DREDGED MATERIAL MANAGEMENT PROGRAM BIENNIAL REPORT

Dredging Years 2000/2001

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PREPARED BY THE DMMP AGENCIES

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EPA
Region 10

DREDGED MATERIAL MANAGEMENT PROGRAM BIENNIAL REPORT

Dredging Years 2000/2001

Puget Sound
Dredged Disposal Analysis

Grays Harbor/Willapa Bay Evaluation Procedures

Lower Columbia River Evaluation Framework (Washington)

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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

DREDGED MATERIAL MANAGEMENT PROGRAM (DMMP) EVALUATION ACTIVITIES for Dredging Years 2000 - 2001

A. 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 2000 and 2001.

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 (DY00 = June 16, 1999 - June 15, 2000; DY01 = June 16, 2000 - June 15, 2001). Tables related to project-specific ranking, sampling, testing, and suitability determinations are presented in the first part of this chapter. The second half of the chapter presents an overall assessment of sampling and testing activities and data. Where projects involved unusual circumstances or the application of best professional judgment by the agencies, more detailed descriptions are provided in **Appendix A**.

During DY00/01 there were 28 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

Table 1-1a. DY00 DMMP Evaluation Activities. These include all projects that concluded with an action by the DMMP between 6/15/99-6/14/00**.**

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	Ranking Determination DY	SAP Review DY	Suitability Determination DY
James Hardie Gypsum	FC	PSDDA	10,000	1998[1]	1999/2000[2]	2000
Seattle, Port of, East Waterway Project, Stage II	FC	PSDDA	584,990	1998[1]	1999	2000
Seattle, Port of, Pier 66	FC	PSDDA	1,700	1998[1]	1999	2000
Tacoma, Port of, Blair Waterway Deepening	VR	PSDDA	+110,000	na	na	2000
Tacoma, Port of, Sitcum Waterway	FC	PSDDA	288,000	1998[1]	2000	2000
Tacoma, Port of, St. Paul Waterway CDF	FC	PSDDA	455,000	1999	1999	2000
USACE, Bay Center Entrance Channel, Willapa Bay	ED	GH/WB	165,000	1995[3]	na	2000
USACE, Duwamish O&M	FC	PSDDA	76,000	1998[1]	2000	2000
USACE, Olympia Harbor O&M	FC	PSDDA	635,000	1999	1999	2000
US Coast Guard Slip 36	FC	PSDDA	33,130	1998[1]	1999	2000
US Navy PSN Shipyard (Phases 1 & 2)	FC	PSDDA	368,050	1998[1]	1999/2000[2]	2000
US Navy PSNS Pit-CAD Characterization	FC	PSDDA	900,000	2000	2000	2000
Weyerhaeuser Bay City Dock	FC	PSDDA	12,000	1995[3]	1999	2000

DMMP Actions

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

Disposal Jurisdictions

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

[1] Ranking source: PSDDA Users Manual, 1st edition, 1998
[2] Two SAPs were prepared for two different rounds of sampling
[3] Ranking source: Dredged material evaluation procedures and disposal site management, Grays Harbor and Willapa Bay, June 1995

Table 1-1b. DY01 DMMP Evaluation Activities. These include all projects that concluded with an action by the DMMP between 6/15/00-6/14/01**.**

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	Ranking Determination DY	SAP Review DY	Suitability Determination DY
Anacortes, Port of, Cap Sante Marina	FC	PSDDA	345,000	1998[1]	1999	2001
Anacortes, Port of, Dakota Creek	FC	PSDDA	246,000	1998[1]	1999	2001
Anacortes, Port of, Pier 1	FC	PSDDA	32,000	1998[1]	1999	2001
Hylebos (Mouth, Murray Pacific) and Blair Slip One	FC	PSDDA	500,000	2000	2000	2001
Hylebos Wood Debris Group - Manke/Louisiana Pacific	FC	PSDDA	109,800	2000[4]	2000	2001
Hylebos Wood Debris Group - Weyerhaeuser	FC	PSDDA	39,900	2000[4]	2000	2001
Everett, Port of, Marina & 10th St. Boat Launch, Jetty Island Dock	FC	PSDDA	49,340	2000[4]	2000	2001
Everett, Port of, 12 Street Marina	FC	PSDDA	294,470	2001	2001	2001
Padden Creek - Bellingham DY 2001	FC	PSDDA	6,800	2000[4]	2000	2001
Skagit, Port of, LaConner Marina	FC	PSDDA	82,000	2000[4]	2001	2001
Tacoma Narrows Bridge Foundation Dredging	FC	PSDDA	110,000	2000[4]	2001	2001
USACE, Bay Center Marina/Inner Channel	FC	GH/WB	38,000	1995[3]	2001	2001
USACE, Everett Harbor & Snohomish River O&M	FD/ED	PSDDA	330,437	na	na	2001
USACE, Grays Harbor O&M	FC	GH/WB	1,860,000	1995[3]	2001	2001
USACE, Squalicum Waterway O&M, Bellingham Bay	FC	PSDDA	172,000	2000	2000	2001

[4] Ranking Source: DMMP PSDDA Users Manual, 2nd edition, February 2000

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**, 13 had DMMP actions completed by June 15, 2000 and are considered DY00 projects. Fifteen projects had DMMP actions completed by June 15, 2001 and are considered DY01 projects. Puget Sound project locations for DY00 and DY01 are shown in **Figure 1-1a**. Projects located in Grays Harbor and Willapa Bay are shown in **Figure 1-1b**. During this biennium there were no projects from the lower Columbia River.

Several characterizations during the DY00/01 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, 2001 is considered a DY 2002 project and is not considered in this report.

B. DY00/01 PROJECTS

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.[5] The PSDDA Users Manual and Columbia River DMEF can be accessed via the internet from the Corp's Dredged Material Management Office home page, at <http://www.nws.usace.army.mil/dmmo/homepage.htm>. A revised and updated version of the Grays Harbor Willapa Bay Users Manual is expected to be added to the same web site during 2002.

Under the jurisdictional specific guidelines summarized above, the initial appraisal of a proposed dredging project requires a careful examination of all

[5] Henceforth referred to as the Columbia River Dredged Material Evaluation Framework (DMEF)

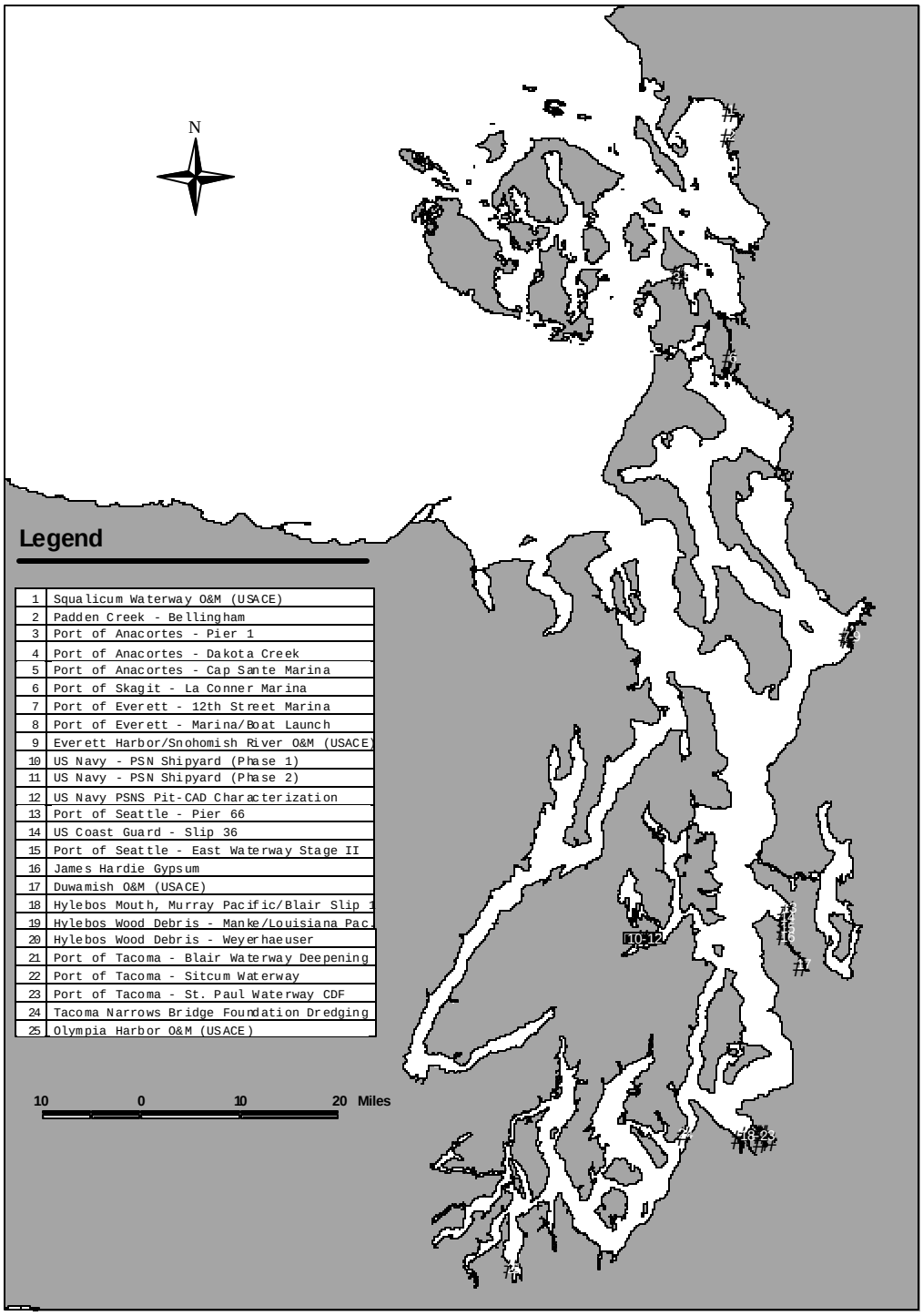


Figure 1-1a Dredging Year 2000/2001 DMMP Project Locations

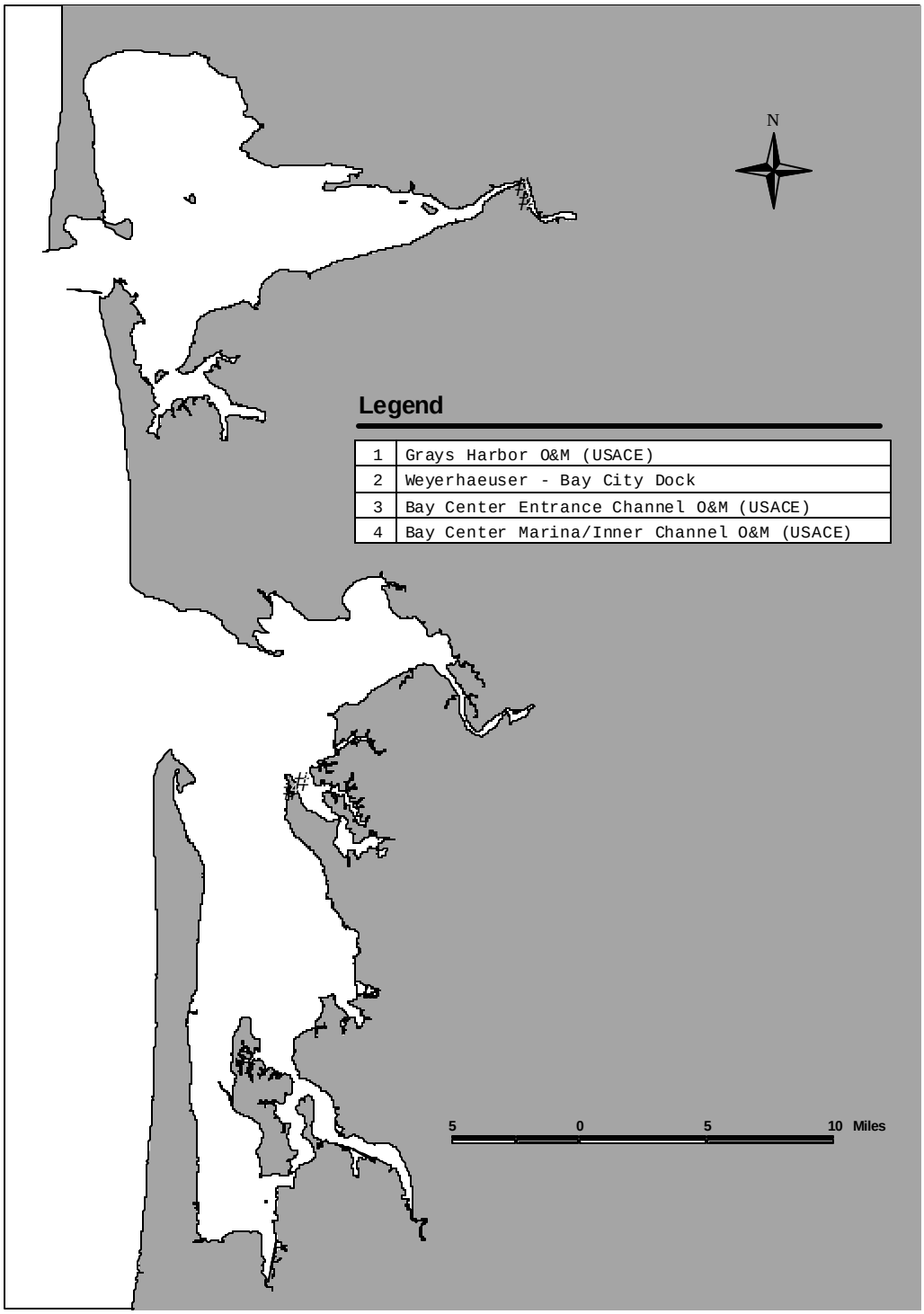


Figure 1-1b Dredging Year 2000/2001 DMMP Project Locations

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; Columbia River DMEF, 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 1-2a** and **1-2b** contain the initial and full characterization rankings of all DY00/01 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.

Two out of eleven DY00 full characterizations (Port of Tacoma St. Paul Waterway CDF and US Navy PSNS Pit CAD) and two out of fourteen DY01 FCs (Hylebos Mouth/Murray Pacific, and Port of Everett 12th St. Marina) had rankings adjusted based on presentation of additional data. In all cases the rankings were adjusted downward. The two DY00 downranked projects were both for confined disposal facilities where dredging took place only to provide capacity for disposal of contaminated sediments. Both these projects included significant amounts of subsurface material and were sited in areas where contamination concerns were lower than in surrounding areas. Both the DY00 projects presented sufficient data from previous characterizations to support a downrank as outlined in the PSDDA Users Manual (2000). It should be noted that the DMMP does not track projects that have had downranking requests denied, based on insufficient "reason to believe" or inadequate data supporting the request.

Table 1-2a. DY00 Project Rankings.

PROJECT	Disposal Jurisdiction	Location	Waterbody	Initial Rank	Final Rank
James Hardie Gypsum	PSDDA	Seattle	Duwamish River	H	H
Seattle, Port of, East Waterway Project, Stage II	PSDDA	Seattle	East Waterway	H	H
Seattle, Port of, Pier 66	PSDDA	Seattle	Elliott Bay	H	H
Tacoma, Port of, Blair Waterway Deepening	PSDDA	Tacoma	Blair Waterway	L	L
Tacoma, Port of, Sitcum Waterway	PSDDA	Tacoma	Sitcum Waterway	L	L
Tacoma, Port of, St. Paul Waterway CDF	PSDDA	Tacoma	St. Paul Waterway	H	LM
US Coast Guard Slip 36	PSDDA	Seattle	East Waterway	H	H
US Navy PSN Shipyard (Phases 1 & 2)	PSDDA	Bremerton	Sinclair Inlet	H	H
US Navy PSNS Pit-CAD Characterization	PSDDA	Bremerton	Sinclair Inlet	H	H/LM
USACE, Bay Center Entrance Channel, Willapa Bay	GH/WB	Bay Center	Willapa Bay	L	L
USACE, Duwamish O&M	PSDDA	Seattle	Duwamish River	H	H
USACE, Olympia Harbor O&M	PSDDA	Olympia	Budd Inlet	L	L
Weyerhaeuser Bay City Dock	GH/WB	Cosmopolis	Chehalis River	LM	LM

L = Low
LM = Low/Moderate
M = Moderate
H = High
E = Meets Exclusionary guidelines

Table 1-2b. DY01 Project Rankings.

PROJECT	Disposal Jurisdiction	Location	Waterbody	Initial Rank	Final Rank
Anacortes, Port of, Cap Sante Marina	PSDDA	Anacortes	Guemes Channel	M	M
Anacortes, Port of, Dakota Creek	PSDDA	Anacortes	Guemes Channel	M	M
Anacortes, Port of, Pier 1	PSDDA	Anacortes	Guemes Channel	M	M
Everett, Port of, 12 Street Marina	PSDDA	Everett	Port Gardner Bay	M	LM
Everett, Port of, Marina & 10th St. Boat Launch, JI Dock	PSDDA	Everett	Port Gardner Bay	M	M
Hylebos (Mouth, Murray Pacific)/Blair Slip One	PSDDA	Tacoma	Hylebos Waterway	H/L	H/LM/ L
Hylebos Wood Debris Group - Manke/Louisiana Pacific	PSDDA	Tacoma	Hylebos Waterway	H	H
Hylebos Wood Debris Group - Weyerhaeuser	PSDDA	Tacoma	Hylebos Waterway	H	H
Padden Creek - Bellingham DY 2001	PSDDA	Bellingham	Padden Creek	H	H
Skagit, Port of, LaConner Marina	PSDDA	LaConner	Swinomish Channel	M	M
Tacoma Narrows Bridge Foundation Dredging	PSDDA	Tacoma	Tacoma Narrows	LM	LM
USACE, Bay Center Marina/Inner Channel	GH/WB	Bay Center	Willapa Bay	L	L
USACE, Everett Harbor & Snohomish River O&M	PSDDA	Everett	Snohomish River	LM	LM
USACE, Grays Harbor O&M	GH/WB	Grays Harbor	Grays Harbor	L	L
USACE, Squalicum Waterway O&M, Bellingham Bay	PSDDA	Bellingham	Squalicum Waterway	M/H	M/H

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[6] 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 1-3a and **1-3b** contain data related to sampling plans approved for DY00/01 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**.

Sampling

Tables 1-4a and **1-4b** contain data related to sampling efforts during DY00/01. In this table the two phases of the US Navy Puget Sound Naval Shipyard characterization effort are listed separately to compare sampling efforts. The two phases of this characterization are considered one project, although they resulted in two suitability determinations.

Two general requirements existing within all three jurisdictions are to sample to the depth of dredging (including overdepth)[7], 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

[6] 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/dmmo/homepage.htm (select hypertext: toolbox).

[7] 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 grab sampler is generally allowed.

Table 1-3a. DY00 Projects - Approved Sampling Plans. Includes information from any SAP submitted that resulted in a DMMP action in DY00. SAPs were not necessarily reviewed in DY00.

PROJECT	Rank	Total Volume (cy)	Surface Volume (cy)	Number of Surface Samples	Number of Surface DMMUs	Subsurface Volume (cy)	Number of Subsurface Samples	Number of Subsurface DMMUs
James Hardie Gypsum	H	9,200	9,200	5	5	0	0	0
Seattle, Port of, East Waterway Project, Stage II	H	584,990	232,530	60	60	352,460	60	39
Seattle, Port of, Pier 66	H	1,700	1,700	3	1	0	0	0
Tacoma, Port of, Sitcum Waterway	L	288,000	288,000	36	6	0	0	0
Tacoma, Port of, St. Paul Waterway CDF	LM	455,000	52,000	5	2	403,000	20 (archived)	8 (archived)
USACE, Duwamish O&M	H	76,000	57,708	54	18	18,292	6	2
USACE, Olympia Harbor O&M	L	635,000	479,145	64	13	145,126	28	4
US Coast Guard Slip 36	H	33,130	27,370	7	7	5,760	1	1
US Navy PSN Shipyard (Phase 1)	H	373,900	304,020	76	76	69,660	7	7
US Navy PSN Shipyard (Phase 2)	H	368,050	307,550	79	79	60,500	12	12
US Navy PSNS Pit-CAD Characterization	H/LM	900,000	111,500	30	30	278,600	40	8
Weyerhaeuser Bay City Dock	LM	12,000	12,000	4	1	0	0	0

Table 1-3b. DY01 Projects - Approved Sampling Plans. Includes information from any SAP submitted that resulted in a DMMP action in DY01. SAPs were not necessarily reviewed in DY01**.**

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
Anacortes, Port of, Cap Sante Marina	M	345,000	345,000	47	12	0	0	0
Anacortes, Port of, Dakota Creek	M	246,000	32,000	8	2	215,000	2	2
Anacortes, Port of, Pier 1	M	32,000	32,000	8	2	0	0	0
Everett, Port of, 12 Street Marina	LM	294,470	78,870	11	3	215,600	11	5
Everett, Port of, Marina & 10th St. Boat Launch, JI Dock	M	49,340	49,340	22	6	0	0	0
Hylebos (Mouth, Murray Pacific)/Blair Slip One	L/LM/ H	500,000	430,956	90	28	69,044	15	4
Hylebos Wood Debris Group - Manke/Louisiana Pacific	H	109,800	109,800	25	25	0	0	0
Hylebos Wood Debris Group - Weyerhaeuser	H	39,900	25,900	7	7	14,000	3	3
Padden Creek - Bellingham DY 2001	H	6,800	6,800	6	2	0	0	0
Skagit, Port of, LaConner Marina	M	82,000	82,000	20	5	0	0	0
Tacoma Narrows Bridge Foundation Dredging	LM	110,000	110,000	8	4	0	0	0

USACE, Bay Center Marina/Inner Channel	L	38,000	28,000	9	2	10,000	9	1
USACE, Grays Harbor O&M	L	1,860,000	1,860,000	82	11	0	0	0
USACE, Squalicum Waterway O&M, Bellingham Bay	M/H	172,000	127,646	37	12	44,258	18	5

TABLE 1-4a. DY00 Project Sampling. Grain sizes given are ranges from all samples for a given project.

PROJECT	GRAIN SIZE PERCENTAGES				SAMPLING EQUIPMENT	MAXIMUM SAMPLE DEPTH (FT)	MEAN SAMPLE DEPTH (FT)
	GRAVEL > 2 mm	SAND .063 - 2mm	SILT .004 - .063mm	CLAY < .004 mm			
James Hardie Gypsum	0 - 8.0	9.8 - 23.3	48.3 - 73.9	9.6 - 27.8	vibracore	~4	~4
Seattle, Port of, East Waterway Project, Stage II	0 - 16.2	7.5 - 81.8	9.2 - 70.7	3.7 - 36.8	vibracore	19.7	9.0
Seattle, Port of, Pier 66	60.4	36.0	2.63	0.97	vibracore	5.4	4.7
Tacoma, Port of, Sitcum Waterway	0	18 - 48	38 - 65	14 - 22	vanVeen grab	0.5	0.5
Tacoma, Port of, St. Paul Waterway CDF	0	33 - 37	52 - 53	10 - 15	vibracore	20	20
USACE, Bay Center Entrance Channel, Willapa Bay	-	>99	-	-	grab	0.5	0.5
USACE, Duwamish O&M	0.0 - 0.4	13.2 - 60.9	31.8 - 70.1	7.0 - 25.4	vibracore	8.0	4.4
USACE, Olympia Harbor O&M	0.6 - 32.7	18.3 - 71.3	10.7 - 49.8	6.3 - 33.9	vibracore		
US Coast Guard Slip 36	0.3 - 5.5	44.1 - 72.2	16.9 - 48.5	4.5 - 9.8	vibracore	12.6	8.8
US Navy PSN Shipyard (Phase 1)	0 – 61.1	4.4 – 79.7	6.4 – 67.4	0.1 – 43.5	vibracore	19.3	7.0
US Navy PSN Shipyard (Phase 2)	0 – 63.7	8.1 – 81.9	1.7 – 61.9	1.7 – 36.4	vibracore	12.9	6.1
US Navy PSNS Pit-CAD Characterization	0.0 - 4.6	0.8 - 69.0	15.6 - 66.9	15.5 - 48.4	Mudmole™	13	10
Weyerhaeuser Bay City Dock	0.2	15.6	60.2	24.1	grab	0.5	0.5

TABLE 1-4b. DY01 Project Sampling. Grain sizes given are ranges from all samples for a given project.

PROJECT	GRAIN SIZE PERCENTAGES				SAMPLING EQUIPMENT	MAXIMUM SAMPLE DEPTH (FT)	MEAN SAMPLE DEPTH (FT)
	GRAVEL > 2 mm	SAND .063 - 2mm	SILT .004 - .063mm	CLAY < .004 mm			
Anacortes, Port of, Cap Sante Marina	0 - 15	4 - 47	35 - 73	6 - 26	MudMole™	5.0	3.8
Anacortes, Port of, Dakota Creek	1 - 11	48 - 56	25 - 36	8 - 15	MudMole™	9.8	6.3
Anacortes, Port of, Pier 1	3 – 24	51 – 68	8 – 42	0 - 8	MudMole™	8.3	5.1
Everett, Port of, Marina & 10th St. Boat Launch, Jetty Is. Dock	0.9 - 2.1	19.2 - 51.1	37.8 - 63.0	8.3 - 17.1	vibracore	6.2	4.0
Everett, Port of, 12 Street Marina	0.2 - 2.6	29.9 - 59.8	31.6 - 54.3	7.2 - 13.1	vibracore	18	12.1
Hylebos (Mouth, Murray Pacific)/Blair Slip One	0 - 11.5	17 - 74	15 - 56	7.7 - 29	vibracore	16.6	6.4
Hylebos Wood Debris Group – Weyerhaeuser	0.9 - 9.6	22.5 - 54.9	27.8 - 52.9	11.0 - 26.4	MudMole™	5.4	2.7
Hylebos Wood Debris Group - Manke/Louisiana Pacific	0 - 50.6	15.9 - 83.6	4.2 - 54.6	1.4 - 29.3	impact core	14.0	5.6
Padden Creek - Bellingham DY 2001	18.3 - 20.2	56.2 - 67.4	9.0 - 15.5	5.3	vibracore	9.0	7.5
Skagit, Port of, LaConner Marina	0.2 - 0.8	<0.1 - 4.3	76.9 - 83.2	15.8 - 18.1	vibracore	2.6	~ 2
Tacoma Narrows Bridge Foundation Dredging	0.1 - 62.7	35.4 - 76.3	0.1 - 28.3	<0.1 - 2.9	grab	0.5	0.5
USACE, Bay Center Marina/Inner Channel	0 - 0.6	6.7 - 65.7	22.7 - 70.3	11.1 - 29.3	vibracore	11.0	8.0
USACE, Grays Harbor O&M	0.4 - 16.1	8.2 - 80.9	2.8 - 65.8	1.7 - 23.3	vanVeen grab	0.5	0.5
USACE, Squalicum Waterway O&M, Bellingham Bay	0 - 17.6	4.4 - 67.2	11.5 - 76.0	6.5 - 27.9	vibracore	12.3	7.4

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.

Chemical Testing

Chemical testing was conducted for 12 full characterizations in DY00 and 13 projects in DY01. For one DY00 project (Blair Waterway Deepening) the agencies used previous data to allow an increase in the project volume with no further testing. Another DY00 project (Bay Center Entrance Channel) met guidelines for site-specific exclusion from chemical testing under Grays Harbor/Willapa Bay jurisdictional guidelines. In DY01 only one project (USACE O&M of Everett Harbor and Snohomish River) did not require chemical testing. For this project the agencies reaffirmed the frequency determination for the bulk of the proposed dredged material, and found that additional material met guidelines for site-specific exclusion from further testing under PSDDA guidelines. Both projects with site-specific exclusions from testing were excluded based on the coarse-grained nature of the sediments.

In general, the QA/QC for projects undergoing chemical testing was acceptable by the DMMP agencies for regulatory decision-making. A complete listing of PSDDA sediment guideline value exceedances for DY00/01 is included in **Appendix C**.

Biological Testing

A total of 12 projects required acute bioassay testing (**Tables 1-5a** and **1-5b**) during the biennium. Six of these projects underwent biological testing in DY00, with one project (US Navy PSNS) requiring two rounds of biological testing. Six projects also underwent biological testing in DY01. Only two DY00 projects exclusively used tiered testing, performing biological tests on only those DMMUs that had exceedances of SLs. Three projects opted for concurrent biological testing, because of a reason-to-believe that at least one COC would exceed SL, and to save time in the testing process. The US Navy PSNS project used exclusively concurrent testing in its first round, and a mix of tiered and concurrent testing during its second round of biological testing.

Table 1-5a. DY00 Biological Testing Data. Summary of bioassay tests performed for DY00 projects.

PROJECT	Number of Bioassays		Number of analyses failing bioassays	Bioassay tests conducted			Control sediment location	Reference sediment location
	Undergoing tiered testing	Undergoing concurrent testing		Amphipod	Sediment Larval	20-day Growth		
James Hardie Gypsum	7	0	5	Aa	De	Na	Narragansett Bay, MA West Beach, WA	Carr Inlet, WA
Seattle, Port of, East Waterway Project, Stage II	0	99	27	Ee	Mg	Na	Beaver Creek, OR Yaquina Bay, OR	Carr Inlet, WA
US Coast Guard Slip 36	0	8	4	Ee	Mg	Na	Beaver Creek, OR Yaquina Bay, OR	Carr Inlet, WA
US Navy PSN Shipyard (Phase 1)[8]	0	83	76	Ee	Mg	Na	Beaver Creek, OR Yaquina Bay, OR	Carr Inlet, WA
US Navy PSN Shipyard (Phase 2)	52	10	0	Aa, Ee	Mg	Na	N. San Francisco Bay, CA; Yaquina Bay, OR	Carr Inlet, WA
US Navy PSNS Pit-CAD Characterization	0	30	1	Aa	Mg	Na	N. San Francisco Bay, CA; Yaquina Bay, OR	Carr Inlet, WA
USACE, Duwamish O&M	14	0	2	Aa	De	Na	N. San Francisco Bay, CA	Carr Inlet, WA

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

[8] See Appendix A for discussion of Phase I amphipod bioassay nontreatment testing issues resulting in amphipod retesting during Phase II

Table 1-5b. DY01 Biological Testing Data. Summary of bioassay tests performed for DY01 projects.

PROJECT	Number of Bioassays		Number of analyses failing bioassays	Bioassays Conducted			Control Sediment Location	Reference Sediment Location
	Undergoing concurrent testing	Undergoing tiered testing		Amphipod	Sediment Larval	20-day Growth		
Anacortes, Port of, Cap Sante Marina	0	1	0	*Aa*	*Sp*	*Na*	Narragansett Bay, MA	Carr Inlet, WA
Hylebos (Mouth, Murray Pacific)/Blair Slip One	0	19	16	*Ee*	*Mg*	*Na*	Yaquina Bay, OR	Carr Inlet
Hylebos Wood Debris Group - Manke/Louisiana Pacific	0	22	13	*Aa, Ra*	*De, Mg*	*Na*	Narrow River, RI; West Beach, WA Yaquina Bay, OR	Carr Inlet, WA; Narrow River, RI; West Beach, WA
Hylebos Wood Debris Group – Weyerhaeuser	0	9	4	*Aa, Ra*	*De, Mg*	*Na*	West Beach, WA; Yaquina Bay, OR; Narragansett Bay, RI	Carr Inlet, WA
Padden Creek - Bellingham DY 2001	0	1	0	*Ee*	*De*	*Na*	Yaquina Bay, OR	Carr Inlet, WA
USACE, Grays Harbor O&M	0	2	0	*Ee*	*De*	*Na*	Yaquina Bay, OR	GHS7/ Yaquina Bay, OR

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

DMMP regulatory use of the saline Microtox® test has been suspended for regulatory decision-making since DY94. 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.

Bioaccumulation Testing

Several project sediments exceeded BT values and so were required to pass bioaccumulation testing prior to being found suitable for open water disposal during the DY00/01 biennium (**Tables 1-6a** and **1-6b**). Though most projects performed three or fewer bioaccumulation analyses, the Port of Seattle East Waterway Deepening Project performed 25 bioaccumulation analyses. Further details on bioaccumulation testing can be found in **Appendix A**.

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 determination 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 1-7a and **1-7b** contain information taken from the suitability determinations or other completion actions for each of the projects that completed their DMMP review during DY00 and DY01, respectively.

For the projects receiving suitability determinations in DY00, 38% of total number of DMMUs (16% of the total volume) were found unsuitable for unconfined-open-water disposal under relevant DMMP evaluation guidelines. For DY01, 27% of the total number of DMMUs (6% of the total volume) were 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 1- 6a. DY00 BIOACCUMULATION TESTING DATA

PROJECT	Number of bioaccum analyses	Number of analyses failing bioaccum	TESTS CONDUCTED		Control Sediment Location(s)	Reference Sediment Location
			Macoma nasuta	*Nephtys caecoides*		
Seattle, Port of, East Waterway Project, Stage II	25	4	25	25	Dillon Beach, CA Yaquina Bay, OR Beaver Creek, OR	Carr Inlet, WA Sequim Bay, WA
USACE, Olympia Harbor O&M	2	0	2	2		
US Navy PSN Shipyard (Phase 2)	1	1	1	1	N. San Francisco Bay, CA	Carr Inlet, WA

Table 1- 6b. DY01 BIOACCUMULATION TESTING DATA

PROJECT	Number of bioaccum analyses	Number of analyses failing bioaccum	TESTS CONDUCTED		Control Sediment Location(s)	Reference Sediment Location
			Macoma nasuta	*Nephtys caecoides*		
Anacortes, Port of, Cap Sante Marina	2	0	2	2	Tomales Bay, CA	Sequim Bay, WA
Hylebos Wood Debris Group – Weyerhaeuser	3	0	3	3	Sequim Bay, WA; Tamales Bay, CA	Sequim Bay, WA; Tamales Bay, CA

Table 1-7a. DY00 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
James Hardie Gypsum	H	9,200	10	7	0	5	4,743	5	4,486	Elliott Bay
Seattle, Port of, East Waterway Project, Stages 1 & 2	H	584,990	99	99	25	34	170,070	65	414,920	Elliott Bay
Seattle, Port of, Pier 66	H	1,700	1	0	0	0	0	1	1,700	Elliott Bay
Tacoma, Port of, Blair Waterway Deepening[9]	L	+110,000	0	0	0	0	na	na	+110,000	Commencement Bay
Tacoma, Port of, Sitcum Waterway	L	288,000	6	0	0	0	0	6	288,000	Commencement Bay
Tacoma, Port of, St. Paul Waterway CDF	LM	455,000	2	0	0	0	0	2	455,000	Commencement Bay
US Coast Guard Slip 36	H	33,130	8	8	0	4	15,790	4	17,340	Elliott Bay
US Navy PSN Shipyard (Phases 1 & 2)	H	368,050	98	155	1	17	77,210	74	290,840	Elliott Bay
US Navy PSNS Pit-CAD Characterization	H/LM	900,000	34	30	0	1	3,700	38	896,300	Elliott Bay
USACE, Bay Center Entrance Channel, Willapa Bay	L	165,000	0	0	0	0	na	na	165,000	Cape Shoalwater
USACE, Duwamish O&M	H	76,000	20	14	0	5	18,600	15	57,400	Elliott Bay
USACE, Olympia Harbor O&M	L	635,000	17	0	2	0	0	17	635,000	Anderson/Ketron
Weyerhaeuser Bay City Dock	LM	12,000	1	0	0	0	0	1	12,000	South Jetty/ Pt. Chehalis

[9] This action increased the amount of suitable dredging material but involved no additional testing; increase in material was from previously tested areas.

Table 1-7b. DY01 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
Anacortes, Port of, Cap Sante Marina	M	345,000	12	1	2	0	0	12	345,000	Rosario Strait
Anacortes, Port of, Dakota Creek	M	246,000	2	0	0	1	16,000	3	230,000	Rosario Strait
Anacortes, Port of, Pier 1	M	32,000	2	0	0	0	0	2	32,000	Rosario Strait
Everett, Port of, 12 Street Marina	LM	294,470	3	0	0	0	0	8	294,470	Port Gardner
Everett, Port of, Marina & 10th St. Boat Launch, JI Dock	M	49,340	6	0	0	0	0	6	49,340	Port Gardner
Hylebos (Mouth, Murray Pacific)/Blair Slip One	L/LM/ H	500,000	32	19	0	19	155,000	13	345,000	Commencement Bay
Hylebos Wood Debris Group - Manke/Louisiana Pacific	H	109,800	25	22	0	13	57,700	12	51,100	Commencement Bay
Hylebos Wood Debris Group - Weyerhaeuser	H	39,900	10	9	3	4	14,200	6	25,700	Commencement Bay
Padden Creek - Bellingham DY 2001	H	6,800	2	1	0	0	0	2	6,800	Rosario Strait
Skagit, Port of, LaConner Marina	M	82,000	5	0	0	0	0	5	82,000	Rosario Strait
Tacoma Narrows Bridge Foundation Dredging	LM	110,000	4	0	0	0	0	4	110,000	Commencement Bay; BU

USACE, Bay Center Marina/Inner Channel	L	38,000	3	0	0	0	0	3	38,000	Goose Pt./ Cape Shoalwater
USACE, Everett Harbor & Snohomish River O&M	LM	330,437	0	0	0	0	na	na	330,437	Port Gardner
USACE, Grays Harbor O&M	L	1,860,000	11	2	0	0	0	11	1,860,000	South Jetty/ Pt. Chehalis
USACE, Squalicum Waterway O&M, Bellingham Bay	M/H	172,000	17	0	0	1	1,688	16	170,200	Rosario Strait; BU

C. SUMMARY AND ASSESSMENT OF DY00/01 DATA

Summary of Testing Results

Chemical Testing. **Table I-8** and **Appendix C** summarize the chemical testing results from DY 2000 and DY 2001. A total of 46 of the 58 DMMP COCs had their screening levels exceeded for at least one project. These included both detected exceedances (42 COCs) and detection limit exceedances (16 COCs). Ten COCs had detected concentrations above the BT, while eighteen were detected above the ML. **Table 1-9** 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 either the SL, BT, or ML most often.

The chemicals most often detected above SL and BT included mercury, TBT, fluoranthene, DDT, and total PCBs. Only mercury and DDT were quantitated in two or more projects. The chemicals for which detection limits were most often exceeded included hexachlorobenzene, hexachlorobutadiene, N-nitrosodiphenylamine. Detection limit exceedances were generally inconsequential, because other detected SL exceedances occurred, which triggered biological testing. Only two DMMUs triggered the need to conduct biological testing, by exceeding the SL detection limits with no other detected SL exceedances (**Appendix C**). Concurrent biological testing was conducted for a large number of projects including the East Waterway Project, U.S. Coast Guard Slip 36 Project, U.S. Navy Puget Sound Naval Shipyard Project, U.S. Navy Pit-CAD (CERCLA Cleanup), Weyerhaeuser Company (Hylebos Wood Debris Group), and Manke-Lumber Company (HWDG).

Table 1-8 (Insert)

Table 1-9. Multiple Exceedances of DMMP Guideline Values.

CHEMICAL	CHEMICALS EXCEEDING SL IN AT LEAST 1/3 OF PROJECTS	CHEMICALS EXCEEDING BT IN AT LEAST 2 PROJECTS	CHEMICALS EXCEEDING ML IN AT LEAST 2 PROJECTS	CHEMICALS WITH DL's[1] EXCEEDING SL IN AT LEAST 1/3 OF PROJECTS
Mercury	X	X	X	
Silver		X		
TBT (porewater)	X	X		
Fluorene	X			
Phenanthrene	X			
Total LPAHs	X			
Fluoranthene	X	X		
Pyrene	X			
Benzo (a) anthracene	X			
Chrysene	X			
Total HPAHs	X			
Hexachlorobenzene				X
Hexachlorobutadiene				X
N-Nitrosodiphenylamine				X
Total DDT		X	X	
Total PCBs	X	X		

[1/] DLs = Detection Limits

Biological Testing. Biological testing was conducted on 12 of the 27 projects undergoing chemical testing during DY00/01. **Table 1-10** shows the number of times each of the three bioassays was conducted and the number of "hits" recorded for each bioassay for nondispersive and dispersive site disposal.

TABLE 1-10. – DY 00/01 Bioassay "Hits"

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	D	ND	
Amphipod	310	2	24	0	0	23	47
Sediment Larval	310	2	170	0	0	40	210
Neanthes Growth	310	2	27	0	0	19	46

Legend: ND = nondispersive site interpretation guidelines; D = dispersive site interpretation guidelines

The table shows that all three bioassays in the test suite recorded hits, with the sediment larval bioassay (either *Dendraster excentricus* or *Mytilus galloprovincialis*) registering the most hits (2H + 1H) at 210 out of 312 bioassays (67.3%). The number of total hits recorded was similar for the amphipod and *Neanthes* growth bioassays, 47 (15.1%) versus 46 (14.7%), respectively. All the hits recorded were for the nondispersive site evaluations, with no hits noted for the two analyses utilizing the dispersive site guidelines.

Amphipod bioassay testing with *Eohaustorius estuarius* suggested that this species may be sensitive to sediments with a higher concentrations of clay (see Appendix A: U.S. Navy PSNS project). The DMMP agencies investigated this issue further using only Puget Sound reference area sediments (SAIC 2001) in order to eliminate the potential for unmeasured chemical toxicants to have influenced the Phase I resukts. While the study results were not conclusive, they did suggest that clay may have contributed to the toxicity that was observed.

Bioaccumulation Testing. Bioaccumulation testing frequency increased significantly during the two-year period covered by this report. A total of thirty-three DMMUs from five projects were subject to bioaccumulation testing during DY 00 and DY 01. **Table 1-11** summarizes the chemical specific testing outcomes for the seven chemicals evaluated during 45-day exposures[10]. Of the

[10] The exposure period was increased by DMMP (June 2000 Clarification Paper) from 28 days to 45 days to approximate steady-state tissue concentrations.

chemicals evaluated TBT was the most frequently tested with 25 tests and one failure among the four projects. Total PCBs was the second most frequently tested with 13 DMMUs tested with 3 failures for the one project tested. The third most frequently tested chemical was total DDT, where four DMMUs were evaluated among two projects with one failure. The remaining chemicals evaluated were mercury, silver, fluoranthene, pentachlorophenol and were only evaluated within a single DMMU and project, with no failures. The project specific bioaccumulation testing conducted during DY00/01 is discussed in detail in **Appendix A**.

Table 1-11. DY 00/01 Bioaccumulation Testing Summary.

Chemical	Project frequency	Macoma TTL[11] exceedances	Nephtys TTL[1] exceedances	TTL[1] Guideline	Pass freq.	Fail freq.
Mercury	1			1 mg/kg[12]	1	0
Silver	1			200 mg/kg[13]	1	0
TBT	4	1		3,000 ug/kg[14]	24	1
Fluoranthene	1			8,400 ug/kg[3]	1	0
Pentachlorophenol	1			900 ug/kg[3]	1	0
Total DDT	2			3,000 ug/kg[15]	3	1[16]
Total PCBs	1	3	3	750 ug/kg[17]	10	3

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 1-2** 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

[11] TTL = Target Tissue Level Interpretation Guideline (all values converted to wet weight basis). Test sediment tissue levels are compared statistically to the reference sediment tissue levels and to TTL guidelines in a one tailed t-Test.
[12] FDA Guideline.
[13] Human Health Guideline developed by PSDDA (see EPTA, 1988).
[14] Adopted by DMMP on interim basis as an Ecological Health TTL from 1999 EPA Superfund development effort for the West Waterway OU.
[15] Based on a literature review conducted for the Port of Seattle's T-18 Pier dredging project, ecological effects are expected to occur at a lower concentration than human health effects. A literature review identified a concentration range of 3-5 ppm ww in gonads or liver for croakers and cutthroat trout associated with induction of sterility and other reproductive effects.
[16] BPJ utilized by DMMP due to discrepancy between initial and resampled/retested DDT. See **Appendix A** (U.S. Navy PSNS Project) for discussion.
[17] The DMMP agencies in a December 1999 re-evaluation and development effort established an interim PCB TTL for human health for the East Waterway Stage II Project.

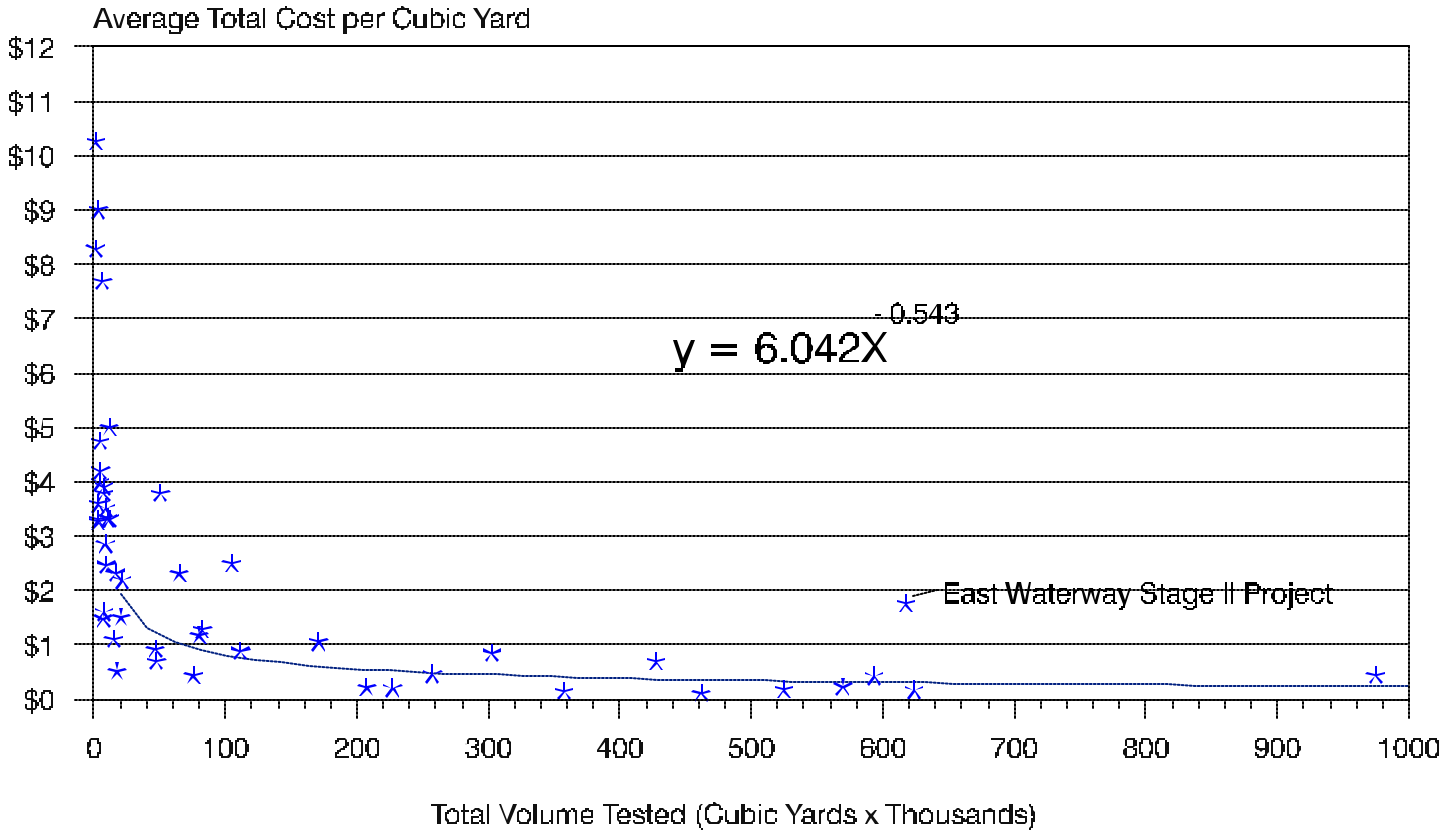
regression of these two variables resulted in a significant ($p<0.001$) correlation and regression equation noted in **Figure 1-2**, which can be used to estimate testing cost given the project size.

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 1-3** 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 $1200 to $1500 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 1-4**. 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.

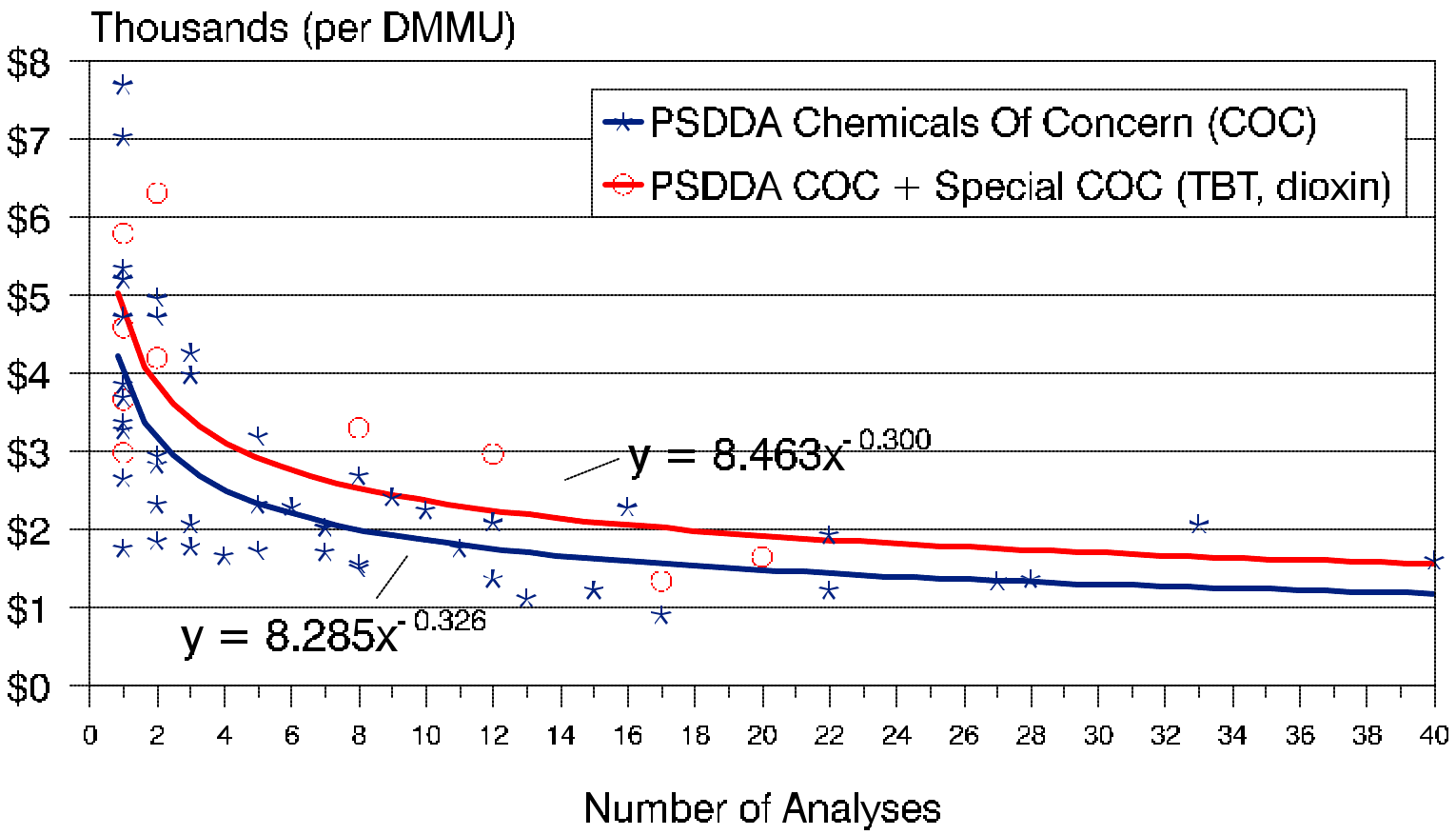
Bioaccumulation testing costs were analyzed for two dredging projects during DY00/01. The USACE/Port of Seattle East Waterway Stage II dredging project conducted 25 bioaccumulation tests (TBT, PCBs, Fluoranthene, total DDT) with an average bioaccumulation cost of $17,953/DMMU. The second project was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

Figure 1-2. Project Size versus Unit Testing Cost



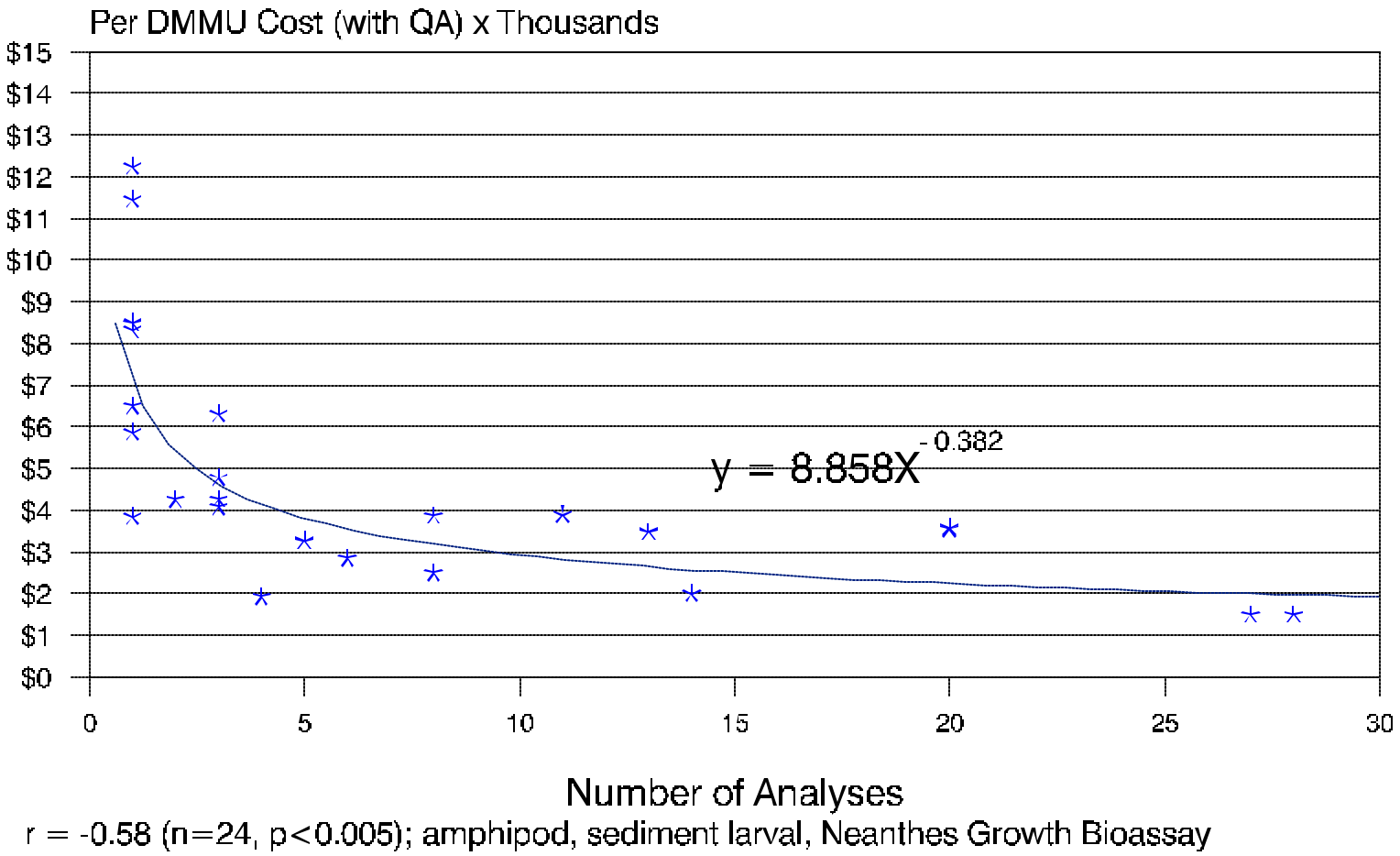
r=-0.50 (n=48, p<0.001)

Figure 1-3. Chemistry Unit Cost



r = -0.52 (n=48, p<0.001); PSDDA COC + Special COC: r = -0.78 (n=10, p<0.01)

Figure 1-4. Bioassay Suite Unit Cost Analysis



r = -0.58 (n=24, p<0.005); amphipod, sediment larval, Neanthes Growth Bioassay

Regulatory Processing

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 which 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 to issue 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.

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 DY00/01

Permit Preparation and Submittal. An application for a Corps of Engineers Section 10/404 permit for dredging and dredged material disposal must be submitted before any DMMP processing may take 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 these comments and modifications have been acknowledged by the applicant, via telephone, letter or e-mail, sampling and analysis may proceed. It is the goal of the DMMO to complete the review of SAPs within three weeks. During DY 00/01 the average time from the submittal of the final SAP for a project to SAP approval was 12 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. These data are entered into the Dredged Analysis Information System by a Corps contractor. Sampling, testing and reporting consume a substantial portion of the DMMP Process time budget, averaging 217 days during DY00/01. This is one of the project phases with the highest degrees of variability, with sampling and analysis taking anywhere from 49 to 563 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 which 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. In DY00/01, the average time required was 35 days. In many cases, this review can be much shorter; time needed during this

biennium ranged from 3 days to 108 days. 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 informs the Corps Regulatory Branch project manager and preparations are made 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, a shorelines development permit may not have yet been obtained by the applicant 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 and transmitted to the applicant for response.

(8) Applicant Responds to Review Comments. The permit applicant is responsible for providing written responses to review comments and supporting data 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.

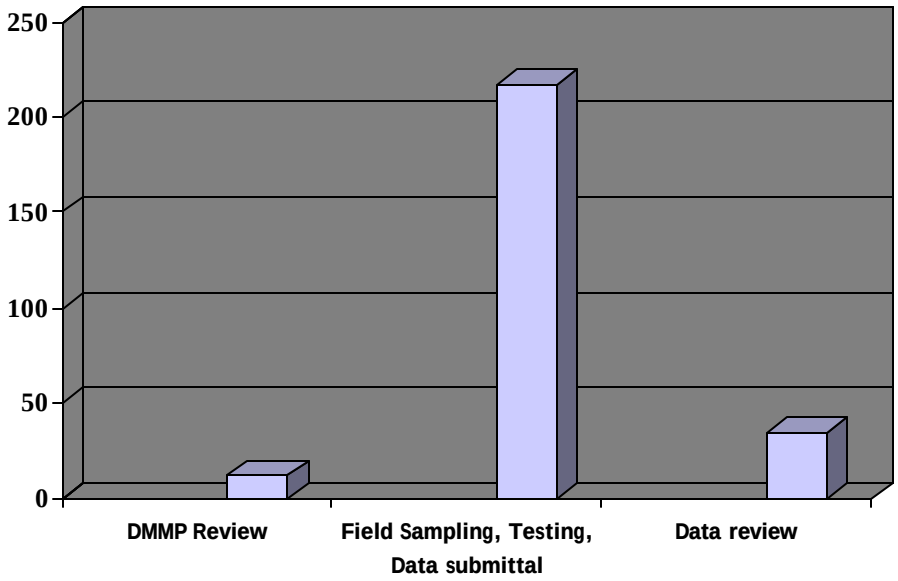
This stage of the process may be very time consuming. Dredging and DMMP processing are often only part of complex projects. Other elements may be involved, such as wetland fills, eelgrass bed impacts or Endangered Species Act issues. The addition of several species to the list of threatened and endangered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

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.

The entire DMMP dredged material evaluation process, as depicted in Figure 1-5, 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 264 days (ranging from 93 to 573 days) in DY00/01, with the majority of that time taken up by sampling, testing, and data report preparation by the applicant. Note that Figure 1-5 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 1-5. DMMP Processing Time

Means for DY00/01 Projects (days)



CHAPTER 2

DISPOSAL SITE USE AND MONITORING

A. DISPOSAL ACTIVITY AND SITE USE

The Washington Department of Natural Resources (DNR) issues site-use authorizations to project proponents wishing to dispose of suitable dredged material at PSDDA and Grays Harbor/Willapa Bay (GH/WBDDA) 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/WBDDA disposal activity for Dredging Years 2000 and 2001 (i.e., June 16, 1999 through June 15, 2000 and June 16, 2000 through June 15, 2001). This information is discussed by year and individual disposal site.

Dredging Year 2000 (June 16, 1999 through June 15, 2000)

In DY00, a total of 1,254,353 cubic yards (cy) of dredged materials were deposited at two PSDDA sites, while 2,224,445 cy were deposited at GH/WBDDA disposal sites. The Commencement Bay disposal site received 893,776 cy of dredged material, primarily from the Blair Waterway Deepening Project, while Elliott Bay received 360,577 cy, primarily from the East Waterway. Grays Harbor received 2,224,445 cy of dredged material, 1,282,663 cy of which went to the South Jetty site. The remaining volume, 941,782 cy, was deposited at the Point Chehalis site. The Willapa Bay disposal sites were not utilized during DY00. These volumes are presented graphically in **Figures 2-1** and **2-2**, and are shown in **Tables 2-1** and **2-2**.

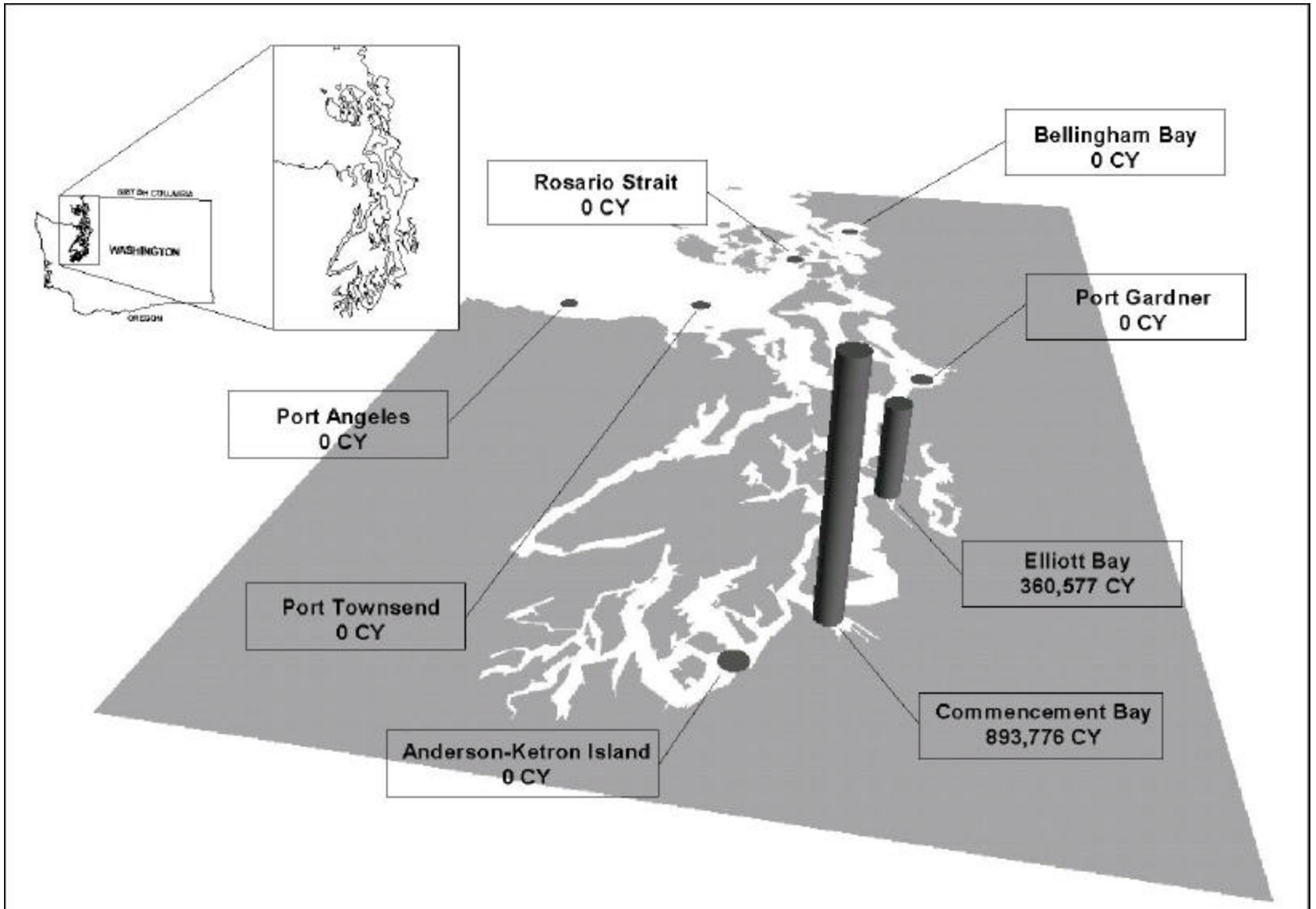


Figure 2-1. Dredging Year 2000 Disposal Volumes

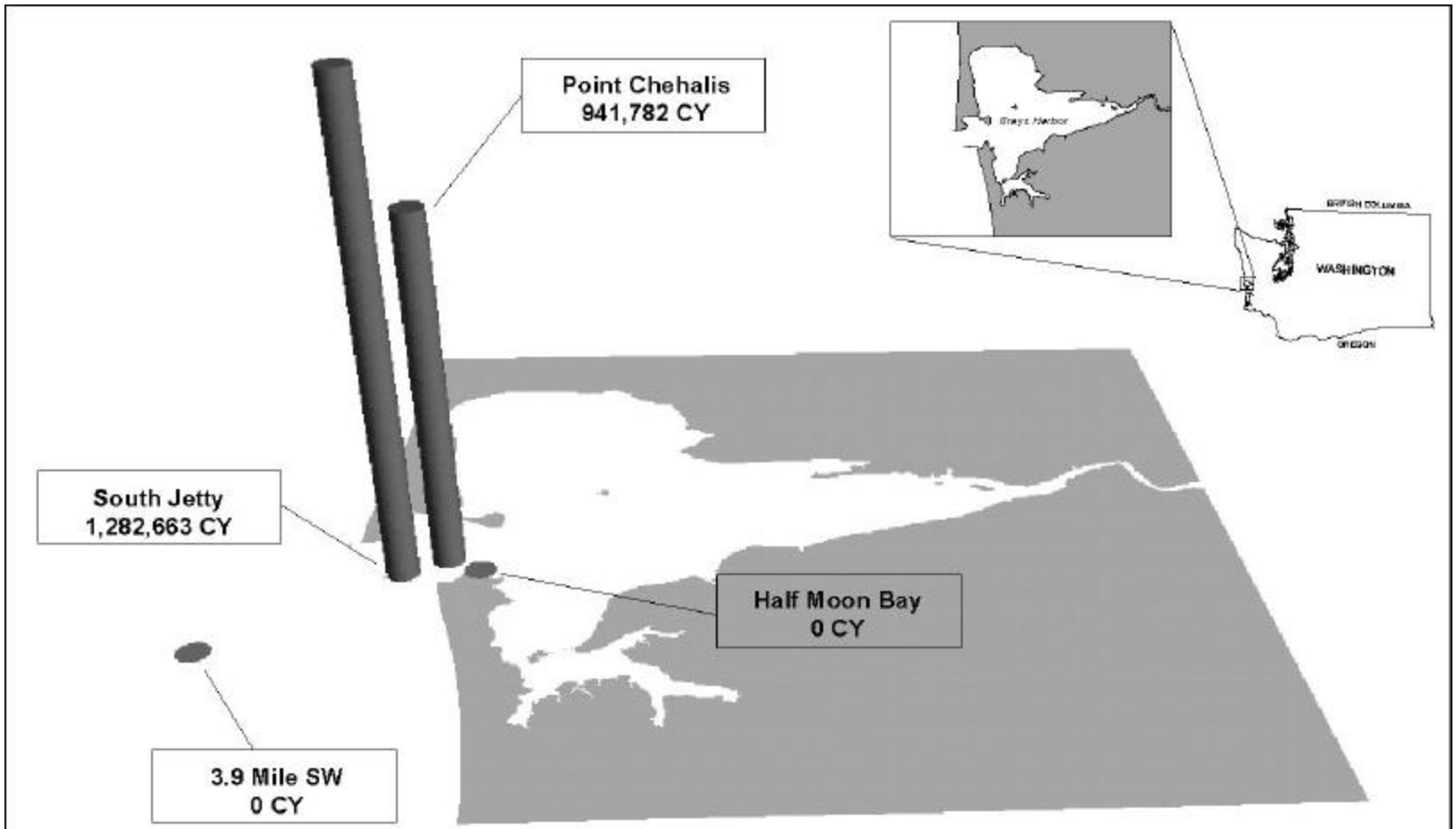


Figure 2-2. Dredging Year 2000 Disposal Volumes for Grays Harbor

Table 2-1. Disposal Site Activity Summary, DY00

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Anderson/Ketron	PSDDA	0	0
Bellingham Bay	PSDDA	0	0
Commencement Bay	PSDDA	1	893,776
Elliott Bay	PSDDA	4	360,577
Port Angeles	PSDDA	0	0
Port Gardner	PSDDA	0	0
Port Townsend	PSDDA	0	0
Rosario Strait	PSDDA	0	0
Point Chehalis	Grays Harbor	1	941,782
South Jetty	Grays Harbor	2	1,282,663
Cape Shoalwater	Willapa Bay	0	0
Goose Point	Willapa Bay	0	0
All Sites within Jurisdiction	PSDDA	5	1,254,353
	Grays Harbor	3	2,224,445
	Willapa Bay	0	0

Table 2-2. Summary of Disposal Activity by Site and Proponent, DY00

Site	Proponent	Dredging Contractor	Disposal Volumes (cy)	# Barge Loads	Off site	Disposal Dates
CB	Port of Tacoma / Corps of Engineers	American Const. Co.	893,776	708	No	Sep 1999 – Feb 2000
EB	Port of Seattle	General Const. Co.	94,075	59	No	Dec 1999 – Jan 2000
EB	Port of Seattle	Manson Const. Co	56,135	50	No	Jan – Feb 2000
EB	Boyer Alaska Barge Line	A.H. Powers, Inc.	3880	3	No	Jul 1999
EB	Harold L. Hurlen	A.H. Powers, Inc.	5633	4	No	Jul 1999
EB	James Hardie Gypsum	Manson Const. Co.	3,682	12	No	Jan 2000
EB	U.S. Army Corps of Engineers	A.H. Powers, Inc. & General Construction	71,368 125,804	44 91	No	Jun 1999 Dec 1999 – Feb 2000
SJ	Port of Grays Harbor	Dutra Dredging Co.	14,832	5	No	Jul – Aug 1999
SJ	U.S. Army Corps of Engineers	Corps	492,187 281,353 746,600	131 72 409	No	Jun – Aug 1999 Mar – May 2000 Apr – May 2000
PC	U.S. Army Corps of Engineers	Corps	52,952 394,539 494,291	23 99 425	No	Jun 1999 Mar – May 2000 Apr – May 2000

Legend: CB = Commencement Bay, EB = Elliott Bay, SJ = South Jetty (Grays Harbor), PC = Point Chehalis (Grays Harbor)

Dredging Year 2001 (June 16, 2000 through June 15, 2001)

In DY01, a total of 1,072,172 cy of dredged materials were deposited at four PSDDA disposal sites. The Commencement Bay site received 265,867 cy of dredged material, while Elliott Bay received 557,340 cy. The Port Gardner and Rosario Strait disposal sites received 248,965 and 10,419 cy, respectively. Grays Harbor received 1,141,417 cy of dredged materials, 555,247 cy of which were deposited at the Point Chehalis site. 358,873 cy were deposited at the South Jetty site, and 227,297 cy were deposited at the Southwest beneficial use site. A total of 178,185 cy of dredged materials were deposited at Willapa Bay, all of which went to the Cape Shoalwater site. These volumes are presented graphically in **Figures 2-3** and **2-4**, and are shown in **Tables 2-3** and **2-4**.

Table 2-3. Disposal Site Activity Summary, DY01

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Anderson/Ketron	PSDDA	0	0
Bellingham Bay	PSDDA	0	0
Commencement Bay	PSDDA	2	265,867
Elliott Bay	PSDDA	2	557,340
Port Angeles	PSDDA	0	0
Port Gardner	PSDDA	1	248,965
Port Townsend	PSDDA	0	0
Rosario Strait	PSDDA	1	10,419
Point Chehalis	Grays Harbor	2	555,247
South Jetty	Grays Harbor	1	358,873
Southwest Beneficial Use Site	Grays Harbor	1	227,297
Cape Shoalwater	Willapa Bay	1	178,185
Goose Point	Willapa Bay	0	0
All Sites within Jurisdiction Combined:	PSDDA	6	1,072,172
	Grays Harbor	4	1,141,417
	Willapa Bay	1	178,185

Table 2-4. Summary of Disposal Activity by Site and Proponent, DY01

Site	Proponent	Dredging Contractor	Disposal Volume (cy)	# Barge Loads	Off Site	Disposal Dates
CB	Port of Tacoma	American Const. Co.	46,393	40+	No	Aug – Dec 2000
CB	Port of Tacoma / U.S. Army Corps of Engineers	American Const. Co.	215,809	179	No	Aug – Nov 2000
CB	Louisiana Pacific	A.H. Powers, Inc.	3665	4	No	Feb 2001
EB	U.S. Navy	General Const. Co.	538,594	481	No	Jun 2000 – Feb 2001
EB	Duwamish Yacht Club	Manson Const. Co.	18,746	39	No	Oct – Dec 2000
PG	Port of Everett / U.S. Army Corps of Engineers	Manson Const. Co.	248,965	135	No	Jan – Feb 2001
RS	Port of Bellingham	A.H. Powers, Inc.	10,419	7	No	Feb 2001
SJ	Port of Grays Harbor	Dutra Dredging Co., Inc.	76,800	17	No	Jan – Feb 2001
SJ	U.S. Army Corps of Engineers	Corps	358,873	327	No	Apr – May 2001
PC	U.S. Army Corps of Engineers	Corps	241,167 314,080	61 96	No	Jul – Aug 2000 Jan – Feb 2001
SW	U.S. Army Corps of Engineers	Corps	227,297	45	No	May 2001
CS	U.S. Army Corps of Engineers	Manson Construction	178,185	192	No	Oct – Nov 2000

Legend: CB = Commencement Bay, EB = Elliott Bay, SJ = South Jetty (Grays Harbor), PC = Point Chehalis (Grays Harbor), SW = Southwest Beneficial Use Site (Grays Harbor)

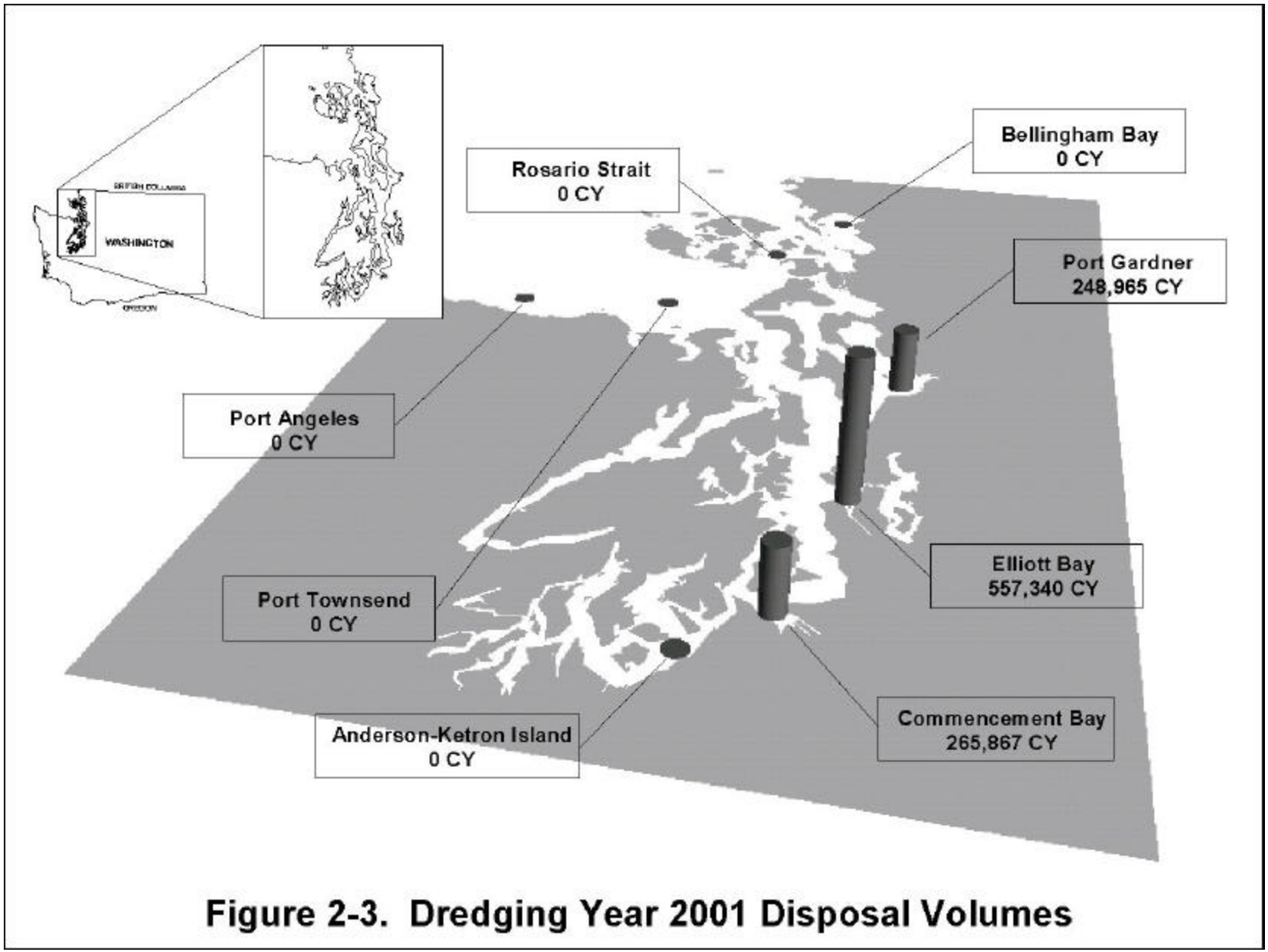


Figure 2-3. Dredging Year 2001 Disposal Volumes

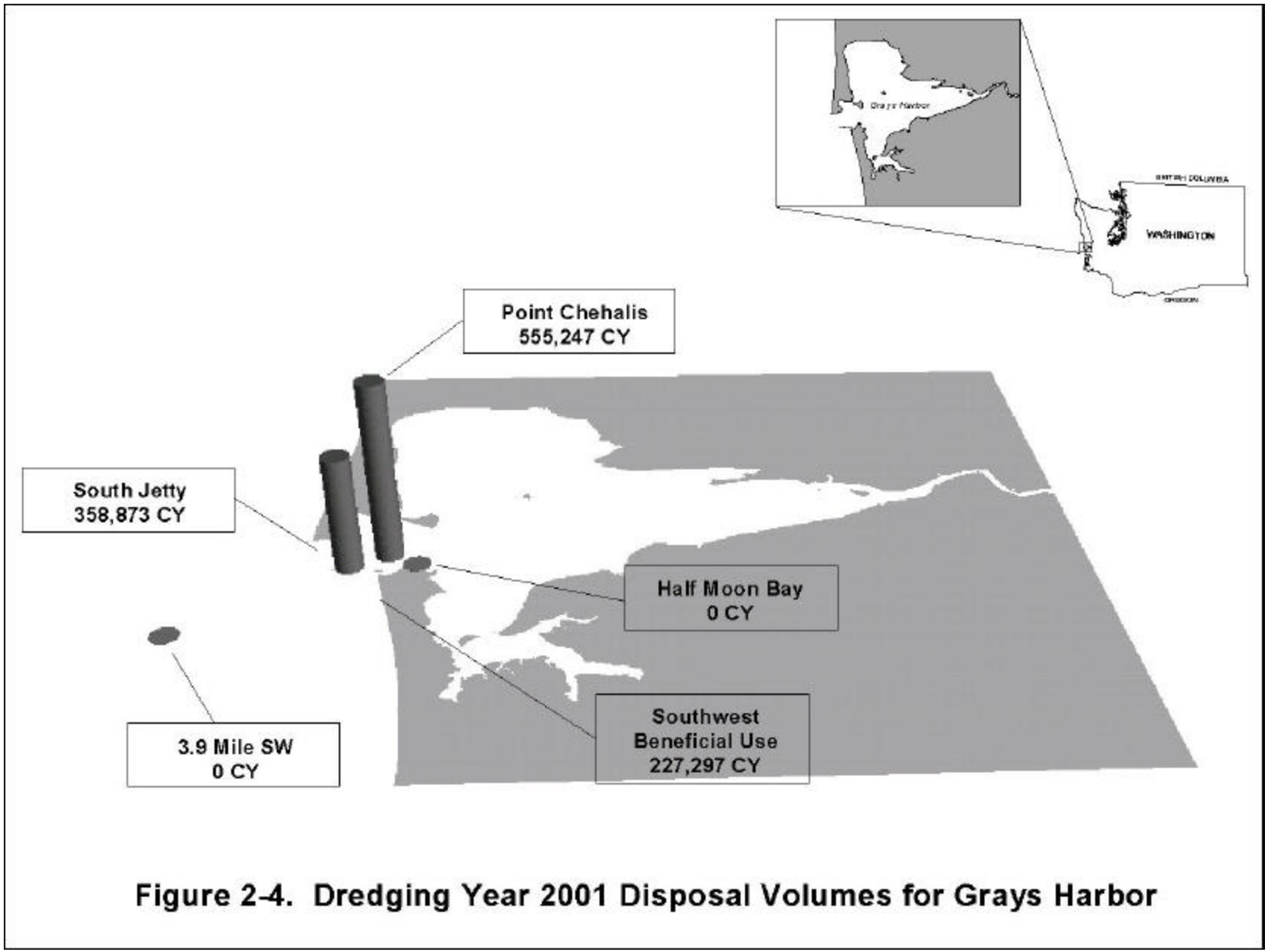


Figure 2-4. Dredging Year 2001 Disposal Volumes for Grays Harbor

B. POST-DISPOSAL SITE MONITORING

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 materials 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 compares the post-disposal monitoring results to "baseline" values. Values for key environmental parameters, such as sediment chemistry, toxicity, and biological community structure, were determined for each PSDDA site and the associated benchmark stations prior to the first use of the sites to serve as baseline data for later reference (PTI, 1988; 1989). The DMMP agencies now use a time-trend analysis approach to evaluate changes in site chemistry over time. The new analysis technique was first used in 1996 to evaluate post-disposal monitoring data from Commencement Bay.

Post-disposal site monitoring surveys address these three major questions:

1. Is the dredged material deposited on site?

2. Is the deposited dredged material producing chemical and/or biological conditions on site beyond the "minor adverse effects" levels allowed by the PSDDA site management plans?

3. Is the dredged material causing any adverse impacts to biological resources beyond the disposal site boundaries?

Full PSDDA monitoring was designed to address all three questions; partial PSDDA monitoring addresses only questions 1 and 2. PSDDA monitoring is now designed to work in a tiered manner, with a partial monitoring event addressing questions 1 and 2. Question 3 is addressed if either of the first two questions is answered in the affirmative.

The U.S. Army Corps of Engineers (Corps) is responsible for physical monitoring, while DNR is responsible for chemical and biological monitoring of the PSDDA non-dispersive disposal sites. This environmental monitoring is conducted at irregular intervals based on the pattern of disposal site-use since the previous monitoring event. This pattern encompasses several important elements, such as volume and characteristics of the materials disposed at a given site, the nature and recency of previous site monitoring data, and site-specific environmental concerns. Each spring, DMMP technical staff review the previous year's disposal activity and determine, by consensus, which site(s), if any, will be monitored and at what intensity.

Based upon the aforementioned criteria, a full monitoring event was scheduled for the Elliott Bay disposal site in 2000. Based upon site use since the previous

monitoring event and the results of a 1998 physical survey of the Commencement Bay disposal site, at the end of DY01 the members of DMMP determined that a full monitoring event of the Commencement Bay site would be conducted in 2000. The results of that monitoring effort will be summarized in the next biennial report.

Full Monitoring at the Elliott Bay Disposal Site

The Elliott Bay disposal site was previously monitored in 1991 (Partial) and 1992 (Full). The disposal of 414,794 cy of dredged material on-site in DY99 prompted a Full Monitoring in 2000. In addition to meeting the goals of all monitoring efforts, the 2000 monitoring at Elliott Bay was also designed to address concerns related to dredged material disposal at PSDDA sites and the listing of Puget Sound Chinook and Bull Trout as threatened under the Endangered Species Act (ESA) of 1973. The tests used for ESA concerns included 45-day bioaccumulation tests using *Macoma* and *Nephtys*, and the P450RGS cell line assay with modifications by the U.S. Army Corps of Engineers Waterways Experiment Station (WES) for sediment and tissue. Physical, chemical, and biological analyses were conducted at up to 61 sampling locations.

Physical Monitoring

Physical monitoring consisted of analysis of the disposal site using the Sediment Vertical Profile System (SVPS), a camera/prism apparatus which allows photographic mapping of vertical profiles of sediment deposits (**Figure 2-5**). The resultant images are then used to determine presence and thickness of dredged materials at each sampling location. Sixty-seven stations were occupied during the 2000 monitoring event, with 210 images collected. One image from each station was analyzed for the aforementioned characteristics, and replicate images for approximately 20% of the stations were analyzed for intercomparison as part of the QA process. The images were analyzed for presence of dredged materials, depth of prism penetration, boundary roughness, depth of apparent Redox Potential Discontinuity (RPD), and infaunal successional stage.

Recently deposited dredged materials were found within the disposal site boundary, with no dredged materials existing off-site based upon analysis of the perimeter stations. The small lobe of materials observed outside of the site boundary in the southwest area of the site was placed in that location by design to cover historic PCB contamination deposited in 1974. The thickest deposits of dredged materials (greater than prism penetration) were found around the center of the disposal site. An elongated (north-south) deposit of bioturbated or relict dredged material surrounds that central deposit, with a slight excursion outside of the site boundary in the south-west (**Figure 2-5**). Again, no dredged materials were observed at any of the perimeter stations, the trigger for determination of off-site materials. Prism penetration was relatively high throughout the site, with a major mode of 16 to 17 cm. A notable exception was observed at perimeter station EBP13 (0.32 cm), which suggests a rocky or hard bottom at that location. The distribution of the grain size

Insert Figure 2-5

major modes showed that the site is covered by very fine sands and silts/clays. The very fine sands at the site center reflect the recent deposition of dredged materials. The sandy sediments in the southern portion of Elliott Bay are due either to Duwamish River discharge or historical dredged material disposal. The distribution of infaunal successional stages shows that highest benthic community successional stages exist throughout much of the site, with the lowest successional stage restricted to the disposal site center. These results are expected, as the site center is the area of greatest disturbance due to the frequency and volume of disposal activities.

Sediment Chemistry

Sediment conventional parameters were generally comparable to the 1988, 1990, and 1992 data. However, total organic carbon (TOC), ammonia, and total volatile solids (TVS) were slightly higher at the onsite stations than in 1992. Total sulfides concentrations were also somewhat higher at the onsite, perimeter, and benchmark stations than in 1992. The higher levels at the perimeter and benchmark stations, which did not show deposits of dredged materials, indicate that the increase in total sulfides was a bay-wide occurrence rather than a site-specific one. Mercury levels exceeded the PSDDA screening level (SL) in four samples, one of which also exceeded the Washington State Sediment Management Standards (SMS) criterion. Compared to 1992 results, cadmium concentrations were generally higher, while copper and silver concentrations were generally lower in 2000 than in 1992. Volatile organic compounds, chlorinated aromatic hydrocarbons, and pesticides were not detected in any of the sediment samples. No PSDDA SL or state SMS criteria were exceeded for PAHs. PCBs were lowest at the site center (undetected), while concentrations in 4 other samples at two stations exceeded the PSDDA SL criterion. It is notable that the highest concentration of PCBs observed was at perimeter station EBP07, which had no dredged material present. This may indicate historic contamination, or more recent contamination that was not covered by dredged material. Butyltin concentrations, which exceeded the PSDDA SL criteria in nine samples, were also lowest at the site center and highest at benchmark stations EBB01 and EBB02. Again, this probably indicates historic contamination since benchmark stations are located in areas removed from influences of dredged material disposal, but in the vicinity of other potential sources of contamination.

Tissue Chemistry

Tissue chemistry data was collected from triplicate samples of *Molpadia* sea cucumber tissue collected at transect stations EBT03 and EBT05. The samples were analyzed for metals, semi-volatile organic compounds, pesticides/PCBs, and butyltin compounds. No organic compounds were detected in any of the samples, and metals detected in all sample replicates were at low concentrations.

Bioassays

PSDDA bioassays were conducted using sediments from three on-site stations. The assays include the 10-day acute amphipod test using *Eohaustorius estuarius*, the sediment larval test using the sand dollar *Dendraster excentricus*, the 20-day polychaete *Neanthes* mean growth test, and the saline Microtox® test. The first amphipod test using *Eohaustorius* and sediments from the site-center station (EBZ01) resulted in high observed mortality (40%), a one-hit failure according to PSDDA guidelines that establish a maximum mortality of 20% over the control. The sediments used for the test were extremely fine-grained, with a clay content of 36.4%. High *Eohaustorius* mortality has been observed in other studies where high clay contents (>15% clay) were present (SAIC, 1999a; b).

Because the amphipod test results for EBZ01 were not consistent with those for the other two on-site stations, the test was run again on archived material using both *Eohaustorius estuarius* and *Ampelisca abdita.* The latter species is not known to be sensitive to clay. The mortality observed in the *Ampelisca* re-test was quite low (5%) and the re-test of *Eohaustorius* produced mortality results of 17%, neither of which is a hit under PSDDA interpretation guidelines.

A toxic response was also observed in the sediment larval test. The samples used during this test were not aerated as required by the DMMP protocol, which tends to reduce the effects of high fine fractions and ammonia levels on the larvae (EPA, 1993). Interstitial ammonia levels were relatively high, so it is quite possible that ammonia levels contributed to the observed toxicity. As a result, DMMP recommended that the sediment larval test be repeated. In attempting to conduct the larval test using *Dendraster excentricus* and the bivalve test using *Mytilus galloprovincialis* under aeration, the bioassay laboratory was unable to obtain viable animals for the tests. The remaining sediment was used during those attempts, so the sediment larval test was not successfully reanalyzed. The issue of aeration was not resolved, so the results of the first test remain suspect. Therefore, the sediment larval test results were not used to evaluate any of the hypotheses of the monitoring effort.

The results of the *Neanthes* test showed no mortality and no exceedances of the PSDDA bioassay evaluation guidelines for mean growth rates. The saline Microtox® test passed for all onsite sediments analyzed.

While any toxic response observed in the first round of bioassay testing would normally trigger the analysis of the benchmark samples, DMMP decided that those analyses would not be necessary for the following reasons:

- The high clay content in recently deposited dredged materials at the site-center station may have been a contributing factor to the toxic response observed.
- The toxic response was not supported by chemical analysis of the sediments.

- The toxic response was not supported by the results of either the *Neanthes,* Microtox® tests, and the amphipod retest.
- No toxicity was observed at the other two on-site stations.

Benthic Infaunal Analysis

Samples of benthic infauna, those organisms living in the sediment below the sediment-water interface, were identified and enumerated for transect stations EBT01, EBT03, and EBT05. Only samples collected from the top 10 cm of each boxcore sample that were sieved through a 1.0 mm sieve were analyzed. The total abundance of major taxa observed increased with distance from the site, as observed in 1988 and 1992. The differences between stations were not statistically significant. The mean number of polychaete worms was lowest at transect station EBT05, while the mean number of mollusks was higher at station five than at the other two stations. Mean crustacean abundances were similar among all three stations. The trend observed for the mean number of taxa, diversity, and Swartz's index was EBT01 > EBT03 > EBT01, which, although not statistically significant, was similar to the trend observed in the 1992 monitoring event.

The overall biomass results showed that transect station EBT05 had biomasses 7 and 15 times higher than stations EBT01 and EBT03, respectively. This is primarily due to the large sea cucumbers (*Molpadia*) collected in the second and fifth replicates at EBT05. The biomasses of other major taxa were comparable among stations, and generally reflected the differences in abundances for those taxa among stations. Numerically dominant species among the three stations included the bivalve *Axinopsida serricata,* the polychaete *Ampharete acutifrons,* the cumaceans *Eudorella pacifica* and *Eudorellopsis integra,* the ostracod *Euphilomedes producta,* the bivalve *Macoma carlottensis,* the amphipod *Harpiniopsis fulgens,* and the polychaete *Euclymeninae* sp.

Special Studies

45-Day Bioaccumulation: The 45-day bioaccumulation test using *Macoma nasuta* and *Nephtys caecoides* was conducted at one benchmark station (EBB02) and one composite of onsite stations (EBZ01, EBS02, and EBS04). Reference sediments were collected from Carr Inlet for parallel testing and comparison. The results of the test using *Macoma* showed significant increases in Silver (Ag), Copper (Cu), Lead (Pb), Antimony (Sb), Zinc (Zn), Mercury (Hg), and Tributyltin above reference sediments. None of those results exceeded standards for human health. The *Nephtys* tests showed significant increases above reference sediments for Lead (Pb) and Mercury (Hg), neither of which exceeded standards for human health.

PCB Analysis and WES Cell-Line Assay: Co-planar polychlorinated biphenyls (PCBs) analysis of tissue samples from the bivalve *Macoma* and the polychaete *Nephtys* were conducted to correlate determined concentrations with the results of the P450 Reported Gene System cell-line screening assay for polychlorinated dibenzo-p-dioxins

and related compounds. For tissues, the assay provides data on the relative amount of dioxin and dioxin-like compounds bioaccumulated by the organism in question (SAIC, 2001). In order for the cell-line test to be effective in screening for dioxin-like congeners in tissues and sediments, it should consistently identify those samples with higher concentrations of dioxin-like PCBs in relation to the other samples, and provide a quantitative estimate of the concentration of dioxin-like congeners that can be correlated with high resolution analytical data. Results of the analysis were inconclusive regarding the utility of using the cell line test to identify sediments and tissues of potential concern or estimate the ecological/human risk associated with those sediments. The lack of conclusive determination of the utility of the test was primarily due to the low levels of PCB contamination observed in both the sediment and tissue samples tested. The results do, however, provide valuable baseline information on cell line response and congeners associated with sediment and tissues from the Elliott Bay dredged material disposal site and surrounding environs. However, the results do show that PCB levels in dredged material disposed at the Elliott Bay site are low and probably not a concern for either endangered species passing through the site or benthic feeding demersal flatfish species that may be foraging at the disposal site.

Conclusions

Based upon the results of the analyses discussed above, the following conclusions have been reached:

1. Recently deposited dredged material is confined within the disposal site perimeter.
2. Chemical concentrations off-site have not increased as a result of dredged material disposal on-site.
3. Sediment chemical concentrations onsite do not exceed PSDDA Site Condition II guidelines due to dredged material disposal.
4. Sediment toxicity at the on-site stations does not exceed the PSDDA Site Condition II guidelines due to dredged material disposal.

C. SUMMARY: DMMP DISPOSAL SITE USE AND MONITORING FREQUENCY

The cumulative dredged material volumes disposed at each PSDDA site and Grays Harbor/Willapa Bay Site since program implementation are depicted in **Table 2-5** and **Figures 2-6 and 2-7**. All eight PSDDA sites have been used, and the two estuarine sites in Grays harbor and Willapa Bay have also been utilized. Thirteen year summaries of site use for the PSDDA sites generally show that site capacities appear to be sufficient to last at least thirty years relative to initial site forecasted volumes and site capacity estimates (**Figure 2-6**, **Table 2-6**). Over the thirteen years of PSDDA implementation (1989-2001) approximately 8,338,457 cubic yards total have been placed at all eight open-water sites, averaging 641,457 cubic yards per year.

Table 2-5. Cumulative Site use summary.

Disposal Site	Dredging Years Used	Cumulative Volumes Disposed (cubic yards)
PSDDA	**(1989 - 2001)**	
Anderson/Ketron (ND)	93, 95	18,874
Commencement Bay (ND)	89, 91, 95, 96, 98, 99, 00, 01	2,762.591
Elliott Bay (ND)	90, 91, 92, 93, 94, 95, 96, 97,98, 99, 00, 01	2,176,804
Port Gardner (ND)	90, 91, 93, 94, 95, 96, 97	1,971,848
Rosario Strait (D)	91, 92, 93, 94, 95, 96, 98, 99	1,278,970
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		**8,338.942**
GRAYS HARBOR	**(1996 - 2001)**	
Point Chehalis (D)	96, 97, 98, 99, 00, 01	4,350,369
South Jetty (D)	96, 97, 98, 99, 00, 01	6,208,824
Half Moon Bay (beneficial uses site)	96, 97, 98, 99	956,203
Southwest beach renourishment site	01	227,297
3.9 Mile Ocean (D)	not used	
Total cumulative volume		**11,742,693**
WILLAPA BAY	(1996-2001)	
Cape Shoalwater (D)	01	178,185
Goose Point (D)	99	27,647
Total cumulative volume		**205,832**

Legend: ND = nondispersive; D = dispersive

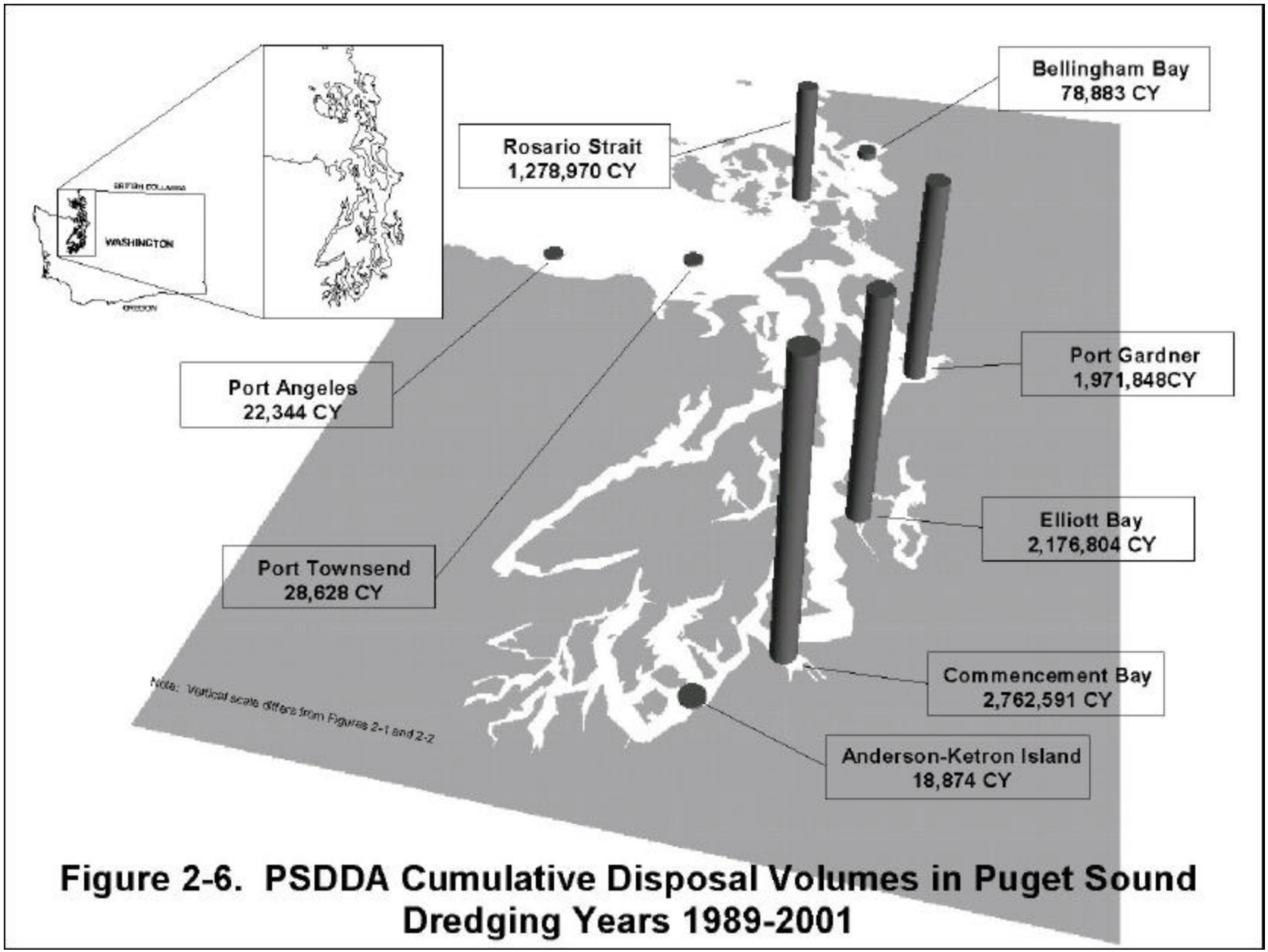


Figure 2-6. PSDDA Cumulative Disposal Volumes in Puget Sound Dredging Years 1989-2001

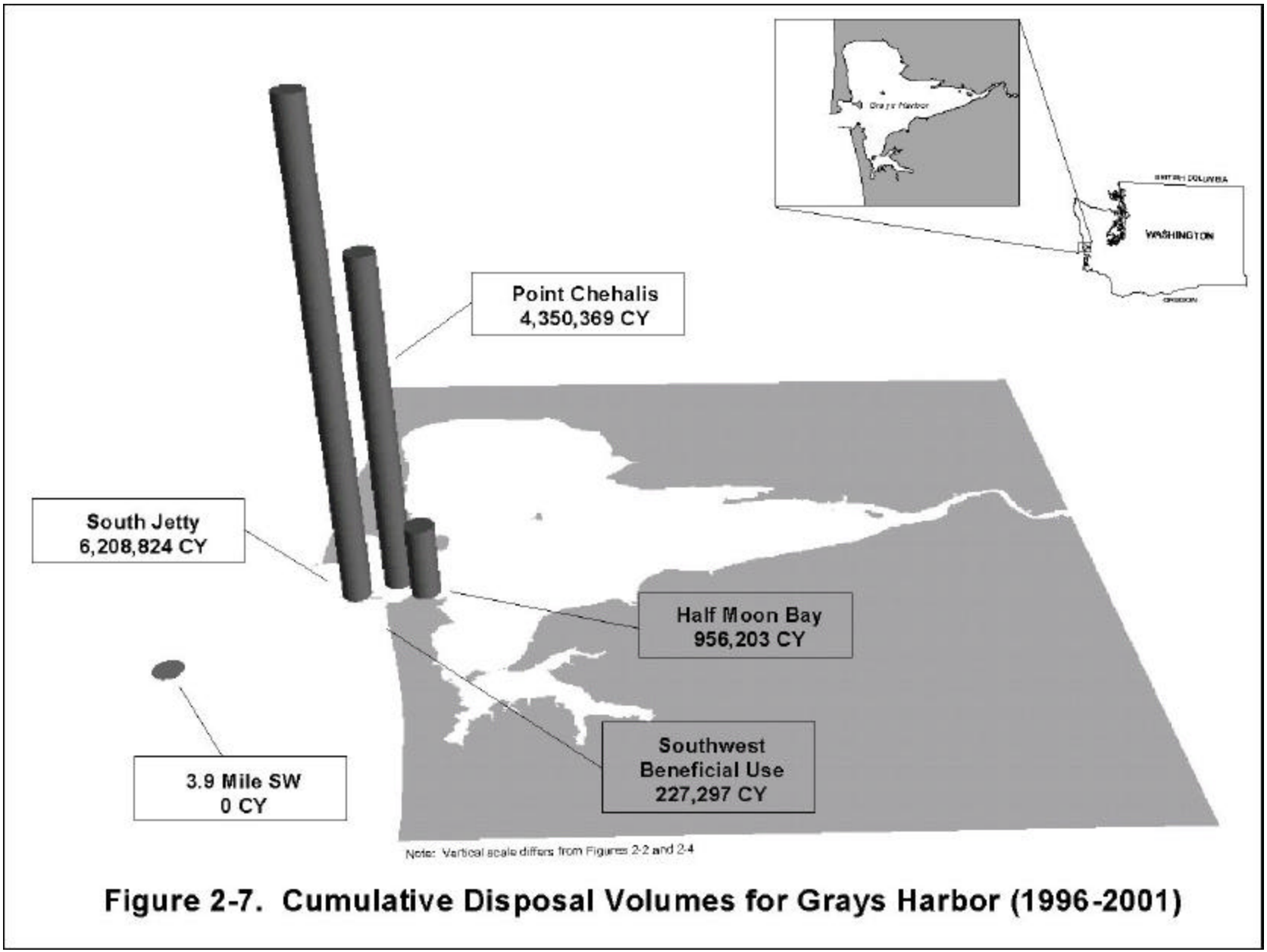


Figure 2-7. Cumulative Disposal Volumes for Grays Harbor (1996-2001)

Table 2-6. Thirteen Year (1989-2001) PSDDA Site Use Summary.

Nondispersive 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[1] (Years)
Port Gardner (1989-2001)	1,971,848	151,681	8,243,000	23.9	46.3
Elliott Bay (1989-2001)	2,176,804	167,446	10,525,000	20.7	40.7
Bellingham Bay (1990-2001)	78,883	6,574	1,181,500	6.7	1,357
Commencement Bay (1989-2001)	2,762,591	212,507	3,929,000	70.3	29.4
Anderson/Ketron Island (1990-2001)	18,874	1,573	785,000	2.4	5,709
SUBTOTALS:	**7,009,000**	**539,154**	**24,763,500**	**28.3**	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[2] (Years)**
Rosario Strait (1990-2001)	1,278,970	106,581	1,801,000	71.0	N/A
Port Townsend (1990-2001)	28,628	2,386	687,000	4.2	N/A
Port Angeles (1990-2001)	22,344	1,862	285,000	7.8	N/A
SUBTOTALS:	**1,329,942**	**110,829**	**2,773,000**	**48.0**	N/A
GRAND TOTALS:	**8,338,942**	**641,457**	**27,536,500**	**30.3**	N/A

[1] Site capacity estimated in Phase II Disposal Site Selection Technical Appendix for non-dispersive sites is approximately 9,000,000 cubic yards.

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

Table 2-7 lists the completed and scheduled DMMP disposal site monitoring events at the PSDDA nondispersive and dispersive sites. To date, the DMMP agencies have conducted ten post-disposal monitoring surveys at nondispersive sites - 4 full, 2 partial, and 2 tiered-full, 1 tiered-partial monitoring, and 1 SVPS only survey. Four of five nondispersive sites have been surveyed. The only nondispersive site not yet monitored is the Ketron/Anderson Island site, which has received relatively use to date. No monitoring at the Ketron/Anderson Island site is anticipated in DY02. Three bathymetric surveys have been conducted at the Rosario Strait dispersive site to date, which is the only dispersive site used on a frequent basis.

Table 2-7. PSDDA 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	SVPS
1999	Rosario Strait	Bathymetric
2000	Elliott Bay	Full
2001	Commencement Bay	Full

Based on PSDDA site monitoring data collected to date (including physical mapping, on and offsite sediment chemistry, sediment toxicity, offsite infaunal bioaccumulation, and offsite benthic community structure data), dredged material disposal is not causing adverse impacts at or adjacent to any of the nondispersive sites. PSDDA evaluation procedures appear to adequately protect the environmental conditions at the disposal sites.

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

The PSDDA Management Plan Reports (MPR, 1988, 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. Seven monitoring events to date have not detected unexpected adverse impacts at any of the four nondispersive sites that have been monitored. In accordance with the management plan, following the 1997 SMARM, the DMMP agencies reduced the frequency and scope of monitoring based on past documented compliance with the site management objectives. These modifications to the management plan formally incorporated tiered-full monitoring into the management plan, and to initiate monitoring when cumulative volumes approach or exceed 300,000 cubic yards since the last monitoring event. The DMMP agencies continue to assess the perimeter chemistry evaluation approach adopted and implemented following the 1997 SMARM.

The Corps, on behalf of the PSDDA agencies, in 1999, initiated 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. Both NMFS and USFWS concurred in letters dated May 31, 2000 and June 19, 2000, respectively, with the findings of the Programmatic Biological Evaluation (PBE), 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.

REFERENCES

EPA, 1993. Refinements of current PSDDA bioassays. Final Report Summary. August 1993. EPA 910/R-9-93-014a. U.S. Environmental Protection Agency, Region 10, Seattle WA.

PTI, 1988. Puget Sound Dredged Disposal Analysis: Baseline Survey of Phase I Disposal Sites. Prepared for Washington Department of Ecology. PTI Environmental Services, Bellevue, WA.

PTI, 1989. Puget Sound Dredged Disposal Analysis: Baseline Survey of Phase II Disposal Sites. Prepared for Washington Department of Ecology. PTI Environmental Services, Bellevue, WA.

SAIC, 1999a. East Waterway channel deepening sediment characterization. Final. July 7, 1999. Prepared for the U. S. Army Corps of Engineers, Seattle District. Science Applications International Corporation, Bothell WA.

SAIC, 1999b. Sediment characterization at Puget Sound Naval Shipyard, Bremerton, Washington, Phase I. September 10, 1999. Prepared for Engineering Field Activity, Northwest, Naval Facilities Engineering Command, Poulsbo, WA. Science Applications International Corporation, Bothell WA.

SAIC, 2001. PCB analysis and cell-line assay testing at the Elliott Bay PSDDA disposal site. November 28, 2001. Prepared for Washington State Department of Natural Resources. Science Applications International Corporation, Bothell WA.