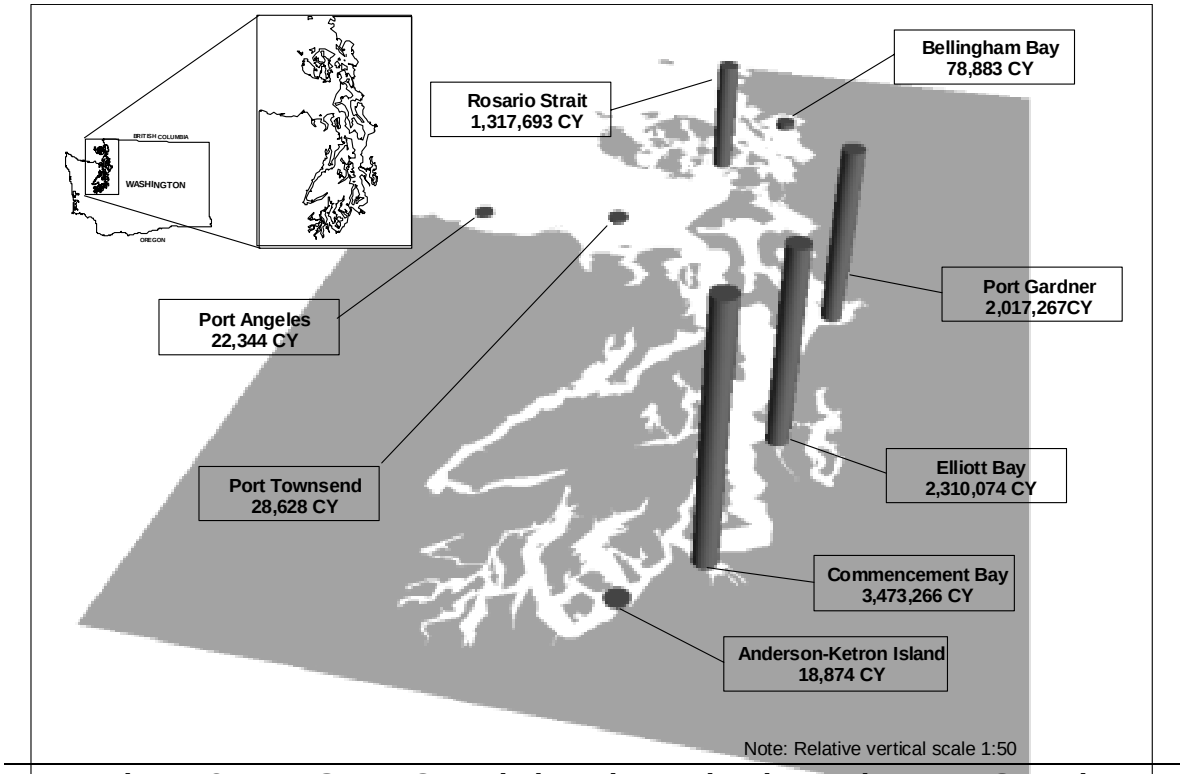

Figure 4-11. DMMP cumulative disposal volumes in Puget Sound dredging years 1989 – 2003

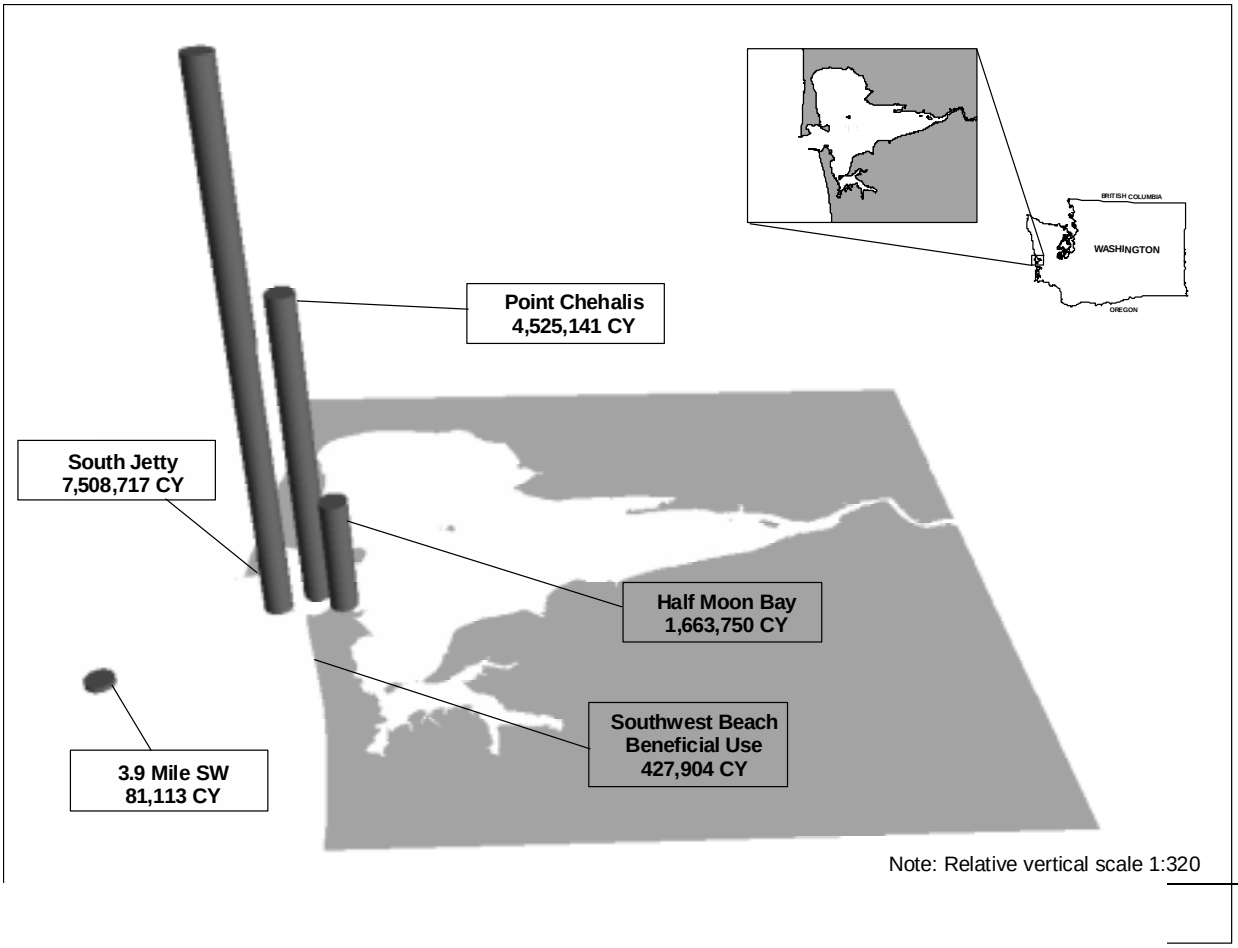

Figure 4-12. Cumulative disposal volumes for Grays Harbor (1996 – 2003)

Table 4-6. Cumulative Site Use Frequency Summary

Disposal Site	Dredging Years Used	Cumulative Volumes Disposed (cubic yards)
PSDDA	**(1989 - 2003)**	
Anderson/Ketron (ND)	93, 95	18,874
Commencement Bay (ND)	89, 91, 95, 96, 98, 99, 00, 01, 03	3,473,266
Elliott Bay (ND)	90, 91, 92, 93, 94, 95, 96, 97,98, 99, 00, 01, 02	2,310,074
Port Gardner (ND)	90, 91, 93, 94, 95, 96, 97, 02	2,017,267
Rosario Strait (D)	91, 92, 93, 94, 95, 96, 98, 99, 02, 03	1,317,693
Bellingham Bay (ND)	93, 96, 98	78,883
Port Townsend (D)	93, 98, 99	28,628
Port Angeles (D)	96	22,344
Total cumulative volume		**9,267,029**
GRAYS HARBOR	**(1996 - 2003)**	
Point Chehalis (D)	96, 97, 98, 99, 00, 01, 02, 03	4,525,141
South Jetty (D)	96, 97, 98, 99, 00, 01, 02, 03	7,508,717
Half Moon Bay (beneficial uses site)	96, 97, 98, 99,02, 03	1,663,750
Southwest beach renourishment site	01, 02	427,904
3.9 Mile Ocean (D)	03	81,113
Total cumulative volume		**14,206,625**
WILLAPA BAY	**(1996-2003)**	
Cape Shoalwater	00, 03	251,095
Goose Point	99. 03	110,004
Total cumulative volume		**361,099**

Legend: ND = nondispersive; D = dispersive

Table 4-7. Fifteen-Year (1989-2003) Puget Sound Site Use Summary

Non-dispersive Disposal Site	Cumulative Volumes (CY)	Average Volume (CY/YR)	15-Year Predictions MPR Phase I/II (CY)	Percent of 15-Year Prediction	Estimated Time to Exceed Site Capacity[4] (Years)
Port Gardner (1989-2003)	2,017,267	134,484	8,243,000	24.5	51.9
Elliott Bay (1989-2003)	2,310,074	154,005	10,525,000	21.9	43.4
Bellingham Bay (1990-2003)	78,883	5,635	1,181,500	6.7	1,583
Commencement Bay (1989-2003)	3,473,266	231,551	3,929,000	88.4	23.9
Anderson/Ketron Island (1990-2003)	18,874	1,348	785,000	2.4	6,663
SUBTOTALS:	7,898,364	527,023	24,763,500	31.9	N/A
Dispersive Disposal Site	**Cumulative Volumes (CY)**	**Average Volume per Year (CY/YR)**	**15-Year Predictions MPR Phase I/II (CY)**	**Percent of 15-Year Prediction**	**Estimated Time to Exceed Site Capacity[5] (Years)**
Rosario Strait (1990-2003)	1,317,693	94,121	1,801,000	73.2	N/A
Port Townsend (1990-2003)	28,628	2,045	687,000	4.2	N/A
Port Angeles (1990-2003)	22,344	1,596	285,000	7.8	N/A
SUBTOTALS:	1,368,665	120,475	2,773,000	49.3	N/A
GRAND TOTALS:	9,267,029	647,498	27,536,500	33.6	N/A

Table 4-8 summarizes the completed and scheduled DMMP disposal site monitoring surveys at the PSDDA nondispersive and dispersive sites. To date, the DMMP agencies have conducted twelve post-disposal monitoring surveys at nondispersive sites and three post-disposal bathymetric surveys at dispersive sites. The monitoring consisted of 4 full, 2 partial, 3 tiered-full, 2 tiered-partial

[4] Site capacity estimated in Phase II Disposal Site Selection Technical Appendix for non-dispersive sites is approximately 9,000,000 cubic yards, therefore (Site Capacity – Cumulative Volume)/average annual disposal volume = Estimated Time to Exceed Site Capacity.

[5] Actual site capacity for dispersive sites is not limited, assuming complete dispersal of dredged material off site.

monitoring, and 1 SPI only survey. The Ketron/Anderson Island site is the only non-dispersive site not yet monitored, but has also been the lowest use site to date. Three bathymetric surveys have been conducted at the Rosario Strait dispersive site, which is the only dispersive site used on a frequent basis. The DMMP agencies will conduct a tiered-partial monitoring survey of the Commencement Bay site during 2004, and this survey will be preceded by a bathymetric survey to ascertain the disposal mound size and height as part of the ongoing site re-evaluation.

Table 4-8. Puget Sound Disposal Site Monitoring Surveys

Year	Disposal Site	Type of Survey
1990	Port Gardner	Full
1990	Elliott Bay	Partial
1992	Elliott Bay	Full
1991	Rosario Strait	Bathymetric
1993	Bellingham Bay	Partial
1994	Port Gardner	Tiered-Full
1994	Rosario Strait	Bathymetric
1995	Commencement Bay	Tiered-Full
1996	Commencement Bay	Tiered-Partial
1998	Commencement Bay	SPI
1999	Rosario Strait	Bathymetric
2000	Elliott Bay	Full
2001	Commencement Bay	Full + Bathymetric
2002	Elliott Bay	Tiered-Partial
2003	Commencement Bay	Tiered-Full
2004 (scheduled)	Commencement Bay	Bathymetric + Tiered-Partial

Legend. SPI = Sediment Profile Imagery Survey

Based on Puget Sound site monitoring conducted to data (including physical mapping, on and offsite sediment chemistry, sediment toxicity, offsite infaunal bioaccumulation, and offsite benthic community structure analysis), dredged material disposal has not caused adverse impacts at or adjacent to any of the non-dispersive sites. DMMP evaluation procedures appear to be adequately protecting the disposal site environments and surrounding areas.

The overall goal of the DMMP site monitoring program is to ensure that the DMMP prescribed disposal site conditions are maintained and verify that DMMP dredged material evaluation procedures adequately protect the aquatic environment. Monitoring surveys provide positive feedback to verify the adequacy of the DMMP dredged material management process. The Sediment Management Annual Review Meetings provide a forum to report on these post-disposal survey findings conducted during any given dredging year, and any management plan adjustments if needed.

The PSDDA Management Plan Reports (MPR, 1998, 1989) recognize that intensive post-disposal monitoring surveys would be required early in the program implementation to gather data on the adequacy of the evaluation procedures to meet the site management objectives. All the monitoring events to data have not detected unexpected adverse impacts at any of the non-dispersive sites that have been monitored. In accordance with the management plan, following the 1997 SMARM

(http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/mon_97.pdf), the DMMP agencies reduced the frequency and scope of monitoring based on past documented compliance with the site management objectives. The DMMP agencies increased the disposal volume soft trigger initiating site monitoring from 300,000 cy to 500,000 cy at the Commencement Bay, Elliott Bay, and Port Gardner disposal sites following the 2002 SMARM (http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/volume_trigger1.pdf), but left the volume trigger at 300,000 cy for the two less frequently used non-dispersive sites (Bellingham Bay and Ketron/Anderson Island).

The Corps, in consultation with the DMMP agencies will be re-initiating a consultation process with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act (ESA) relative to the PSDDA disposal sites to update the existing programmatic biological evaluation. The existing five year programmatic Biological Evaluation will expire during 2005. The findings of NMFS and USFWS in their respective concurrence letters (May 31, 2000 and June 19, 2000) found that disposal of dredged material at the five non-dispersive disposal sites and three dispersive sites "may affect, but are not likely to adversely affect" the listed species.

In 1996, the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) was reauthorized and amended to establish procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a federal fisheries management plan (i.e. only for commercially harvested species). MSFCMA requires all federal agencies to consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency that may adversely affect EFH (MSFCMA 305(b)(2)). Therefore, the Corps, in consultation with the DMMP agencies under contract prepared a draft Essential Fish Habitat Assessment of the eight PSDDA disposal sites in Puget Sound. The objective of this EFH assessment is to describe potential adverse effects to designated EFH for federally managed fisheries species within the proposed action areas. It also describes conservation measures proposed by the U.S. Army Corps of Engineers (Corps) to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action. Monitoring results verify that during the first 10 years of operation of the sites, the program management plan has effectively protected the environment from unacceptable impacts. Continued use of the PSDDA management and monitoring program, including adaptive management, is expected to allow continued safe and publicly acceptable disposal of dredged materials. Therefore, potential cumulative impacts to designated EFH are not considered to be significant. The NMFS issued an opinion (June 2, 2003 letter) under consultation on the EFH programmatic assessment, which will be in effect until June 2005, which states that the built-in conservation measures described in the EFH Assessment, while not completely avoiding the adverse effects attributable to open-water disposal of dredged material, they do minimize, to the maximum extent practicable, those effects.

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APPENDIX A

The following discussion includes those projects requiring explanation beyond the summaries provided in Chapter 1 for ranking, sampling plan development, chemical testing, biological testing, or those for which the DMMP agencies used best professional judgment.

DREDGING YEAR 2002

Manke Lumber Company Recency Extension (PN 1999-00694)

The proposed dredged material at the Manke Lumber Company dredging site underwent DMMP characterization through March 2000. The results of that characterization are documented in a 10 October 2000 suitability determination memorandum, in which 11 of 24 dredged material management units (DMMUs) were found to be suitable for unconfined-open-water disposal at the Commencement Bay disposal site. The proposed dredging site was ranked high for initial testing purposes, which means that the data have a two-year recency guideline that subsequently expired during March 2002.

The purpose of the recency memorandum was to document the DMMP consensus on the recency extension request by the applicant's agent (Anchor Environmental) and the supporting documentation provided in support of the extension request. The applicant requested that the DMMP suitability of surface DMMUs evaluated as suitable for unconfined-open-water disposal be extended by 11 months through February 2003, and that subsurface material suitability evaluated as suitable for unconfined-open-water disposal be extended by 23 months through February 2004.

The DMMP agencies after evaluating the supporting documentation concurred that an extension of the recency date of the surface suitable material through February 2003 was acceptable. Likewise the DMMP agencies concurred that extending the recency of the subsurface suitable material through February 2004 was acceptable under BPJ.

Pierce County Terminal (PN 2000-2-00765)

This project was an expansion of the Port of Tacoma Blair Waterway Turning Basin. It underwent two rounds of testing beginning in August of 2000 and ending with a Suitability Determination Memorandum dated July 12, 2001

Much of the proposed dredge prism was a cutback of the existing shoreline, in order to expand the turning basin. Before a SAP was even submitted, the DMMP evaluated the proposed PCT project for eligibility for consideration under the DMMP program. The DMMP used a weight-of-evidence approach to agree that the material could be tested and evaluated for open-water disposal.

Initial testing found that PCBs and pesticides contaminated portions of the dredge prism. Given the high levels of PCBs found in the composite sample from one of the initially defined DMMU (C6), it was clear that the frequency of sampling for this DMMU was not suitable for making regulatory decisions. No biological testing was performed on any of the Phase I sediments pending further sampling and analysis to determine the extent of contamination.

During Phase 2 testing, PCB and pesticide exceedances were again found in areas where there were previously found during Phase 1, and three DMMU subsequently underwent bioassay testing. All three test sediments passed non-dispersive site disposal guidelines for the amphipod and *Neanthes* bioassays. However, mortality in the sediment larval test was high enough to fail all three test sediments under the one-hit rule. During the QA/QC review, it was discovered that all larval tests had very high levels of unionized ammonia (NH_3) and, contrary to cited protocols, were not aerated during the test period. PSEP protocols for the *Mytilus* bioassay specify that data should be qualified as potential false positives when unionized ammonia levels exceed 0.13 mg/L unionized ammonia (PSEP 1995). Initial levels of unionized ammonia for all three test sediments exceeded that level (range 0.28 to 0.40 mg/L NH_3), and all increased over the course of the test (range 0.74 to 1.15 mg/L NH_3). Based on this evidence, larval tests were considered potential false positives and not considered valid. Without valid bioassay results needed for decision-making, the sediments represented by UN1, UN3 and LN3 were considered unsuitable for open-water disposal.

DREDGING YEAR 2003

Glacier Northwest Cement Terminal (92-2-00452)

This project is a proposed berth maintenance on the lower Duwamish River. In addition to being high-ranked, the Lower Duwamish area, in which this project is located, is a Superfund site, added to the National Priorities List on 1 December 2000. Three composites were analyzed for conventional parameters and DMMP chemicals of concern. DMMU 1 and DMMU 2 each had only one detected SL exceedance, for PCBs. DMMU 3 had SL exceedances of arsenic, zinc, DDT, PCBs and TBT. All three DMMUs had non-detected exceedances of 2,4-Dimethylphenol (at 30 ppb; SL = 29 ppb).

All three DMMUs subsequently underwent bioassay analyses. Reference sediment was initially collected from Carr Inlet (CARR REF). However, the grain sizes of the reference sediments collected showed approximately 30% difference in fines content from the test sediments, a larger discrepancy than that recommended by the DMMP program. Results of the initial bioassay suggested that the CARR REF sediment did not adequately factor out any grain size effects, particularly for the amphipod bioassay, and that test was rerun. Since holding times for initially collected sediments had expired, new sediments were collected from the initial sampling locations. Reference sediments were collected from a Holmes Harbor (HH 06-A) reference site that more closely matched the fines, and particularly the clay content, of the test sediments for the amphipod bioassay. Control sediments for both rounds of bioassay testing were from Yaquina Bay, Oregon.

DMMU 1 passed DMMP guidelines for open water disposal, but DMMU 2 did not. Since DMMU 3 exceeded the BT trigger for TBT, it would have needed to pass bioaccumulation testing as well as bioassays before being found suitable for open-water disposal. Thus, though DMMU 3 passed bioassay testing, it could not be found suitable for open-water disposal in the absence of bioaccumulation testing. Glacier Northwest opted not to conduct this testing.

Archived composites from the Z-samples (1 foot below proposed dredging prism) of DMMU 2 and DMMU 3 were analyzed for some chemicals of concern for comparison with Washington State antidegradation

standards. The evaluation standard for interpreting Z-sample sediment quality data is the Sediment Management Standards Sediment Quality Standard (SQS). The Z-sample for DMMU 1 was not analyzed, as this DMMU passed suitability criteria for open water disposal.

DMMU 2-Z was analyzed for total PCBs and metals. No PCBs were detected. Arsenic was measured at 64.3 mg/kg, which is above the SQS criterion of 57 mg/kg. The measured mercury concentration of 0.60 mg/kg is above both the SQS and CSL criteria of 0.41 mg/kg and 0.59 mg/kg, respectively.

Sample DMMU 3-Z was analyzed for TBT (porewater) only. The detected concentration of 3.4 µg/L was well above both the DMMP SL and BT criteria (0.15 µg/L), and above that found in the overlying DMMU (0.71 µg/L).

Based on the above data, the agencies made the following determination of data sufficiency, which was sent to Glacier Northwest in a letter dated 5 November 2002:

1. Data collected to date for this project were **sufficient** for determining that DMMU #1 is suitable for open water disposal, and ***may*** be dredged without violating state antidegradation regulations and DMMP policies (see WAC 173-204-120, and Kendall 2001).
2. Data collected to date were **sufficient** for determining that DMMUs #2 and 3 are not suitable for open water disposal, and for determining that these DMMUs ***may not*** be dredged to the original proposed depth without violating state antidegradation regulations and DMMP policies.
3. Data collected to date are **insufficient** for determining an alternative depth to which dredging may take place without violating state antidegradation regulations and DMMP policies.

Haug Channel (2001-2-00677)

The proposed moderate ranked dredging project of 10,000 cubic yards is located in Fairweather Bay, Lake Washington. The chemical testing of the single composited DMMU indicated that there were detected and detection limit exceedances of screening level (Acenaphthene, Phenanthrene, total LPAH, Phenol, 4-Methylphenol, Benzyl alcohol), bioaccumulation trigger (Pentachlorophenol, Hexachlorobutadiene, N-nitrosodiphenylamine), and maximum level (2-Methylphenol, 2,4-Dimethylphenol, Pentachlorophenol, Benzoic acid, 1,2,4-Trichlorobenzene, Hexachlorobutadiene, N-nitrosodiphenylamine) guideline exceedances for the chemicals-of-concern in Lake Washington. Laboratory blank contamination was indicated for Phenol, and Benzoic acid, which may have contributed to the concentrations observed. The analysis of the sample also included an assessment of Tributyltin, which was quantitated below the SL. Because of the detected and detection limit exceedances of screening, bioaccumulation trigger, and maximum levels, biological testing was required, which would have included bioassay as well as bioaccumulation testing.

However, due to the exceedingly fine nature of the sediment with a high total organic carbon content, the bioassay laboratory (AMEC) indicated bioassays could not be performed on the sample. Therefore, using best-professional-judgment ("BPJ") the DMMP agencies concluded that the 10,000 cy DMMU was unsuitable for unconfined open-water disposal without required biological testing.

East Waterway Terminal 18 Stage 1a Recency Characterization (2003-2-00074)

The East Waterway Terminal 18 Stage 1A Project was located in the high ranked lower Duwamish Waterway. The Project was retested under recency guidelines, where the identified DMMUs were initially tested and found suitable in 1996. The use of best professional judgment for this project was exercised during bioaccumulation testing. The bioassay testing results were relatively routine and will not be discussed here.

As noted above Bioaccumulation Triggers were exceeded for TBT (3 DMMUs) and PCB (1 DMMU). The Port elected to conduct bioaccumulation on both DMMU-5 and DMMU-4. The requirement to analyze DMMU-4 was linked to the unsuitable analysis outcome of DMMU-3 and to facilitate the testing of DMMU-4, the Port elected to conduct concurrent bioassay and bioaccumulation testing for TBT before chemical testing had been completed. The TBT quantitated for DMMU-4 was actually below the SL/BT at 0.046 ug/L (tin).

DMMU-1 had BT exceedances for both TBT and PCBs, and DMMUs 3 and 5 had BT exceedances for TBT. DMMU-3 failed the bioassay interpretive guidelines and was not tested further. The Port of Seattle elected not to pursue bioaccumulation for DMMU-1, and also not to test archived DMMU-2 as required based on DMMP recommendations. Therefore, DMMU-1 and DMMU-2 without the required testing are considered unsuitable using best-professional judgment. The Port elected to conduct bioaccumulation testing on DMMU-5. Results of DMMU-3 testing triggered the requirement to test archived sample DMMU-4. Because of testing timeline considerations the Port also elected to conduct concurrent bioassay testing and bioaccumulation testing for TBT on DMMU-4 before the chemistry analyses had been conducted. Subsequent chemical testing indicated DMMU-4 had no BT exceedances, and TBT was quantitated at 0.046 ug/L.

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As noted above, two DMMUs (4 and 5) were subjected to bioaccumulation testing for TBT. Bioaccumulation testing was performed with *Macoma nasuta*, a facultative deposit feeding/suspension feeding bivalve and *Nephtys caecoides*, a burrowing facultative deposit feeding/carnivorous polychaete. The two species were tested together in the same 8-gallon aquaria. To provide a better approximation of steady-state tissue concentrations for the tested chemical, TBT the exposure period for the bioaccumulation test has been extended to 45 days by the DMMP program (http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/bioac_00.pdf).

Five replicate 8-gallon aquaria were run for the negative control (*Nephtys*: Tomales Bay, California; *Macoma*: Sequim Bay, Washington), the reference sediment (Carr Inlet: CR-23), and for the two tested DMMUs. In addition to the routine water quality metrics (temperature, salinity, dissolved oxygen, pH) that were monitored during the exposure period, an additional metric, wet-weight growth was collected during the exposure period to further assess the general health and well being of the test animals. To accomplish this, ten animals of each species were randomly selected from each replicate and weighed at the beginning and end of the test. Animals were depurated for 24 hours before homogenization and freezing for tissue analysis. The results of weight measurements and survival measurements taken for each species during the exposure period suggested that for *Macoma nasuta* there was no apparent relationship between mean wet weight and survival during the 45 exposure period, and only the control sample showed a positive weight gain at the end of the exposure period. There was insufficient biomass to conduct the wet weight

measurements for *Nephtys caecoides,* except for the control sediment, which showed a negative weight loss, compared to the starting weight.

The observed tissue TBT (as tin) concentrations for the two species over the 45-day exposure period were adjusted when undetected tissue concentrations were observed for the reference sediment measurements by adjusting to ½ the detection limit observed. Tissue concentrations of chemicals-of-concern from the 45-day exposures were compared statistically to the appropriate reference sediment, based on grain size similarity comparisons. For DMMU-5 the initial to retested sediment porewater TBT concentration ratio is 2.86, which was used to adjust the tissue concentrations for DMMU-5 for a worst-case analysis. Statistical comparisons of test DMMUs and reference tissue concentrations for the final interpretation "worst case" analyses were based on the adjusted tissue concentrations. The summary tissue chemistry interpretation for TBT is provided in Table 1 for the 2 DMMUs tested.

The DMMP agencies agreed that comparing statistical differences from reference is necessary, but not sufficient to determine a DMMU unsuitable for open-water disposal. For those DMMUs that were statistically greater than reference, a more in depth evaluation was required to determine the significance of the bioaccumulation that had occurred. A normal evaluation focuses on a) Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food, but there is no FDA guideline for TBT; b) PSDDA target tissue concentration values for chemicals of concern to human health (43 mg/kg ww as TBT extracted from 17 March 1997 Port of Seattle, T-18 SDM re-evaluation of risk-based approach), and c) ecological residue-effects data from the literature (see discussion below).

A recent effort by the Port of Seattle (May 1999)[6] involved compilation of the residue-effect literature for TBT. It was prepared for the Port of Seattle by EVS Solutions for submittal to the U.S. Environmental Protection Agency for the Harbor Island Superfund Site, Waterway Sediment Operable Unit. Using residue-effects data from this and other studies, EPA Superfund developed a tissue trigger level of **3 ppm dry weight of TBT** in tissue (**0.6 ppm wet weight**) that was used to evaluate bioaccumulation data from the West Waterway OU (for more information see Appendix D of the May 1999 EVS report). This tissue concentration is protective for growth and reproduction endpoints in polychaetes, crustaceans, bivalves, and most gastropods. However, it might not protect the most sensitive species of meso- and neogastropods against imposex-related sterility. Considering that meso- and neogastropods are rare in Elliott Bay (Appendix D in EVS, 1999), the DMMP agencies have decided to use the West Waterway **TBT trigger level (3 ppm dry weight, or 0.6 ppm wet weight)** on an interim basis to interpret bioaccumulation relative to disposal at the Elliott Bay site.

To summarize, the DMMP agencies used the following TTLs to interpret the bioaccumulation test data for the East Waterway Terminal 18 Stage 1A:

TBT: 3.0 ppm dry weight (dw) as TBT, or 0.6 ppm (wet weight) as TBT

[6] For TBT, the DMMP agencies relied upon Appendix D of a May 1999 report entitled: "Review of Tissue Residue Effects Data for Tributyltin, Mercury, and Polychlorinated Biphenyls". Prepared by EVS Solutions for the Port of Seattle.

The agencies used best professional judgment in developing this interpretation guideline to meet PSDDA disposal site management objectives; achievement of other sediment management objectives will require additional evaluation. These guidelines are subject to change for future PSDDA/DMMP projects as additional bioaccumulation data become available.

Both DMMUs were compared to these interpretation guidelines using a one-tailed one-sample t-test). An alpha level (the probability of making a Type I error, rejecting the null hypothesis of no difference between test and reference responses when, in fact, they are not different) of 0.1 was selected for these statistical comparisons by the DMMP agencies to reflect the higher within sample variability, and to increase the power of the test to discriminate between reference and test responses. Neither DMMU statistically exceeded the bioaccumulation interpretation guidelines. In summary, both DMMUs tested passed the bioaccumulation test.

APPENDIX B - DY02/DY03 GUIDELINE VALUES (CHEMISTRY)

CHEMICAL NAME	Units	SL	BT	ML	(SL+ ML)/2
METALS & ORGANOMETALS					
Antimony	mg/kg	150	150	200	175
Arsenic	mg/kg	57	507.1	700	378.5
Cadmium	mg/kg	5.1		14	9.55
Chromium	mg/kg				
Copper	mg/kg	390		1,300	845
Lead	mg/kg	450		1,200	825
Mercury	mg/kg	0.41	1.5	2.3	1.355
Nickel	mg/kg	140	370	370	255
Silver	mg/kg	6.1	6.1	8.4	7.25
Zinc	mg/kg	410		3,800	2,105
TBT ion (porewater)	ug/L	0.15	0.15		
LPAH					
Naphthalene	ug/kg	2,100		2,400	2,250
Acenaphthene	ug/kg	500		2,000	1,250
Acenaphthylene	ug/kg	560		1,300	930
Fluorene	ug/kg	540		3,600	2,070
Phenanthrene	ug/kg	1,500		21,000	11,250
Anthracene	ug/kg	960		13,000	6,980
2-Methylnaphthalene	ug/kg	670		1,900	1,285
TOTAL LPAHS	ug/kg	5,200		29,000	17,100
HPAH					
Fluoranthene	ug/kg	1,700	4,600	30,000	15,850
Pyrene	ug/kg	2,600		16,000	9,300
Benzo(a)anthracene	ug/kg	1,300		5,100	3,200
Benzofluoranthenes (b+k)	ug/kg	3,200		9,900	6,550
Chrysene	ug/kg	1,400		21,000	11,200
Benzo(a)pyrene	ug/kg	1,600	3,600	3,600	2,600
Indeno(1,2,3-c,d)pyrene	ug/kg	600		4,400	2,500
Dibenzo(a,h)anthracene	ug/kg	230		1,900	1,065
Benzo(g,h,I)perylene	ug/kg	670		3,200	1,935
TOTAL HPAHS	ug/kg	12,000		69,000	40,500
CHLORINATED HYDROCARBONS					
1,2,4-Trichlorobenzene	ug/kg	31		64	47.5
1,2-Dichlorobenzene	ug/kg	35	37	110	72.5
1,3-Dichlorobenzene	ug/kg	170	1,241	--	
1,4-Dichlorobenzene	ug/kg	110	120	120	115

CHEMICAL NAME	Units	SL	BT	ML	(SL+ ML)/2
Hexachlorobenzene (HCB)	ug/kg	22	168	230	126
PHTHALATES					
Bis(2-ethylheyesyl)phthalate	ug/kg	8,300	13,870		4,150
Butylbenzylphthalate	ug/kg	970		--	
Di-n-butyl phthalate	ug/kg	5,100	10,200	--	
Di-n-octyl phthalate	ug/kg	6,200	--		
Diethylphthalate	ug/kg	1,200	–		
Dimethylphthalate	ug/kg	1,400	1,400	--	
PHENOLS					
2-Methylphenol	ug/kg	63		77	70
4-Methylphenol	ug/kg	670		3,600	2,135
2,4-Dimethylphenol	ug/kg	29		210	120
Pentachlorophenol	ug/kg	400	504	690	545
Phenol	ug/kg	420	876	1,200	810
MISCELANEOUS EXTRACTABLES					
BENZYL ALCOHOL	ug/kg	57		870	463.5
Benzoic acid	ug/kg	650		760	705
Dibenzofuran	ug/kg	540		1,700	1,120
Hexachlorobutadiene	ug/kg	29	212	270	149.5
Hexachloroethane	ug/kg	1,400	10,220	14,000	7,700
N-Nitrosodiphenylamine	ug/kg	28	130	130	79
VOLATILE ORGANICS					
Ethylbenzene	ug/kg	10	27	50	30
Tetrachloroethene	ug/kg	57	102	210	133.5
Total Xylene (sum of o,m,p)	ug/kg	40		160	100
Trichloroethene	ug/kg	160	1,168	1,600	880
PESTICIDES AND PCBs					
TOTAL DDT	ug/kg	6.9	50	69	37.95
Aldrin	ug/kg	10	37	--	
alpha-Chlordane	ug/kg	10	37	--	
Dieldrin	ug/kg	10	37	--	
Heptachlor	ug/kg	10	37	--	
gamma-BHC (Lindane)	ug/kg	10	--	--	
TOTAL PCBS	ug/kg	130	38 [1]	3,100	1,615

[1] mg/kg - carbon normalized

APPENDIX C - DY 02/03 Evaluation Guideline Exceedances