DREDGED MATERIAL MANAGEMENT PROGRAM

Puget Sound Dredged Disposal Analysis
Grays Harbor/Willapa Bay Evaluation Procedures
NW Regional Sediment Evaluation Framework (WA)

BIENNIAL REPORT

Dredging Years 2006/2007

PREPARED BY THE DMMP AGENCIES

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Grays Harbor/Willapa Bay Evaluation Procedures
Lower Columbia River Evaluation Framework (Washington)

BIENNIAL REPORT

Dredging Years 2006/2007

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LIST OF ACRONYMS

BT	Bioaccumulation Trigger
COC	Chemical of Concern
CWA	Clean Water Act
CY	Cubic Yard
DMMO	Dredged Material Management Office
DMMP	Dredged Material Management Program
DMMU	Dredged Material Management Unit
DNR	Washington Department of Natural Resources
DY	Dredging Year
Ecology	Washington Department of Ecology
EPA	Environmental Protection Agency
EPTA	Evaluation Procedures Technical Appendix (PSDDA)
ESA	Endangered Species Act
FC	Full Characterization
H	High Rank
HPAH	High-molecular-weight PAH
L	Low Rank
LM	Low-Moderate Rank
LPAH	Low-molecular-weight PAH
M	Moderate Rank
ML	Maximum Level
MPR	Management Plan Report
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
O&M	Operations and Maintenance
PAH	Polynuclear Aromatic Hydrocarbon
PC	Partial Characterization
PCBs	Polychlorinated Biphenyls
PPB	Parts Per Billion
PPM	Parts Per Million
PPTR	Parts Per Trillion
PSDDA	Puget Sound Dredged Disposal Analysis
PSEP	Puget Sound Estuary Program
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SD	Suitability Determination
SEF	[Northwest Regional] Sediment Evaluation Framework
SMARM	Sediment Management Annual Review Meeting
SMS	Sediment Management Standards
SL	Screening Level
TEQ	Toxic Equivalent
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) is an interagency approach to the management of dredged material in the State of Washington. The four cooperating agencies are: U.S. Army Corps of Engineers (USACE), Seattle District; U.S. Environmental Protection Agency (EPA), Region 10; Washington Department of Ecology (Ecology); and Washington Department of Natural Resources (DNR). This report summarizes DMMP activities for Dredging Years 2006 and 2007.

The Dredging Year begins with the opening of the in-water work window on June 16. As defined by the DMMP agencies, DY06 covers the period from June 16, 2005 to June 15, 2006. DY07 covers the period from June 16, 2006 to June 15, 2007.

The DMMP applies dredged material evaluation guidelines to federal and permitted projects in Washington State. These guidelines were originally developed for the Puget Sound Dredged Disposal Analysis (PSDDA) program in the 1980s. The geographic scope was expanded in 1995 to cover Grays Harbor and Willapa Bay. The DMMP agencies modify the evaluation guidelines, as needed, through an annual review process. Updated guidelines for Puget Sound, Grays Harbor and Willapa Bay are found in the DMMP Users Manual.

In 2002, an interagency program was initiated to derive dredged material evaluation guidelines for application throughout the states of Washington, Oregon and Idaho. Under the auspices of the Regional Sediment Evaluation Team, the Northwest Regional Sediment Evaluation Framework (SEF) was published as an interim final document in 2006. Integration of SEF and DMMP guidance is an ongoing process. In the interim, projects on the Columbia River are being evaluated using the SEF guidance.

During DY06/07 there were 30 projects for which the DMMP agencies completed some kind of action or determination. These projects are summarized in Tables 1-1a and 1-1b. Many were full characterizations (FC) of a project area, intended to assess the suitability of the proposed dredged material for open-water disposal. Full characterizations result in a suitability determination (SD) memorandum, signed by the DMMP agencies, that summarizes the results of the FC and provides an official determination regarding suitability for open-water disposal. Other DMMP actions include volume revisions, frequency/recency determinations, no-test determinations and post-dredged sediment surface evaluations.

As listed in Tables 1-1a and 1-1b, twelve projects had DMMP suitability determinations or other actions completed by June 15, 2006 and are considered DY06 projects. Another nineteen projects had DMMP suitability determinations or other actions completed by June 15, 2007 and are considered DY07 projects. Puget Sound project locations for DY06 and DY07 are plotted in Figure 1-1. Projects in Grays Harbor and Willapa Bay are shown in Figure 1-2. Projects on the Columbia River are shown in Figure 1-3.

The DMMP agencies reviewed and approved sampling and analysis plans (SAPs) for another seven projects during DY06/07, each of which was subsequently sampled and tested. However, either the data had not yet been submitted by the end of DY07, or the suitability determination was finalized after the end of DY07. These projects are listed in Table 1-1c, but are not discussed in the remainder of the report.

Chapter 2 includes tables related to project-specific ranking, sampling, testing and suitability determinations. Information regarding no-test determinations, recency extensions, frequency

determinations, volume revisions and post-dredge surface sediment evaluations is also presented. Chapter 3 presents an overall assessment of sampling and testing activities, including a cost analysis and regulatory processing-time evaluation. Chapter 4 provides details of projects that were complex in nature or where the application of best professional judgment by the agencies was necessary. Chapter 5 reviews disposal-site monitoring activities during DY06/07.

Appendices A and B include the chemical and biological evaluation guidelines respectively. Appendix C tabulates exceedances of those guidelines.

Table 1-1a. DMMP Evaluation Activities Completed in DY06.

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	SAP Review DY	Suitability Determination DY
Driftwood Key Community Navigation Channel	FC	PSDDA	29,000	DY05/DY06	DY06
Golden Tides Marina	FC/PDE	PSDDA	1,336	DY06	DY06
Mercer Island Lake Line Replacement Project	FC	PSDDA	28,000	DY06	DY06
MJB Properties North Dock (Barge Channel 1)	FC	PSDDA	33,300	DY06	Application withdrawn
Olympia Yacht Club, Home Island Outstation Moorage Basin	FC	PSDDA	8,650	DY03	DY06
Point Hudson Marina	FC	PSDDA	10,900	DY05	DY06
Point Roberts Marina	FC	PSDDA	164,900	DY05	DY06
Burlington Northern Santa Fe Railway Company, Dog Creek Culvert	NTD	CR	2,000	NA	NA
Anchor Cove Marina	VR	PSDDA	+4,900	NA	NA
La Conner Marina	VR	PSDDA	+6,000	NA	NA
Port of Everett, 12th Street Marina	VR	PSDDA	+41,000	NA	NA
Port of Seattle, Terminal 18 - Stage 1A	RE	PSDDA	150	NA	NA

DMMP Actions
FC = Full Characterization
NTD = No-Test Determination
PDE = Post-Dredge Evaluation (surface sediment quality)
RE = Recency Extension
VR = Volume Revision

Disposal Jurisdictions
CR = Columbia River
PSDDA = Puget Sound Dredged Disposal Analysis

NA = Not applicable

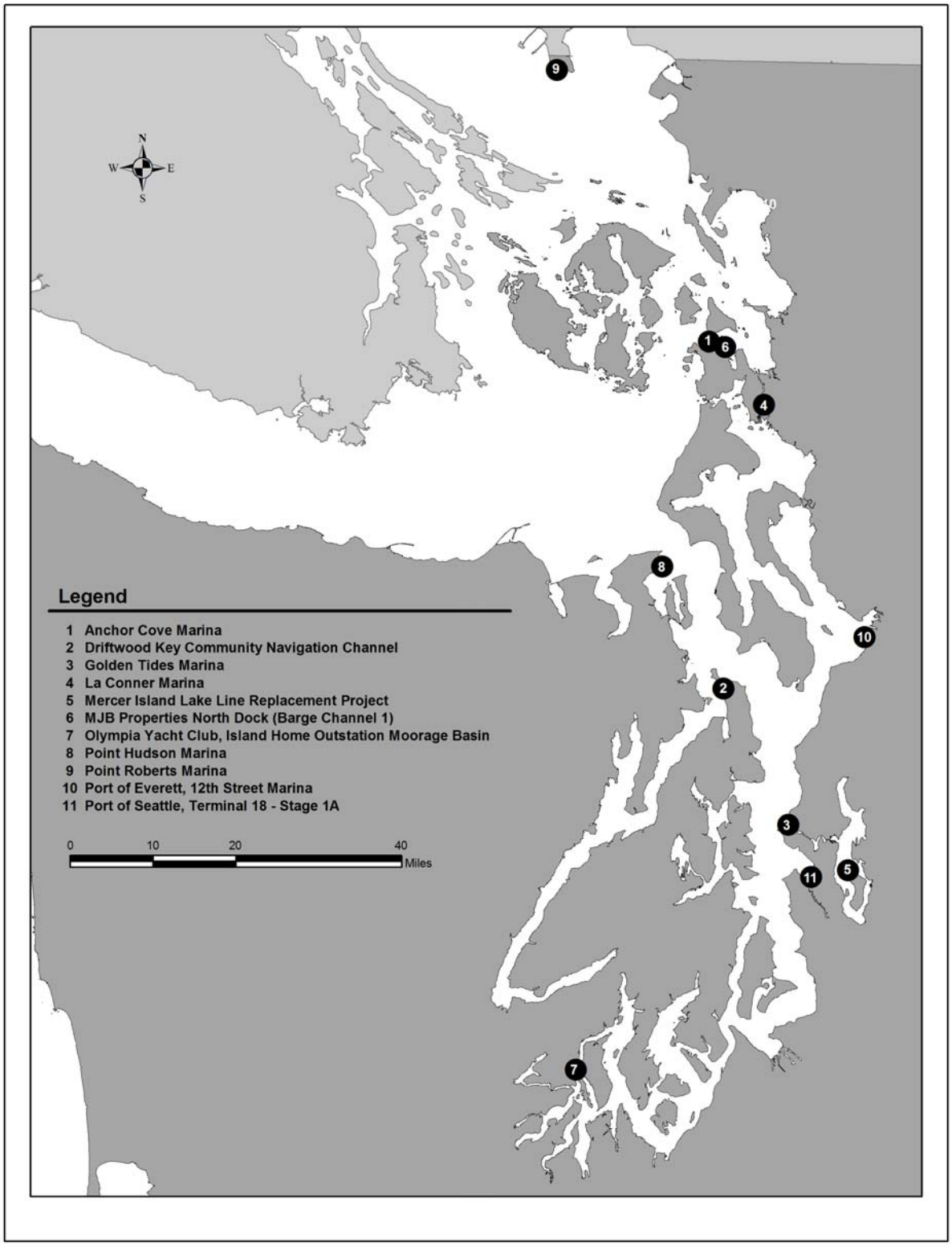


Figure 1-1a. DY06 Puget Sound Project Locations

Table 1-1b. DMMP Evaluation Activities Completed in DY07.

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	SAP Review DY	Suitability Determination DY
City of Renton Municipal Airport Seaplane Base	FC	PSDDA	16,000	DY07	DY07
Haug Channel, Lake Washington	FC	PSDDA	10,000	NA	DY07
MJB Properties, South Dock and North Dock (Barge Channel 2) Deepening	FC	PSDDA	69,000	DY06	DY07
Oak Harbor Municipal Marina	FC	PSDDA	206,000	DY07	DY07
Port of Seattle, Terminal 30	FC	PSDDA	59,000	DY06	DY07
Port of Seattle, Terminal 91	FC	PSDDA	9,400	DY06	DY07
USACE, Toke Point Entrance and Tokeland Marina	FC	GH/WB	62,846	DY06	DY07
USACE/Port of Olympia, Olympia Harbor	SC	PSDDA	458,734	DY06	DY07
Beebe Springs Creek Habitat Project	SpC	Upland	10,000	NA	NA
Briggs Reservoir	NTD	Upland	3,085	NA	NA
Christensen Shipyards	NTD	CR, Upland	10,000	NA	NA
Nichols Brothers Boat Builders, Holmes Harbor	NTD	PSDDA	150	NA	NA
Bridgehaven Community Club	VR	PSDDA	+4,000	NA	NA
Point Hudson Marina	VR	PSDDA	+100	NA	NA
Dakota Creek Industries Shipyard/Pier 1	RE	PSDDA	262,000	NA	NA
Port of Everett, South Marina	RE	PSDDA	6,000	NA	NA
USACE, Lower Snohomish	FD	PSDDA, BU	75,000	NA	NA
Glacier NW	PDE	PSDDA	NA	NA	NA
Shilshole Bay Marina	PDE	PSDDA	NA	NA	NA

DMMP Actions
FC = Full Characterization
FD = Frequency Determination
NTR = No Testing Required
PDE = Post-Dredge Evaluation (surface sediment quality)
PR = Permit Revision
RE = Recency Extension
SC = Supplemental Characterization
SpC = Special Characterization
VR = Volume Revision

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

NA = Not applicable

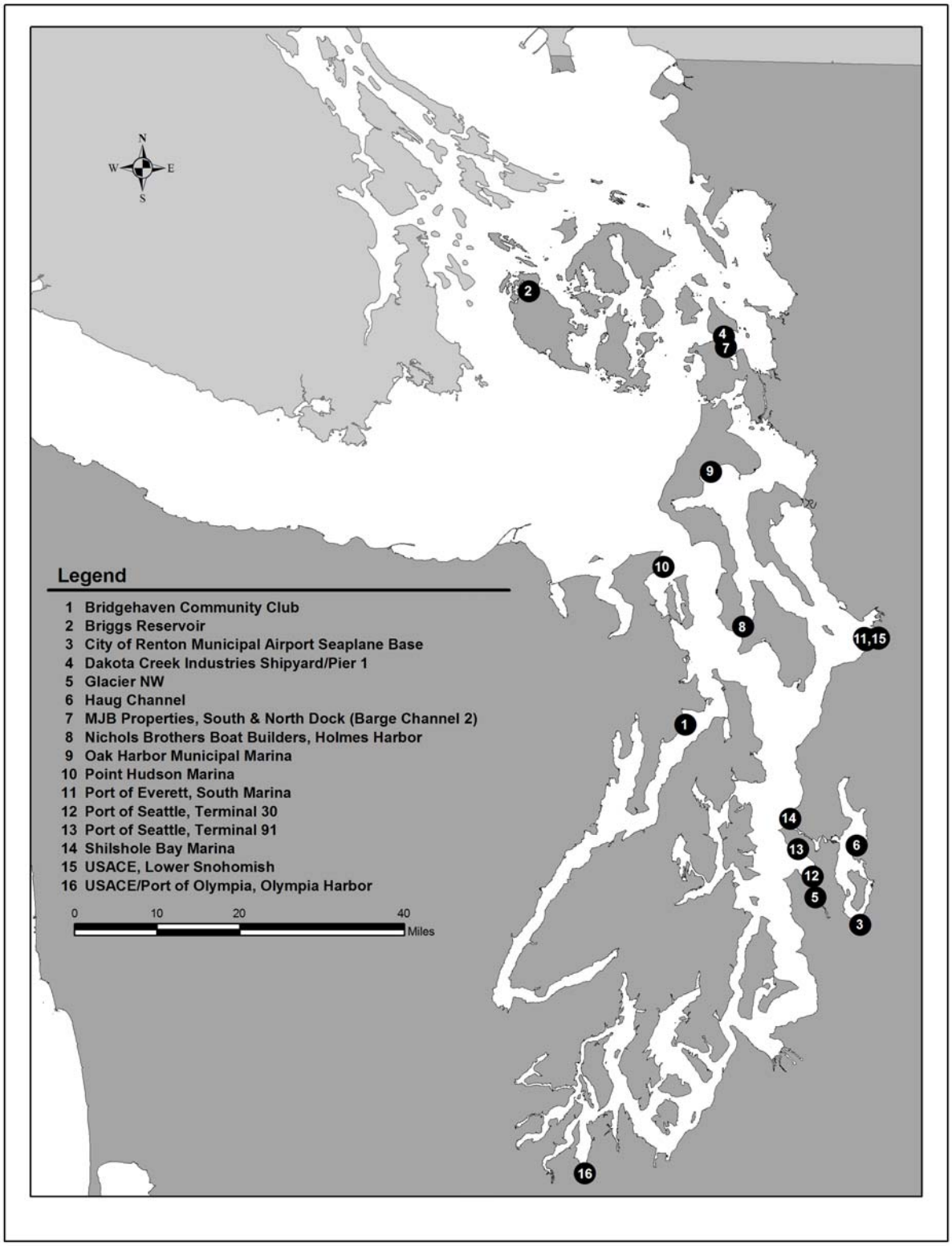


Figure 1-1b. DY07 Puget Sound Project Locations

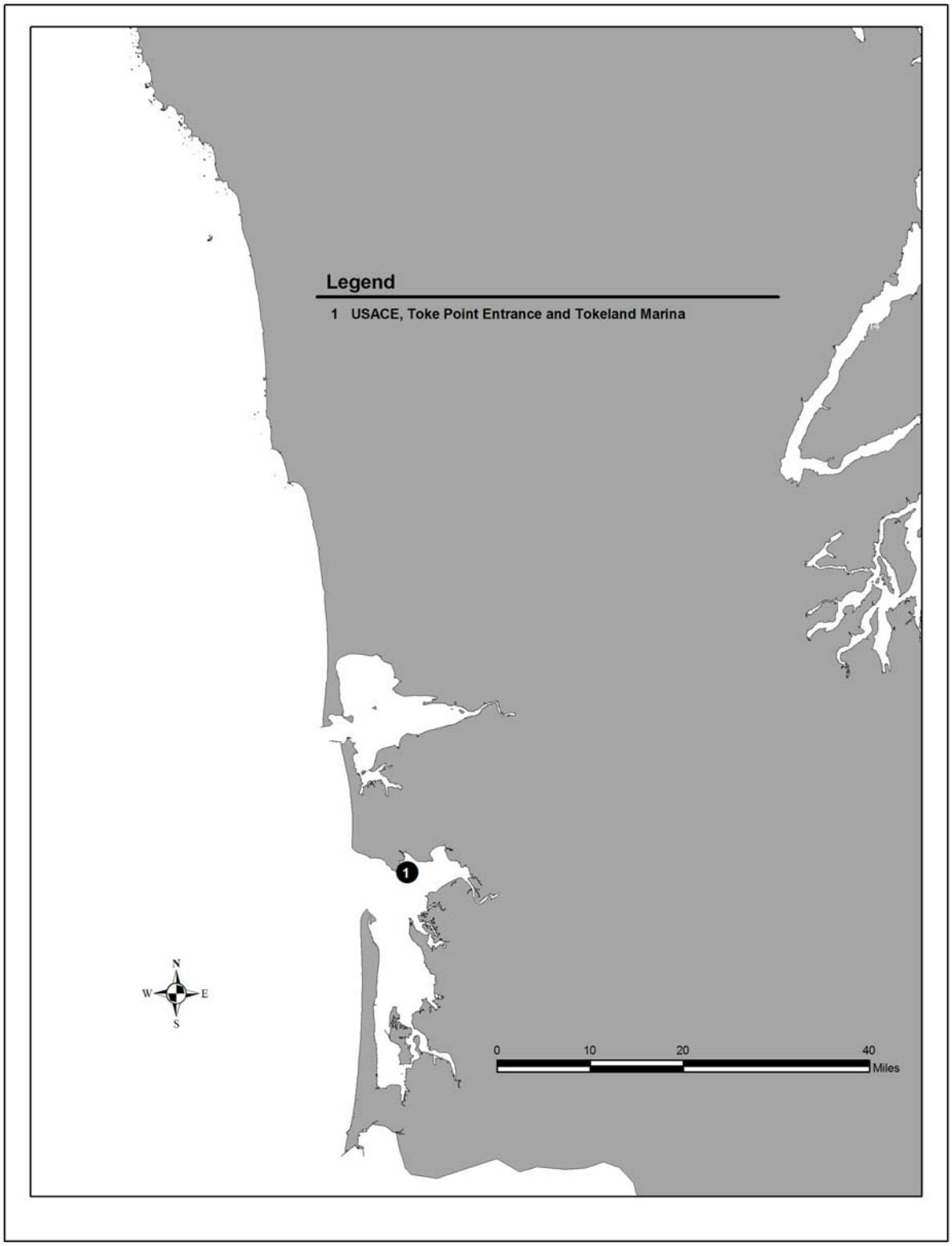


Figure 1-1c. DY06/07 Coastal Project Locations

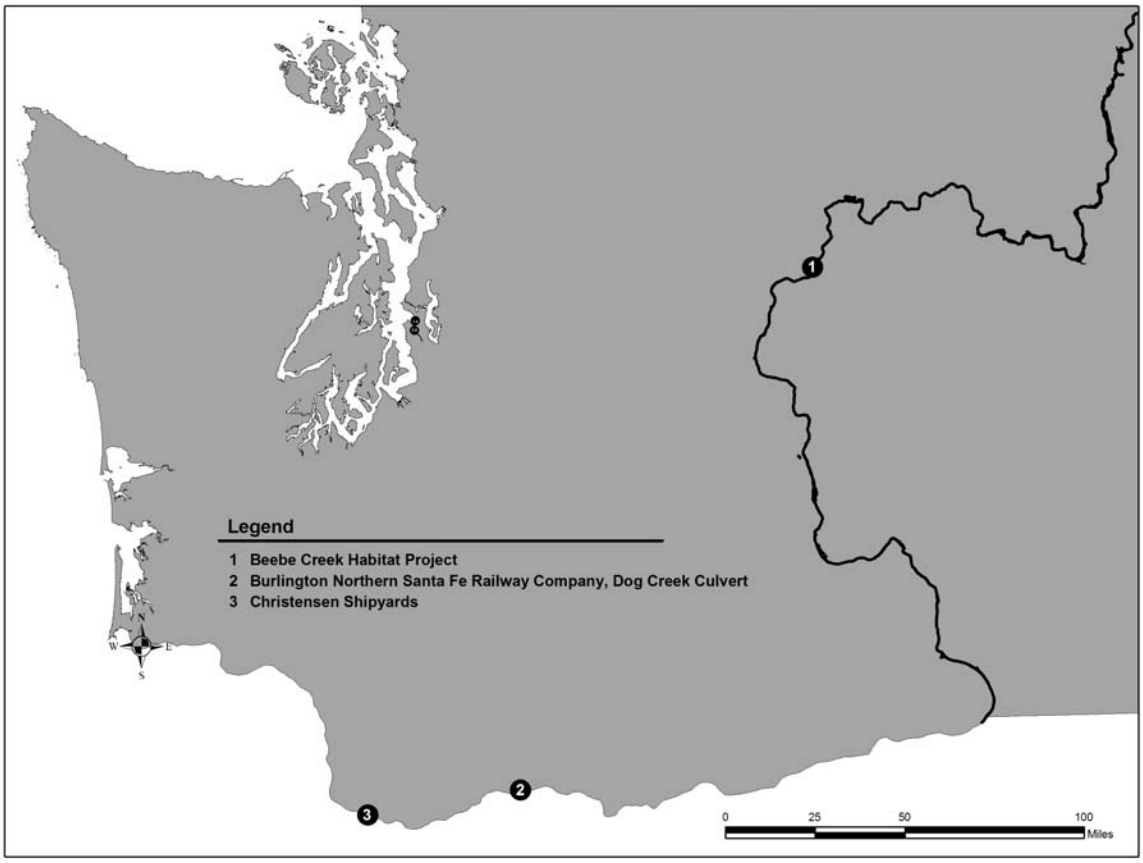


Figure 1-1c. DY06/07 Columbia River Project Locations

Table 1-1c. DMMP Evaluation Activities Initiated, But Not Completed, in DY06/07.

PROJECT	DMMP Action	Disposal Jurisdiction	Project Volume (cy)	SAP Review DY	Status
Delta Marine Industries	FC	PSDDA	11,905	DY07	SD – DY08
Georgia-Pacific Camas Slough	FC	CR	20,000	DY07	SD – DY08
Port of Bellingham, I&J Waterway	FC	PSDDA/MTCA	9,950 cy (NC[1]) 12,080 cy (C)	DY06	Testing completed
Port of Bellingham, Squalicum Gate 3	FC	PSDDA	49,884	DY07	Testing completed
Port of Tacoma, East Blair Development	FC	PSDDA	540,000	DY07	SD – DY08
Semiahmoo Marina	FC	PSDDA	156,800	DY07	Testing completed
USACE, Grays Harbor O&M	FC	GH/WB	2.5 million	DY07	SD – DY08

DMMP Actions
FC = Full Characterization

Disposal Jurisdictions
CR = Columbia River
GH/WB = Grays Harbor/Willapa Bay
PSDDA = Puget Sound Dredged Disposal Analysis
MTCA = Model Toxics Control Act

C = Contingent on MTCA evaluation
NC = Non-contingent on MTCA evaluation
SD = Suitability Determination

[1] NC = Non-contingent surface. Additional volume may be dredged depending on the MTCA evaluation/determination.

CHAPTER 2 - DY06/07 PROJECTS

This chapter presents project-specific information related to the evaluation of DY06/07 projects. Sections 2.1 through 2.7 pertain only to those projects that underwent full or supplemental characterization. Sections 2.8 through 2.11 address those projects for which no-test determinations, recency extensions, frequency determinations or post-dredge surface sediment evaluations were completed. The application for the Port of Anacortes MJB Marine Area project was withdrawn subsequent to sampling plan approval. Therefore, this project is included in Tables 2-1a and 2-2a, but not in the other tables.

2.1 RANKING

Project ranking is based on a "reason to believe" that sediments in a project area may have elevated concentrations of chemicals of concern. Sampling and analysis requirements are determined, to a large extent, by the project ranking. The DMMP agencies have established ranks for geographic areas (e.g., Elliott Bay) and activities (e.g., marinas) based on historical data or the presence of active sources of contamination. Ranking guidance for Puget Sound, Grays Harbor and Willapa Bay can be found in the DMMP Users Manual. Ranking guidance for projects on the Columbia River can be found in the Northwest Regional Sediment Evaluation Framework document.

Adjustment of the initial ranking is possible if the historical data at the site are adequate, or if the applicant conducts a partial characterization (PC). If the PC chemistry data support a lower ranking, sampling and analysis requirements may be reduced during the full characterization (FC), commensurate with the revised ranking. Chemicals of concern may also be eliminated for analysis during the FC, based on the PC data. There were no partial characterizations conducted in DY06/06. However, the Tokeland Marina project was reranked from moderate to low-moderate based on testing results from 1991 and 1998. In some cases, based on new data, the ranking may be raised to a higher level of concern. That was the case for the Olympia Harbor project, which was reranked from low-moderate to high based on post-cleanup monitoring at the nearby Cascade Pole MTCA site.

Tables 2-1a and 2-1b contain the initial and final ranking for all DY06/07 projects undergoing full or supplemental characterization. The "initial rank" was taken from the guidance documents that were in effect at the time of project initiation. The "final rank" reflects any adjustment made by the DMMP agencies prior to characterization.

Table 2-1a. DY06 Project Rankings.

PROJECT	Disposal Jurisdiction	Location	Waterbody	Initial Rank	Final Rank
Driftwood Key Community Navigation Channel	PSDDA	Kitsap Peninsula	Coon Bay, Hood Canal	LM	LM
Golden Tides Marina	PSDDA	Seattle	Shilshole Bay, Puget Sound	H	H
Mercer Island Lake Line Replacement Project	PSDDA	Mercer Island	Lake Washington	M	M
MJB Properties North Dock (Barge Channel 1)	PSDDA	Anacortes	Fidalgo Bay	M	M
Olympia Yacht Club, Home Island Outstation Moorage Basin	PSDDA	Kitsap Peninsula	Pickering Passage	LM	LM
Point Hudson Marina	PSDDA	Port Townsend	Port Townsend	M	M
Point Roberts Marina	PSDDA	Point Roberts	Strait of Georgia	M	M

Ranking:
LM = Low-moderate
M = Moderate
H = High

Disposal Jurisdictions:
CR = Columbia River
PSDDA = Puget Sound Dredged Disposal Analysis

Table 2-1b. DY07 Project Rankings.

PROJECT	Disposal Jurisdiction	Location	Waterbody	Initial Rank	Final Rank
City of Renton Municipal Airport Seaplane Base	PSDDA	Renton	Lake Washington	M	M
Haug Channel	PSDDA	Hunts Point	Haug Channel, Lake Washington	M	M
MJB Properties, South Dock and North Dock (Barge Channel 2) Deepening	PSDDA	Anacortes	Fidalgo Bay	M	M
Oak Harbor Municipal Marina	PSDDA	Oak Harbor	Oak Harbor	M	M
Port of Seattle, Terminal 30	PSDDA	Seattle	East Waterway	M/H	M/H
Port of Seattle, Terminal 91	PSDDA	Seattle	Elliott Bay	M	M
USACE/Port of Olympia, Olympia Harbor	PSDDA	Olympia	West Bay, Budd Inlet	LM	H
USACE, Toke Point Entrance and Tokeland Marina	Willapa Bay	Tokeland	Willapa Bay	L (TEC) M (TM)	L (TEC) LM (TM)

Ranking:
L = Low
LM = Low-moderate
M = Moderate
H = High
NA = Not Applicable

Disposal Jurisdictions
CR = Columbia River
PSDDA = Puget Sound Dredged Disposal Analysis program

Project
TEC = Tokepoint Entrance Channel
TM = Tokeland Marina

2.2 SAMPLING AND ANALYSIS PLANS

An approved sampling and analysis plan (SAP) is required before an applicant collects sediment samples. The sampling and analysis requirements are determined by the volume of surface and subsurface dredged material and the final rank. The minimum number of field samples and dredged material management units for a full characterization are calculated as follows:

Project Rank	Maximum Volume Represented by a Field Sample (CY)	Heterogeneous Sediment		Homogeneous Sediment DMMUs (CY)
		Surface DMMUs (CY)	Subsurface DMMUs (CY)	
Low	8,000	48,000	72,000	60,000
Low-Moderate	8,000	32,000	48,000	40,000
Moderate	4,000	16,000	24,000	20,000
High	4,000	4,000	12,000	8,000

A conceptual dredging plan is presented in the SAP, with the dredging area divided into the requisite number of DMMUs. The number of DMMUs may need to be increased beyond the minimum to address site-specific considerations. Sampling locations are identified and a compositing plan is presented. Protocols for station positioning, decontamination, field sampling, sample compositing, chemical analysis, biological testing, QA/QC and data submittal requirements are also included. Once completed, the DMMO coordinates review and approval of the plan with the DMMP agencies. Tables 2-2a and 2-2b contain data for sampling plans approved for DY06/07 projects. Descriptions of those projects for which best professional judgment was applied are provided in Chapter 4.

Table 2-2a. DY06 Projects - Approved Sampling Plans.

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
Driftwood Key Community Navigation Channel	LM	29,000	29,000	4	2	0	0	0
Golden Tides Marina	H	1,336	1,336	2	1	0	0	0
Mercer Island Lake Line Replacement Project	M	28,000	28,000	7	3	0	0	0
MJB Properties North Dock (Barge Channel 1)	M	33,300	33,300	9	3	0	0	0
Olympia Yacht Club, Home Island Outstation Moorage Basin	LM	8,650	6,780	3	1	1,870	1	1
Point Hudson Marina	M	10,900	10,900	4	1	0	0	0
Point Roberts Marina	M	164,900	164,900	35	11	0	0	0

Table 2-2b. DY07 Projects - Approved Sampling Plans.

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
City of Renton Municipal Airport Seaplane Base	M	16,000	16,000	4	2	0	0	0
Haug Channel, Lake Washington	M	10,000	10,000	5	1	0	0	0
MJB Properties, South Dock and North Dock (Barge Channel 2) Deepening	M	69,000	69,000	13	6	0	0	0
Oak Harbor Municipal Marina	M	206,000	158,400	40	10	47,600	12	2
Port of Seattle, Terminal 30	M/H	59,000	49,500	15	5	9,500[1]	0	0
Port of Seattle, Terminal 91	H	9,400	9,400	4	2	0	0	0
USACE/Port of Olympia, Olympia Harbor	H	458,734	328,786	19	19	129,948	14	8
USACE, Toke Point Entrance and Tokeland Marina	L/LM	62,900	62,900	11	3	0	0	0

[1]This material was tested in 1999 and found suitable for open-water disposal. Because this was subsurface material, the DMMP agencies deemed it unlikely to have a changed condition and no additional testing was required.

2.3 SAMPLING

Tables 2-3a and 2-3b contain data related to sampling efforts during DY06/07. Two general requirements exist with respect to core sampling: 1) samples must be taken to the depth of dredging (including overdepth and Z-samples) and 2) positioning data must be collected with a minimum precision of one-tenth of a second, latitude and longitude. In areas with high shoaling rates or that meet Section 404 or Section 103 exclusionary criteria, core samples are unnecessary. In these cases sampling of the surface sediment with a van Veen grab sampler is generally allowed.

For projects utilizing coring devices, the maximum sample depth in the tables corresponds to the maximum thickness of the dredging prism, including overdepth. Exceptions include projects in which sampling problems were encountered, such as core refusal due to compact native sediment, gravel or woody debris. In high-ranked areas there is an additional requirement to collect 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. DY06 Project Sampling. Grain sizes 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 – 2 mm	SILT .004 – .063 mm	CLAY < .004 mm			
Driftwood Key Community Navigation Channel	0.5	62.3	32.3	5.4	Hand Corer/ VanVeen	1.1	0.6
Golden Tides Marina	22.9	69.7	5.9	1.5	Impact Corer	3.1	2.9
Mercer Island Lake Line Replacement Project	8.2	36.4	17.3	29.0	Vibracorer	7.0	5.6
Olympia Yacht Club, Home Island Outstation Moorage Basin	8.6	67.7	16.9	7.0	Gravity Corer	6.7	4.9
Point Hudson Marina	0.1	40.3	46.0	14.0	Vibracorer	5.0	4.2
Point Roberts Marina	1.6	28.7	43.0	26.8	Gravity Corer/ Vibracorer	5.7	3.5

TABLE 2-3b. DY07 Project Sampling. Grain sizes 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 – 2 mm	SILT .004 – .063 mm	CLAY < .004 mm			
City of Renton Municipal Airport Seaplane Base	2.8	84.6	10.0	2.7	Vibracorer	9.3	7.5
MJB Properties, South Dock and North Dock (Barge Channel 2) Deepening	13.2	27.2	39.1	20.5	Impact Corer	7.5	5.1
Oak Harbor Municipal Marina	0.6	9.1	59.0	30.3	Vibracorer	15.0	5.8
Port of Seattle, Terminal 30	0.6	66.6	25.4	7.3	Vibracorer	5.6	3.8
Port of Seattle, Terminal 91	45.5	40.0	10.5	4.0	Vibracorer	4.0	4.0
USACE, Toke Point Entrance and Tokeland Marina	0.5	14.7	67.0	17.7	VanVeen	0.3	0.3
USACE/Port of Olympia, Olympia Harbor	5.3	30.1	29.5	20.0	Vibracorer	19.0	6.7

2.4 CHEMICAL TESTING

Chemical testing was conducted for six full characterizations in each of DY06 and DY07, as well as special or supplemental testing for the Beebe Springs Creek, Haug Channel and Olympia Harbor projects. For the Beebe Creek Restoration project the DMMP agencies required that metals and DDT be tested. Haug Channel received a suitability determination in DY03 and underwent supplemental testing for a select list of semivolatiles in DY07. Supplemental testing for dioxins/furans was conducted for the Olympia Harbor project. All three projects are addressed in more detail in Chapter 4.

A complete listing of DMMP chemical guideline exceedances for DY06/07 is included in Appendix C. Only those projects with guideline exceedances are included. But for those projects that *are* included, all DMMUs are listed whether or not they had any guideline exceedances.

2.5 BIOLOGICAL TESTING

Only four projects required bioassay testing (Table 2-4) during DY06/07. Tiered testing was employed for all four projects, meaning that biological tests were conducted only on those DMMUs that had one or more exceedances of DMMP screening levels. None of the tested DMMUs failed bioassay interpretive guidelines.

Table 2-4. DY06/07 Biological Testing Summary.

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		
Point Roberts Marina (DY06)	1	0	0	Ee	Me	Na	West Beach, Whidbey Island	West Beach, Whidbey Island
USACE, Toke Point Entrance and Tokeland Marina (DY07)	3	0	0	Ee	Mg	Na	Long Beach, CA (Na) Newport, OR (Ee)	Willapa Bay
Port of Seattle, Terminal 30 (DY07)	1	0	0	Ee	De	Na	Yaquina Bay, Oregon	Sequim Bay
Port of Seattle, Terminal 91 (DY07)	1	0	0	Ee	Cg	Na	Yaquina Bay, Oregon	Carr Inlet

Cg = *Crassostrea gigas*
De = *Dendraster excentricus*
Ee = *Eohaustorius estuarius*
Me = *Mytilus edulis*
Mg = *Mytilus galloprovincialis*
Na = *Neanthes arenaceodentata*

2.6 BIOACCUMULATION TESTING

None of the DY06/07 projects had any chemical concentration that exceeded a bioaccumulation trigger. Therefore, no bioaccumulation testing was required.

2.7 SUITABILITY DETERMINATIONS

A suitability determination summarizes the evaluation procedures used in the characterization of project sediments, evaluates 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 representatives from the DMMP agencies. It documents the suitability of proposed dredged sediments for open-water disposal. The suitability determination 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 for each of the projects that completed their DMMP review during DY06 and DY07, respectively. For the projects receiving suitability determinations in DY06 and DY07, only the Olympia Harbor project included material that was found unsuitable for unconfined open-water disposal. Of the 1,109,366 cubic yards covered by the thirteen suitability determinations, 238,234 cubic yards (21.5%) were found unsuitable for open-water disposal.

Table 2-5a. DY06 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
Driftwood Key Community Navigation Channel	LM	29,000	2	0	0	0	0	2	29,000	PT/PG
Golden Tides Marina	H	1,336	1	0	0	0	0	1	1,336	EB
Mercer Island Lake Line Replacement Project	M	28,000	3	0	0	0	0	3	28,000	EB
Olympia Yacht Club, Home Island Outstation Moorage Basin	LM	8,650	2	0	0	0	0	2	8,650	AK
Point Hudson Marina	M	10,900	1	0	0	0	0	1	10,900	PT
Point Roberts Marina	M	164,900	11	1	0	0	0	11	164,900	RS

Table 2-5b. DY07 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
City of Renton Municipal Airport Seaplane Base	M	16,000	2	0	0	0	0	2	16,000	EB
MJB Properties, South and North Docks	M	69,000	6	0	0	0	0	6	69,000	RS/FB
Oak Harbor Municipal Marina	M	206,000	12	0	0	0	0	12	206,000	PS/PG
Port of Seattle, Terminal 30	M/H	59,000	5	1	0	0	0	5	59,000	EB
Port of Seattle, Terminal 91	H	9,400	2	1	0	0	0	2	9,400	EB
USACE, Toke Point Entrance and Tokeland Marina	L/LM	62,846	3	3	0	0	0	3	62,846	CS/GP
USACE/Port of Olympia, Olympia Harbor	M/H	458,734	29	0	0	13	238,234	16	220,500	AK

2.8 NO-TEST DETERMINATIONS

Projects can be exempted from sediment testing under three different scenarios: 1) the small-project guidelines are met; 2) the proposed dredged material meets the Section 404 or Section 103 exclusionary criteria; or 3) upland disposal is planned and there are no issues with the sediment surface to be exposed by dredging.

The *small-project* guidelines are as follows:

Project Rank	Maximum No-Test Volume (CY)
L	8,000
LM or M	1,000

The *exclusionary criteria* are described in the regulations for the Marine Protection, Research, and Sanctuaries Act (MPRSA) (40 CFR 227.13) and Clean Water Act (40 CFR 230.60). Generally, relatively larger grained material (e.g., sand and gravel) from high-energy environments that are geographically removed from contaminant sources meet the exclusion criteria. The DMMP agencies apply the exclusion criteria on a case-by-case basis.

A total of four projects received no-test determinations, one in DY06 and three in DY07. Table 2-6 includes the pertinent information.

Table 2-6. DY06/07 No-Test Determinations

PROJECT	DY	Total Volume (cy)	Rank	Reason for No-Test Determination	Proposed Disposal Site
Burlington Northern Santa Fe Railway Company, Dog Creek Culvert	DY06	2,000	NA	Exclusionary	Dog Creek (habitat improvement)
Briggs Reservoir	DY07	3,085	NA	Class A water source – no concern regarding sediments exposed by dredging	Upland
Christensen Shipyards	DY07	10,000	NA	Exclusionary	Upland
Nichols Brothers Boat Builders, Holmes Harbor	DY07	150	LM	Small project	Upland

2.9 RECENCY/FREQUENCY DETERMINATIONS

Recency guidelines apply to material that has been sampled and tested for open-water disposal but not yet dredged. Key considerations in determining whether the existing data are still representative is the recency of the information and sources of contamination in the vicinity of the project. For high-ranked projects, the recency guidelines allow characterization data to be valid for a period of 2 years. The PSDDA guidelines specify a recency period of 5 to 7 years for moderate, low-moderate and low-ranked projects. For Grays Harbor and Willapa Bay, more definitive guidance is provided, with recency periods of 5, 6 and 7 years for moderate, low-moderate and low-ranked projects respectively.

When other permitting requirements prevent a project from being dredged during the recency period, extension of the recency period is considered on a case-by-case basis. When considering whether existing data continue to adequately characterize sediment from a specific project, the agencies review previous characterization data, any new data from the dredge site or vicinity, and site use and character. Based on this review, the agencies may extend the recency determination, typically for one year. This extension may be allowed with no additional testing, or may require some level of confirmatory testing.

Frequency guidelines refer to the extent of time a given dredging project can be maintained with repeated dredging without further testing. Once the sampled and tested material has been dredged, frequency guidelines apply. Time durations for the frequency guidelines are the same as for the recency guidelines. Sediment dredged within the frequency guidelines generally does not require testing. Table 2-7 presents information for the three recency extensions and the single frequency determination.

Table 2-7. DY06/07 Recency/Frequency Determinations

PROJECT	DY	Rank	Determination Type	Sampling Date	Original Recency/ Frequency Time Limit	Recency Extension
Port of Seattle, Terminal 18 - Stage 1A	DY06	H	Recency Extension	Sept. 2002	Sept. 2004	Dec. 2005
Dakota Creek Industries Shipyard/Pier 1	DY07	M	Recency Extension	April 2000	April 2007	July 2009
Port of Everett, South Marina	DY07	M	Recency Extension	April 2000	April 2007	April 2008
USACE, Lower Snohomish	DY07	LM	Frequency	Sept. 2003	Sept. 2010	NA

2.10 PROJECT VOLUME REVISIONS

Dredging projects are dynamic by nature and shoaling continues to occur between the time of sediment characterization and the time of dredging. When the project volume changes, subsequent to full characterization, a dredging applicant may request a revision of the volume found in the suitability determination. There may be other reasons for volume revisions as well, such as the datum error that was reported for Anchor Cove Marina. The DMMP agencies review such requests on a case-by-case basis. Table 2-8 has the pertinent information for volume revisions approved by the DMMP agencies in DY06/07.

Table 2-8. DY06/07 Volume Revisions

PROJECT	DY	Rank	Original Volume (CY)	Revised Volume (CY)	Reason for Volume Revision
Anchor Cove Marina	DY06	M	22,400	25,300	Probable datum error in the original bathymetric survey
La Conner Marina	DY06	L	55,000	61,000	Over-dredging by the contractor
Port of Everett, 12th Street Marina	DY06	LM	294,000	335,000	Additional shoaling
Bridgehaven Community Club	DY07	LM	7,000	11,000	Additional shoaling
Point Hudson Marina	DY07	M	10,900	11,000	Reconcile suitability determination volume with permitted volume

2.11 POST-DREDGE SEDIMENT SURFACE EVALUATIONS

Dredging operations expose new sediments to direct contact with biota and the water column. The exposed sediment must meet the State of Washington Sediment Management Standards (SMS). A "Z sample" is a sample from the first foot below the dredging overdepth and typically is collected during sampling of heterogeneous sediments. In some cases collection of Z-samples is not possible (e.g. refusal during vibracore sampling). In other cases, where DMMUs with elevated concentrations of chemicals of concern have been removed, there may be concern that residuals from the dredging operation may leave a contaminated surface. In either case, sampling and testing of the post-dredge sediment surface may be necessary. In DY06/07, the DMMP agencies required post-dredge sampling and testing for two projects, the details of which are included in Table 2-9.

Table 2-9. DY06/07 Post-Dredge Sediment Surface Evaluations

PROJECT	DY	Rank	Reason for Post-Dredge Evaluation	Did the New Surface Meet SMS?
Glacier Northwest	DY07	H	Nearby subsurface contamination	Yes
Shilshole Bay Marina	DY07	M	De minimus dredging under floats; evaluate compliance with antidegradation WAC	Yes

CHAPTER 3 - SUMMARY AND ASSESSMENT OF DY06/07 DATA

3.1 SUMMARY OF CHEMICAL TESTING RESULTS

Table 3-1 and Appendix C summarize the chemical testing results from DY 2006 and DY 2007. A total of 8 of the 58 standard DMMP COCs had screening levels exceeded for at least one project. These included both detected exceedances (4 COCs) and detection limit exceedances (6 COCs). No COCs had detected concentrations above the BT; no COCs were undetected above the BT. No chemicals were detected above the ML; one was undetected above the ML.

There were very few chemicals with elevated concentrations for the DY06/07 projects. This represents a marked change from past reports in which numerous chemicals from multiple projects exceeded DMMP guidelines. However, it should be noted that detection limits continue to be a problem for some projects. Four DMMUs from 2 projects required bioassay testing based on detection limit exceedances of screening levels. This highlights the importance of bringing detection limits down below screening levels, so as not to trigger bioassays unnecessarily.

Table 3-1. DY06/07 Chemical Testing Summary. Total projects[3] = 13; total # of DMMU = 50.

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
CHLORINATED HYDROCARBONS												
Hexachlorobenzene (HCB)							1	1				
PHTHALATES												
Di-n-butyl phthalate [1]	1	1										
PHENOLS												
2-Methylphenol [1]	1	1										
2,4-Dimethylphenol [1]	1	1					2	1				
MISCELANEOUS EXTRACTABLES												
Benzoic acid [1]											1	1
N-Nitrosodiphenylamine							1	1				
PESTICIDES												
Total DDT	1	1					1	1				
Total chlordane [2]							3	1				

D = Detected U = Undetected SL = Screening Level BT = Bioaccumulation Trigger ML = Maximum Level

[1] = No BT exists [2] = No ML exists

[3]Olympia Harbor is not included; only the supplemental dioxin testing is included in this report for that project.

Dioxin Evaluation

The DY06/07 timeframe was a period of transition for the evaluation procedures for dioxins and furans. In the past, the DMMP agencies have applied best professional judgment on a case-by-case basis in determining the suitability of dioxin-containing dredged material for open-water disposal. This case-by-case evaluation relied in part on a risk assessment done in Grays Harbor in 1991, which used seafood consumption rates for recreational fishers. But as more information about the amount of seafood consumed by subsistence (tribal) fishers became known, it was clear that the approach derived for Grays Harbor should not be applied to DMMP projects in Puget Sound.

In 2006, the detection of elevated levels of dioxins in sediment proposed for dredging from Olympia Harbor triggered a site-specific determination related to the conditions at the Anderson/Ketron open-water disposal site. A risk-based approach was attempted for the Anderson/Ketron open-water disposal site, but ultimately a background-based interim framework was adopted. This interim framework was extended to the other nondispersive disposal sites using data from a dioxin survey conducted by the DMMP agencies in 2007.

Dioxin results for Olympia Harbor are included in Appendix C. A total of 13 DMMUs, consisting of 238,234 cubic yards, were found unsuitable for open-water disposal based on their dioxin concentrations.

3.2 BIOLOGICAL TESTING

Biological testing was conducted on 4 of the 13 projects undergoing chemical testing during DY06/07. Table 3-2 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. As can be seen from the table, there were no hits – either dispersive or nondispersive – for any of the bioassays. This result is not surprising given the low concentrations of chemicals of concern in the tested dredged material.

Table 3-2. DY 06/07 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	2	4	0	0	0	0	0
Sediment Larval	2	4	0	0	0	0	0
Neanthes Growth	2	4	0	0	0	0	0

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, there were no bioaccumulation trigger exceedances. Therefore, none of the projects required bioaccumulation testing.

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 DMMP projects submitting data from DY90 to DY07. The regression of these two variables resulted in a significant ($p<0.001$) correlation and regression equation noted in Figure 3-1. However, it should be noted that costs have not been adjusted for inflation over time, so this figure should not be used to estimate actual testing costs.

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 period DY90 to DY07 are depicted in Figure 3-2 as a function of the number of analyses for 1) the standard suite of chemicals and 2) 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.

Please note that the costs shown in Figures 3-2 and 3-3 have not been adjusted for inflation.

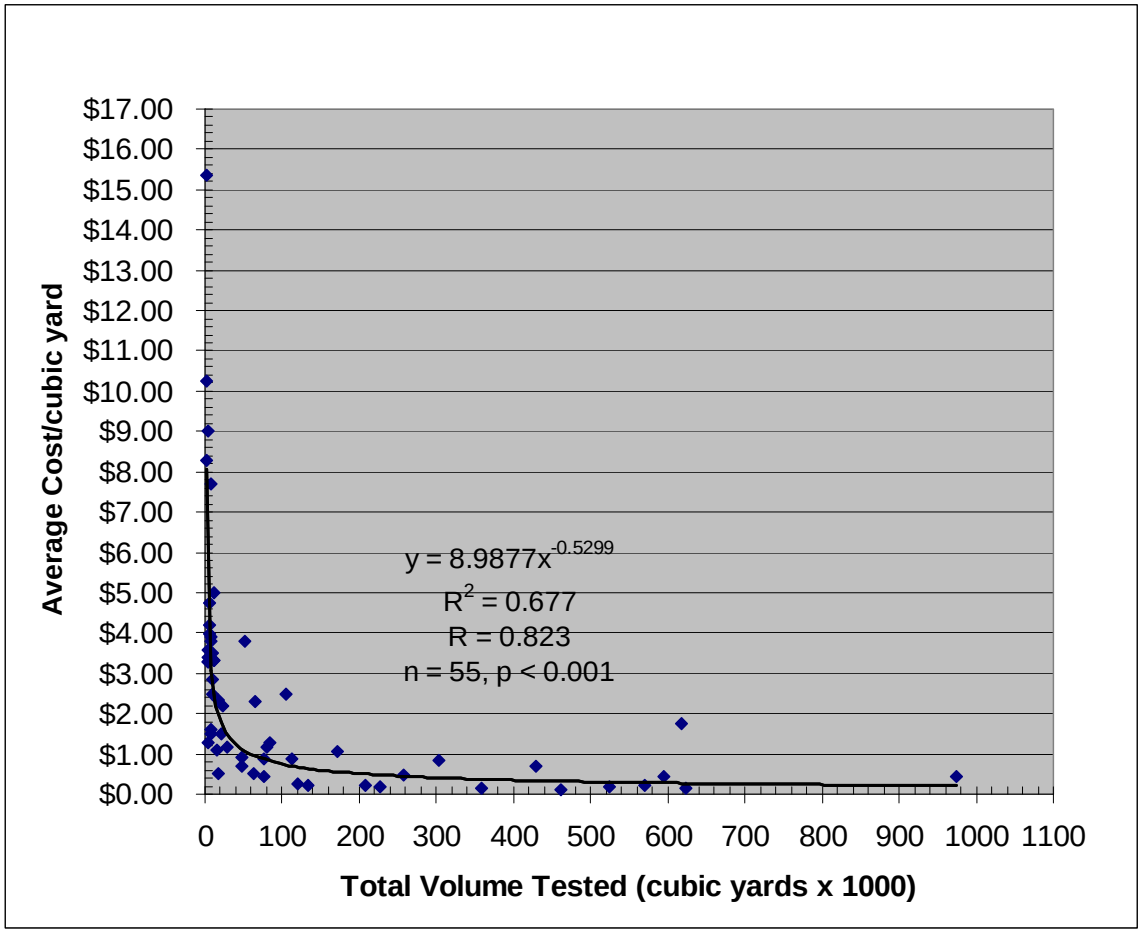


Figure 3-1. Project Size versus Unit Testing Cost

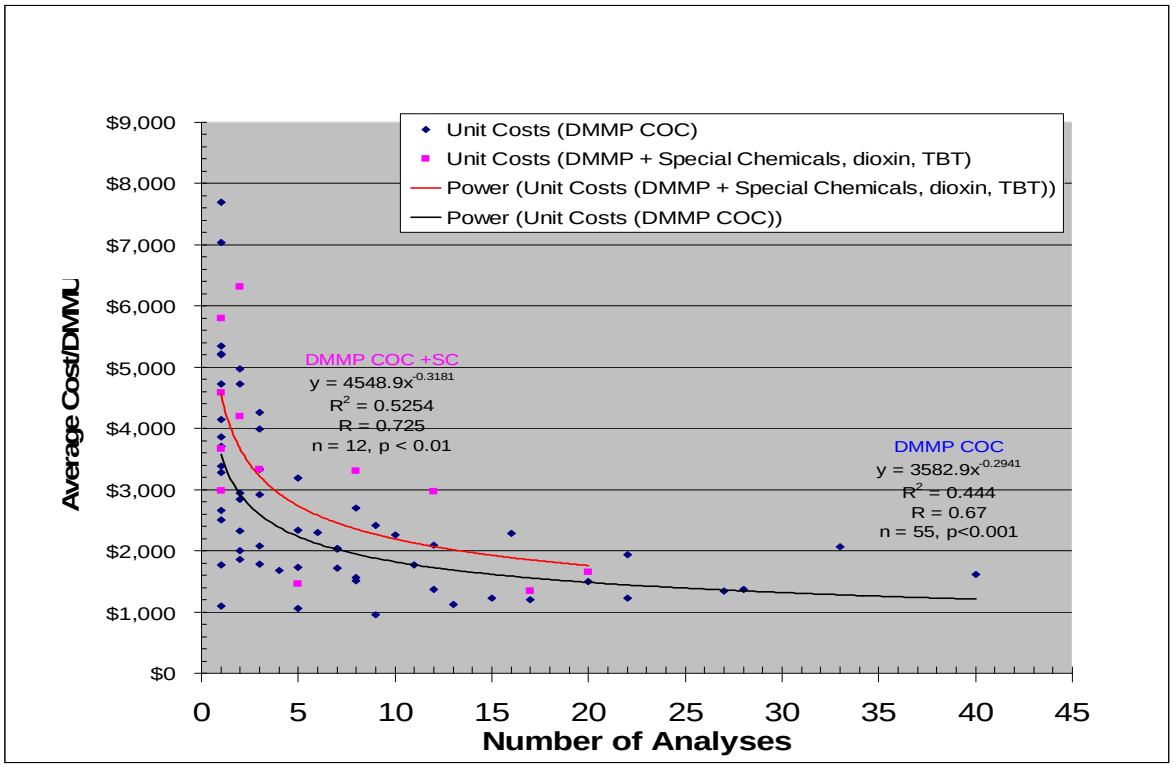


Figure 3-2. Chemistry Unit Cost

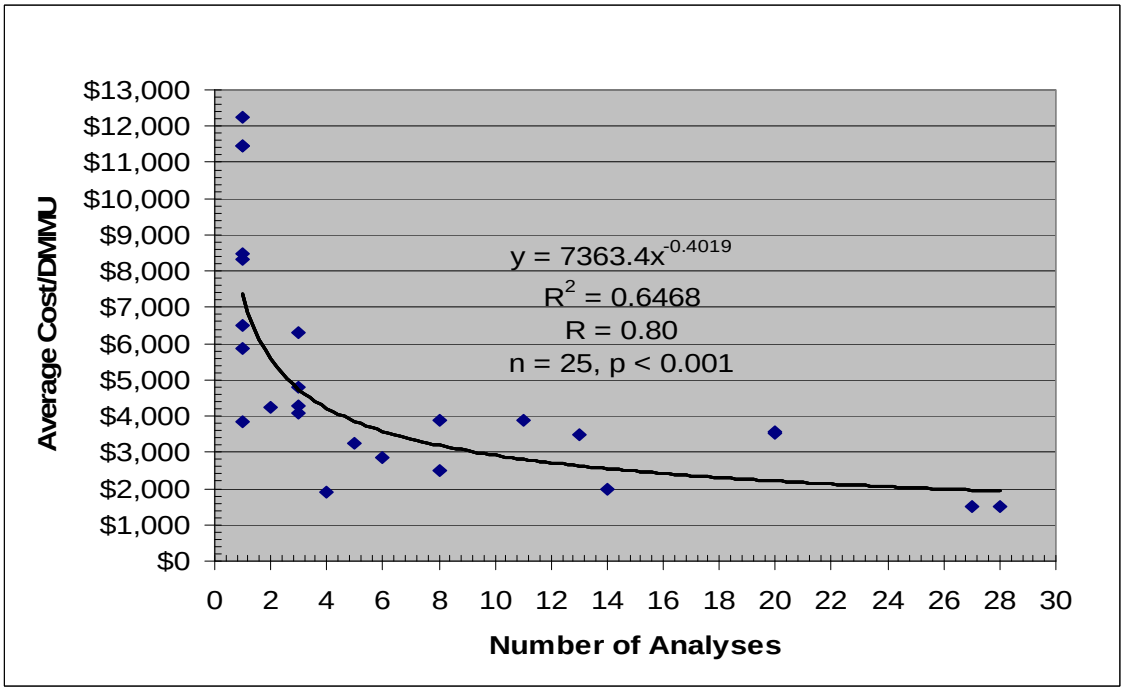


Figure 3-3. Bioassay Suite Unit Cost Analysis

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 steps are typically sequenced as follows:

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

(2) Receive approval of SAP from DMMP agencies.

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

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

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

(6) Corps prepares and issues public notice.

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

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

(9) Corps completes public interest review, 404(b)(1) evaluation, NEPA documentation, ESA consultation, and NHPA coordination - as necessary - and issues permit decision.

The DMMP dredged material evaluation process consists of Steps 1 through 4, which are elaborated on in the following sections.

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.

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 06/07 the average time from the submittal of the final SAP for a project to SAP approval was 29 days.

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 dredged material characterization report. Sampling, testing and reporting consume a substantial portion of the DMMP process time budget, averaging 187 days during DY 06/07. This is one of the project phases with the highest degrees of variability, with sampling, analysis and reporting taking anywhere from 40 to 956 days during this 2 year time period. Factors influencing the time required for this phase include 1) weather 2) sampling difficulties 3) laboratory capacity and turn-around 4) QA problems arising during chemical and biological testing and 5) report compilation time. Those projects that include bioassay or bioaccumulation testing usually are those with the longer turn-around times.

Data Review and Suitability Determination. Once a full set of chemical/biological testing data is submitted, 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 DY06/07, the average time required was 24 days, with review times ranging from 2 to 101 days. The longest reviews usually involve complications such as a change in dredge volume or especially large or complex data sets.

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 240 days (ranging from 76 to 1,026 days) in DY06/07, with the majority of that time taken up by sampling, testing, and data report preparation by the applicant. Note that Figure 3-4 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.

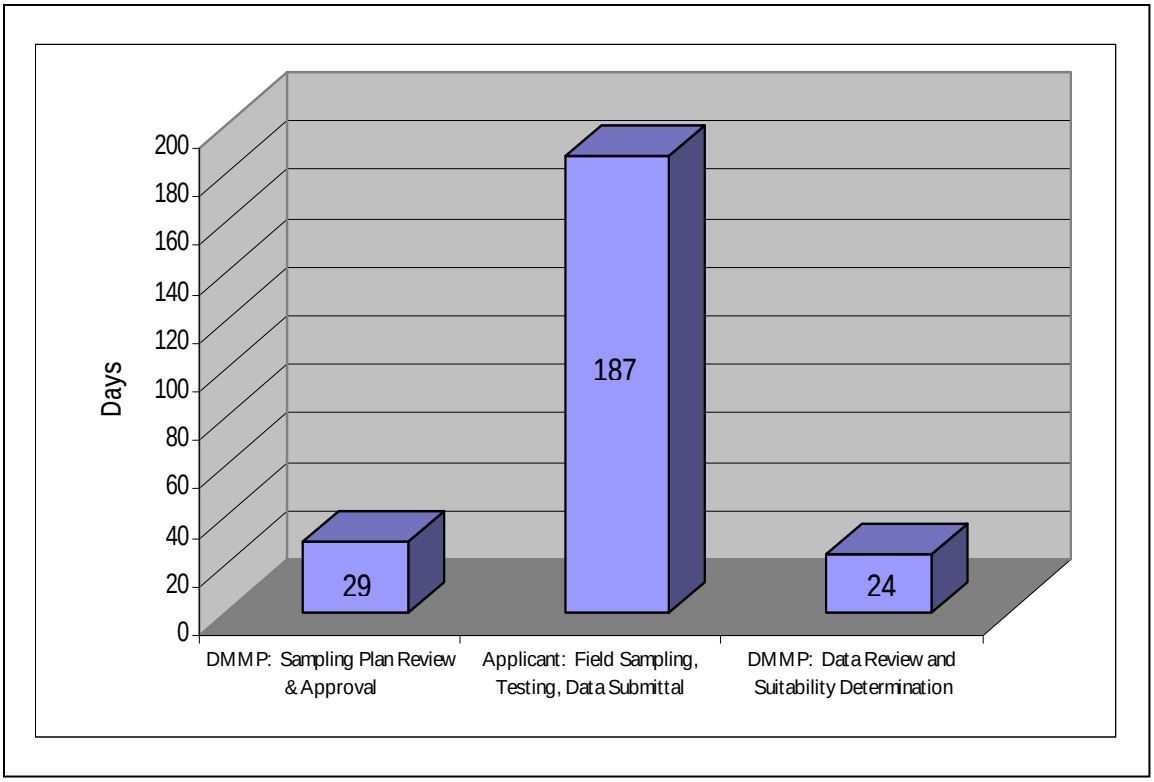


Figure 3-4. DMMP Processing Time (means for DY 06/07 projects in days)

CHAPTER 4 – UNUSUAL AND/OR COMPLEX PROJECTS

The following discussion includes unusual or complex projects requiring explanation beyond the summaries provided in Chapters 1 and 2. Projects with special considerations for ranking, sampling plan development, sampling, chemical testing, biological testing, or those for which the DMMP agencies used best professional judgment (BPJ) are further described in this chapter.

4.1 DREDGING YEAR 2006

Burlington Northern Santa Fe Railway Company, Dog Creek Culvert (Columbia River)
The applicant proposed to dredge approximately 2,000 cubic yards of gravel and cobble, with entrained woody debris, from the outlet of the Dog Creek culvert, which drains into the Columbia River. The material was to be placed several hundred feet downstream along the right bank of the Columbia River to create shallow-water habitat. There are no known sources of contamination in the Dog Creek drainage. The DMMP agencies concluded that there was little reason to believe that these sediments were contaminated and the material was deemed suitable for dredging without testing.

Driftwood Key Community Navigation Channel (Coon Bay, Kitsap County)
This project was characterized with two sampling and testing events. Initially, the project proponent had proposed disposal at an upland location. The purpose of characterization at that point was to address water-quality concerns at the dredging site, not in-water disposal. A reduced list of chemicals of concern was evaluated.

Subsequently, open-water disposal was proposed, and a second round of sampling and testing was required to characterize the material for this disposal option. DMMP chemicals of concern that were not analyzed during the first round of testing were now tested (except for the entrance channel, which was exempted from the second round of testing due to its very low fines content (3%). All the proposed dredged material was found suitable for open-water disposal.

MJB Properties, North Dock (Barge Channel 1)
This project was determined to be within the Agreed Order area for the MTCA cleanup of the former Scott Paper Mill. Additional sampling and testing would have been necessary to meet the requirements of Ecology's Toxics Cleanup Program. The applicant decided not to move ahead with sampling and testing and subsequently withdrew the permit application for dredging of Barge Channel 1.

Point Roberts Marina
The depth of the proposed dredged material, including one foot of overdepth, ranged from 1.5 to 6.7 feet. Subsurface sediments (greater than 4 feet deep) were not separated from surface material for characterization purposes as the subsurface volume was limited primarily to the edges of the moorage basin and at a few isolated locations. It was determined to be impractical to dredge the subsurface sediment separately from the surface sediment.

The sampling plan called for the use of a gravity corer, which was successful in collecting sediment from 5 of the 11 DMMUs. However, attempts to sample the remaining DMMUs with the gravity corer were unsuccessful and a vibracorer was brought in to complete the job. Neither coring technique recovered significant sample volume once native material was encountered, primarily in the northern portion of the

marina. As a result, cores were advanced just into the native material based on guidance found in the DMMP Users Manual.

Port of Seattle, Terminal-18 Stage 1A, Permit Revision, Supplemental Suitability Determination
The project described in the permit revision was relatively small in scope, involving the armoring of an existing buried communication cable. In order to armor the cable it was necessary to remove approximately 150 cubic yards of sediment by suction dredging, with upland disposal of this material. The excavated area would then be backfilled with 60 cubic yards of small riprap material for armoring and covered with 90 cubic yards of clean sand.

The sediment in the project area had been sampled in September 2002 and found suitable for open-water disposal. The recency period for this sediment characterization expired in September 2004 (2-year recency period for a high-ranked area). However, due to the small size of the project and the fact the dredged material would be disposed upland, the DMMP agencies agreed to extend the recency period to December 2005 to allow the project to go forward. No additional testing was required.

4.2 DREDGING YEAR 2007

Beebe Springs Creek Habitat Project (Columbia River)
This was a high-interest habitat development project in Eastern Washington adjacent to the Columbia River. The project consisted of excavating approximately 30,806 cy of soil to construct a creek bed within a former apple orchard. Because of past use, the DMMP agencies required testing for metals and organochlorine pesticides - especially DDT - at six locations and at 4 depth strata (e.g., 0-1 ft, 1-2 ft, 2-3 ft, and 3-4 ft). Analyses were initially conducted on the 0-1 ft, and 1-2 ft samples. The results found high residues of DDT within the top 1 foot of soil to be excavated for the creek, ranging from a low of 85 ppb to a high of 1,075 ppb total DDT. The DMMP agencies determined that the top 2 feet of the material proposed for excavation and habitat development, representing approximately 10,000 cy, were unsuitable for habitat development.

Bridgehaven Community Club (Hood Canal) - Volume Revision
Due to project delays, the dredging volume increased from 7,000 cy to approximately 9,000 cy between 2004 and 2006. The project was accruing at a rate of approximately 900 cy/year. In anticipation of further delays, the applicant asked to increase the potential volume to 11,000 cy. The DMMP agencies reviewed the testing data collected in 2002 and approved the volume increase without a requirement for additional testing.

Briggs Reservoir (San Juan Island)
This project involves dredging approximately 3,000 cubic yards of hydric soil and reservoir sediments in the process of constructing a replacement dam. All material will be placed upland with no return flow. The sediment is being dredged from a Class A water source. The DMMP agencies reviewed the project and determined that there was no concern about the quality of the dredged material or the newly exposed surface.

City of Renton Municipal Airport Seaplane Base (Lake Washington)

The project is situated near the mouth of the Cedar River. The "Hanukkah Eve Storm" of November 2006 occurred shortly before sediment sampling was scheduled to begin and resulted in significant new shoaling at the project site. The sampling equipment approved in the sampling and analysis plan was not adequate to penetrate the full dredging prism. An additional round of testing, with heavier sampling equipment, was required to adequately test the newly deposited sediment.

Dakota Creek Industries Shipyard/Pier 1 (Anacortes)

A DMMP sediment evaluation for the Dakota Creek Industries (DCI) Shipyard and Port of Anacortes Pier 1 dredging project was accomplished in 2000. The original recency period expiration date was April 2007. Due to project delays, including supplemental dioxin testing in 2004, the project could not be completed prior to the expiration date. The DMMP agencies evaluated recency confirmation data that had been collected by the Port's contractor at Pier 1 at the time that the supplemental dioxin testing was being conducted. This data indicated that conditions had not changed at the site since the time of the original suitability determination. Therefore, the DMMP agencies extended the recency period deadline from April 2007 to July 2009 to allow the project to be completed without additional characterization.

Haug Channel (Lake Washington)

This project was initially characterized in 2001. There were detection limit exceedances of maximum levels for a number of chemicals. Bioassays could not be performed due to the peaty nature of this material. The applicant elected in 2006 to retest without prior DMMP review and approval to see if the better detection limits could be achieved. The testing lab did achieve better detection limits, but the detection limit for benzoic acid was still above the ML and several other chemicals had detection limits above the SL. Because the sediments could not undergo toxicity testing, the DMMP agencies determined that these sediments were unsuitable for unconfined open-water disposal and beneficial-use projects.

MJB Properties, South Dock and North Dock (Barge Channel 2) Deepening (Anacortes)

The depth of the proposed dredged material, including one foot of overdepth, ranged from 3.5 to 5.5 feet for the South Dock and 6.75 to 9.0 feet for the North Dock. Subsurface sediments (greater than 4 feet deep) were not separated from surface material for characterization purposes as the subsurface volume was limited primarily to the perimeter of the North Dock dredging area.

The sampling plan called for the use of a gravity corer. However, it was not possible to penetrate the native material with this device. Refusal was encountered at all North Dock sampling stations and one South Dock station. As a result, cores were advanced just into the native material based on guidance found in the DMMP Users Manual.

Because of the close proximity of the North Dock to the old Scott Paper Mill site, dioxins/furans were added as additional COCs for this portion of the project. The results of the dioxin analyses within the 4 DMMUs evaluated within the North Dock sediment ranged from 0.9 pptr to a high of 3.1 pptr TEQ (using the 2005 WHO mammalian TEFs) and the 4 analyses had a mean concentration of 1.7 pptr TEQ. As the dredged material was proposed for placement at the MJB Mitigation Site, a sample of material from the mitigation site was tested for dioxins/furans. The concentration at the mitigation site was 1.8 pptr TEQ. Three of the 4 DMMUs had concentrations lower than this value. The remaining DMMU had a concentration of 3.1 ppt - TEQ.

At the time of the suitability determination, there were no established interpretation guidelines for disposal of dioxin-containing dredged material at dispersive sites, so the DMMP agencies could not evaluate this disposal option for the North Dock dredged material. However, the DMMP agencies approved placement of the North Dock material at the MJB Mitigation Site, as long as sequencing was used to ensure that the exposed surface had a TEQ less than the 1.8 pptr that was originally found at the mitigation site.

Olympia Harbor Federal/Port O&M

The Olympia Harbor joint Federal/Port of Olympia project, (458,734 cy of dredged material) located in Budd Inlet, Olympia, Washington was initially evaluated in 1999 (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/Oly-Harbor-sdm.pdf) for open-water disposal at the Anderson/Ketron Island disposal site. Concerns over the lack of dioxin/furan testing at the Port of Olympia and in the navigation channel were raised during a January 5, 2006 DMMP monthly coordination meeting. The DMMP agencies, after conducting a reason-to-believe evaluation, subsequently required a supplemental dioxin/furan evaluation within the entire project area.

Concerns about data gaps and area ranking for previous testing within the Port's berthing area led to a requirement by the DMMP agencies to require supplemental testing for dioxins/furans within the entire project area and to conduct limited PAH retesting at several locations. The DMMP required collection of vibracore samples at 21 locations within the joint Federal/Port project area. The sampling collected surface, subsurface, and Z-samples at each location, for a total of 29 DMMUs.

The suitability determination for the supplemental testing is available at http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/Final-Supp-OLY-HARBOR-DIOXIN-SDM_091206.pdf, and the technical appendix describing the rationale for the interpretative approach applied to these data is found at http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/060912_FINAL_AK_Dioxin_Evaluation.pdf . Validated dioxin/furan congener specific testing results for quantitated dioxins/furans TEQ (Toxicity Equivalence) concentrations ranged from a low of 0.11 pptr to a high of 54.2 pptr (all values reported here are updated with 2005 World Health Organization Toxicity Equivalence Factors). The limited PAH analyses conducted within the Berthing area and within Olympia Harbor showed low concentrations well below DMMP screening level guidelines and SMS SQS Guidelines consistent with the 1999 characterization results.

The DMMP agencies have acknowledged the complexity of setting interpretative guidelines for PCDD/F. Currently there is no agreed upon approach for regulating PCDD/F in Puget Sound, and the DMMP has not established programmatic SLs, BTs, or MLs for this complex chemical. In the recent past the DMMP agencies have applied the Grays Harbor dioxin risk framework, developed in 1991, to the four Puget Sound projects that underwent PCDD/F testing between 1991 and 2005. After revisiting the basis for the Grays Harbor guidelines, the DMMP agencies concluded that the process used in Grays Harbor is deficient because the approach used to estimate exposure and risk is outdated and not specific to Puget Sound.

In February 2007, the DMMP agencies adopted an interim interpretative approach for PCDD/F based on maintaining "background" concentrations currently existing at and in the vicinity of the Anderson-Ketron site. The use of this approach was supported by the results of a risk-screening exercise that considered the best available information for the proposed disposal site, as well as updated modeling approaches and exposure information for highly exposed human populations. The purpose of the exercise was to evaluate the plausibility of setting risk-based guidelines while meeting the needs of the applicant's time constraints. While this screening exercise and the resulting interim approach received internal and some external review, it has not been thoroughly vetted with the stakeholder community. Such a review is necessary and

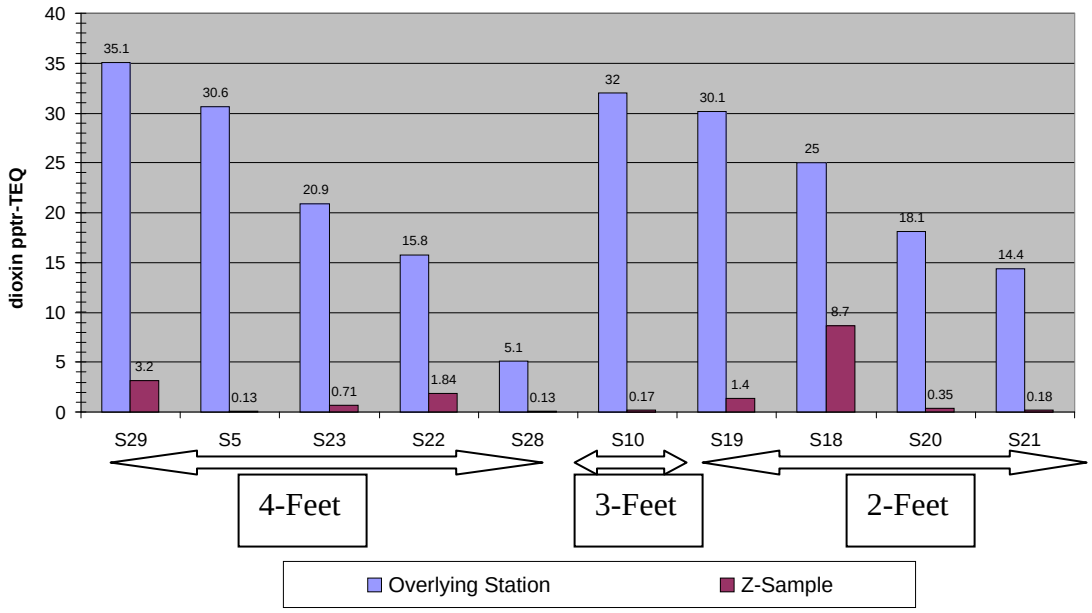
is being pursued as the DMMP develops a broader approach for establishing interpretative guidelines for Puget Sound on a programmatic basis. The intended focus of this broad stakeholder coordinated effort was an agreed-on approach to setting limits for dioxin at both dispersive and non-dispersive sites that would be presented at the 2008 Sediment Management Annual Review Meeting. However, the complexity of the alternatives may now lead to a broad cross-program, multi-agency and multi-year process to develop a regulatory approach for PCDD/F that was legally defensible and consistent with the 2020 vision of the Puget Sound Partnership.

The following abbreviated summary explains the interim approach that the DMMP developed to interpret polychlorinated dibenzodioxins and furans (PCDD/F) testing results for the Olympia Harbor joint Federal/Port Project. The interpretative framework was developed specifically for the Olympia Harbor Project and is only applicable to dredged material proposed for disposal at the Anderson/Ketron Island Disposal Site. The goal of the interpretive approach is to insure that disposal of project sediments does not increase "background" concentrations of dioxin at the Anderson/Ketron site. The "background" dioxin concentration at the site is defined using a set of recently-collected sediment data from the immediate vicinity (but outside the boundaries) of the disposal site. This case-specific approach is based on a two-tiered process. Tier 1 focuses on evaluating the project PCDD/F data relative to the Anderson/Ketron Island disposal site maximum observed sediment value 7.3 pptr TEQ (subsequently adjusted to 6.8 pptr TEQ using updated 2005 World Health Organization Toxicity Equivalence Factors). This concentration is used as a site specific ceiling value not to be exceeded. Every DMMU above this value would be unsuitable for unconfined open-water disposal, whereas, all DMMUs with PCDD/F concentrations below this value would then proceed to the second tier of interpretive framework. Tier 2 focuses on comparing the volume-weighted mean concentration of all project sediments within a given DMMU at or below 7.3 pptr TEQ maximum (now 6.8 pptr TEQ), to the disposal site mean concentration (3.8 pptr TEQ, readjusted mean = 3.6 pptr TEQ using 2005 WHO TEFs). If the volume-weighted mean concentration exceeds the disposal site mean concentration, the project proponent could eliminate DMMUs contributing to the volume-weighted mean exceedance until the volume-weighted mean is at or below the disposal site mean concentration.

The results of these analyses in summary indicate that all 220,500 cy of material (total volume tested = 458,734 cy) below the Tier 1 standard (6.8 pptr TEQ) were also below the Tier 2 Anderson/Ketron Island disposal site mean concentration (<3.6 pptr TEQ) and were therefore suitable for unconfined open-water disposal at this site. The revised suitable volume, after removing material for a potential beneficial uses project also meets the Tier 2 guideline of < 3.6pptr TEQ was also suitable for unconfined-open-water disposal at the Anderson/Ketron Island site. The beneficial uses component of this project was subsequently withdrawn after public interest review.

The results indicate that 238,234 cy of material exceed the DMMP dioxin interpretation framework Tier 1 maximum level of 6.8 pptr TEQ and are unsuitable for unconfined-open-water disposal, and must be disposed at an Ecology-approved upland disposal site or in-water confined disposal site. Evaluation of the Z-samples demonstrated that all the exposed surfaces represented by these analyses were significantly lower that the overlying surfaces, and would meet the Washington State anti-degradation policy (see Figure 4-1).

Figure 4-1. Comparative Dioxin/Furan Concentrations in Overlying Stations and Underlying Z-samples



An intensive Ecology effort is currently underway in lower Budd Inlet to further evaluate the dioxin/furan contamination (e.g., Nature and Extent Analysis) and develop a broad cleanup strategy through a regional stakeholder process.

Based on a reconfiguration of the Federal O&M component of the project, the DMMP re-evaluated a subset of the "suitable" material characterized within the navigation channel for compliance with the interim interpretive guidelines. The volume weighted average concentration for the 100,949 cy proposed for dredging was 2.41 pptr-TEQ with concentrations measured within the four DMMUs ranging from a low of 0.111 pptr-TEQ to a high of 6.7 pptr-TEQ.

Port of Everett South Marina Recency Extension

The Port of Everett requested a recency extension for 6,000 cubic yards of sediment from the southeastern portion of the South Marina. Vessels and floats were grounding in this area at low tides. Sediment in this area was last characterized in 2000 and there were no screening level exceedances during that round of testing. Based on this data and a review of past fuel spills in the marina, the DMMP agencies determined that there was little reason to believe that there was any changed condition at the site. The recency expiration data was extended from November 2007 to April 2008.

Port of Seattle, Terminal 30

The project is located within the East Waterway Operable Unit of the Harbor Island Superfund site. Portions of this project were previously characterized in 1998 during the East Waterway Stage II DMMP evaluation (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/ew_P2_errat-99sdm.pdf) and were found to be suitable for unconfined open-water disposal. The Terminal 30 dredging area was subject to a recency extension evaluation in 2001 (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/EW-T30ssdm2.pdf). All but one quarter of the southern portion of the proposed dredged material footprint was dredged in 2002, to -44 feet MLLW plus 2 feet of allowable overdredge. The 2006 dredged material footprint included approximately 9,500 cy of subsurface material and 11,100 cy of surface material in the undredged southern portion of the project. All of this material had been previously tested in 1998 and found suitable for open-water disposal, and all DMMUs underwent concurrent toxicity testing, with all material found to be suitable for unconfined open-water disposal. The subsurface material, being isolated from contact with the water column, was deemed to be still suitable by the DMMP agencies without additional testing. The overlying surface material was resampled and tested for confirmation and was again found suitable for open-water disposal (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/POS_T30_sdm_06.pdf). Surface material re-characterized at the South end of the dredging footprint (DMMU S1), near the Lander Street Outfall had no detected chemicals exceeding SLs (PCBs were quantitated at 130 ppb, which equaled but did not exceed the SL). DDT, while undetected, had a detection limit that exceeded the SL. After subsequent attempts to confirm the detection limits for DDT were below the SL were unsuccessful, this DMMU underwent toxicity testing. The results of toxicity testing indicated that this DMMU met the non-dispersive site interpretation guidelines.

This project received a lot of scrutiny during public-interest review, because this project lies within the existing Harbor Island Superfund site, and especial concerns about PCB concentrations within this material were highlighted during the project review, although the two rounds of testing of the surface material near the Lander Street Outfall in 1998 and again in 2006 showed PCB concentrations near the PSDDA SL and SMS Sediment Quality Standard (SQS), and all material suitable for unconfined-open-water disposal. However, the Port of Seattle Commissioners elected to dispose the 20,600 cy of material located at the south end of T30 represented by surface DMMU-S1 (11,100 cy), and underlying subsurface DMMU-D1 (9,500 cy) at an appropriate upland disposal site in lieu of open-water disposal at the Elliott Bay disposal site.

Port of Seattle, Terminal 91

Bioassays were required for one DMMU that exceeded the screening level for Total DDT. The initial test organism used for the sediment larval test – the bivalve *Mytilus galloprovincialis* – failed to perform in three successive attempts. The bivalve *Crassostrea gigas* was substituted for *M. galloprovincialis* in a fourth attempt (this time successful), but by the time this fourth attempt was initiated, the 56-day holding time limit had been exceeded. But because the sediment had been stored in the dark at 4 degrees C under a nitrogen atmosphere, and the chemical triggering the bioassays – total DDT – is of low volatility and unlikely to have been biodegraded during the holding period, the DMMP agencies used best professional judgment in accepting the *C. gigas* test results for decision-making, despite the holding time exceedance.

In the juvenile infaunal bioassay (*Neanthes arenaceodentata*), the control sediment exceeded the performance standard of 20 percent mortality. The cause of this exceedance is unknown, but the mean individual growth rate of the remaining organisms in the control sediment was far above the minimum standard of 0.38 mg/individual/day. In addition, the mortality rates in the reference and test sediments were

both below 20 percent, providing additional evidence that the overall test was valid. Based on these mitigating factors, the DMMP agencies accepted the results as adequate for decision-making.

One DMMU consisted largely of rip-rap (approximately 2,100 cubic yards). This material was not allowed to be disposed at the Elliott Bay disposal site. If removed, the DMMP agencies required that this material be disposed upland or reused.

Shilshole Bay Marina

This small project consisted of dredging approximately 430 cy of sediment, which had sloughed from an unstable side slope, to prevent dock access floats from grounding at low tide. The dredged material was to be disposed at an upland site but the DMMP agencies required that the newly exposed sediment be sampled and tested to ensure compliance with the Sediment Management Standards Sediment Quality Standards (SQS). The problem was that 220 cubic yards of the material was to be dredged from the unstable side slope, with immediate placement of quarry spalls after dredging to prevent additional sloughing. Sampling of the "newly exposed" sediment on the side slope would not be possible due to the presence of the quarry spalls. The DMMP agencies agreed that testing of the newly exposed sediment beyond the toe of the slope would be sufficient for comparison to SQS. The analysis of this sediment showed that the surface sediment quality was in compliance with the Sediment Management Standards Sediment Quality Standards (SQS) and no further action was needed.

USACE Toke Point Entrance Channel and Tokeland Marina

There were no detected exceedances of any DMMP screening levels (SLs). However, there were detection limit exceedances of SLs for hexachlorobenzene, benzoic acid, N-nitrosodiphenylamine, dimethylphenol and chlordane. Therefore, bioassay testing was required. All of the dredged material passed bioassay testing.

CHAPTER 5 – DISPOSAL SITE USE AND MONITORING

5.1 DISPOSAL ACTIVITY AND SITE USE

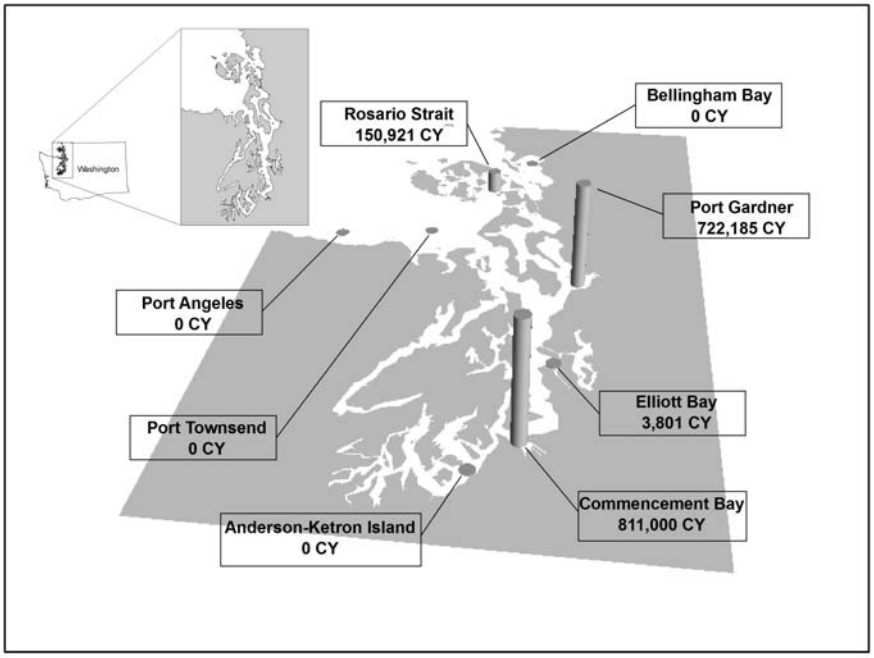
The Washington State Department of Natural Resources (DNR) issues site-use authorizations to project proponents electing to dispose of suitable dredged material at PSDDA and Grays Harbor/Willapa Bay (GH/WB) designated disposal sites. These authorizations are issued for sediments that are 1) suitable 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 2006 and 2007. This information is discussed by dredging year and individual disposal site.

Dredging Year 2006 (June 16, 2005 through June 15, 2006). In DY06, a total of 1,687,907 cubic yards (cy) of dredged material were deposited at four PSDDA sites. Of the four PSDDA sites utilized in DY06, Commencement Bay received the bulk of the material with 811,000 cy from one project, followed by Port Gardner in second with disposal of 722,185 cy from three projects. The Elliott Bay site received only 3,801 cy from one project, while the Rosario Strait site received 150,921 cy from two projects during DY06.

In Grays Harbor a total of 1,503,230 cy were disposed at the two estuarine disposal sites. An additional total of 182,062 cy of Grays Harbor sediments was placed at two beneficial uses sites: Half Moon Bay received 126,892 cy of federal maintenance dredged material, while 55,170 cy was disposed at the South Beach beneficial use site. The Goose Point (Willapa Bay) disposal site received 95,973 cy from a single project during DY06. The volumes disposed at both Puget Sound and Grays Harbor sites in DY06 are graphically presented in Figures 5-1a and 5-1b, and are summarized in Tables 5-1 and 5-2.

Dredging Year 2007 (June 16, 2006 through June 15, 2007). In DY07, a total of 1,597,246 cy of dredged material were deposited at six PSDDA sites. The bulk of the material was disposed of at the Commencement Bay site with 1,324,254 cy from one project, the Port of Tacoma's Blair Waterway Development Project. The Elliott Bay site received 24,250 cy from one project (Fisherman's Terminal). The dispersive Rosario Strait site received 20,970 cy from one project (LaConner Marina), while the dispersive Port Townsend site received 10,996 from one project (Pt. Hudson Marina), the Anderson/Ketron Island site received 10,407 cy from a single project (Olympia Yacht Club), and the Port Gardner site received 4,400 cy from one project (12th Street Marina). Additionally, the Corps placed 75,000 cy from Everett maintenance dredging at the Jetty Island beneficial use site, and dredged Keystone Harbor, placing 25,199 cy on the adjacent beach as a beneficial use.

In Grays Harbor 1,021,493 cy were disposed at the two estuarine disposal sites from Corps maintenance dredging, and no disposal took place at the Southwest ocean site. A total of 140,406 cy was placed at the Half Moon Bay beneficial use site, and no material was placed at the South Beach beneficial use site. No disposal took place at the Willapa Bay disposal sites. Additionally, the Corps placed 9,600 cy of maintenance dredged material from the Quillayute Harbor at an upland disposal site at the Quillayute Indian Reservation. The volumes disposed at both Puget Sound and Grays Harbor sites are graphically presented in Figures 5-2a and 5-2b, and are summarized in Tables 5-3 and 5-4.



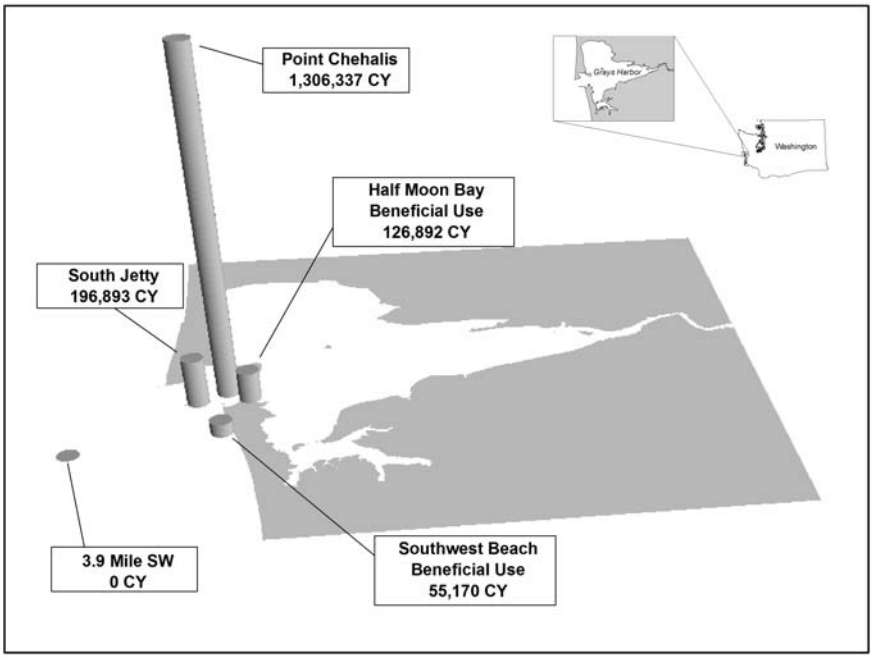
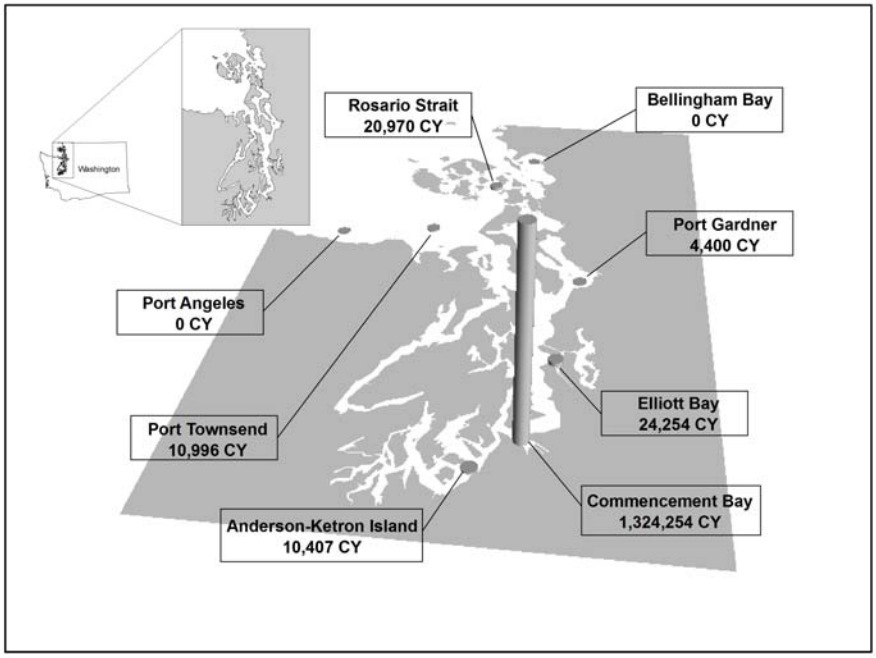


Figure 5-1a (Upper). DY06 disposal volumes in Puget Sound
Figure 5-1b (Lower). DY06 disposal volumes in Grays Harbor



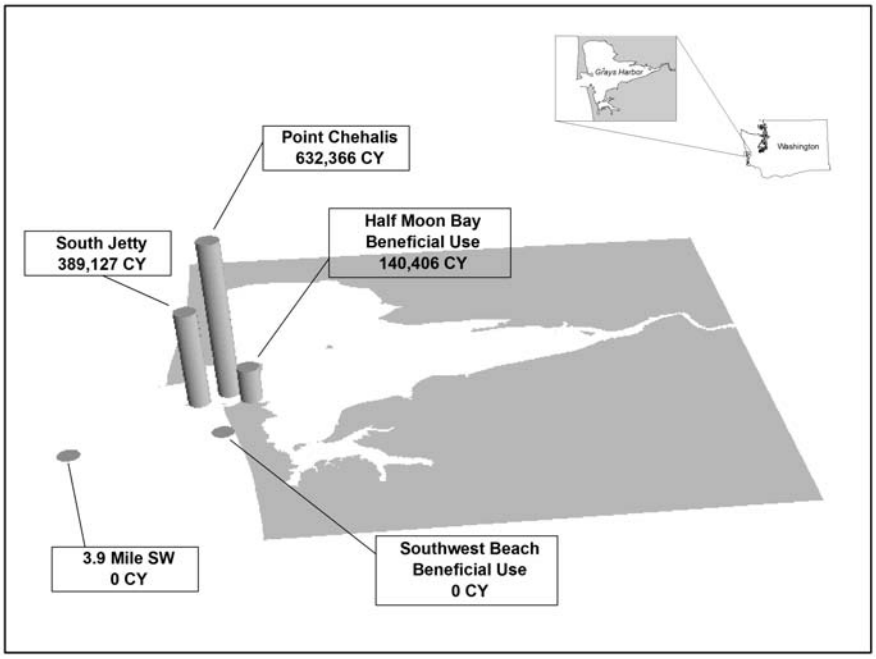


Figure 5-2a (Upper). DY07 disposal volumes in Puget Sound
Figure 5-2b (Lower). DY07 disposal volumes in Grays Harbor

Table 5-1. Disposal Site Activity Summary, DY06

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Commencement Bay	PSDDA	1	811,000
Port Gardner	PSDDA	3	722,185
Elliott Bay	PSDDA	1	3,801
Rosario Straight	PSDDA	2	150,921
Point Chehalis	Grays Harbor	2	1,306,337
South Jetty	Grays Harbor	1	196,893
SB-BU	Grays Harbor	1	55,170
HMB-BU	Grays Harbor	1	126,892
Goose Point	Willapa Bay	1	95,973
All Sites within Puget Sound Jurisdiction	PSDDA sites Puget Sound	6	1,687,907
All Sites within GH/WB Jurisdiction	Grays Harbor Estuarine sites Grays Harbor BU Willapa Bay sites	3 2 1	1,503,230 182,062 95,973

Table 5-2. Summary of Disposal Activity by Jurisdiction and Site, DY06

Site	Proponent	Dredging Contractor	Disposal Volume (cy)	# Barge Loads	Off Site	Disposal Dates
CB	Port of Tacoma, Blair Waterway	Dutra Dredging	811,000	233	No	11/22/05 – 2/28/06
PG	Port of Everett , 12th Street	Dutra Dredging	390,180	143	No	9/21/05 – 11/06/05
PG	Port of Everett, Snohomish R.	General Construction	177,180	115	No	12/06/05 – 12/30/06
PG	USACE, Everett O&M	General Construction	154,806	115	No	12/6/05 – 12/30/05
EB	Port of Silverdale	American Construction	3,801	4	No	08/24/05 – 8/30/06
RS	Port of Anacortes	Dutra Dredging	81,802	38	No	11/07/05 – 12/15/05
RS	Port of La Conner	American Construction	69,119	45	No	10/11/05 – 2/15/06
PC	USACE, Grays Harbor O&M	Great Lakes	801,555	195	No	11/11/05 – 2/2/06
PC	USACE, Grays Harbor O&M	Corps Hopper Dredge	473,282	312	No	4/30/06 – 5/30/06
SJ	USACE, Grays Harbor O&M	Great Lakes	196,893	62	No	11/21/05 – 2/2/06
SB-BU	USACE, Grays Harbor O&M	Corps Hopper Dredge	55,170	10	No	5/4/06 – 5/15/06
HMB-BU	USACE, Grays Harbor O&M	Corps Hopper Dredge	126,892	127	No	4/30/06 – 5/30/06
GP	Port of Peninsula, Willapa Bay	Hickey Marine Enterprise	95,973	85	No	11/16/05 – 12/09/05

Legend: CB = Commencement Bay; PG = Port Gardner; EB = Elliott Bay; RS = Rosario Strait; PC = Point Chehalis (Grays Harbor); SJ = South Jetty (Grays Harbor); SB-BU = South Beach beneficial use (Grays Harbor); Half Moon Bay beneficial use (Grays Harbor); GP = Goose Point (Willapa Bay)

Table 5-3. Disposal Site Activity Summary, DY07

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Commencement Bay	PSDDA	1	1,324,254
Anderson/Ketron Island	PSDDA	1	10,407
Elliott Bay	PSDDA	1	24,250
Port Gardner	PSDDA	1	4,400
Rosario Straight	PSDDA	2	20,970
Port Townsend	PSDDA	1	10,996
Keystone Harbor Beach BU	PSDDA	1	25,199
Jetty Island Beach BU	PSDDA	1	75,000
Point Chehalis	Grays Harbor	2	632,366
South Jetty	Grays Harbor	1	389,127
Half Moon Bay BU	Grays Harbor	1	140,406
Upland, Quillayute Harbor	Coastal Washington	1	9,600
All Sites within Puget Sound Jurisdiction	PSDDA sites Puget Sounds Keystone Beach BU Jetty Island (Everett) BU	7 1 1	1,597,246 25,199 75,000
All Sites within Grays Harbor and Willapa Bay Jurisdiction	Grays Harbor Estuarine sites Grays Harbor BU Willapa Bay sites	2 1 0	1,021,493 140,406 0
Coastal Washington	Quillayute Harbor Upland	1	9,600

Table 5-4. Summary of Disposal Activity by Jurisdiction and Site, DY07

Site	Proponent	Dredging Contractor	Disposal Volume (cy)	# Barge Loads	Off Site	Disposal Dates
CB	Port of Tacoma, Blair Waterway	Manson Construction	1,324,254	897	No	8/22/06 – 2/28/07
AK	Olympia Yacht Club, Hope Island Outstation	Star Marine	10,407	8	No	1/24/07 – 2/2/07
EB	Port of Seattle, Fisherman's Terminal	Island Tug & Barge	24,250	14	No	11/14/06 – 12/15/06
PG	Port of Everett, 12th Street Marina	American Construction	4,400	2	No	1/1/07 – 1/5/07
RS	Port of Skagit County, LaConner Marina	Dunlap Towing	4,500	3	No	10/10/06 – 10/26/06
RS	Anchor Cove Condo	Dunlap Towing	16,470	7	No	11/3/06 – 1/31/07
PT	Port of Port Townsend, Pt. Hudson Marina	Forewest Maritime	10,996	19	No	1/16/07 – 2/19/07
KS – BU	USACE, Keystone Harbor O&M	American Const., Clamshell	25,199	16	NA	10/31/06 – 11/20/06
JI – BU	USACE, Everett Harbor O&M	Manson, Pipeline	75,000	NA	NA	1/29/07 – 2/20/07
PC	USACE, Grays Harbor O&M	American Const., Clamshell	362,048	145	No	12/18/06 – 2/11/07
PC	USACE, Grays Harbor O&M	Corps Hopper Dredge Yaquina	237,206	375	No	4/24/07 – 5/25/07
PC	Port of Grays Harbor, Terminal 2	Brusco Tug & Barge	33,112	12	No	2/6/07 – 2/12/07
SJ	USACE, Grays Harbor O&M	Corps Hopper Dredge Essayons	332,611	96	No	4/14/07 – 4/25/07
SJ	USACE, Grays Harbor O&M	American Const., Clamshell	56,516		No	12/18/06 – 2/11/07
HMB – BU	USACE, Grays Harbor O&M	Corps Hopper Dredge Yaquina	140,406		No	4/24/07 – 5/25/07
Upland - BU	USACE, Quillayute O&M	American Const., Clamshell	9,600	NA	NA	5/12/07 – 5/27/07

Legend: CB = Commencement Bay; AK = Anderson/Ketron Island; EB = Elliott Bay; PG = Port Gardner; RS = Rosario Strait; PT = Port Townsend; KS – BU = Keystone beneficial use (beach); JI – BU = Jetty Island beneficial use (beach); PC = Point Chehalis (Grays Harbor); SJ = South Jetty (Grays Harbor); HMB = Half Moon Bay beneficial use (Grays Harbor); Upland - BU = Quillayute Tribal Reservation upland beneficial use

5.2 POST-DISPOSAL SITE MONITORING (2006 – 2007)

Environmental monitoring is the primary public feedback tool utilized in the management of DMMP 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 DMMP 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 DMMP 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 CTS (Chemical Tracking System) a time-trend analysis approach, and 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 DMMP site monitoring was designed to collect data to answer the three questions and six testable hypotheses (Table 5-5). The DMMP 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 Corps is responsible for physical monitoring at all eight disposal sites, while DNR is responsible for chemical and biological monitoring at the five Puget Sound non-dispersive disposal sites. This environmental monitoring is conducted at irregular intervals based on the documented pattern of disposal site-use occurring between monitoring surveys. 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. For the Central Puget Sound Sites, the DMMP agencies have established a soft trigger of 500,000 cubic yards to initiate monitoring at these sites. The soft-trigger requires the DMMP agencies to evaluate whether disposal site monitoring is warranted based on an analysis of the projects utilizing the sites and the relative priority after balancing the needs for monitoring at other sites using best-professional-judgment

During the 2006 dredging year (June 16, 2005 to June 15, 2006) a total of 722,185 cubic yards from 3 projects was disposed at the Port Gardner site. The site was last monitored in 1994, with relatively low site use until 2006 (e.g., no disposals in 1998, 1999, 2000, 2003, 2004, 2005), and a total volume of 1,383,860 cy was cumulatively disposed at the site since 1994. Therefore, the DMMP agencies placed monitoring at this site as a high priority in 2006.

During the 2007 dredging year (June 16, 2006 to June 15, 2007) 1,324,254 cy was placed at the Commencement Bay disposal site, with only minimal disposal at three other non-dispersive sites (Figure 5-3). This volume triggered a full monitoring event. The DMMP agencies are currently conducting a NEPA/SEPA evaluation of the Commencement Bay site and the 2007 monitoring information was gathered to help inform that evaluation. As part of that effort, the DMMP also elected to assess demersal bottom-feeding fishes and invertebrates at this site and vicinity through a trawling study (7.6 meter Otter Trawl).

As part of a special dioxin baseline data acquisition effort, the DMMP agencies analyzed archived sediment and tissue data from the 2005 Anderson/Ketron Island Monitoring effort. The DMMP agencies collected dioxin baseline sediment and tissue data at the Port Gardner disposal site in 2006, and subsequently collected dioxin baseline sediment and tissue data at the Commencement Bay, Elliott Bay and Bellingham Bay non-dispersive sites in 2007. The dioxin/furans data for all non-dispersive sites are summarized later in this report. The DMMP agencies are in the process of working with regional stakeholders to evaluate alternatives to develop a dioxin/furans regulatory framework for evaluating suitability of dredged material for open-water disposal at both non-dispersive and dispersive disposal sites.

Full Monitoring at the Port Gardner Disposal Site (2006). The Port Gardner disposal site was only used sparingly between 1994 and 2005 (no disposal in 1998, 1999, 2000, 2001, 2003-2005), but had 722,185 cy disposed at the site during dredging year 2006, which triggered full-monitoring at the site during June 2007. This monitoring effort examined all three monitoring questions, and six testable hypotheses as noted in Table 5-5. Additionally, baseline dioxin/furan data was collected at the Port Gardner site as part of an effort to collect dioxin baseline data at all five non-dispersive sites, and these data will be described in a separate section to follow summarizing these data for all five sites.

Port Gardner Monitoring Results (2006). The Port Gardner Sediment Profile Imagery (SPI) survey was conducted with a Benthos Model 3731 Sediment Profile Camera equipped with an Ocean Imaging System digital camera. A total of 183 images were collected from 61 stations (e.g., triplicate replicates/station) including 14 onsite, 16 perimeter, 17 transect, 12 central cross, and 2 benchmark stations. Following SPI image collection, a computer image analysis system was used to analyze the SPI images for the presence of dredged material, and other physical and biological parameters. The data collected consisted of grain size major mode, prism penetration depth, surface boundary roughness, presence or absence of mud clasts, apparent redox potential discontinuity (RPD) depth, infaunal successional stage, and calculation of the organism-sediment index (OSI)(Rhoads and Germano, 1982). Figure 5-3 shows the distribution of recent and historic dredged material within the disposal site, and sediments at the site center consisted of coarse to medium sand grading to silts and clays at the edges of the dredged material mound and offsite (>4 phi). The dredged material footprint was distributed well within the disposal site boundary and largely within the disposal zone. Therefore, Hypothesis No. 1 relating to Question 1 (e.g., Does the Dredged Material remain onsite?) was accepted (Table 5-5).

Table 5-5. 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 < 1/2 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 also use best professional judgment.

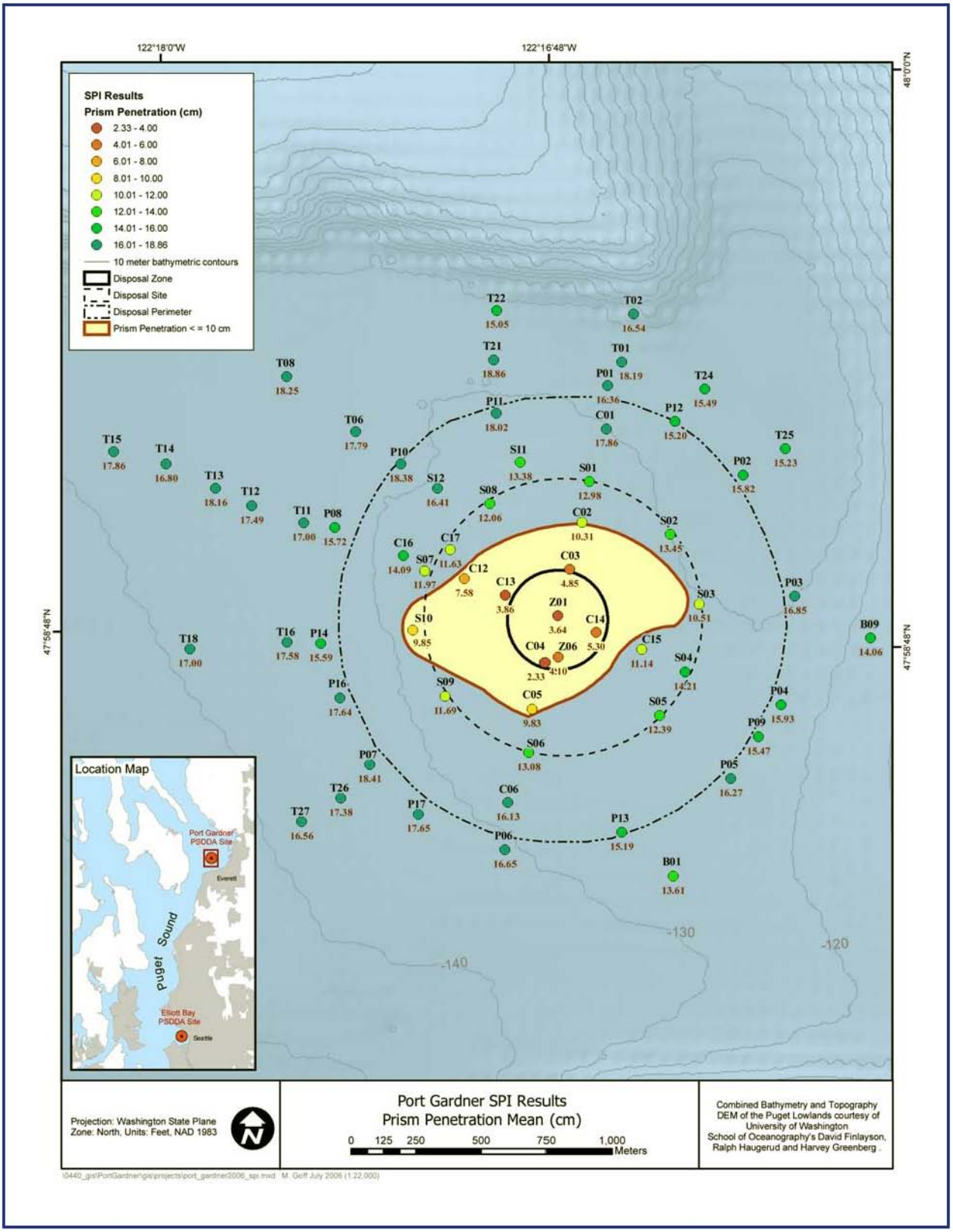


Figure 5-3. Mean Prism Penetration Depth and Dredged Material Footprint, SVPS Survey (after SAIC,2006)

The RPD ranged from 1.73 to 5.53 cm, with a average RPD depth of 3.9 cm. Benthic infaunal succession follows a three-stage succession following a physical disturbance on the seafloor as depicted in Figure 5-4. Stage III communities were observed at all stations at Port Gardner, including the onsite stations with dredged material as depicted in Figure 5-5. A stage II over III community denotes a community recovering from a physical disturbance, as depicted in Figure 5-5 within the dredged material footprint. The indicator species for Stage II classification at Port Gardner was the stick amphipod (Podoceridae). The OSI ranged from a low of +7.67 to +11.0 with a major mode of +10.7 (Figure 5.6), which indicates that the benthic habitat quality was high throughout Port Gardner, where an OSI of +6 or above are indicative of a relatively healthy benthic habitat quality. The high OSI's observed compare favorably with the predisposal initial baseline conditions (PTI, 1988).

Figure 5-7 shows the chemical and biological sampling stations occupied during the 2006 disposal site monitoring exercise. Twelve Port Gardner stations were occupied for chemical testing (3 onsite, 4 perimeter, 3 transect, and 2 benchmark stations). Additionally, 2 Carr Inlet reference stations were utilized for interpretation of onsite station toxicity testing with the bivalve larval test (*Mytilus galloprovinicalis*), amphipod acute (*Eohaustorius estuarius*), and 20-day *Neanthes* growth bioassay. Transect and benchmark stations were occupied for benthic infauna and benthic infaunal tissue analyses utilizing the sea cucumber (*Molpadia intermedia*). Onsite and perimeter sediment stations were analyzed for Biological-Chemicals-of-Concern (BCOC) list 1 and 2 chemicals. Benchmark station sediments (archived) were analyzed only for BCOC compounds with short holding times (mercury and tributyltin = TBT). All BCOC List-1 chemicals were compared to DMMP Bioaccumulation Triggers (BTs). BT's have not yet been developed for List 2 BCOCs.

Additionally, as part of a special dioxin baseline data collection effort at all the DMMP non-dispersive sites, the polychaetes *Nephtys* and *Travisia* were targeted for collection at perimeter, transect and benchmark stations. Lastly, as part of the dioxin baseline effort, a limited trawling effort (7.6 meter (25-foot) Otter Trawl, 3-meter Beam Trawl) was conducted to collect tissue samples of English Sole and Dungeness Crab for dioxin/furans analyses. The results of these dioxin/furans analyses are discussed later in this report collectively for all the non-dispersive sites.

The results of the perimeter chemistry found that all detected chemicals were well below the Washington State Sediment Quality Standards (SQS) criteria. An analysis using CTS (Chemical Tracking System) evaluated time-trends at the Port Gardner site. At perimeter stations PGP01, PGP07 and PGP09, all of the chemical groups showed decreasing trends or very small increasing trends (< 1% per year/statistically insignificant) in Chemicals-of-Concern (COCs) chemical groups over time since the predisposal 1988 baseline. For example, at Station PGP07, all the chemical groups show decreases except slight increases in HPAHs, which was statistically insignificant. The largest variation in sediment grain size parameters also occurred at Station PG07, with a statistically significant decrease in sand content and corresponding increase in clay content. The metals group shows decreasing trends at all four perimeter stations except PG08, which showed a very small increase that was not statistically significant. Therefore, based on the perimeter chemistry results comparison to SQS criteria (< SQS) and the CTS analysis results, Hypothesis No. 2 relating to Question 1 (e.g., Does the Dredged Material remain onsite?) is accepted (Table 5-5).

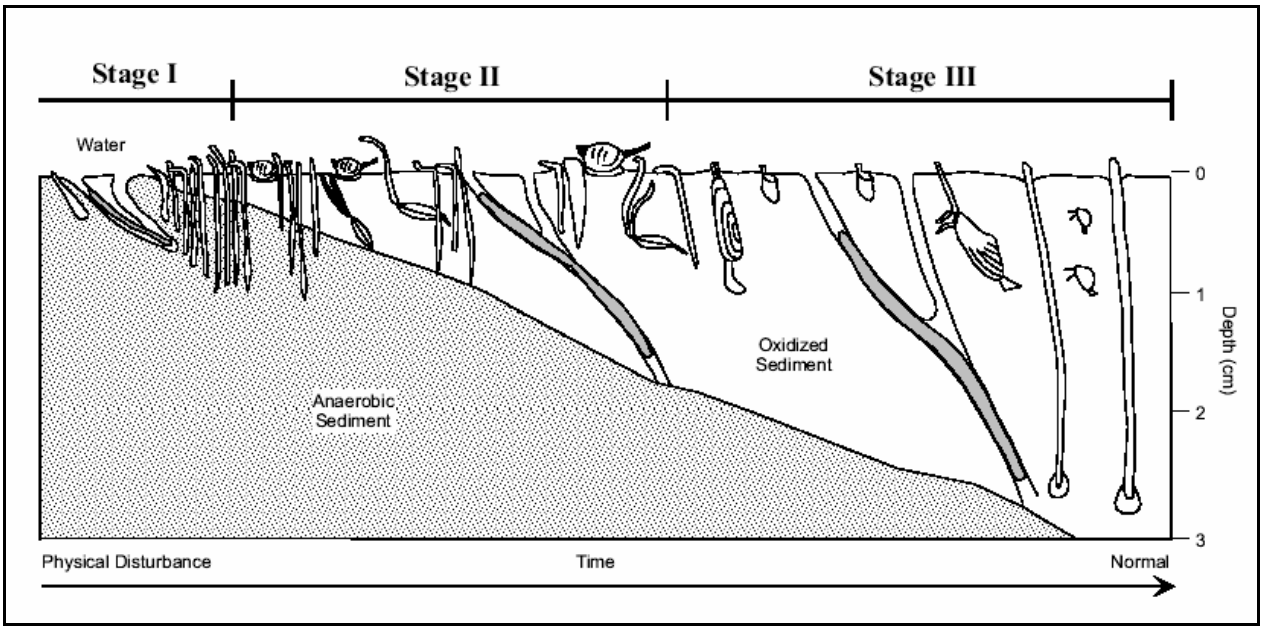


Figure 5-4. Idealized Development of Infaunal Successional Stages over time following a Physical Disturbance (after SAIC, 2006; Source: Rhoads and Germano (1986) modified from Pearson and Rosenberg (1978)).

Onsite chemistry at all three stations were less than the ML, and were actually quantitated below the SL and SQS. Therefore, Hypothesis No. 3 relating to Question 2 (e.g., Is Site Condition II Exceeded?) is accepted (Table 5-5).

Toxicity testing results at the 3 onsite stations (PGZ01, PGS04, PGS08) with the amphipod (*Eohaustorius estuaries*), sediment bivalve larval test (*Mytilus galloprovincialis*), and 20-day *Neanthes* growth test met the non-dispersive site condition II interpretation guidelines. Therefore, Hypothesis No. 4) relating to Question 2 (e.g., Is Site Condition II Exceeded? is accepted (Table 5-5).

Evaluation of tissue chemistry in the sea cucumber, *Molpadia intermedia* for the DMMP List 1 and List 2 BCOC detected only low concentrations of metals, which were well below the 1988 guideline values. All organic compounds, butyltins, and hexavalent chromium were undetected in tissue samples. Therefore, Hypothesis No. 5 relating to Question 3 (e.g., Were biological resources affected offsite?) is accepted (Table 5-5).

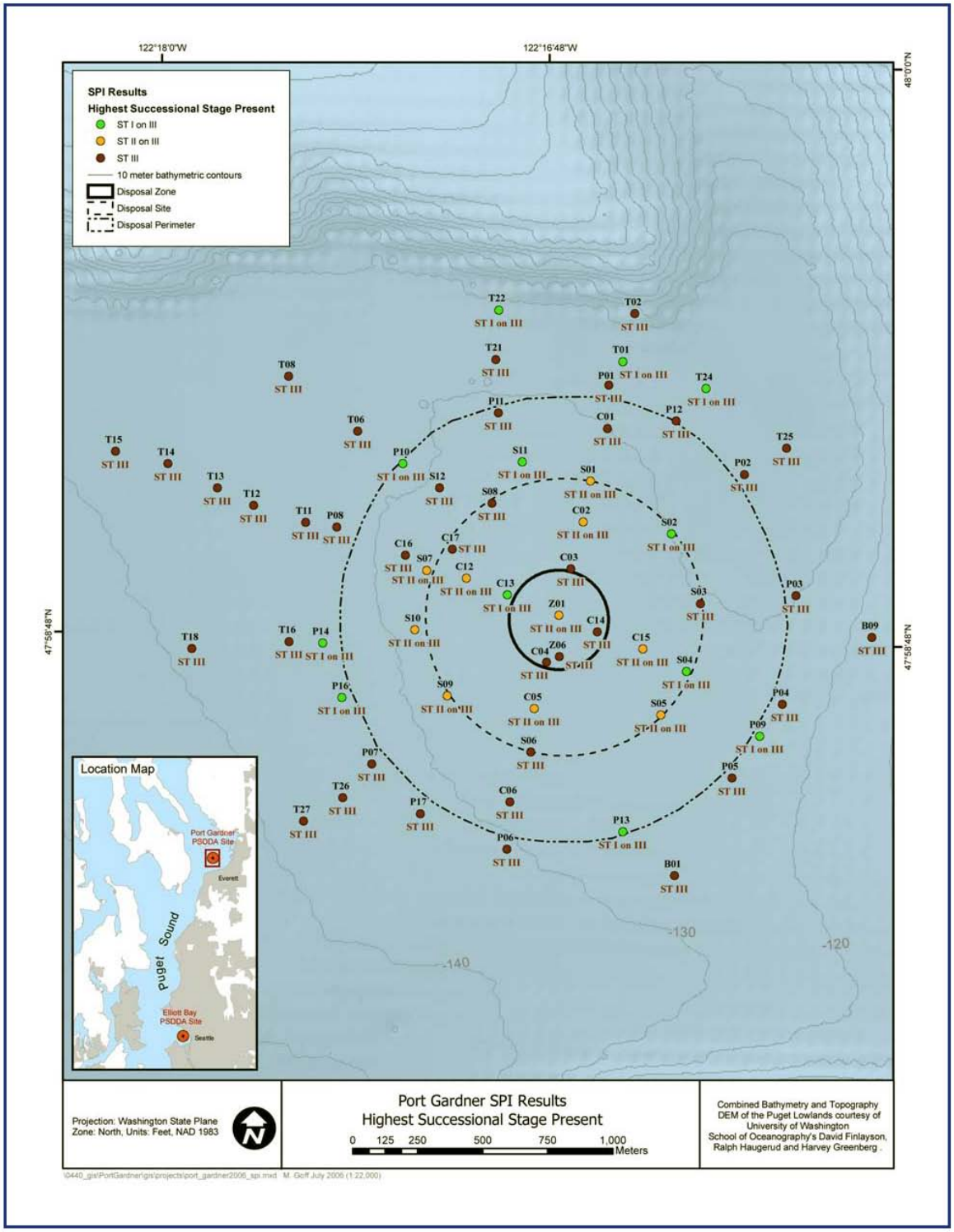


Figure 5-5. Infaunal Successional Stage Measured during the 2006 SVPS Survey (after SAIC, 2006)

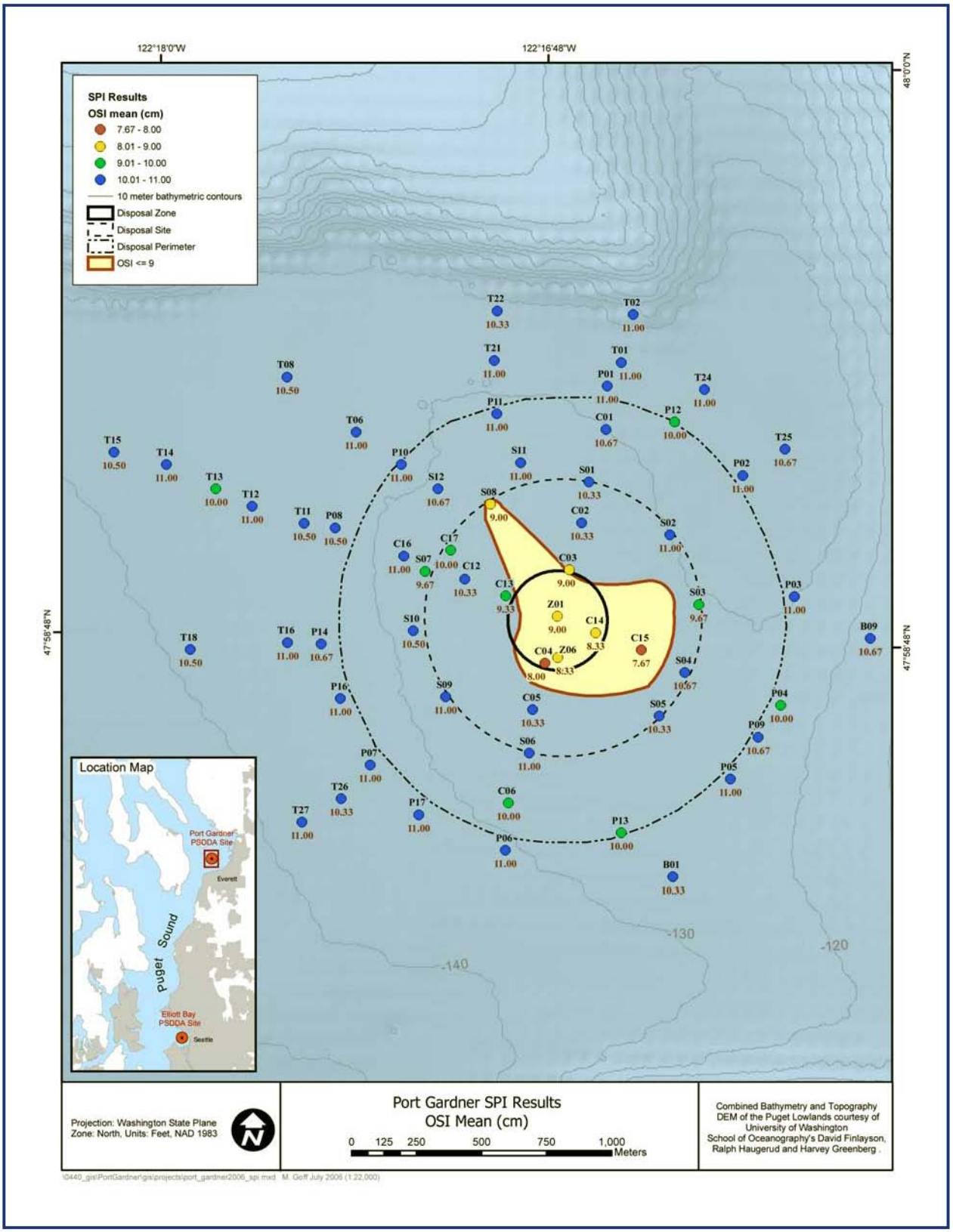


Figure 5-6. Organism Sediment Index Values Measured during the 2006 SVPS Survey (SAIC, 2006)

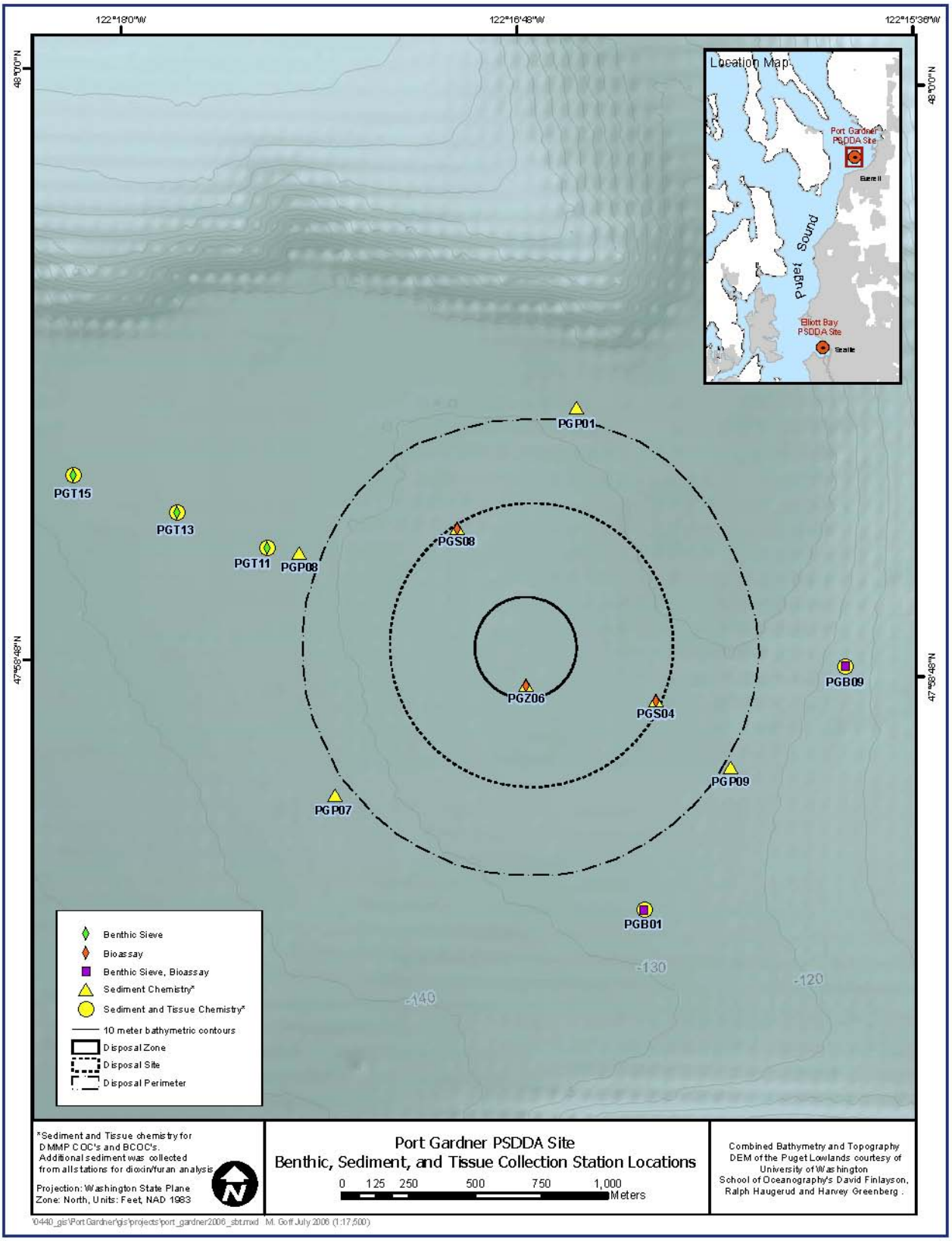


Figure 5-7. Port Gardner Sediment and Tissue Sampling Stations (SAIC, 2006)

Comparisons of the benthic taxa abundance at transect stations (i.e., annelids, arthropods, mollusca, and miscellaneous taxa) were conducted between the 2006 and 1988 baseline data, and the 1990 data. In 1990, an area wide change in benthic infaunal abundance was noted, which accounted for the net differences noted between 1988 and 1990. Therefore, comparing the 2006 results with the 1990 benthic data may more appropriate than the 1988 baseline. This comparison showed no statistically significant reductions in the abundance of major taxa groups at stations PGT11 and PGT13, but did show a significant reduction in molluscan abundance at station PGT15. This reduction may be due to natural variability rather than dredged material disposal, as this station is the farthest from the disposal activity. Because the numerically dominant taxa observed in 2006 were different than the dominant taxa from the 1990 and 1988 surveys, it appears that there has been a shift in benthic community structure. This may have occurred region wide consistent with long term benthic community structure studies by Nichols (2003), which have documented major shifts in species dominants in Puget Sound over time. Therefore, Hypothesis No. 6 relating to Question 3 (e.g., Were biological resources affected offsite?) is accepted using best professional judgment (Table 5-5).

Full Monitoring at the Commencement Bay Disposal Site (2007).

A total of 1,324,254 cy of dredged material was disposed at the Commencement Bay site during DY 2007 (June 16, 2006 to June 15, 2007), which triggered the requirement to conduct a Full Monitoring effort at this site, which was initiated during June 2007. The Corp's navigation section on behalf of the DMMP agencies conducted a multibeam bathymetric survey in June 2007 of the disposal site, to evaluate the existing dredged material footprint and mound height.

Additionally, to assist the ongoing NEPA/SEPA evaluation of the site by the DMMP agencies, a limited trawling effort was conducted with a 7.6 meter Otter Trawl to estimate the abundance of demersal bottom fish resources, and shellfish (pandalid shrimp and crab) resources within the disposal site and near-vicinity environment. These studies will augment previous siting studies conducted for the initial 1988 environmental-impact statement in the Environmental Assessment being prepared under contract for the DMMP.

Figure 5-8 depicts the 2007 Multibeam Bathymetric Survey of the dredged material disposal mound situated within the inner disposal zone (e.g., 1,800 ft diameter circle within the site boundary), and surrounding disposal site boundary, and outer perimeter line extending 1/8 nautical mile outside the disposal site boundary. It also depicts the new disposal coordinates. The site coordinates were moved 565 feet to the Southeast, which became effective on 16 June 2007 (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/CB-Site-Management-07-Clarification.pdf). The results of this survey indicate that the disposal mound is centered within the existing disposal zone and site boundary and exhibits a mound height of 121 ft with nearly 8 million cy dredged material placed at the site. There is no evidence that the existing disposal mound is migrating due to localized currents. Evidence to date is that the Commencement Bay site is located within a non-dispersive environment, and the existing mound has remained stabilized within the disposal zone over the 19 years of site use.

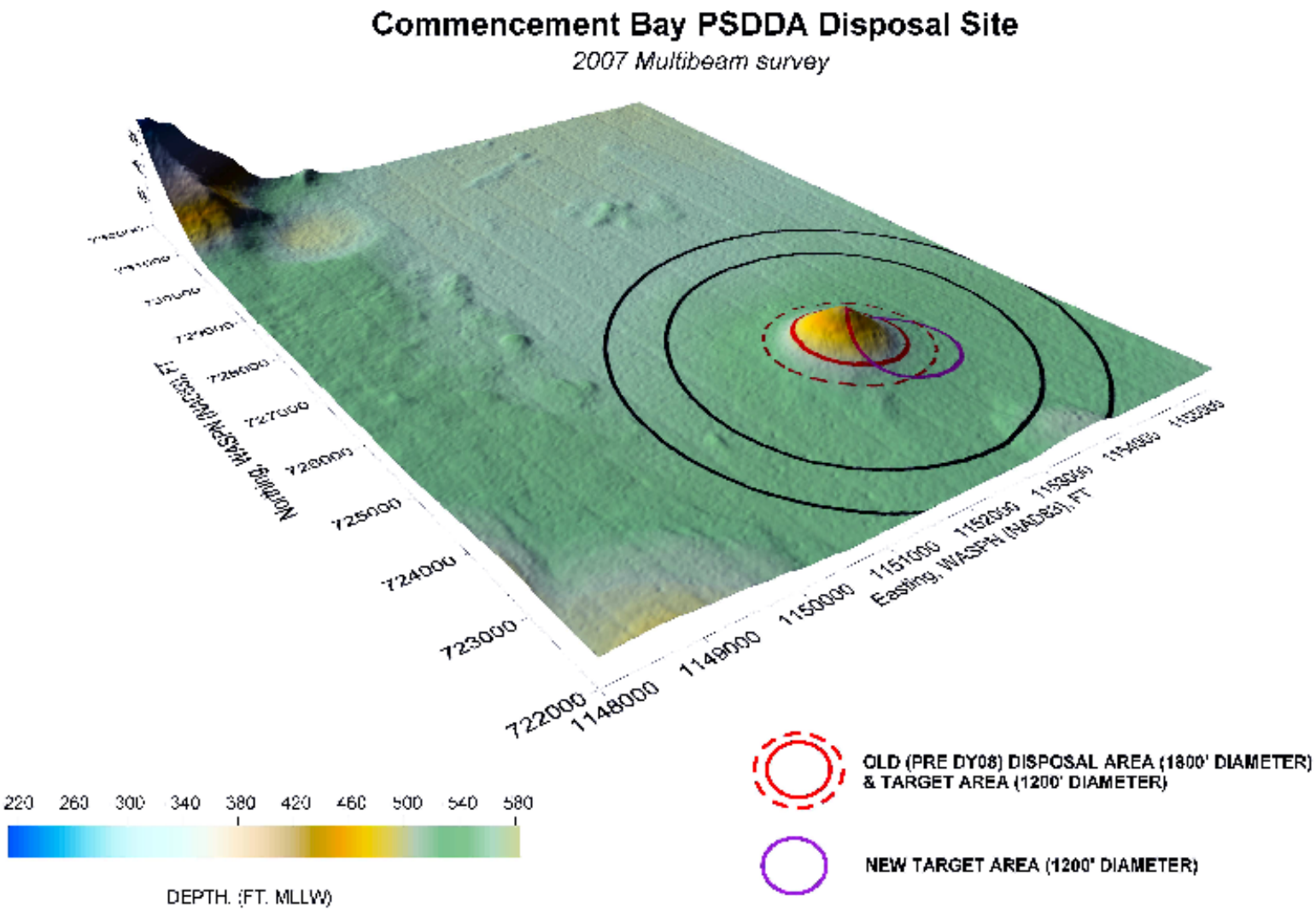


Figure 5-8. Commencement Bay DMMP disposal site with disposal mound based on 2007 Multibeam survey (vertical scale is undistorted)(after Michalsen, 2008).

Commencement Bay Monitoring Results (2007).

Physical mapping of the disposal site and dredged material footprint was accomplished with a Sediment Profile Imagery (SPI) survey using a Benthos Model 3731 Sediment Profile Camera equipped with an Ocean Imaging System digital camera. A total of 204 images were collected from 68 stations (e.g., triplicate replicates/station) including 14 onsite, 16 perimeter, 17 transect, 12 central cross, and 3 benchmark stations. Following SPI image collection, a computer image analysis system was used to analyze the SPI images for the presence of dredged material, and other physical and biological parameters. The data collected consisted of grain size major mode, prism penetration depth, surface boundary roughness, presence or absence of mud clasts, apparent redox potential discontinuity (RPD) depth, infaunal successional stage, and calculation of the organism-sediment index (OSI)(Rhoads and Germano, 1982). Figure 5-9 shows the distribution of recent and historic dredged material within the disposal site, and sediments at the site center consisted of coarse to medium sand grading to silts and clays at the edges of the dredged material mound and offsite (>4 phi). The dredged material footprint of recently deposited dredged material was largely confined within the site perimeter, with the exception of three thin lobes extending to the north, northwest, and west. However, the recent dredged material measured at perimeter stations, did not exceed the > 3 cm management trigger, ranging from 0 – 2.61 cm), although the SPI images did show historic dredged material exceeding the 3 cm trigger from past disposal at the site. Therefore, Hypothesis No. 1 relating to Question 1 (e.g., Does the Dredged Material remain onsite?) was accepted (Table 5-5).

Furthermore, the SPI survey results suggest that benthic habitat quality has not been degraded from the disposal of 1.5 million cy of dredged material in 2007, or cumulatively since the pre-disposal 1988 baseline survey at the site. The results showed Stage III benthic communities were widely dispersed at every SPI station sampled, except at 4 stations located within the site boundary (See Figure 5-10), and at 2 northern stations where the successional stage was indeterminate. The OSI values were generally high ranging from +4 to +10, with a mean of +9 (see Figure 5-11). OSI values exceeded +6 with the exception of the 4 onsite stations, and 2 northern stations where successional stage exhibited either Stage I community or was indeterminate. These results indicate that the benthic habitat quality remains high despite the relatively high disposal volumes.

Chemistry measured at the site perimeter stations were below the Sediment Management Standards "Sediment Quality Standards" (SQS) criteria, and time trend analysis with the Chemical Tracking System (CTS) indicated no significant increases in the mass of offsite chemicals or chemical groups attributable to disposal. Therefore, Hypothesis 2 relating to Question 1 was accepted.

Evaluation of Question 2 (Site Condition II was not exceeded?) indicated that Hypothesis 3, was accepted, and all chemistry results for 3 onsite Stations (CBZ01, CBS08, and CBS01) were below screening levels (SLs), and SQS. The management condition specifies that onsite chemistry < maximum level concentrations. Hypothesis 4 relative to Question 2, was also accepted, as toxicity testing at the 3 onsite stations passed the DMMP non-dispersive site interpretation guidelines, for the bivalve larval (*Mytilus galloprovincialis*) bioassay, *Neanthes* 20-day Growth, and Amphipod bioassay (*Eohaustorius estuarius*).

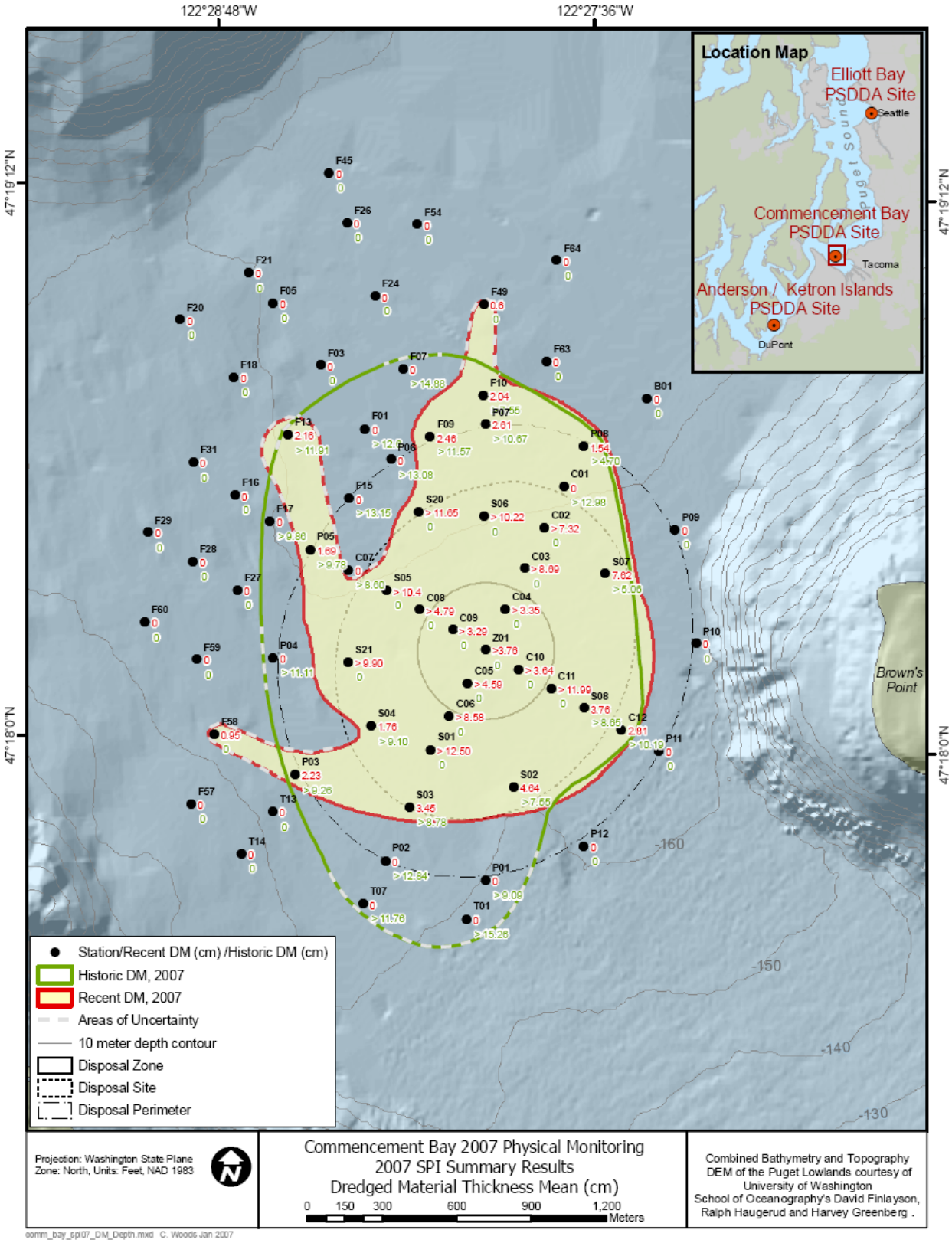


Figure 5-9. 2007 Commencement Bay Dredged Material Footprint (after SAIC, 2008a)

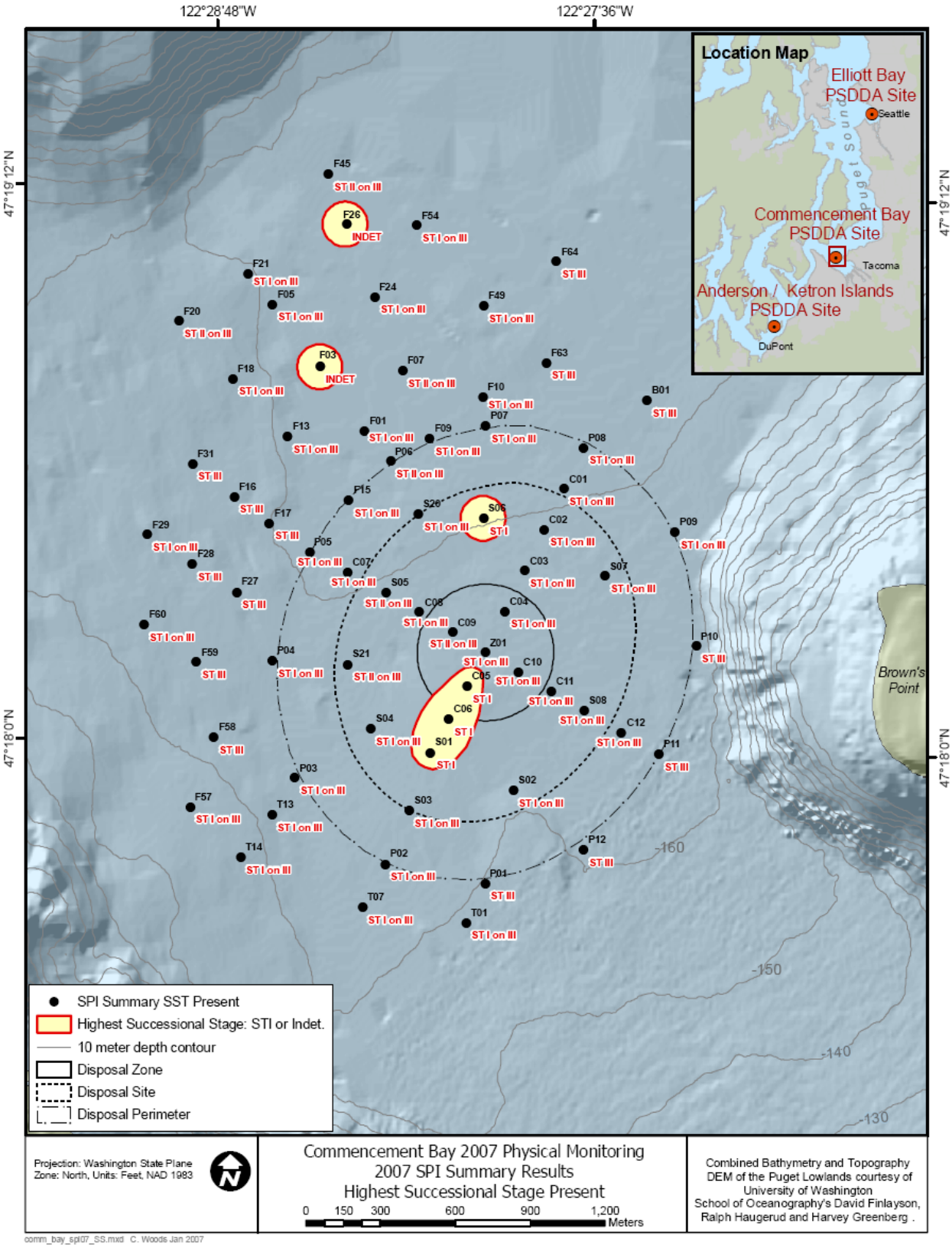


Figure 5–10. 2007 Infaunal Successional Stage Distribution (after SAIC, 2008a)

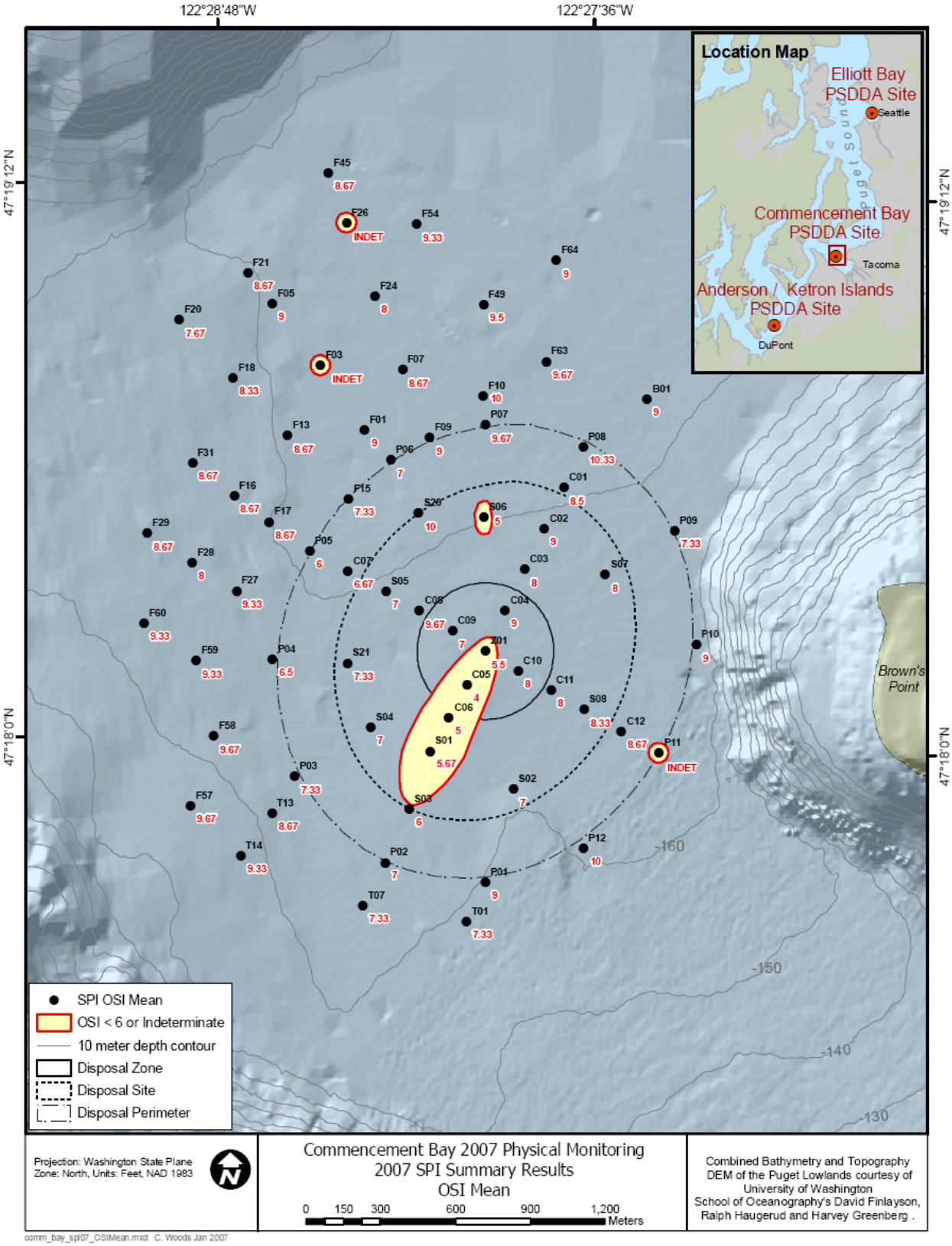


Figure 5-11. 2007 OSI Distribution (after SAIC, 2008a)

Evaluation of the biological resources offsite examines the 3rd Monitoring Question and testable Hypotheses 5 and 6. Evaluation of tissue chemical concentrations in the sea cucumber, *Molpadia intermedia* at Transect Stations indicated that Arsenic was measured at levels above the DMMP Target Tissue Levels (TTL) criteria, though these levels were comparable to the 2003 concentrations and below the guideline values. There were no detected organic compounds analyzed including compounds from the BCOC Lists 1 and 2 chemicals. Therefore, Hypothesis 5 was accepted. Analysis of benthic infaunal community abundances of major taxa found statistically significant reductions in arthropods and mollusks at Transect Stations compared to the 1995 baseline data. Archived benchmark samples were analyzed to evaluate whether the infaunal abundance reductions are due to an area wide change or related to dredged material disposal, and a similar reduction in infaunal abundance in 2001 was attributed to an area wide affect and not due to dredged material. The results of the benchmark analyses also showed a reduction in benthic taxa abundance, similar to the transect stations. Therefore, Hypothesis 6 relating to Question 3, is accepted using BPJ, and the benthic abundance changes were attributable to area-wide changes, and not due to dredged material disposal.

DMMP Dioxin/Furan Baseline Survey Summary at Non-Dispersive Sites

The DMMP agencies collected dioxin/furan baseline data at the Commencement Bay, Elliott Bay, and Bellingham Bay sites in 2007. These data complement dioxin data collected at the Port Gardner site in 2006, and the analysis of archived sediment and benthic infaunal tissue samples for the Anderson/Ketron Island site, from 2005 monitoring. The analysis of the Anderson/Ketron Island samples for dioxin/furans was triggered in 2006 after dioxin reason-to-believe issues surfaced for the Olympia Harbor Federal/Port Navigation and operation and maintenance project in lower Budd Inlet.

These data are being used in part to develop an interim regulatory approach for dioxins. During the 2007 monitoring effort at Commencement Bay, sediment and tissue samples were collected and analyzed. Additionally, the DMMP agencies agreed to conduct special dioxin/furan sampling efforts at Elliott Bay and Bellingham Bay disposal sites for sediment and tissues. Special efforts were made to collect representative benthic infaunal species at each disposal site for dioxin analysis. This effort also included conducting near site trawling with a 7.6 meter Otter Trawl to collect representative demersal fishes, targeting samples of English Sole for dioxin analysis, and Dungeness crab meat and hepatopancreas samples for dioxin/furans analyses. These analyses consisted of 3 composited analyses each of representative demersal flatfish species and crab samples (e.g., 5 crabs per analysis and 5 whole fish per analysis).

Table 5-6 summarizes the onsite and offsite dioxin in sediments, as the total Toxic Equivalence Quotients (TEQ) summed for all 17 congeners of dioxin/furan using the 2005 World Health Organization Toxic Equivalency Factors (TEFs) for all five non-dispersive sites. These analysis show that the order from highest to lowest dioxin/furan TEQ's was Elliott Bay > Bellingham Bay > Port Gardner > Anderson/Ketron Island > Commencement Bay.

Table 5-6. Dioxin/Furan Sediment Concentrations* at DMMP Nondispersive Sites

Disposal Site	Onsite: Mean (Range), n = # of stations	Offsite: Mean (Range), n = # of stations
Anderson/Ketron Island	3.1, n = 1	3.6 (1.7 – 6.8), n = 7
Commencement Bay	5.2 (1.1 – 14.2) n = 4	2.4 (0.86 – 5.2), n = 10
Elliott Bay	9.7 (2.5 – 17), n = 3	8.7 (4.0 – 12.2), n = 11)
Port Gardner	1.8 (0.71 – 2.6), n = 4	4.1 (3.1 – 5.2), n = 9)
Bellingham Bay	5.5 (4.9 – 6.1), n = 2	6.9 (4.3 – 10.5)[1],n = 9

* ppt-dry weight-TEQ, data extracted from SAIC, 2006, 2008b

Table 5-7 summarizes the dioxin/furan invertebrate and flatfish tissue data collected during 2007 at the Commencement Bay site, Elliott Bay site, and the Bellingham Bay site. It also includes archived tissue samples analyzed at the Anderson/Ketron Island site in 2006, and tissue data collected at the Port Gardner site during 2006 monitoring previously discussed. Additionally, the Puget Sound Ambient Monitoring Program (PSAMP) provided the DMMP with Dungeness Crab and English Sole samples from their monitoring efforts in Nisqually Reach during 2007. These samples were collected from the vicinity of the Anderson/Ketron Island site in order to supplement the DMMP's efforts to evaluate dioxin in tissues from this location.

Dioxin/furan tissue data have been collected for six polychaete species, three bivalve species, Dungeness crab (meat and hepatopancreas), and two species of flatfish (English Sole, and Starry Flounder). English sole was the only sampled species that was collected at all five sites. Dioxin/furan concentrations in English Sole (whole body) ranged from 0.69 ppt-TEQ to 0.29 pptr-TEQ. Dungeness Crab samples were collected at four sites. No crabs were found at the Commencement Bay site, which is consistent with the 1986 siting resource studies. Edible meat concentrations in crab ranged from 0.46 pptr-TEQ at the Anderson/Ketron Island site to 0.09 pptr-TEQ at the Bellingham Bay site. Crab hepatopancreas concentrations ranged from 13.5 pptr-TEQ at the Anderson/Ketron Island site to 2.04 pptr-TEQ at the Port Gardner site.

[1] Mean excludes Benchmark station BBB01 located near the Georgia Pacific Outfall with 22 pptr-dry- weight-TEQ

Table 5-7. Dioxin/Furan Tissue Concentrations (ppt-dry-wgt-TEQ[2])* in the Vicinity of DMMP Nondispersive Disposal Sites (after SAIC, 2008b)

Taxa	Anderson/Ketron Island	Commencement Bay	Elliott Bay	Port Gardner	Bellingham Bay
BENTHIC:					
Annelids:					
Capitellidae					0.37 (0.21 – 0.59), n = 8
Glyceridae		0.38 (0.26 - 0.56), n = 7	0.94 (0.31 – 2.51), n = 8		0.40 (0.19 – 0.61), n = 2
Maldanidae		0.35 (0.23 - 0.43), n = 4	0.49 (0.42 – 0.53), n = 3		
Nephtys sp.				0.13 (0.093 - 0.164), n = 9	
Spiondae					0.21 (0.16 – 0.25), n = 3
Travisia sp.		0.85 (0.66 - 1.07), n = 4	0.66, n = 1	0.42 (0.36 - 0.60), n = 9	
Bivalves:					
Compsomyax sp.	0.07 (0.05 - 0.13), n = 3	0.08 (0.06 - 0.09), n = 2			0.07 (0.06 – 0.083), n = 5
Yoldia sp.	0.47, n = 1				
Macoma sp.	0.14, n = 1				0.12 (0.09 – 0.14), n = 3
Dungeness Crab					
(Meat)	0.46 (0.214 - 0.716), n = 3		0.18, n = 1	0.19 (0.18 - 0.19), n = 3	0.09 (0.07 – 0.11), n = 3
(Hepatopancreas)	13.5 (11.5 - 14.9), n = 3		5.55, n = 1	2.04 (1.7 - 2.8), n = 3	2.6 (1.7 – 3.3), n = 3
English Sole (*Parophrys vetulus*) (whole body)	0.29 (0.172 - 0.345), n = 3	0.66 (0.49 - 0.92), n = 3	0.69 (0.41 – 1.03), n = 3	0.44 (0.28 - 0.57), n = 3	0.29, n = 1
Starry Flounder (*Platichthys stellatus*) (whole body)					0.10 (0.07 – 0.146), n = 3

* Table entries show mean concentration, range (in parentheses) and number of observations (n)

[2] Undetected congeners of dioxin/furan were summed at ½ detection limit

5.3 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 5-12 and 5-13 and Table 5-8. All eight DMMP Puget Sound sites have been used, and the two estuarine sites in Grays Harbor and Willapa Bay have also been utilized. Seventeen-year summaries of site use for the Puget Sound sites general show that general site capacities[3] used in the FEIS appear to be sufficient to last at least 50 years, except the Commencement Bay site which may reach the theoretical site capacity within the next 2 years (Table 5-9, Figures 5-3 and 5-12).

Table 5-10 summarizes the completed and scheduled DMMP disposal site monitoring surveys at the Puget Sound non-dispersive and dispersive sites. To date, the DMMP agencies have conducted sixteen post-disposal monitoring surveys at non-dispersive sites and three post-disposal bathymetric surveys at dispersive sites and four bathymetric surveys at the Commencement Bay site. The monitoring consisted of 5 full, 2 partial, 3 tiered-full, 3 tiered-partial monitoring, 2 SPI only surveys, and one Side Scan Sonar Survey. Additionally, three special studies were also conducted (see Table 5-8). Three bathymetric surveys have been conducted at the Rosario Strait dispersive site, which is the only Puget Sound dispersive site used on a frequent basis. During 2005 the DMMP agencies conducted a full monitoring exercise at the Anderson/Ketron Island Site, which will become the new monitoring baseline for that site. Additionally, during 2005, an SPI survey was conducted at the Commencement Bay site, a special study was conducted to evaluate phenol chemistry, and a special study was conducted at the Elliott Bay site to evaluate the onsite chemistry from recent dredging/disposal activities occurring within East Waterway within a Superfund cleanup area.

Based on Puget Sound site monitoring conducted to date (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 have consistently met the site management objectives, and appear to be adequately protecting the disposal site environments and surrounding areas.

The overall goals of the DMMP site monitoring program is to ensure that the DMMP prescribed disposal site conditions are maintained and to 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.

[3] Site Capacity, as used in the FEIS, did not mean that once reached the site had no additional capacity, but implies that additional NEPA/SEPA review would be required before a shoreline permit would be granted by the shoreline permitting agency. In the case of the Commencement Bay site, that NEPA/SEPA review is ongoing.

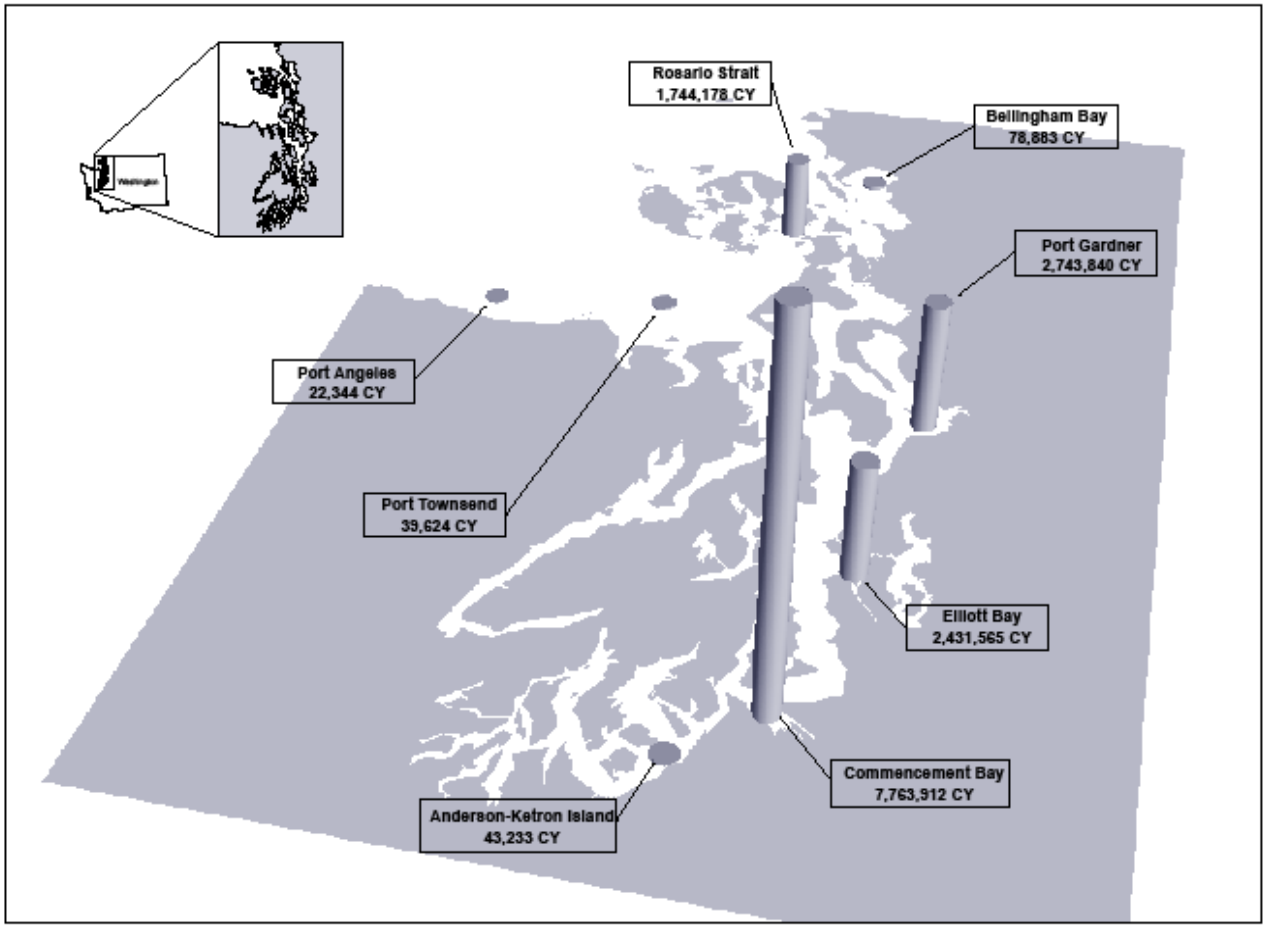


Figure 5-12. DMMP cumulative disposal volumes in Puget Sound 1989 – 2007.

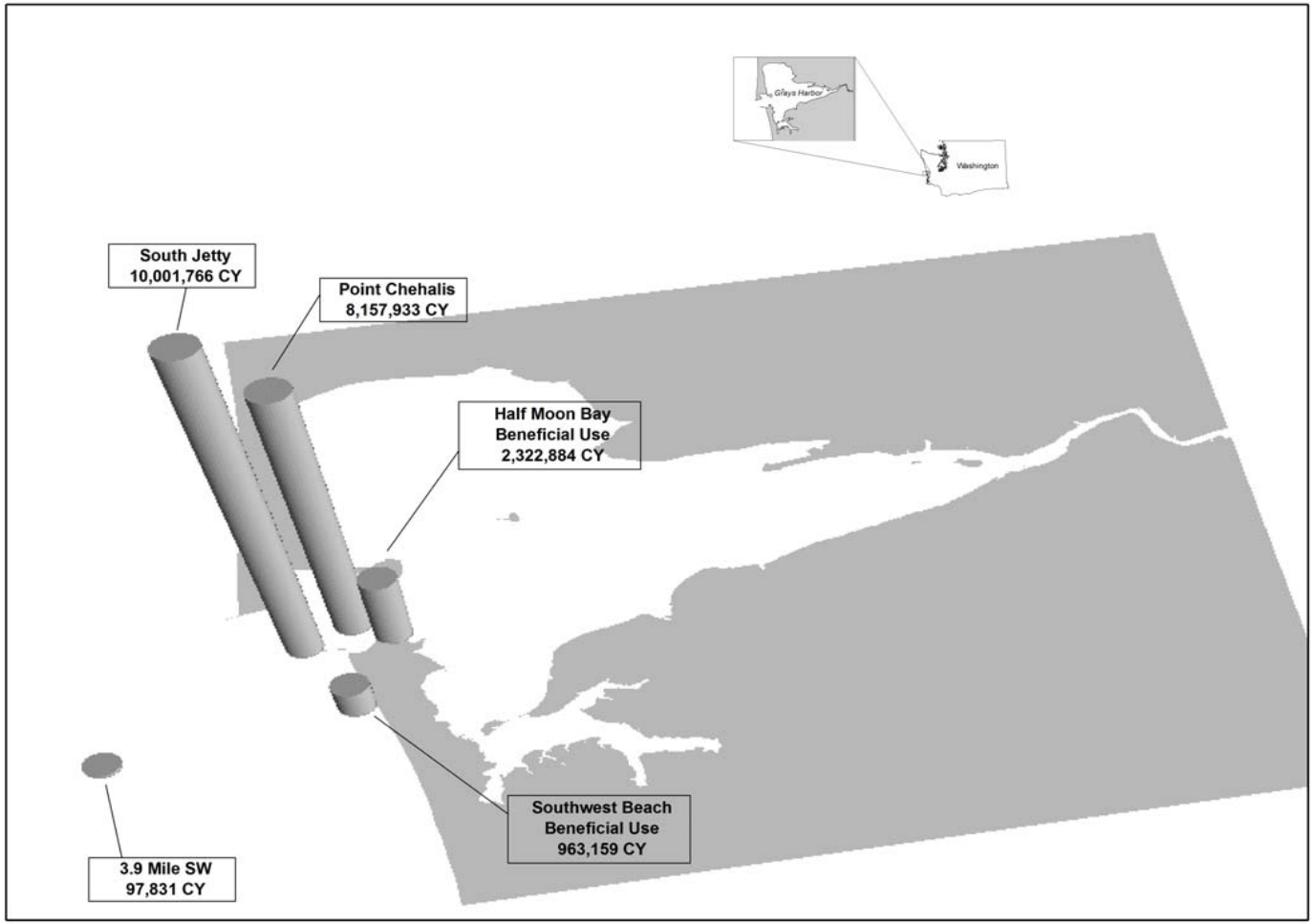


Figure 5-13. DMMP cumulative disposal volumes in Grays Harbor 1996 – 2007.

Table 5-8. Cumulative Site-Use Frequency Summary

Disposal Site	Dredging Years Used	Cumulative Volumes Disposed (cy)	Average Annual Disposal Volume (cy)
PSDDA (Central)	(1989 - 2007)		
Port Gardner (ND)	90, 91, 93, 94, 95, 96, 97, 02, 06, 07	2,743,840	144,413
Elliott Bay (ND)	90, 91, 92, 93, 94, 95, 96, 97,98, 99, 00, 01, 02, 04, 05, 06, 07	2,431,565	127,977
Commencement Bay (ND)	89, 91, 95, 96, 98, 99, 00, 01, 03, 04, 05, 06, 07	7,763,912	408,627
PSDDA (North / South)	(1990 – 2007)		
Bellingham Bay (ND)	93, 96, 98	78,883	4,382
Anderson/Ketron (ND)	93, 95, 04, 05, 07	43,233	2,402
Rosario Strait (D)	91, 92, 93, 94, 95, 96, 98, 99, 02, 03, 04, 05, 06, 07	1,744,178	96,899
Port Townsend (D)	93, 98, 99, 07	39,624	2,201
Port Angeles (D)	96	22,344	1,241
Total cumulative volume		14,867,579	782,504
GRAYS HARBOR	(1996 - 2007)		
Point Chehalis (D)	96, 97, 98, 99, 00, 01, 02, 03, 04, 05, 06, 07	8,157,933	679,828
South Jetty (D)	96, 97, 98, 99, 00, 01, 02, 03, 04, 05, 06, 07	10,001,766	833,481
Half Moon Bay (beneficial uses site)	96, 97, 98, 99, 02, 03, 04, 05, 06, 07	2,322,884	193,574
Southwest beach nourishment site	01, 02, 04, 05, 06	963,159	137,594
3.9 Mile Ocean (D)	03, 04	97,831	8,152
Total cumulative volume		21,543,573	1,795,298
WILLAPA BAY	(1996 – 2007)		
Cape Shoalwater (D)	00, 03	251,095	2,092
Goose Point (D)	99, 03, 06	205,977	17,165
Total cumulative volume		457,073	38,089

Legend: ND = nondispersive; D = dispersive

Table 5-9. Puget Sound Site-Use Summary 1989 - 2007

Non-dispersive Disposal Site	Cumulative Volumes (CY)	Average Volume per Year (CY/YR)	15-Year Predictions MPR[4] Phase I/II (CY)	Percent of 15-Year Prediction	Estimated Time to Exceed Site Capacity[5] (Years)
Port Gardner (1989-2007)	2,743,840	144,840	8,243,000	33.3	43.2
Elliott Bay (1989-2007)	2,431,565	127,977	10,525,000	23.1	51.3
Bellingham Bay (1990-2007)	78,883	4,382	1,181,500	6.7	1,583
Commencement Bay (1989-2007)	7,763,912	408,627	3,929,000	197.6	3.0[6]
Anderson/Ketron Island (1990-2007)	43,233	2,402	785,000	4.5	3,729
SUBTOTALS:	12,939,317	681,017	24,763,500	52.2	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[7] (Years)**
Rosario Strait (1990-2007)	1,744,178	96,899	1,801,000	96.8	N/A
Port Townsend (1990-2007)	39,624	2,201	687,000	5.8	N/A
Port Angeles (1990-2007)	22,344	1,241	285,000	7.8	N/A
SUBTOTALS:	1,806,146	100,341	2,773,000	65.1	N/A
GRAND TOTALS:	14,867,579	782,504	27,536,500	41.7	N/A

[4] MPR = Management Plan Reports, Phase I (Central Puget Sound), Phase II (North and South Puget sound)

[5] Site capacity estimated in Phase I and II Disposal Site Selection Technical Appendices 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.

[6] Based on the recent site use, the theoretical site capacity soft trigger of 9,000,000 cy will be exceeded in two years or less. The DMMP agencies are currently preparing a NEPA/SEPA evaluation to evaluate the long term management strategy at this site

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

Table 5-10. Puget Sound Disposal Site Monitoring Survey History[8]

Year	Disposal Site	Type of Survey
1988	Port Gardner, Elliott Bay, Commencement Bay	Initial Baseline Surveys: Full
1989	Bellingham Bay, Anderson/Ketron Island	Initial Baseline surveys: Full
1990	Bellingham Bay	Dungeness Crab Density Study
1990	Port Gardner	Full
1990	Elliott Bay	Partial
1991	Rosario Strait	Bathymetric Survey
1991	Port Gardner, Bellingham Bay	Special Study: new PG benchmark station Special Study: tissue chemistry protocol PG/BB
1992	Elliott Bay	Full
1993	Bellingham Bay	Partial, Side Scan Sonar Survey
1994	Port Gardner	Tiered-Full
1994	Rosario Strait	Bathymetric Survey
1995	Elliott Bay	Side Scan Sonar Survey (debris evaluation)
1995	Commencement Bay	Tiered-Full (new baseline)
1996	Commencement Bay	Tiered-Partial
1998	Commencement Bay	SPI Survey
1999	Rosario Strait	Bathymetric Survey
2000	Elliott Bay	Full, special PCB Congener Study, 45-day bioaccumulation
2001	Commencement Bay	Full + Bathymetric Survey
2002	Elliott Bay	Tiered-Full, BCOC special study
2003	Commencement Bay	Tiered-Full
2004	Commencement Bay	Tiered-Partial + Bathymetric Survey
2005	Commencement Bay	SPI Survey + Special Phenol Study
2005	Anderson/Ketron Island	Full (new baseline) + Dioxin (sediment + tissue)
2005	Elliott Bay	Special Onsite Chemistry Study
2006	Port Gardner	Full, dioxin baseline (S + T)[9]
2006	Commencement Bay	Multibeam bathymetric Survey (MBS)
2007	Commencement Bay, Bellingham Bay, Elliott Bay,	Tiered Full @ CB site + MBS + Resource Trawls; dioxin baseline (S + T) at all 3 sites

Legend. SPI = Sediment Profile Imagery Survey; PG = Port Gardner; BB = Bellingham Bay; BCOC = bioaccumulative chemicals of concern; Partial = Answers 1st 2 Monitoring Questions (hypothesis 1-4);
Full = Answers all 3 Monitoring Questions (Hypothesis 1-6); S = Sediment; T = Tissue

[8] The DMMP agencies elected to forego monitoring between 1997-2000 due to DNR R&D contract at the request of DMMP directors to develop *Leptocheirus* sp. As a potential chronic/sublethal bioassay.

[9] Includes tissue dioxin for English Sole and Dungeness Crab and 2 species of polychaetes (*Travisia*, *Nephtys* at Port Gardner), and various polychaete and bivalve species tissues at Commencement Bay, Elliott Bay, and Bellingham Bay sites.

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 date 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, 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, but left the volume trigger at 300,000 cy for the two less frequently used non-dispersive sites (Bellingham Bay and Ketron/Anderson Island). It should be emphasized that the monitoring triggers are soft triggers, and may be relaxed at the discretion of the DMMP agencies based on best-professional-judgment.

The Corps, in consultation with the DMMP agencies re-initiated 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) during March 2005 relative to the Puget Sound disposal sites after updating the existing programmatic biological evaluation (USACE, 2005). The findings of NMFS and USFWS in their respective concurrence letters (June 15, 2005 and May 17, 2005) 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 2007, the DMMP agencies re-initiated consultation with the NMFS for Puget Sound Steelhead (*Oncorhynchus mykiss*) and Southern resident (SR) killer whales (*Orcinus orca*) and SR killer whale critical habitat (USACE, 2007), and received concurrence letters (June 26, 2007, and August 21, 2007) on both species, that the sites "**may affect", but are "not likely to adversely affect"** for both PS steelhead and SR killer whales. NMFS also analyzed the potential impacts of the projects on SR killer whale critical habitat and determined that effects on that habitat will be insignificant.

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, updated the existing Essential Fish Habitat Assessment for the eight PSDDA disposal sites in Puget Sound as part of the Programmatic Biological Evaluation for the Section 7 ESA Consultation. The objective of this EFH assessment was 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 16 years of operation of the sites, the program management plan has effectively protected the environment from unacceptable impacts. Continued use of the DMMP 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 (June15, 2005 letter) under consultation on the EFH programmatic

assessment, which will be in effect until June 2010, 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 - DY06/07 GUIDELINE VALUES

CHEMICAL NAME	Units	SL	BT	ML	(SL+ ML)/2
METALS					
Antimony	mg/kg	150	---	200	175
Arsenic	mg/kg	57	507.1	700	378.5
Cadmium	mg/kg	5.1	11.3	14	9.55
Chromium	mg/kg	---	267	---	---
Copper	mg/kg	390	1,027	1,300	845
Lead	mg/kg	450	975	1,200	825
Mercury	mg/kg	0.41	1.5	2.3	1.355
Nickel	mg/kg	140	370	370	255
Selenium	mg/kg	---	3	---	---
Silver	mg/kg	6.1	6.1	8.4	7.25
Zinc	mg/kg	410	2,783	3,800	2,105
ORGANOMETALLICS					
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[1]	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	11,980	16,000	9,300
Benzo(a)anthracene	ug/kg	1,300	---	5,100	3,200
Benzofluoranthenes (sum of b,j,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	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	---	110	72.5
1,3-Dichlorobenzene	ug/kg	170	---	---	
1,4-Dichlorobenzene	ug/kg	110	---	120	115
Hexachlorobenzene (HCB)	ug/kg	22	168	230	126

CHEMICAL NAME	Units	SL	BT	ML	(SL+ ML)/2
PHTHALATES					
Bis(2-ethylhexyl) phthalate	ug/kg	1,300	---	8300	4,800
Butylbenzyl phthalate	ug/kg	63	---	970	517
Di-n-butyl phthalate	ug/kg	1,400	---	5100	3,250
Di-n-octyl phthalate	ug/kg	6,200	---	6200	6,200
Diethyl phthalate	ug/kg	200	---	1200	700
Dimethyl phthalate	ug/kg	71	---	1400	736
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	---	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	1120
Hexachlorobutadiene	ug/kg	29	---	270	149.5
Hexachloroethane	ug/kg	1,400	---	14,000	7,700
N-Nitrosodiphenylamine	ug/kg	28	---	130	79
VOLATILE ORGANICS					
Ethylbenzene	ug/kg	10	---	50	30
Tetrachloroethene	ug/kg	57	---	210	133.5
Total Xylene (sum of o,m,p)	ug/kg	40	---	160	100
Trichloroethane	ug/kg	160	---	1,600	880
PESTICIDES AND PCBs					
Total DDT[2]	ug/kg	6.9	50	69	37.95
Aldrin	ug/kg	10	---	---	
Total Chlordane[3]	ug/kg	10	37	---	
Dieldrin	ug/kg	10	---	---	
Heptachlor	ug/kg	10	---	---	
Gamma-BHC (Lindane)	ug/kg	10	---	---	
Total PCBs	ug/kg	130	38[4]	3,100	1,615

[1]2-Methylnaphthalene is not included in the summation for total LPAH.

[2]Total DDT is the sum of 4,4'-DDD, 4,4'-DDE and 4,4'-DDT.

[3]Total Chlordane is the sum of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane.

[4]This value is normalized to total organic carbon and is expressed in mg/kg carbon.

APPENDIX B - BIOASSAY PERFORMANCE STANDARDS AND EVALUATION GUIDELINES

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Dispersive Disposal Site Interpretation Guidelines		Nondispersive Disposal Site Interpretation Guidelines	
			1-hit rule	2-hit rule	1-hit rule	2-hit rule
Amphipod	$M_C \leq 10\%$	$M_R - M_C \leq 20\%$	$M_T - M_C > 20\%$ and M_T vs. M_R SS (p=.05) and		$M_T - M_C > 20\%$ and M_T vs. M_R SS (p=.05) and	
			$M_T - M_R > 10\%$	NOCN	$M_T - M_R > 30\%$	NOCN
Larval	$N_C \div I \geq 0.70$	$N_R \div N_C \geq 0.65$	$N_T \div N_C < 0.80$ and N_T/N_C vs. N_R/N_C SS (p=.10) and		$N_T \div N_C < 0.80$ and N_T/N_C vs. N_R/N_C SS (p=.10) and	
			$N_R/N_C - N_T/N_C > 0.15$	NOCN	$N_R/N_C - N_T/N_C > 0.30$	NOCN
Neanthes growth	$M_C \leq 10\%$ and $MIG_C \geq 0.38$	$M_R \leq 20\%$ and $MIG_R \div MIG_C \geq 0.80$	$MIG_T \div MIG_C < 0.80$ and MIG_T vs. MIG_R SS (p=.05) and		$MIG_T \div MIG_C < 0.80$ and MIG_T vs. MIG_R SS (p=.05) and	
			$MIG_T/MIG_R < 0.70$	NOCN	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

M = mortality, N = normal larvae, I = initial count, MIG = mean individual growth rate (mg/individual/day)
SS = statistically significant, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

Appendix C: DY 06/07 Evaluation Guideline Exceedances.

PROJECT:	Point Roberts Marina										
DMMU ID:	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Assessment Rank:	M	M	M	M	M	M	M	M	M	M	M
METALS (mg/kg)											
Antimony											
Arsenic											
Cadmium											
Chromium											
Copper											
Lead											
Mercury											
Nickel											
Selenium											
Silver											
Zinc											
LPAH (ug/kg)											
2-Methylnaphthalene											
Acenaphthene											
Acenaphthylene											
Anthracene											
Fluorene											
Naphthalene											
Phenanthrene											
Total LPAH											
HPAH (ug/kg)											
Benzo(a)anthracene											
Benzo(a)pyrene											
Benzo(g,h,i)perylene											
Benzofluoranthenes											
Chrysene											
Dibenzo(a,h)anthracene											
Fluoranthene											
Indeno(1,2,3-c,d)pyrene											
Pyrene											
Total HPAH											
CHLORINATED HYDROCARBONS (ug/kg)											
1,2,4-Trichlorobenzene											
1,2-Dichlorobenzene											
1,3-Dichlorobenzene											
1,4-Dichlorobenzene											
Hexachlorobenzene											
PHTHALATES (ug/kg)											
Bis(2-ethylhexyl)phthalate											
Butyl benzyl phthalate											
Di-n-butyl phthalate				2500 bd							
Di-n-octyl phthalate											
Diethyl phthalate											
Dimethyl phthalate											
PHENOLS (ug/kg)											
2 Methylphenol				75							
2,4-Dimethylphenol				65							
4 Methylphenol											
Pentachlorophenol											
Phenol											
MISCELLANEOUS EXTRACTABLES (ug/kg)											
Benzoic acid											
Benzyl alcohol											
Dibenzofuran											
Hexachlorobutadiene											
Hexachloroethane											
N-Nitrosodiphenylamine											
VOLATILE ORGANICS (ug/kg)											
Ethylbenzene											
Tetrachloroethene											
Total Xylene											
Trichloroethene											
PESTICIDES AND PCBs (ug/kg)											
Aldrin											
Chlordane											
Dieldrin											
Heptachlor											
Lindane											
Total DDT											
Total PCBs											
Total PCBs (carbon-normalized)											
OTHER CHEMICALS OF CONCERN											
Tributyltin (ug/l porewater)	-	-	-	-	-	-	-	-	-	-	-
Dioxins/Furans (pptr TEQ)	-	-	-	-	-	-	-	-	-	-	-
GRAINSIZE (% fines)	74.7	59.4	80.3	48	80.2	39.5	76.6	-	76.5	79.6	38.5
BIOASSAYS											
Amphipod	-	-	-	NH	-	-	-	-	-	-	-
Larval	-	-	-	NH	-	-	-	-	-	-	-
Neanthes Growth Rate	-	-	-	NH	-	-	-	-	-	-	-
Bioassay Result:	-	-	-	PASS	-	-	-	-	-	-	-
OVERALL PASS/FAIL:	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
VOLUME (CY):	15,900	15,800	15,800	14,700	14,300	14,900	13,800	14,200	13,800	15,800	16,000
HIGHEST RANKING (based on testing):	L	L	L	M	L	L	L	L	L	L	L

Appendix C: DY 06/07 Evaluation Guideline Exceedances.

PROJECT:	Port of Seattle (POS) T30					POS T91		USACE Tokeland		
DMMU ID:	S1	S2	S3	S4	S5	C1	C2	C1	C2	C3
Assessment Rank:	MH	MH	MH	MH	MH	H	H	L	L	L
METALS (mg/kg)										
Antimony										
Arsenic										
Cadmium										
Chromium										
Copper										
Lead										
Mercury										
Nickel										
Selenium										
Silver										
Zinc										
LPAH (ug/kg)										
2-Methylnaphthalene										
Acenaphthene										
Acenaphthylene										
Anthracene										
Fluorene										
Naphthalene										
Phenanthrene										
Total LPAH										
HPAH (ug/kg)										
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(g,h,i)perylene										
Benzofluoranthenes										
Chrysene										
Dibenzo(a,h)anthracene										
Fluoranthene										
Indeno(1,2,3-c,d)pyrene										
Pyrene										
Total HPAH										
CHLORINATED HYDROCARBONS (ug/kg)										
1,2,4-Trichlorobenzene										
1,2-Dichlorobenzene										
1,3-Dichlorobenzene										
1,4-Dichlorobenzene										
Hexachlorobenzene										30 u
PHTHALATES (ug/kg)										
Bis(2-ethylhexyl)phthalate										
Butyl benzyl phthalate										
Di-n-butyl phthalate										
Di-n-octyl phthalate										
Diethyl phthalate										
Dimethyl phthalate										
PHENOLS (ug/kg)										
2 Methylphenol										
2,4-Dimethylphenol									31 u	77 u
4 Methylphenol										
Pentachlorophenol										
Phenol										
MISCELLANEOUS EXTRACTABLES (ug/kg)										
Benzoic acid										1400 u
Benzyl alcohol										
Dibenzofuran										
Hexachlorobutadiene										
Hexachloroethane										
N-Nitrosodiphenylamine										31 u
VOLATILE ORGANICS (ug/kg)										
Ethylbenzene										
Tetrachloroethene										
Total Xylene										
Trichloroethene										
PESTICIDES AND PCBs (ug/kg)										
Aldrin										
Chlordane								33 ui	20 u	20 u
Dieldrin										
Heptachlor										
Lindane										
Total DDT	7.9 u						17.8			
Total PCBs										
Total PCBs (carbon-normalized)										
OTHER CHEMICALS OF CONCERN										
Tributyltin (ug/l porewater)										
Dioxins/Furans (pptr TEQ)	-	-	-	-	-	-	-	-	-	-
GRAINSIZE (% fines)	36.5							75.3	71.5	70.9
BIOASSAYS										
Amphipod	NH	-	-	-	-	-	NH	NH	NH	NH
Larval	NH	-	-	-	-	-	NH	NH	NH	NH
Neanthes Growth Rate	NH	-	-	-	-	-	NH	NH	NH	NH
Bioassay Result:	PASS	-	-	-	-	-	PASS	PASS	PASS	PASS
OVERALL PASS/FAIL:	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
VOLUME (CY):	11,100	9,600	9,600	9,600	9,600	4,700	4,700	17,394	9,351	36,101
HIGHEST RANKING (based on testing):	LM	L	L	L	L	L	LM	LM	LM	H

Appendix C: DY 06/07 Evaluation Guideline Exceedances.

PROJECT:	USACE/Port of Olympia - Olympia Harbor											
DMMU ID:	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Assessment Rank:												
METALS (mg/kg)												
Antimony												
Arsenic												
Cadmium												
Chromium												
Copper												
Lead												
Mercury												
Nickel												
Selenium												
Silver												
Zinc												
LPAH (ug/kg)												
2-Methylnaphthalene												
Acenaphthene												
Acenaphthylene												
Anthracene												
Fluorene												
Naphthalene												
Phenanthrene												
Total LPAH												
HPAH (ug/kg)												
Benzo(a)anthracene												
Benzo(a)pyrene												
Benzo(g,h,i)perylene												
Benzofluoranthenes												
Chrysene												
Dibenzo(a,h)anthracene												
Fluoranthene												
Indeno(1,2,3-c,d)pyrene												
Pyrene												
Total HPAH												
CHLORINATED HYDROCARBONS (ug/kg)												
1,2,4-Trichlorobenzene												
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
Hexachlorobenzene												
PHTHALATES (ug/kg)												
Bis(2-ethylhexyl)phthalate												
Butyl benzyl phthalate												
Di-n-butyl phthalate												
Di-n-octyl phthalate												
Diethyl phthalate												
Dimethyl phthalate												
PHENOLS (ug/kg)												
2 Methylphenol												
2,4-Dimethylphenol												
4 Methylphenol												
Pentachlorophenol												
Phenol												
MISCELLANEOUS EXTRACTABLES (ug/kg)												
Benzoic acid												
Benzyl alcohol												
Dibenzofuran												
Hexachlorobutadiene												
Hexachloroethane												
N-Nitrosodiphenylamine												
VOLATILE ORGANICS (ug/kg)												
Ethylbenzene												
Tetrachloroethene												
Total Xylene												
Trichloroethene												
PESTICIDES AND PCBs (ug/kg)												
Aldrin												
Chlordane												
Dieldrin												
Heptachlor												
Lindane												
Total DDT												
Total PCBs												
Total PCBs (carbon-normalized)												
OTHER CHEMICALS OF CONCERN												
Tributyltin (ug/l porewater)												
Dioxins/Furans (pptr TEQ)	1.9	52.3	37.4	52.6	31.2	21.2	3.2	0.1	6.9	32.3	6.4	20.0
GRAINSIZE (% fines)	3.1	89.4	74.2	66.2	94.5	89.2	22.0	25.8	49.0	100.0	52.4	96.3
BIOASSAYS												
Amphipod												
Larval												
Neanthes Growth Rate												
Bioassay Result:												
OVERALL PASS/FAIL:	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	FAIL	PASS	FAIL
VOLUME (CY):	7,547	11,643	8,310	8,403	20,774	20,148	21,283	21,584	9,014	9,014	7,952	BUP
HIGHEST RANKING (based on testing):	L	H^D	H^D	H^D	H^D	H^D	L	L	L	H^D	L	H^D

Appendix C: DY 06/07 Evaluation Guideline Exceedances.

PROJECT:	Olympia Harbor (continued)											
DMMU ID:	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24
Assessment Rank:												
METALS (mg/kg)												
Antimony												
Arsenic												
Cadmium												
Chromium												
Copper												
Lead												
Mercury												
Nickel												
Selenium												
Silver												
Zinc												
LPAH (ug/kg)												
2-Methylnaphthalene												
Acenaphthene												
Acenaphthylene												
Anthracene												
Fluorene												
Naphthalene												
Phenanthrene												
Total LPAH												
HPAH (ug/kg)												
Benzo(a)anthracene												
Benzo(a)pyrene												
Benzo(g,h,i)perylene												
Benzofluoranthenes												
Chrysene												
Dibenzo(a,h)anthracene												
Fluoranthene												
Indeno(1,2,3-c,d)pyrene												
Pyrene												
Total HPAH												
CHLORINATED HYDROCARBONS (ug/kg)												
1,2,4-Trichlorobenzene												
1,2-Dichlorobenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
Hexachlorobenzene												
PHTHALATES (ug/kg)												
Bis(2-ethylhexyl)phthalate												
Butyl benzyl phthalate												
Di-n-butyl phthalate												
Di-n-octyl phthalate												
Diethyl phthalate												
Dimethyl phthalate												
PHENOLS (ug/kg)												
2 Methylphenol												
2,4-Dimethylphenol												
4 Methylphenol												
Pentachlorophenol												
Phenol												
MISCELLANEOUS EXTRACTABLES (ug/kg)												
Benzoic acid												
Benzyl alcohol												
Dibenzofuran												
Hexachlorobutadiene												
Hexachloroethane												
N-Nitrosodiphenylamine												
VOLATILE ORGANICS (ug/kg)												
Ethylbenzene												
Tetrachloroethene												
Total Xylene												
Trichloroethene												
PESTICIDES AND PCBs (ug/kg)												
Aldrin												
Chlordane												
Dieldrin												
Heptachlor												
Lindane												
Total DDT												
Total PCBs												
Total PCBs (carbon-normalized)												
OTHER CHEMICALS OF CONCERN												
Tributyltin (ug/l porewater)												
Dioxins/Furans (pptr TEQ)	24.7	0.7	0.1	1.6	0.2	25.6	30.7	19.2	15.3	16.9	22.2	4.6
GRAINSIZE (% fines)	97.5	19.3	34.8	42.7	23.7	78.5	85.6	61.3	66.3	85.7	48.3	8.1
BIOASSAYS												
Amphipod												
Larval												
Neanthes Growth Rate												
Bioassay Result:												
OVERALL PASS/FAIL:	FAIL	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS
VOLUME (CY):	BUP	24,056	31,771	13,926	27,864	29,062	18,422	21,716	25,277	29,434	26,079	9,264
HIGHEST RANKING (based on testing):	H^D	L	L	L	L	H^D	H^D	H^D	H^D	H^D	H^D	L

Appendix C: DY 06/07 Evaluation Guideline Exceedances.

PROJECT:	Olympia Harbor (continued)				
DMMU ID:	S25	S26	S27	S28	S29
Assessment Rank:					
METALS (mg/kg)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Selenium					
Silver					
Zinc					
LPAH (ug/kg)					
2-Methylnaphthalene					
Acenaphthene					
Acenaphthylene					
Anthracene					
Fluorene					
Naphthalene					
Phenanthrene					
Total LPAH					
HPAH (ug/kg)					
Benzo(a)anthracene					
Benzo(a)pyrene					
Benzo(g,h,i)perylene					
Benzofluoranthenes					
Chrysene					
Dibenzo(a,h)anthracene					
Fluoranthene					
Indeno(1,2,3-c,d)pyrene					
Pyrene					
Total HPAH					
CHLORINATED HYDROCARBONS (ug/kg)					
1,2,4-Trichlorobenzene					
1,2-Dichlorobenzene					
1,3-Dichlorobenzene					
1,4-Dichlorobenzene					
Hexachlorobenzene					
PHTHALATES (ug/kg)					
Bis(2-ethylhexyl)phthalate					
Butyl benzyl phthalate					
Di-n-butyl phthalate					
Di-n-octyl phthalate					
Diethyl phthalate					
Dimethyl phthalate					
PHENOLS (ug/kg)					
2 Methylphenol					
2,4-Dimethylphenol					
4 Methylphenol					
Pentachlorophenol					
Phenol					
MISCELLANEOUS EXTRACTABLES (ug/kg)					
Benzoic acid					
Benzyl alcohol					
Dibenzofuran					
Hexachlorobutadiene					
Hexachloroethane					
N-Nitrosodiphenylamine					
VOLATILE ORGANICS (ug/kg)					
Ethylbenzene					
Tetrachloroethene					
Total Xylene					
Trichloroethene					
PESTICIDES AND PCBs (ug/kg)					
Aldrin					
Chlordane					
Dieldrin					
Heptachlor					
Lindane					
Total DDT					
Total PCBs					
Total PCBs (carbon-normalized)					
OTHER CHEMICALS OF CONCERN					
Tributyltin (ug/l porewater)					
Dioxins/Furans (pptr TEQ)	2	0.3	0.2	5.3	36.2
GRAINSIZE (% fines)	2.5	80.6	-	50.3	86.1
BIOASSAYS					
Amphipod					
Larval					
Neanthes Growth Rate					
Bioassay Result:					
OVERALL PASS/FAIL:	PASS	PASS	PASS	PASS	FAIL
VOLUME (CY):	5,898	6,752	3,674	13,827	9,952
HIGHEST RANKING (based on testing):	L	L	L	L	H^D

APPENDIX C - LEGEND

S	=	reported concentration exceeds screening level
SB	=	reported concentration exceeds screening level and bioaccumulation trigger
M	=	reported concentration exceeds maximum level
BM	=	reported concentration bioaccumulation trigger and maximum level
(U)	=	detection limit exceeds either screening level, bioaccumulation trigger, or maximum level
(B)	=	analyte detected in corresponding blank
(E)	=	estimate
(J)	=	detected between the SDL and the CRDL
(UJ)	=	analyte not detected above the sample quantitation limit; however the reported quantitation limit is approximate
(D)	=	compound required a dilution as a result of the matrix or the sample concentration
(M)	=	estimated value of anlyte found and confirmed by analyst, but with low spectral match
(N)	=	estimate based on presumptive evidence
(G)	=	estimate is greater than value shown
(Y)	=	raised non-detect due to matrix interferences
NA	=	not analyzed
NT	=	not tested
2H	=	a hit under the two-hit interpretation guideline
1H	=	a hit under the one-hit interpretation guideline
PASS	=	test sediment passes DMMP guidelines for open-water unconfined disposal
FAIL	=	test sediment fails DMMP guidelines for open-water unconfined disposal
FAIL (C)	=	DMMU found unsuitable for open-water disposal in the absence of bioaccumulation and/or Tier IV testing data
(BPJ)	=	best professional judgement applied to suitability determination
(BTI)	=	bioassay testing incomplete
L	=	the highest reported concentration was below SL
LM	=	the highest reported concentration was between SL and (SL + ML)/2
M	=	the highest reported concentration was between (SL + ML)/2 and ML
H	=	the highest reported concentration exceeded ML
H*	=	the sediment rank is based on biological testing results
H^D	=	the sediment rank is based on dioxin results