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 2010/2011

PREPARED BY THE DMMP AGENCIES

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Lower Columbia River Evaluation Framework (Washington)

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TABLE OF CONTENTS

TABLE OF CONTENTS iii
LIST OF TABLES iv
LIST OF FIGURES v
LIST OF ACRONYMS vi
CHAPTER 1. INTRODUCTION & PROJECT OVERVIEW 1
1.1 Introduction 1
1.2 Project Overview 1
CHAPTER 2. DY10/11 PROJECTS 10
2.1 Ranking 10
2.2 Sampling and Analysis Plans 12
2.3 Sampling 14
2.4 Chemical Testing 17
2.5 Biological Testing 17
2.6 Bioaccumulation Testing 17
2.7 Suitability Determinations 19
2.8 Antidegradation Evaluations 19
2.9 No-Test Determinations 23
2.10 Recency/Frequency Determinations 24
2.11 Project Revisions 24
CHAPTER 3. SUMMARY AND ASSESSMENT OF DY10/11 DATA 25
3.1 Summary of Chemical Testing Results. 25
3.2 Biological Testing 29
3.3 Bioaccumulation Testing 29
3.4 Regulatory Processing 29
CHAPTER 4. UNUSUAL AND/OR COMPLEX PROJECTS 32
4.1 Dredging Year 2010 32
4.2 Dredging Year 2011 43
CHAPTER 5. DISPOSAL SITE USE AND MONITORING 51
5.1 Disposal Activity and Site Use 51
5.2 Post-Disposal Site Monitoring (2010 – 2011) 58
5.3 Larval Rockfish Assessment (April 2011 – February 2012) 68
5.4 Fate and Transport Study – Puget Sound Dispersive Sites 70
5.5 Summary: DMMP Disposal Site Use, Activities, and Monitoring Frequency 72
5.6 Endangered Species act (ESA) Consultation 77
REFERENCES 78
APPENDIX A. DY10/DY11 GUIDELINE VALUES 80
APPENDIX B. BIOASSAY PERFORMANCE STANDARDS AND EVALUATION GUIDELINES 82
APPENDIX C. GUIDELINE EXCEEDANCES 83
APPENDIX D. DY10/DY11 DIOXIN DATA 88

LIST OF TABLES

Table 1-1. DMMP Evaluation Activities Completed in DY10. 3
Table 1-2. DMMP Evaluation Activities Completed in DY11 5
Table 1-3. DMMP Evaluation Activities Initiated in DY10/11 but ongoing into DY12 9
Table 2-1. DY10 Project Rankings 11
Table 2-2. DY11 Project Rankings 12
Table 2-3. DMMP Sampling Requirements 12
Table 2-4. DY10 Projects – Approved Sampling Plans 13
Table 2-5. DY11 Projects – Approved Sampling Plans 14
Table 2-6. DY10 Project Sampling 15
Table 2-7. DY11 Project Sampling 16
Table 2-8. DY10/11 Biological Testing Summary 18
Table 2-9. DY10 Suitability Determinations 20
Table 2-10. DY11 Suitability Determinations 21
Table 2-11. DY10/11 Antidegradation Evaluations 22
Table 2-12. DY10/11 No-Test Determinations 23
Table 2-13. DY10/11 Recency/Frequency Determinations 24
Table 2-14. DY10/11 Project Revisions 24
Table 3-1. DY10/11 Chemical Testing Exceedance Summary 26
Table 3-2. Dioxin Guidelines* Utilized to Evaluate DY10/11 Projects 27
Table 3-3. Dioxin Testing Summary for DY10/11 Projects with Dioxin Testing 28
Table 3-4. DY 08/09 Bioassay "Hit" Summary 29
Table 4-1. South Lake Union Sediment Sampling Approach prior to Excavation 39
Table 4-2. Sediment Characterization Details, South Park Bridge Project 46
Table 4-3. Bioaccumulation summary for South Park Bridge project 49
Table 5-1. Disposal-Site Activity Summary, DY10 54
Table 5-2. Project-Specific Disposal Activity, DY10 55
Table 5-3. Disposal-Site Activity Summary, DY11 56
Table-5-4. Project-Specific Disposal Activity, DY11 57
Table 5-5. Monitoring History relative to Soft Triggers and Site-Use Disposal 58
Table 5-6. The DMMP Monitoring Framework 60
Table 5-7. Calculation of the Organism-Sediment Index 65
Table 5-8. Cumulative Site-Use Frequency Summary 74
Table 5-9. Puget Sound Site-Use Summary 1989 – 2011 75
Table 5-10. Puget Sound Disposal Site Monitoring Survey History 76

LIST OF FIGURES

Figure 1-1. DY10 Puget Sound Project Locations 4
Figure 1-2. DY11 Puget Sound Project Locations 6
Figure 1-3. DY10/11 Coastal Project Locations 7
Figure 1-4. DY10/11 Columbia River Project Locations 8
Figure 3-1. DMMP Processing Time (means for DY 10/11 projects in days) 31
Figure 5-1. DY10 disposal volumes in Puget Sound 52
Figure 5-2. DY10 disposal volumes in Grays Harbor 52
Figure 5-3. DY11 disposal volumes in Puget Sound 53
Figure 5-4. DY11 disposal volumes in Grays Harbor 53
Figure 5-5. Dredged Material Footprint at Port Gardner 61
Figure 5-6. Apparent RPD Depths Measured during 2010 SPI survey 62
Figure 5-7. Idealized Infaunal benthic successional paradigm over Time following a Physical Disturbance (Rhoads and Germano, 1986; modified from Pearson and Rosenberg, 1978). 63
Figure 5-8. Infaunal Successional Stage Measured during the 2010 SPI survey. 64
Figure 5-9. Organism-Sediment Index Values Measured during the 2010 SPI Survey. 66
Figure 5-10. PBDE Congener summary at the Port Gardner disposal site during 2010 monitoring survey (logarithmic scale) 67
Figure 5-11. Proposed Sampling Stations for Ichthyoplankton Study 70
Figure 5-12. ADCP Transect Locations (▬) at PSDDA Dispersive Dredged Material Disposal Sites 71
Figure 5-13. DMMP cumulative disposal volumes in Puget Sound 1989 – 2011 73
Figure 5-14. DMMP cumulative disposal volumes in Grays Harbor 1996 – 2011 73

LIST OF ACRONYMS

AET	Apparent Effects Threshold
BT	Bioaccumulation Trigger
COC	Chemical of Concern
CWA	Clean Water Act
CY	Cubic Yard
DAIS	Dredged Analysis Information System
DL	Detection Limit
DMMO	Dredged Material Management Office
DMMP	Dredged Material Management Program
DMMU	Dredged Material Management Unit
DNR	Washington Department of Natural Resources
DY	Dredging Year
EPA	Environmental Protection Agency
EPTA	Evaluation Procedures Technical Appendix (PSDDA)
FC	Full Characterization
HPA	Hydraulic Project Approval
HPAH	High-molecular-weight PAH
LPAH	Low-molecular-weight PAH
ML	Maximum Level
MPR	Management Plan Report
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWRSEF	Northwest Regional Sediment Evaluation Framework
O&M	Operations and Maintenance
OSI	Organism Sediment Index
PAH	Polynuclear Aromatic Hydrocarbon
PC	Partial Characterization
PCBs	Polychlorinated Biphenyls
PPB	Parts per Billion
PPM	Parts per Million
PSDDA	Puget Sound Dredged Disposal Analysis
PSEP	Puget Sound Estuary Program
RPD	Redox Potential Discontinuity
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SDM	Suitability Determination Memorandum
SMARM	Sediment Management Annual Review Meeting
SMS	Sediment Management Standards
SL	Screening Level
SPI	Sediment Profile Imaging (equivalent to SVPS)
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 & PROJECT OVERVIEW

1.1 Introduction

The Dredged Material Management Program 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, Seattle District; U.S. Environmental Protection Agency, Region 10; Washington Department of Ecology; and Washington Department of Natural Resources. 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 program in the 1980s, and expanded to cover Grays Harbor and Willapa Bay in 1995. The DMMP agencies modify the program, including evaluation guidelines, as needed through an annual review process.

In 2002, the Regional Sediment Evaluation Team (RSET) was initiated to establish dredged material evaluation guidelines that would be applicable throughout the states of Washington, Oregon and Idaho. One goal of RSET was the consolidation of the existing regional guidance manuals into one "umbrella" document, allowing consistent evaluation of dredging projects across the region. This document, called the Northwest Regional Sediment Evaluation Framework (SEF), was published in May 2009.

Integration of guidance from RSET--the larger regional program, and DMMP—the Washington-specific program--is an ongoing process. Projects in Puget Sound, on the Washington Coast, and on the north side of the Columbia River use the DMMP Users Manual for SAP preparation and data review. Elements from SEF, such as freshwater bioassays, are used for projects in Washington State on a case-by-case basis to augment the guidance found in the DMMP Users Manual.

This report summarizes DMMP activities for Dredging Years 2010 and 2011. As defined by the DMMP agencies, DY10 covers the period from June 16, 2009 to June 15, 2010. DY11 covers the period from June 16, 2010 to June 15, 2011.

1.2 Project Overview

During DY10/11 there were 43 projects for which the DMMP agencies completed some kind of action or determination. These projects are summarized in Tables 1-1 and 1-2. 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 memorandum (SDM), 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 antidegradation evaluations.

As listed in Tables 1-1 and 1-2, 24 projects had DMMP suitability determinations or other actions completed by June 15, 2010 and are considered DY10 projects. Another 19 projects had DMMP suitability determinations or other actions completed by June 15, 2011 and are considered DY11 projects. Puget Sound project locations for DY10 and DY11 are plotted in Figures 1-1 and 1-2. Projects in Grays Harbor and Willapa Bay for both years are shown in Figure 1-3. Projects on the Columbia River for the biennium are shown in Figure 1-4.

The DMMP agencies reviewed and approved sampling and analysis plans (SAPs) for another 6 projects during DY11, but they were not completed before the end of DY11. These projects are listed in Table 1-3 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 antidegradation evaluations is also presented. Chapter 3 presents an overall assessment of sampling and testing activities, including an evaluation of regulatory processing time. 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 DY10/11.

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

Table 1-1. DMMP Evaluation Activities Completed in DY10.

PROJECT	DMMP Action	Disposal Area/Type	Project Volume (cy)	SAP DY	SDM DY
Boyer Towing	FC	PSDDA	3,900	2010	2010
Broadmoor Golf Club	NTD	Upland	< 1,000	NA	NA
Cape George Colony Club	NTD	Beneficial Use	1,000	NA	NA
Delta Marine Industries	RE	PSDDA	NA	NA	NA
Fairweather Bay	ADD	Upland	NA	NA	NA
Former Scott Paper Mill	FC	PSDDA	25,640	2009	2010
Georgia-Pacific Camas Slough	PDE	NA	NA	2010	NA
Longview Fibre	FE	Upland	10,000	2002	NA
National Park Service – Nippon Paper Outfall	FC	PSDDA	1,000	2010	2010
Percival Landing	ADD	Upland	NA	NA	NA
Port of Everett Boat Launch and Settling Basin	PC	PSDDA	400,000	2009	NA
Port of Everett 10th Street Boat Launch	FC	PSDDA	32,000	2010	2010
Port of Everett Pacific Terminal	FC	PSDDA	10,192	2010	2010
Port of Seattle Terminal 18	PDE	Upland	NA	2009	NA
Port of Seattle Terminal 5	SC	PSDDA	1,510	2010	2010
Quilcene Marina	ADD	Upland	NA	2009	NA
Skyline Marina, City of Anacortes	FC	PSDDA	105,700	2009	2010
South Lake Union Park, Seattle Parks Depart.	ADD	MTCA[1]	NA	2006	NA
Thatcher Bay Restoration	FC	PSDDA	12,900	2009	2010
Tokeland Marina, Willapa Bay[2]	DFR	WB Flowlane	NA	NA	NA
USACE Duwamish	FC	PSDDA/Upland	109,535	2009	2010
USACE Snohomish - Dioxin	SC	PSDDA/BU	801,849	2010	2010
USACE Swinomish O&M	FC	PSDDA	152,000	2010	2010
Weyerhaeuser Longview	FC	CR Flowlane	115,300	2010	2010

[1] No dredging involved. Sediment characterization conducted to determine quality of surface sediments.
[2] Project evaluated by DMMP in DY07, resulting in a suitability determination. A DY10 addendum to the suitability determination included a minor expansion of the dredging footprint.

DMMP Actions
ADD = Anti-Degradation Determination
DFR = Dredging Footprint Revision
FC = Full Characterization
FE = Frequency Extension
NTD = No-Test Determination
PC = Partial Characterization
PDE = Post-Dredge Evaluation
RE = Recency Extension
SAP = Sampling and Analysis Plan Review
SC = Supplemental Characterization
SDM = Suitability Determination Memorandum
VR = Volume Revision

Disposal Area/Type
BU = Beneficial Use
CR = Columbia River
MTCA = Model Toxics Control Act (Cleanup)
PSDDA = Puget Sound Dredged Disposal Analysis
WB = Willapa Bay

NA = Not applicable

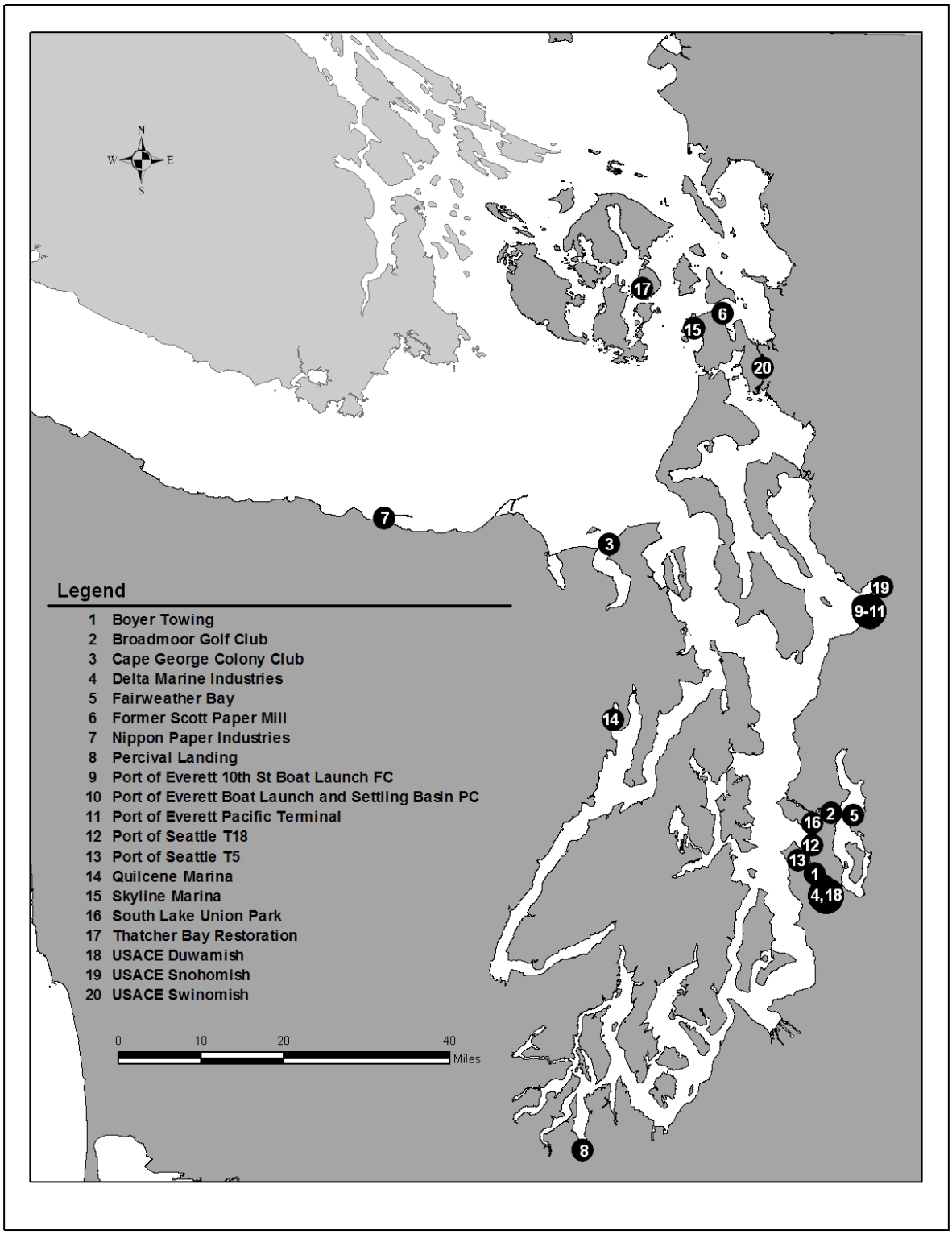

Figure 1-1. DY10 Puget Sound Project Locations

Table 1-2. DMMP Evaluation Activities Completed in DY11

PROJECT	DMMP Action	Disposal Area/Type	Project Volume (cy)	SAP DY	SDM DY
Bellingham Cold Storage	FC	PSDDA	6,660	2011	2011
Birch Bay Village Community Club	NTD	Beneficial Use	<1,000	NA	NA
Carpenter Island Boat Launch	NTD	Upland	28,238	NA	NA
Chinook Ventures (Millennium Bulk Terminals)	FC	CR Flowlane	31,300	2011	2011
Crescent Bar Recreation Improvement	FC	BU/Upland	49,750	2011	2011
D&M Live Crab – Westport Marina	NTD	Upland	100	NA	NA
Hat Island Marina	ED	PSDDA/Upland	70,500	NA	NA
Mukilteo Lighthouse Park Boat Launch	NTD	Beneficial Use	440	NA	NA
NAS Whidbey Island Fuel Pier	FC	PSDDA	25,000	2011	2011
Phillips Private Pier	NTD	Upland	520	NA	NA
Port of Bellingham Blaine Marina	NTD	Upland	200	NA	NA
Port of Bellingham Gate 3	FC	Upland	49,884	2010[1]	2011
Port of Everett Marina	FC	PSDDA	131,700	2011	2011
Priest Rapids Recreational Improvement	FC	BU/Upland	8,000	2011	2011
South Park Bridge, King County DOT	FC	PSDDA/Upland	26,307	2009	2011
SR520 Pontoon Construction Bridge	FC	Grays Harbor	95,900	2010	2011
USACE - Grays Harbor Inner Harbor O&M	FC	Grays Harbor	1,800,000/yr	2011	2011
USACE Quillayute O&M	FC	Beneficial Use	100,000	2011	2011
Wanapum Dam Upper Boat Launch	L1	Beneficial Use	<1,000	NA	2011

[1]The original SAP was approved in DY07; a supplemental SAP was approved in DY10.

DMMP Actions
ED = Exclusionary Determination
FC = Full Characterization
L1 = Level-1 Determination
NTD = No-Test Determination
PC = Partial Characterization
SAP = Sampling and Analysis Plan Review
SDM = Suitability Determination Memorandum

Disposal Area/Type
BU = Beneficial Use
CR = Columbia River
PSDDA = Puget Sound Dredged Disposal Analysis

NA = Not applicable

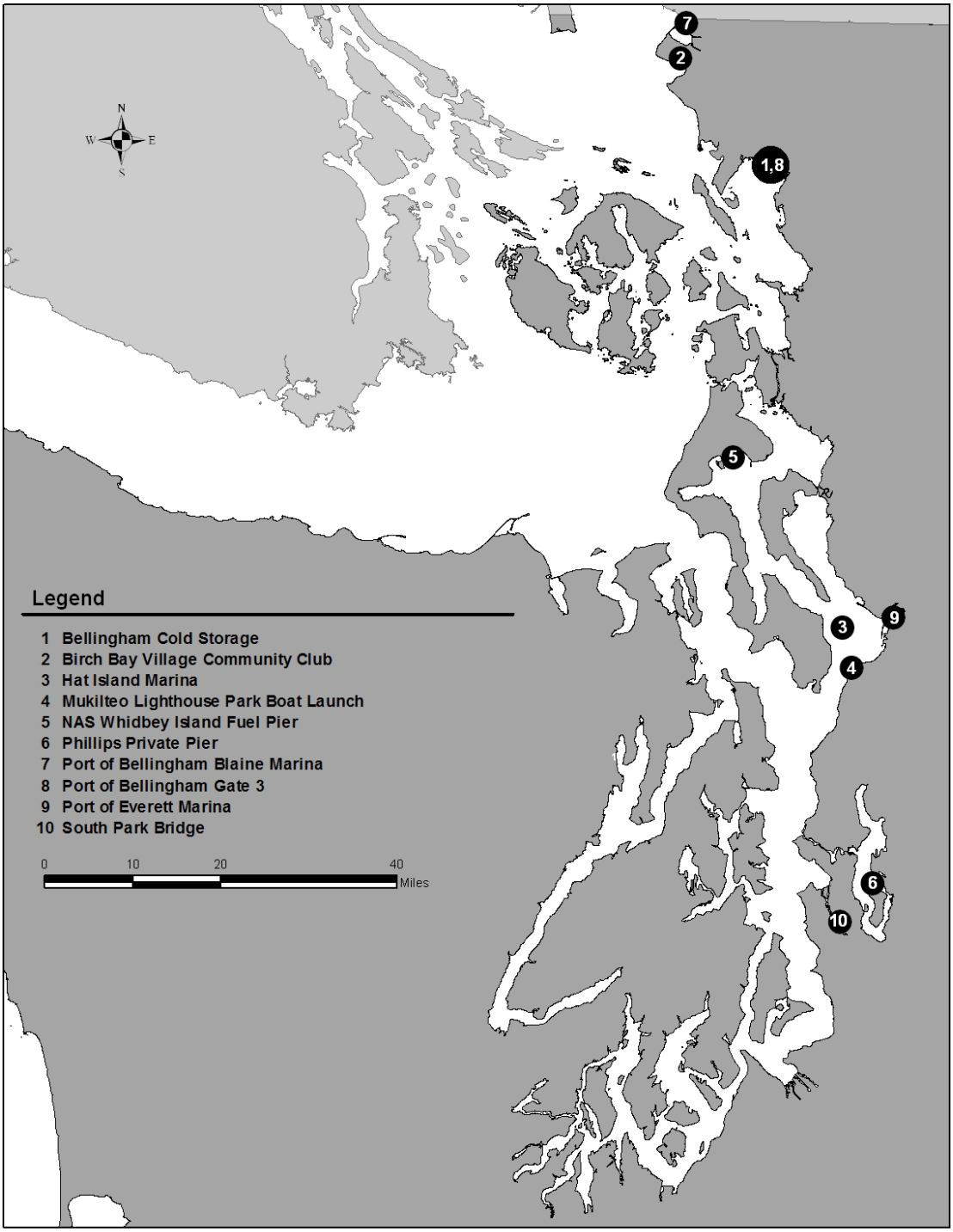

Figure 1-2. DY11 Puget Sound Project Locations

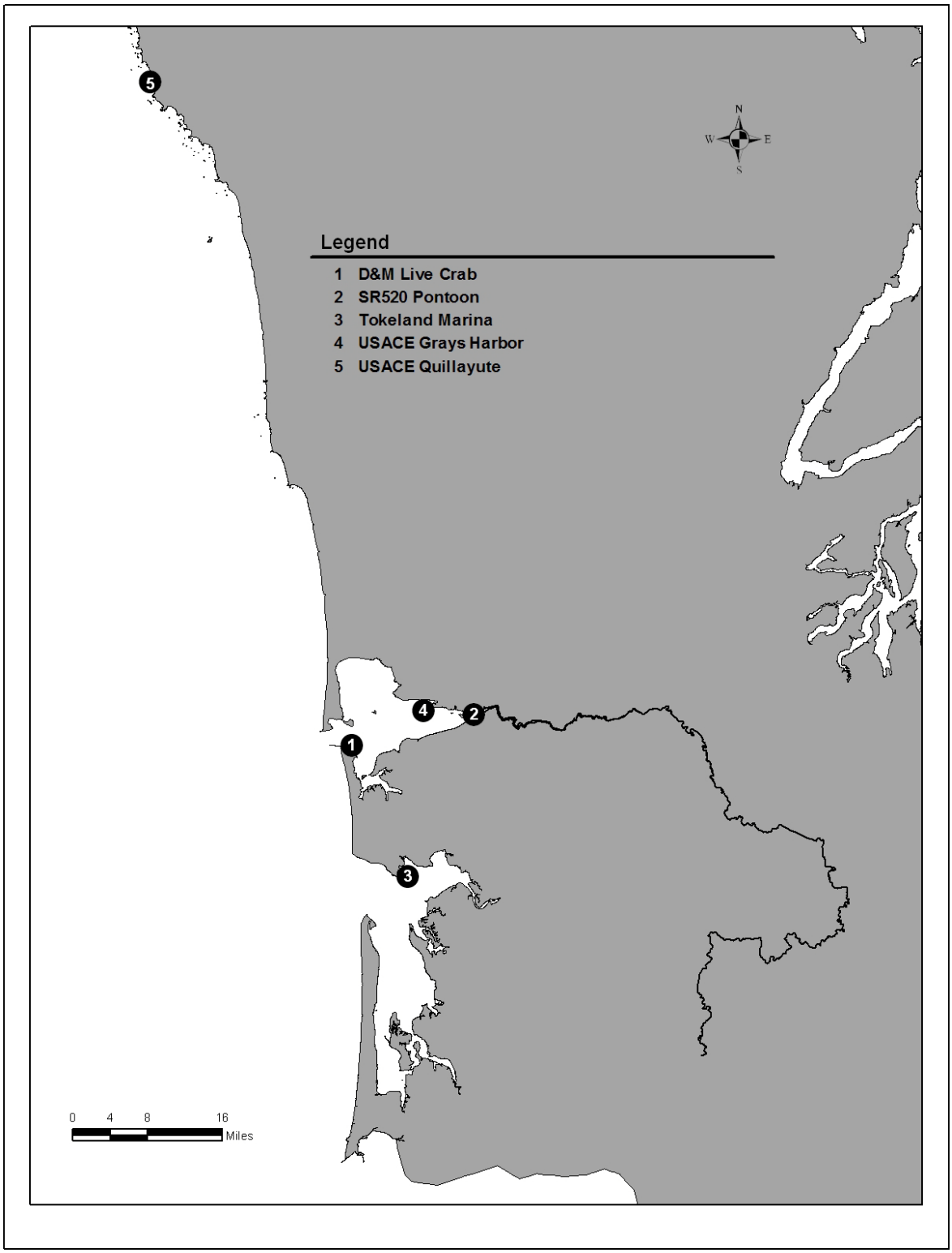

Figure 1-3. DY10/11 Coastal Project Locations

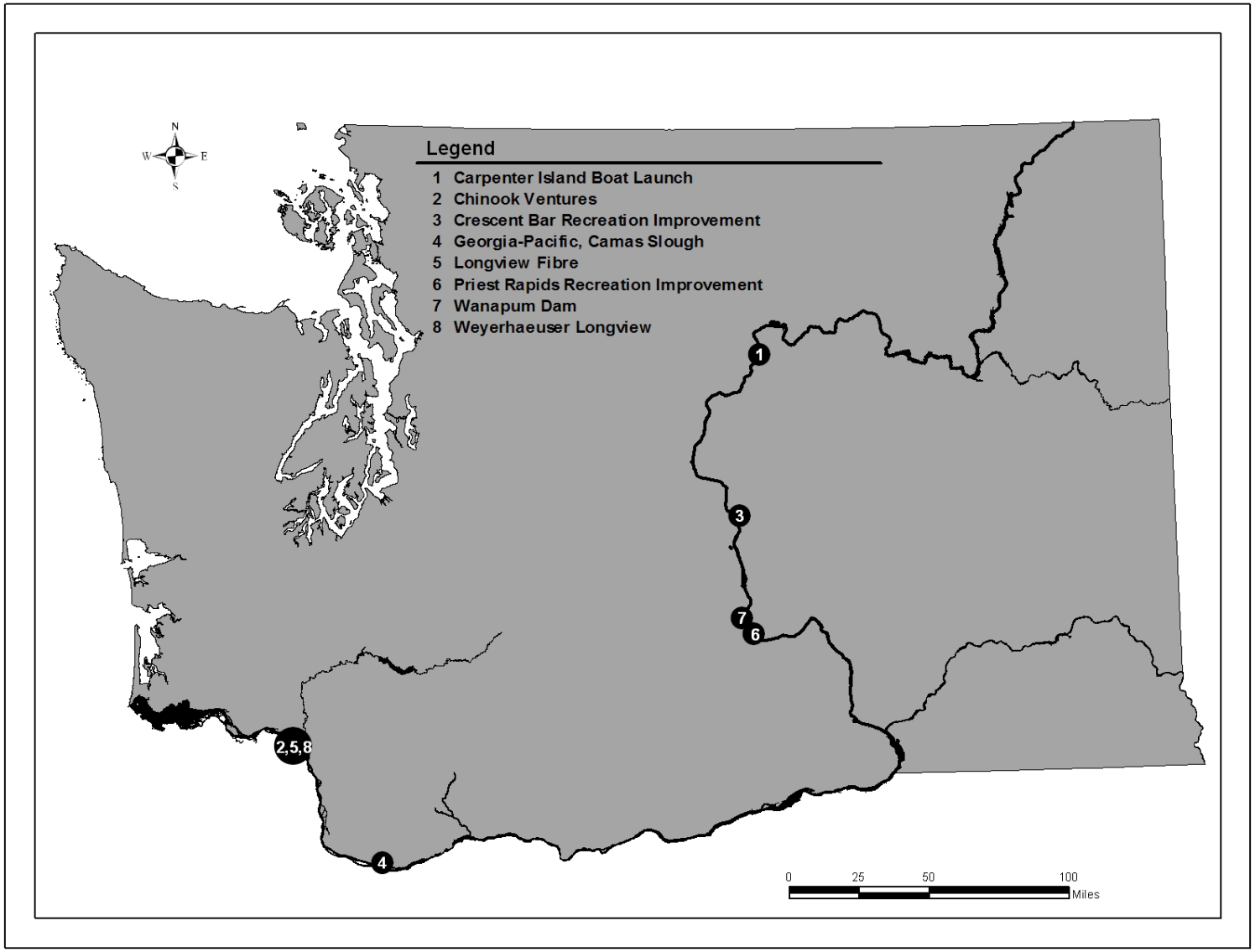

Figure 1-4. DY10/11 Columbia River Project Locations

Table 1-3. DMMP Evaluation Activities Initiated in DY10/11 but ongoing into DY12

PROJECT	DMMP Action	Project Volume (cy)	SAP Review DY	Status at end of 2011
Bay Center Marina/Entrance, Willapa Bay	FC	18,000	2011	SD in prep
Harbour Village Marina, Kenmore	FC	7,500	2011	SD in prep
Port of Tacoma Husky Terminal	FC	42,100	2011	SD in prep
USACE Duwamish O&M	FC	127,093	2011	SD in prep
USACE Keystone O&M	FC	60,000	2011	SD in prep
USN – Big Beef Creek Estuary Mitigation Restoration	FC	125,000	2011	Pending

FC = Full Characterization
SD = Suitability Determination in preparation

CHAPTER 2. DY10/11 PROJECTS

This chapter presents project-specific information related to the evaluation of DY10/11 projects. Sections 2.1 through 2.8 pertain only to those projects that underwent sediment testing – including full, partial, supplemental or exclusionary characterizations. Sections 2.9 and 2.11 address those projects for which no-test determinations, recency extensions, frequency determinations or volume revisions were completed.

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, if the applicant conducts a partial characterization (PC), or in special cases where additional information is available. 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 was one partial characterization completed in DY10, that being for the Port of Everett 10th Street Boat Launch and potential relocation of the Snohomish River lower settling basin.

The Chinook Ventures (also known as Millennium Bulk Terminals) project would normally have been ranked moderate, given the type of facility and its location, but due to an Ecology investigation regarding a spill of petroleum coke at the site, the DMMP agencies reranked the project to high for the DY11 round of testing. The DY11 testing results were such that the project will revert to a moderate rank in the next round of testing. The Port of Bellingham Gate 3 project was ranked moderate for the original testing in 2006, but due to the elevated concentrations of dioxin found at the site the project has now been reranked to high for the next round of testing.

Tables 2-1 and 2-2 contain the initial and final ranking for all DY10/11 projects that underwent DMMP sediment sampling and testing. The "initial rank" was taken from the guidance documents that were in effect at the time of project initiation (with the exception of Chinook Ventures/Millennium Bulk). The "final rank" reflects any adjustment made by the DMMP agencies prior to, or based on, the characterization.

Table 2-1. DY10 Project Rankings

PROJECT	Location	Waterbody	Initial Rank	Final Rank
Boyer Towing	Seattle	Duwamish River	H	H
Former Scott Paper Mill	Anacortes	Fidalgo Bay	H	H
Georgia-Pacific Camas Slough	Camas	Camas Slough	M	M
Nippon Paper Industries Outfall	Port Angeles	Strait of Juan de Fuca	H	H
Port of Everett 10th Street Boat Launch and Lower Settling Basin PC[1]	Everett	Snohomish River	M	L[3]
Port of Everett 10th Street Boat Launch FC[2]	Everett	Snohomish River	L	L
Port of Everett Pacific Terminal	Everett	Everett Harbor East Waterway	H	H
Port of Seattle Terminal 18	Seattle	Duwamish East Waterway	H	H
Port of Seattle Terminal 5, Supplemental	Seattle	Duwamish West Waterway	H	H
Quilcene Marina	Jefferson County	Hood Canal	M	M
Skyline Marina, City of Anacortes	Anacortes	Flounder Bay	M	M
South Lake Union Park	Seattle	Lake Union	H	H
Thatcher Bay Restoration	Blakely Island, San Juan County	Thatcher Bay	LM	LM
USACE Duwamish	Seattle	Duwamish River	LM/H	LM/H
USACE Snohomish - Dioxin	Everett	Snohomish River	LM	LM
USACE Swinomish O&M	Skagit County	Swinomish Channel	L	L
Weyerhaeuser	Longview	Columbia River [4]	LM	LM

Ranking:
L = Low
LM = Low-moderate
M = Moderate
H = High
Shaded projects included ranking changes during the course of the project
[1] PC = Partial characterization
[2] FC = Full characterization
[3] The Port of Everett 10th Street Boat Launch was downgraded as a result of this PC
[4] DMMP program oversees Columbia River projects only on the Washington side of the river. Portland District & RSET oversee projects on the Oregon side of the Columbia River.

Table 2-2. DY11 Project Rankings

PROJECT	Location	Waterbody	Initial Rank	Final Rank
Bellingham Cold Storage	Bellingham	Squalicum Waterway	M	M
Chinook Ventures (Millennium Bulk)	Longview	Columbia River	H	M
Crescent Bar Recreational	Crescent Bar	Columbia River	LM/M	LM/M
NAS Whidbey Island Fuel Pier	Oak Harbor	Crescent Harbor	M	M
Port of Bellingham Gate 3	Bellingham	Squalicum Harbor	M	H
Port of Everett Marina	Everett	Snohomish River	LM	LM
Priest Rapids Recreational	Desert Aire	Columbia River	L/M	L/M
South Park Bridge, King County DOT	Seattle	Duwamish River	H	H
SR520 Pontoon Construction	Aberdeen	Chehalis River	H	H
USACE - Grays Harbor	Grays Harbor	Inner Grays Harbor	L	L
USACE Quillayute O&M	La Push	Quillayute River	L/M	L/M

Ranking:
L = Low
LM = Low-moderate
M = Moderate
H = High
Shaded projects included ranking changes during the course of the project

2.2 Sampling and Analysis Plans

A sampling and analysis plan (SAP) must be prepared by the applicant and approved by the DMMP agencies before sediment samples are collected. The sampling and analysis requirements are determined by the volume of surface and subsurface dredged material and by the project rank. The minimum number of field samples and dredged material management units for a full characterization are calculated as follows:

Table 2-3. DMMP Sampling Requirements

Project Rank	Maximum Volume Represented by a Field Sample (CY)	Heterogeneous Sediment		Homogeneous Sediment DMMUs (CY)
		Surface[1] DMMUs (CY)	Subsurface[1] 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

[1]"Surface" is defined as the top 4 feet of the dredge prism. "Subsurface" is defined as that portion of the dredge prism beneath the 4-ft surface layer.

The applicant presents a conceptual dredging plan 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 2-4 and 2-5 contain data for sampling plans approved for DY10/11 projects. Descriptions of those projects for which best professional judgment was applied are provided in Chapter 4.

Table 2-4. DY10 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
Boyer Towing	H	3,900	3,900	1	1	0	0	0
Former Scott Paper Mill	H	25,640	25,640	14	7	0	0	0
GP Camas Slough[1]	M	NA	NA	3	NA	NA	6	NA
Nippon Paper Industries	H	1,000	1,000	7	7	0	0	0
Port of Everett Boat Launch and Settling Basin PC	M	400,000	160,000	2	NA	240,000	2	NA
POE 10th Street Boat Launch	L	32,000	32,000	4	1	0	0	0
Port of Everett Pacific Terminal	H	10,192	10,192	6	3	0	0	0
Port of Seattle Terminal 18[1]	H	NA	NA	4	NA	NA	0	NA
Port of Seattle Terminal 5	H	1,510	1,210	2	1	300	2	1
Quilcene Marina	M	3,500	3,500	1	1	0	0	0
Skyline Marina	M	105,700	105,700	21	12	0	0	0
South Lake Union Park[1]	H	NA	NA	1	NA	NA	0	NA
Thatcher Bay Restoration	LM	12,900	12,900	5	1	0	0	0
USACE Duwamish	LM/H	109,535	102,968	18	12	6,567	10	2
USACE Snohomish - Dioxin	LM	810,849	810,849	36	16	0	0	0
USACE Swinomish O&M	L	152,000	152,000	22	3	0	0	0
Weyerhaeuser Longview	LM	115,300	115,300	18	5	0	0	0

[1] Post-dredge sampling and analysis conducted for antidegradation evaluation only.

Table 2-5. DY11 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 Subsurface Samples	Number of Subsurface DMMUs
Bellingham Cold Storage	M	6,660	6,660	6	2	0	0	0
Chinook Ventures (Millennium Bulk)	H	31,300	19,990	6	6	11,310	3	1
Crescent Bar Recreational Improvement	LM/M	49,750	49,750	9	3	0	0	0
NAS Whidbey Island Fuel Pier	M	25,000	12,500	6	2	12,500	6	2
Port of Bellingham Gate 3	M	49,884	49,884	16	4	0	0	0
Port of Everett Marina	LM	131,700	131,700	24	8	0	0	0
Priest Rapids Recreational Improvement	LM	8,000	8,000	3	1	0	0	0
South Park Bridge, King County DOT	H	26,307	3,047	NA	NA[1]	23,250	14	4
SR520 Pontoon Construction	H	95,900	26,900	7	7	69,000	8	8
USACE - Grays Harbor Inner Harbor O&M	L	2,586,821	2,586,821	72	9	0	0	0
USACE Quillayute O&M	L/M	100,000	100,000	15	3	0	0	0

[1] Surface sediments were considered unsuitable based on an earlier reconnaissance evaluation and were not subject to re-evaluation by DMMP. See Chapter 4 for additional details.

2.3 Sampling

Tables 2-6 and 2-7 contain data related to sampling efforts during DY10/11. 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. There is an additional requirement to collect an archived sample from the two feet of sediment beyond the dredging prism ("Z" sample). This additional depth is not reflected in the tables.

Table 2-6. DY10 Project Sampling

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			
Boyer Towing	3	78	12	5	Vibracore	5.0	5.0
Former Scott Paper Mill	0 - 3	11 - 43	45 - 81	7 - 10	Vibracore	6.3	3.9
Nippon Paper Industries	0 - 74	27 - 96	0 - 2	0 - 1	Vibracore/ Van Veen	2.4	0.6
Port of Everett Boat Launch and Settling Basin PC	0 - 9	47 - 94	4 - 43	2 - 10	Impact corer	8	6.7
POE 10th Street Boat Launch	0	51	38	10	Impact corer	9.3	8.1
Port of Everett Pacific Terminal	2 - 8	84 - 87	1 - 9	2 - 5	Vibracore	5.0	4.8
Port of Seattle Terminal 18	0 - 2	53 - 65	22 - 30	11 - 17	Van Veen	0.5	0.5
Port of Seattle Terminal 5 (supplemental sampling addendum)	9.7	69.9	12.4	8.0	Vibracore	10	9.3
Quilcene Marina	7	76	11	5	Vibracore	10	5.3
Skyline Marina	0 - 2	28 - 89	7 - 31	3 - 19	Vibracore	10	6.5
Thatcher Bay Restoration	1	5	84	10	vibracore	6.5	5.1
USACE Duwamish	0 - 4	26 - 90	5 - 62	2 - 13	Vibracore/ Van Veen	12.9	6.1
USACE Snohomish - Dioxin	0 - 36	32 - 95	1 - 45	1 - 23	Vibracore	0.5	0.5
USACE Swinomish O&M	0 - 1	90 - 97	0 - 7	2 - 3	Van Veen	0.3	0.3
Weyerhaeuser Longview	0	42 - 78	19 - 48	2 - 6	Van Veen	0.5	0.5

Table 2-7. DY11 Project Sampling

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			
Bellingham Cold Storage	0 - 2	4 - 31	56 - 80	12 -16	Vibracore	3.8	2.5
Chinook Ventures (Millennium Bulk)	0 - 3	79 - 96	1 - 20	0 - 1	Vibracore	10.4	6.3
Crescent Bar Recreation Improvement	1 - 14	50 - 95	5 - 47[1]	---	Sonic Corer	9	5.3
NAS Whidbey Island Fuel Pier	1 - 7	65 - 86	8 - 12	7 - 15	Vibracore	5	4.6
Port of Bellingham Gate 3	0	4 - 15	54 - 70	26 - 32	Vibracore	4.7	3.0
Port of Everett Marina	0 - 3	5 - 51	37 - 73	12 - 24	MudMole	7.8	6.1
Priest Rapids Recreation Improvement	63 - 69	17 - 18	13 - 19[1]	---	Sonic Corer	9	9
South Park Bridge, King County DOT	1 - 3	65 - 91	5 - 25	3 - 7	Rotary Drill Rig	18	4.0
SR520 Pontoon Construction	2 - 58	10 - 27	12 - 66	9 - 23	Sonic Drill Rig, MudMole	20	4.2
USACE Grays Harbor	0	8 - 61	19 - 62	17 - 34	Van Veen	0.3	0.3
USACE Quillayute O&M	0 - 5	22 - 98	1 - 71	1 - 7	Ponar Grab	0.3	0.3

[1]Did not differentiate clays and silts and used #200 rather than #230 sieve for % fines; the percentages shown are for total fines.

2.4 Chemical Testing

Chemical testing was conducted for nineteen (19) characterizations in DY10 and eleven (11) in DY11.

A complete listing of DMMP chemical guideline exceedances for DY10/11 is included in Appendix C. Only those projects with guideline exceedances are included. Appendix D includes all dioxin testing results.

2.5 Biological Testing

Six projects required bioassay testing (Table 2-8) during DY10/11. Tiered testing was employed for the Crescent Bar and South Park Bridge projects, as well as the first round of testing for the Duwamish O&M project. Tiered testing means that bioassays are conducted only on those DMMUs having one or more exceedances of DMMP screening levels. For the rest of the projects, including the second and third round of Duwamish O&M testing, bioassays were conducted concurrently with chemical testing. Two of the projects – South Park Bridge and Duwamish O&M - had DMMUs that failed bioassay interpretive guidelines. Details are provided in Chapter 4.

2.6 Bioaccumulation Testing

Bioaccumulation testing was conducted for only one DY10/11 project. The South Park Bridge project had one DMMU with bioaccumulation trigger (BT) exceedances for total PCBs, and underwent 45-day bioaccumulation testing with *Macoma nasuta* and *Nephtys caecoides*. There were a number of protocol irregularities that surfaced after the testing was completed, and the DMMP agencies applied best professional judgment to reach a determination that the material tested was suitable for unconfined open-water disposal. See Chapter 4 for a complete discussion of these testing results.

Two other Port of Seattle projects had BT exceedances for which bioaccumulation testing was *not* conducted. For the T5 project, one DMMU (and the material underlying it) exceeded the BT for TBT. The Port of Seattle elected not to conduct bioaccumulation testing, but to dispose of this material upland instead. This DMMU is to be overdredged, followed by placement of a clean sand layer to isolate any remaining TBT. The T18 project consisted of post-dredge sampling to evaluate the sediment surface exposed by dredging. The three samples taken all exceeded the BT for TBT. This area will be addressed by the EPA Superfund program. See Chapter 4 for details.

Table 2-8. DY10/11 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 Mortality	Sediment Larval Development	Midge 20-day Mortality & Growth	*Neanthes* 20-day Mortality & Growth		
Crescent Bar Recreational Improvement	1	0	0	*Ha*	---	*Cd*	---	Commercial Silica Sand (30-Mesh)	Quilamene Wildlife Refuge
Former Scott Paper Mill	0	7	0	*Ee*	*De*	---	*Na*	Yaquina Bay	Carr Inlet
South Lake Union Park	0	1	1	*Ha*	---	*Cd*	---	Yaquina Bay	Lake Washington
South Park Bridge	1	0	0	*Ee*	*Mg*	---	*Na*	Yaquina Bay	Carr Inlet
USACE Duwamish Round 1	7	0	7	*Ee*	*Mg*	---	*Na*	Yaquina Bay	Dabob Bay/ Sequim Bay
USACE Duwamish Round 2	0	7	6	*Ee*	*Mg*	---	*Na*	Yaquina Bay	Carr Inlet
USACE Duwamish Round 3	0	1	1	*Ee*	*De*	---	*Na*	Yaquina Bay	Carr Inlet
USACE Grays Harbor[1]	0	2	0	*Ee*	*Mg*	---	*Na*	Yaquina Bay	Grays Harbor - North Bay

[1]Safety-net testing

De = Dendraster excentricus
Ee = Eohaustorius estuarius
Mg = Mytilus galloprovincialis
Na = Neanthes arenaceodentata
Ha = Hyalella azteca
Cd = Chironomus dilutus

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 2-9 and 2-10 contain information taken from the suitability determinations for each of the projects that completed their DMMP review during DY10 and DY11, respectively. For the projects receiving suitability determinations in DY10 and DY11, ten projects included material that was found unsuitable for unconfined open-water disposal. Of the 7,749,935 cubic yards covered by 31 suitability determinations (the DY08 Blair-Hylebos Redevelopment study phase was excluded because all study-phase DMMUs and volume were also included in the DY11 project-phase suitability determination), 428,327 cubic yards (5.5%) were found unsuitable for open-water disposal at a non-dispersive site.

2.8 Antidegradation Evaluations

Dredging operations expose new sediment to direct contact with biota and the water column. The exposed sediment must meet the State of Washington Sediment Quality Standards (SQS) or the antidegradation policy contained in the Sediment Management Standards. All DMMP suitability determinations include a section in which antidegradation is evaluated, but not all projects require special testing to support that evaluation. Projects that received DMMP suitability determinations for open-water disposal but did not require additional testing to address antidegradation are not included in this section of the biennial report. The projects included in this section met one of the following criteria: a) upland disposal was planned, so the project did not have a DMMP suitability determination; the only DMMP action was to conduct an antidegradation evaluation; b) additional testing was conducted to support the antidegradation evaluation, including analysis of surface sediment or Z-samples prior to dredging, or analysis of post-dredge samples.

A "Z-sample" is a sample from the sediment layer just below the dredging overdepth and typically is collected during sampling of heterogeneous sediments. Historically, the DMMP agencies defined the first foot beyond the overdepth as the z-layer. This was changed to the first two feet beyond the overdepth at the 2010 SMARM. Additional Z-samples are sometimes collected (e.g. 2 to 3 feet below overdepth). Depending on the results from characterization of the dredged material prism, it may be necessary to analyze the Z-samples to determine whether dredging the project will result in degradation of the surface sediment condition.

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 new surface sediment after dredging may be necessary.

In DY10/11, the DMMP agencies required analysis of Z-samples or post-dredge sampling and testing for seven projects, the details of which are included in Table 2-11. Three other projects slated for upland disposal were evaluated for antidegradation based on data from the dredge prism. One project (South Lake Union Park) required analysis of the existing surface sediment prior to excavation. Sampling and testing of the post-dredge surface will also be required of this project.

Table 2-9. DY10 Suitability Determinations

PROJECT	Rank	Total Volume (cy)	DMMUs, chemical analyses	DMMUs, bioassay analyses	DMMUs, bioaccum analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed Disposal Site/Type
Boyer Towing	H	3,900	1	0	0	0	0	1	3,900	EB
Former Scott Paper Mill	H	25,640	7	7	0	1	3,980	6	21,660	PG
Nippon Paper Industries	H	1,000	7	0	0	0	0	7	1,000	PA/SC
10th Street Boat Launch	L	32,000	1	0	0	0	0	1	32,000	PG
Port of Everett Pacific Terminal	H	10,192	3	0	0	0	0	3	10,192	PG
Port of Seattle T5	H	1,510	2	0	0	1	1,210	1	300	EB
Skyline Marina	M	105,700	12	0	0	0	0	12	105,700	RS
Thatcher Bay	LM	12,900	1	0	0	0	0	1	12,900	RS
USACE Duwamish	LM/H	109,535	15	8	0	7	34,389	8	75,146	EB
USACE Snohomish	LM	801,849	16	0	0	0	0	16	801,849	PG/BU
USACE Swinomish O&M	L	152,000	3	0	0	0	0	3	152,000	RS
Weyerhaeuser	LM	115,300	5	0	0	0	0	5	115,300	CR
Totals:	---	1,371,526	73	15	0	9	39,579	64	1,331,947	---

Disposal Sites
EB = Elliott Bay (ND)
CR = Columbia River (D)
PG = Port Gardner (ND)
RS = Rosario Strait (D)
PA = Port Angeles (D)
PC = Point Chehalis (D)
SJ = South Jetty (D)

Disposal Type
BU = Beneficial Use (includes both aquatic and upland)
SC = Sidecast
D = Dispersive
ND = Non-Dispersive
UP = Upland Disposal

Table 2-10. DY11 Suitability Determinations

PROJECT	Rank	Total Volume (cy)	DMMUs, chemical analyses	DMMUs, bioassay analyses	DMMUs, bioaccum analyses	DMMUs Failing	Volume Failing (cy)	DMMUs Passing	Volume Passing (cy)	Proposed Disposal Site/Type
Bellingham Cold Storage	M	6,660	2	0	0	0	0	2	6,660	EB
Chinook Ventures (Millennium Bulk)	H	31,300	7	0	0	0	0	7	31,300	CR
Crescent Bar Recreational Improvement	LM/M	49,750	3	1	0	1	7,025	2	42,725	BU/UP
NAS Whidbey Island Fuel Pier	M	25,000	3	0	0	0	0	3	25,000	PG
POB Gate 3	M	49,884	4	0	0	3	44,684	1[1]	5,200	EB
Port of Everett Marina	LM	131,700	8	0	0	0	0	1[2]	29,000	PG
Priest Rapids Recreational Improvement	LM	8,000	1	0	0	0	0	1	8,000	BU
South Park Bridge	H	26,307	4	1	1	NA[3]	3,057	4	23,250	EB/UP=-098[4
SR-520 Pontoon Construction	H	95,900	17	0	0	0	0	17	95,900	SJ/PC
USACE Grays Harbor	L	2,586,821	9	2	0	0	0	9	2,586,821	SJ/PC/ BU
USACE Quillayute O&M	M/L	100,000	3	0	0	0	0	3	100,000	BU
Wanapum Dam[4]	L	<1,000	1	0	0	0	0	1	<1,000	BU
Totals:	---	3,112,322	62	4	1	4	54,766	51	2,954,856	---

[1]Only a portion of one DMMU was found suitable for open-water disposal. See Chapter 4 for details.
[2]A total of 8 DMMUs were tested, but the suitability determination for 7 of these DMMUs is awaiting additional dioxin testing. See Chapter 4.
[3] The surface material (not included in the project volume shown in this table) was determined to be unsuitable based on testing conducted prior to undergoing DMMP characterization. Additional details on this project are provided in Chapter 4.
[4]This project was evaluated using data collected under a Level-1 assessment. See Chapter 4 for details.

Table 2-11. DY10/11 Antidegradation Evaluations

PROJECT	DY	Rank	Type	Reason for Z-Sample Analysis, Post-Dredge Evaluation or Surface-Sediment Testing	Did the New Surface Meet SQS or Antidegradation Policy?
Bellingham Cold Storage	2011	M	Z-samples	Upfront testing proposed by project proponent	Yes
Boyer Towing	2010	H	Z-samples	Other projects on the Duwamish River have had increasing levels of contamination with depth	Yes
Fairweather Bay[1]	2010	M	Based on Data from Dredge Prism	Not applicable	Yes
Georgia-Pacific Camas Slough	2010	M	Post-Dredge	Dredging violation	Yes
Percival Landing[1]	2010	H	Based on Data from Dredge Prism	Not applicable	No; requires overdredging and placement of cover material
Port of Bellingham Gate 3	2011	M	Z-samples	Elevated dioxin concentrations in dredged material	Not for DMMU 4, which will be left in place; yes for other DMMUs
Port of Seattle T5	2010	H	Z-samples and Post-Dredge	Overlying sediment was found unsuitable for open-water disposal	No; requires overdredging and placement of cover material
Port of Seattle Terminal 18	2010	H	Post-Dredge	Required by the DY09 suitability determination	No; will be addressed by CERCLA RI/FS
Quilcene Marina[1]	2010	M	Based on Data from Dredge Prism	Not applicable	Yes
South Lake Union Park[1]	2010	H	Existing Sediment Surface	Required by Corps permit	No; requires overdredging and placement of cover material
Weyerhaeuser Longview	2010	LM	Z-samples	Bis(2-ethylhexyl)phthalate exceeded freshwater guideline in DMMU1. See Chapter 4.	Yes

[1]Upland disposal was planned so there was no DMMP suitability determination for open-water disposal. The only DMMP action was to conduct an antidegradation evaluation.

2.9 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 nine projects received no-test determinations, two in DY10 and seven in DY11 (Table 2-12).

Table 2-12. DY10/11 No-Test Determinations

PROJECT	DY	Total Volume (cy)	Rank	Reason for No-Test Determination	Proposed Disposal Site
Broadmoor Golf Club	2010	< 1,000	M	Issued under NWP 3; meets small-project no-test guideline	Upland
Cape George Colony Club	2010	1,000	E	Exclusionary	Beach Nourishment
Birch Bay Village Community Club	2011	< 1,000	M	Meets small-project no-test guideline	Beach Nourishment
Carpenter Island Boat Launch	2011	28,238	L	Upland disposal with no concern for antidegradation	Upland
D&M Live Crab	2011	100	M	Meets small-project no-test guideline	Upland
Hat Island Marina	2011	70,500	E	Exclusionary	Port Gardner: up to 1,000 cy Upland: up to 70,500 cy
Mukilteo Lighthouse Park Boat Launch	2011	440	M	Meets small-project no-test guideline	Beach Nourishment
Phillips Private Pier	2011	520	M	Meets small-project no-test guideline	Upland
Port of Bellingham Blaine Marina	2011	200	M	Meets small-project no-test guideline	Upland

Ranking:
E = Exclusionary
L = Low
LM = Low-moderate
M = Moderate
H = High

2.10 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 are 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, site use, and sources of contamination. Based on this review, the agencies may extend the recency determination, typically for one to two years. 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 2-13 presents information for the two recency/frequency extensions that were allowed in DY10/11.

Table 2-13. DY10/11 Recency/Frequency Determinations

PROJECT	DY	Rank	Determination Type	Sampling Date	Original Deadline	Recency/ Frequency Extension
Delta Marine Industries	2010	H	Recency	July 2007	July 2009	Feb 2010
Longview Fibre	2010	M	Frequency	Nov 2001	Nov 2008	Feb 2010

2.11 Project Revisions

Dredging projects are dynamic by nature and shoaling continues to occur between the time of sediment characterization and the time of dredging. There may also be design changes that alter the dredging volume or footprint. When the project volume or footprint changes subsequent to full characterization, a dredging applicant may request a revision of the volume/footprint found in the suitability determination. The DMMP agencies review such requests on a case-by-case basis. Table 2-14 includes the pertinent information for the single project revision approved by the DMMP agencies in DY10/11.

Table 2-14. DY10/11 Project Revisions

PROJECT	DY	Rank	Original Volume (CY)	Revised Volume (CY)	Reason for Volume Revision
Tokeland Marina	2010	LM	47,654	52,113	Expanded Dredging Footprint

CHAPTER 3. SUMMARY AND ASSESSMENT OF DY10/11 DATA

3.1 Summary of Chemical Testing Results.

Table 3-1 and Appendix C summarize the chemical testing results from DY 2010/2011 for projects with chemical-of-concern guideline exceedances. Only 5 of the 58 standard DMMP COCs, plus TBT, had screening levels exceeded for at least one project. BT exceedances were restricted to PCBs and TBT. There were no ML exceedances. The number of DMMUs included post-dredge surface analyses (Z-samples), but excluded exclusionary testing, which did not include chemical testing.

This biennium was marked by the 2nd fewest number of guideline exceedances since the biennium report format was begun in 1993. Only the DY96/97 biennium had fewer exceedances. This continues the trend in recent years toward projects with fewer guideline exceedances. In earlier biennial reports (http://www.nws.usace.army.mil/PublicMenu/Doc_List.cfm?sitename=DMMO&pagename=Biennial_Reporting) prior to DY06/07 there were many more chemicals and projects that exceeded DMMP guidelines. In DY10/11, there were no reporting-limit exceedances of DMMP guidelines at all. This was the first biennium for which this was true.

Dioxin Evaluation. For the evaluation of dioxins and furans for projects in Puget Sound, Grays Harbor, and the Lower Columbia River in DY10/11, the DMMP agencies utilized the guidelines found in Table 3-2. New interim evaluation guidelines were implemented on December 6, 2010 for Puget Sound projects. Suitability determinations finalized for Puget Sound projects prior to that date used the former interim guidelines. Suitability determinations finalized after that date used the new interim guidelines. Table 3-2 includes both sets of guidelines. Appendix D includes all the dioxin testing data for the biennium and Table 3-3 summarizes the dioxin testing outcomes for all projects subject to dioxin testing. Of the 24 projects receiving suitability determinations during the biennium, 18 included dioxin testing. Of the 135 DMMUs evaluated, 103 were analyzed for dioxin/furans. An additional 17 samples were evaluated for anti-degradation.

Table 3-1. DY10/11 Chemical Testing Exceedance Summary

CHEMICAL OF CONCERN	# of DMMU / AE D > SL	# of Projects D > SL	# of DMMU / AE D > BT	# of Projects D > BT	# of DMMU / AE D > ML	# of Projects D > ML	# of DMMU / AE U > SL	# of Projects U > SL	# of DMMU / AE U > BT	# of Projects U > BT	# of DMMU / AE U > ML	# of Projects U > ML
METALS												
Cadmium	2	1	0	0	0	0	0	0	0	0	0	0
Zinc	2	1	0	0	0	0	0	0	0	0	0	0
HPAH												
Fluoranthene	1	1	0	0	0	0	0	0	0	0	0	0
PESTICIDES and OTHER CHEMICALS												
Total DDT	3	2	0	0	0	0	0	0	0	0	0	0
Total PCBs	4	3	1	1	0	0	0	0	0	0	0	0
Tributyltin ion (porewater)[2]	4	2	4	2	0	0	0	0	0	0	0	0
Tributyltin ion (bulk)[2]	1	1	1	1	0	0	0	0	0	0	0	0

D = Detected, U = Undetected, SL = Screening Level, BT = Bioaccumulation Trigger, ML = Maximum Level; AE = new surface/anti-degradation evaluation

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

Table 3-2. Dioxin Guidelines* Utilized to Evaluate DY10/11 Projects

(a) New Puget Sound Nondispersive-Site Interim Guidelines**		
Disposal Site	Project Volume-Weighted Average	DMMU Maximum
Anderson Ketron, Commencement Bay, Elliott Bay, Port Gardner, Bellingham Bay	4	10
(b) New Puget Sound Dispersive-Site Interim Guideline		
Disposal Site	DMMU Maximum = Non-Urban Puget Sound Background	
Port Angeles, Port Townsend, Rosario Strait	4	
(c) Former Puget Sound Nondispersive-Site Interim Guidelines		
Disposal Site	Project Volume-Weighted Average	DMMU Maximum
Anderson/Ketron Island	3.6	6.8
Commencement Bay	2.4	5.2
Elliott Bay	8.7	12.2
Port Gardner	4.1	5.2
Bellingham Bay	6.9	10.5
(d) Former Puget Sound Dispersive-Site Interim Guideline		
DMMU Maximum = Samish Bay Reference: 2.44		
(e) Grays Harbor Guideline		
DMMU Maximum Derived from 1991 Risk Assessment: 15		
(f) Lower Columbia River Background Dioxin Concentrations		
0.65 – 2.387		

* Dioxin concentrations expressed in pptr-dry weight-TEQ

** Case-by-case determinations may be made for exceedances of these guidelines based on material placement sequencing, presence or absence of other bioaccumulatives, and frequency of disposal-site use

The results in Table 3-3 indicate that most of the material evaluated from the 18 projects and 103 DMMUs was found to be suitable for open-water disposal. Only two projects (Port of Bellingham Gate 3 and the former Scott Paper Mill) had dredged material that was found unsuitable for open-water disposal due to dioxin. Of the four projects with Z-samples analyzed for dioxin, two (Port of Bellingham Gate 3 and USACE Duwamish) would expose sediments (if dredged) that would violate Washington State's anti-degradation policy. A decision was made in both cases not to dredge those DMMUs for which the underlying material had elevated dioxin.

Table 3-3. Dioxin Testing Summary for DY10/11 Projects with Dioxin Testing

Project ID	Dredged Material Evaluation (regarding dioxin)							Anti-Degradation Evaluation		
	Disposal Site	Evaluation Guideline	# DMMUs	# Suitable ND	# Unsuitable ND	# Suitable D	# Unsuitable D	# Z-samples	Pass-AE	Fail-AE
Bellingham Cold Storage	EB	FPSIG	2	2	0	--	--	2	2	0
Boyer Towing	EB	FPSIG	1	1	0	--	--	0	--	--
Port of Bellingham Gate 3	EB/Upland	FPSIG	7	1	6	--	--	4	3	1
Port of Seattle T5	EB	FPSIG	2	2	0	--	--	0	--	--
South Park Bridge	EB	FPSIG	2	2	0	--	--	0	--	--
USACE Duwamish	EB	FPSIG	10	10	0	--	--	4	3	1
Former Scott Paper Mill	PG/Upland	FPSIG	7	6	1	--	--	0	--	--
Port of Everett 10th St and Basin	PG	FPSIG	4	4	0	--	--	0	--	--
Port of Everett Marina	PG	NPSIG	8[1]	1	--	--	--	4[1]	--	--
Port of Everett Pacific Terminal	PG	FPSIG	3	3	0	--	--	0	--	--
USACE Snohomish	PG	FPSIG	15	15	0	--	--	0	--	--
Nippon Paper Industries Outfall	PA	FPSIG	2	--	--	2	0	0	--	--
Skyline Marina	RS	FPSIG	12	--	--	12	0	0	--	--
Thatcher Bay Restoration	RS	FPSIG	1	--	--	1	0	0	--	--
USACE Swinomish	RS	FPSIG	3	--	--	3	0	0	--	--
SR520 Pontoon	GH	GH	15	--	--	15	0	0	--	--
USACE Grays Harbor	GH	GH	9	--	--	9	0	0	--	--
Georgia-Pacific Camas Slough	CR (Upland)	CR	--	--	--	--	--	3	3	0
Totals:			**103**	**47**	**7**	**42**	**0**	**17**	**11**	**2**

Legend: ND = Nondispersive; D = Dispersive; -- = This evaluation not performed; AE = New Surface/Antidegradation evaluation; FPSIG = former Puget Sound interim guidelines; NPSIG = new Puget Sound interim guidelines; CB = Commencement Bay; EB = Elliott Bay; PT = Port Townsend; PG = Port Gardner; RS = Rosario Strait; BB = Bellingham Bay; GH = Grays Harbor (South Jetty/Point Chehalis); CR = Columbia River; FLD = Flowlane Disposal; BU = Beneficial Uses

[1]Only DMMU 1 was evaluated; a decision on the remaining DMMUs and associated Z-samples is being held in abeyance until further evaluation can be accomplished.

3.2 Biological Testing

Biological testing was conducted on 19 DMMUs from 5 projects in DY10/11. Table 3-4 shows that all but two of the DMMUs were evaluated for nondispersive disposal. A single 2-hit response was noted for the amphipod bioassay and two 2-hit responses for the *Neanthes* growth bioassay. There were five 1-hit responses and three 2-hit responses for the sediment larval bioassay. One of the four projects (Crescent Bar, in the Columbia River) used freshwater bioassay organisms. Based on all bioassay testing results, seven DMMUs were found to be unsuitable for non-dispersive disposal, all from one project (USACE Duwamish O&M). The other four projects and 12 DMMU passed bioassay testing and were found suitable for open water disposal. No hits were recorded for the one DMMU utilizing the dispersive site guidelines (USACE Grays Harbor O&M), or the one project using freshwater tests. See Appendix B for bioassay interpretation guidelines in place during this 2-year testing evaluation summary.

Table 3-4. DY 08/09 Bioassay "Hit" Summary

BIOASSAY	Type	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	Marine	18	0	1	NA	0	NA	1
Sediment Larval	Marine	18	0	3	NA	5	NA	8
Neanthes Growth	Marine	18	0	2	NA	0	NA	2
Chironomus Growth	FW	0	1	NA	0	NA	0	0
Hyalella Mortality	FW	0	1	NA	0	NA	0	0

ND = non-dispersive site interpretation guidelines
D = dispersive site interpretation guidelines
FW = freshwater
NA = not applicable

3.3 Bioaccumulation Testing

During the two-year period covered by this report, there were only two chemicals for which the bioaccumulation trigger was exceeded, these being TBT and total PCBs. Two projects had BT exceedances for TBT and one project had a PCB BT exceedance. Bioaccumulation testing was conducted for a single project (see Section 2.6).

3.4 Regulatory Processing

3.4.1 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 HPA 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.

3.4.2 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.

3.4.3 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. Agency comments are provided to the applicant, the applicant revises the SAP to address the comments, and the revised SAP is submitted to the agencies for approval. Occasionally, more than one round of revision is needed to adequately address all agency comments. Once the SAP is finalized, an approval letter or email message is sent to the applicant. At that point, sampling and analysis may proceed. It is the goal of the DMMO to complete the review of SAPs within three weeks. During DY10/11 the average time for SAP reviews was 13 days, and ranged from a low of 1 day to a high of 33 days. Only one project exceeded the goal of a three-week turnaround time. For those projects with more than one review cycle, the average review time was used in compiling these statistics.

3.4.4 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 143 days during DY 10/11. This is one of the project phases with the highest degrees of variability, with sampling, analysis and reporting taking anywhere from 27 to 260 days for projects completed within this biennium. Factors influencing the time required for this phase include 1) weather; 2) sampling difficulties; 3) laboratory capacity and turn-around time; 4) QA problems arising during chemical and biological testing; 5) data validation; and 6) report compilation time. Those projects that include bioassay or bioaccumulation testing usually are those with the longer turn-around times. During the 2-year reporting period, 6 of 24 projects required toxicity testing and one project underwent bioaccumulation testing.

3.4.5 Data Review and Suitability Determination. Once a full set of validated 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 for unconfined open-water disposal or beneficial use. The suitability determination also includes an evaluation of the sediment surface that will be exposed by dredging vis-à-vis the State of Washington's

antidegradation standard. The goal of the DMMO is to complete the data review and finalize the suitability determination within three weeks of data submittal. In DY10/11, the average time required was 9 days, with review times ranging from 1 to 21 days. Occasionally, the dredged material characterization report requires revision after agency review. In those cases, the average time required for review of draft and final data reports was used in compilation of these statistics.

3.4.6 Total DMMP Process Time. The entire DMMP dredged material evaluation process, as depicted in Figure 3-4, includes 1) sampling and analysis plan review and approval; 2) field sampling, testing, validation and data report preparation; and 3) data review and completion of the suitability determination. The average time required for the DMMP dredged material evaluation process was 164 days (ranging from 57 to 287 days) in DY10/11, with the majority of that time taken up by sampling, testing, and data report preparation by the applicant.

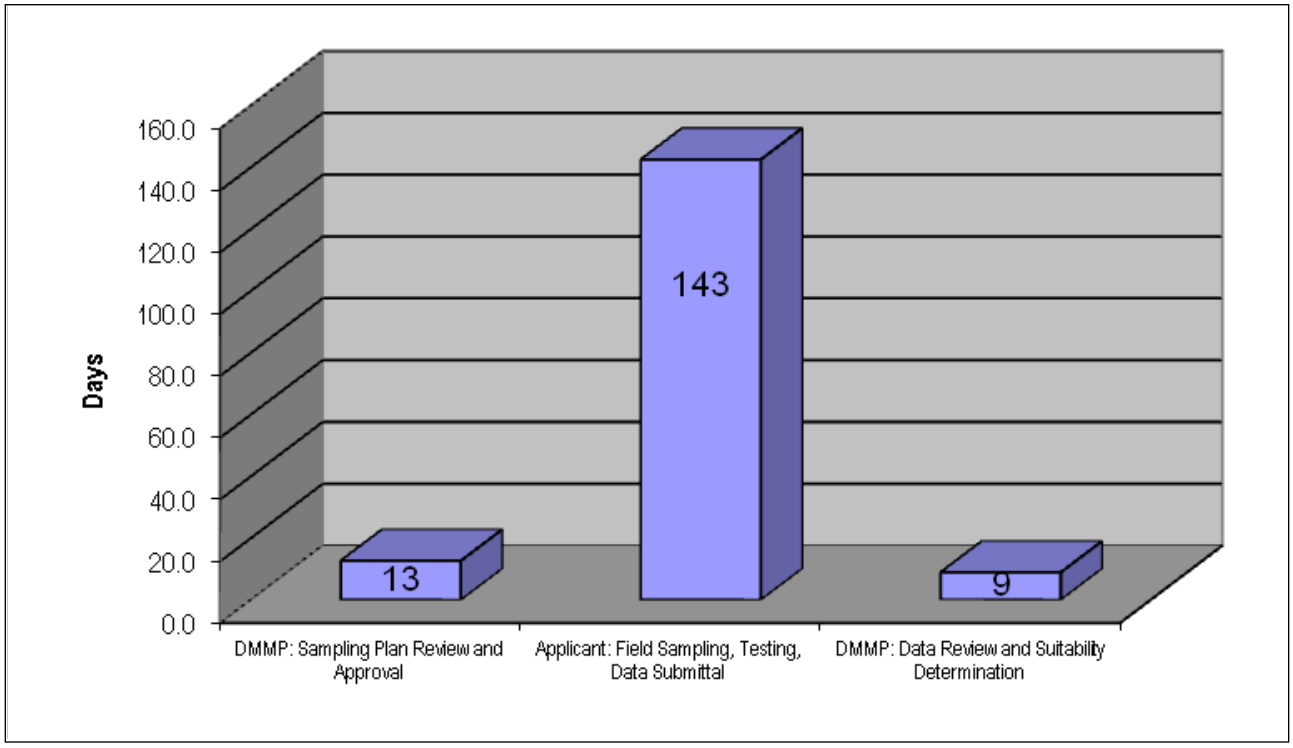

Figure 3-1. DMMP Processing Time (means for DY 10/11 projects in days)

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. Decision documents detailing all projects summarized here are available at the Corps' Seattle District website (http://www.nws.usace.army.mil; see tab for Dredged Material Management).

4.1 Dredging Year 2010

4.1.1 Thatcher Bay Restoration

The Thatcher Bay Restoration project is being carried out by the Skagit Fisheries Enhancement Group to improve habitat at the site of a former sawmill. The saw mill activities resulted in accumulation of wood waste in an intertidal area. Due to the heterogeneity of the site and the need to adequately characterize the wood-waste content, five field samples were required for this project. The wood content of the dredged material was determined using ASTM total volatile solids method 2974C, modified to include a 300-gram sample in place of the standard 50-gram sample size. The resulting volatile solids content was 12.9%. This equates to an approximate wood content of 25.8% by volume. DMMP allows up to 50% wood content by volume without triggering a requirement for bioassays. Dioxin testing was required due to the likely former existence of a hog-fuel burner on site. The toxicity equivalence (with undetects = ½ detection limit) was 0.34 parts per trillion (pptr).

4.1.2 USACE Duwamish

The Lower Duwamish Waterway, including the federal navigation channel and turning basin, has been the focus of an investigation by the EPA Superfund program since September 2001. The DMMP characterization of proposed dredged material between stations 242+00 and 275+56 was conducted in consultation with EPA Superfund. Sampling and testing requirements were modified to address particular concerns expressed by EPA.

The channel and turning basin between stations 254+00 and 275+56 (Section A) were ranked by the Dredged Material Management Program (DMMP) agencies as "low-moderate" concern for potential contamination. The channel between stations 242+00 and 254+00 (Section B) was ranked by the DMMP agencies as "high" concern for potential contamination.

The estimated volume between stations 242+00 and 254+00 was 41,363 cubic yards. Because the dredging depth in 1999 was -15 feet (MLLW) plus 1 foot of overdepth, and dredging in the current cycle was planned for -15 feet plus 2 feet of overdepth, concern was expressed that the sediment between -16 feet and -17 feet could have higher concentrations of chemicals of concern, reflecting legacy contamination. The DMMP agencies decided to sample this layer separately from the overlying sediment, which had accumulated since 1999. Ten DMMUs were allocated to the sediment between mudline and -16 feet MLLW. Based on consultation with Superfund, a single sampling station was used for each of these DMMUs. Two DMMUs were allocated to the sediment between -16 and -17 feet.

In addition to the sampling requirements stipulated by the Dredged Material Management Program, EPA Superfund requested that samples be taken in side-slope areas due to the close proximity of Section B to

upland sources of contamination, elevated contaminant concentrations in sediment adjacent to the channel, and the potential for the side-slope material to slough into the navigation channel during dredging. A total of 13 side-slope stations were included in the sampling and analysis plan (SAP). Sediment from 5 of these stations was slated for immediate analysis, with sediment from the rest of the stations archived for potential future analysis.

Sampling and testing took place in three rounds. Issues with the chemistry and bioassays in the first round prompted a second round of sampling and testing. The third round of testing was necessitated by a shoal in the navigation channel that created an immediate impediment to navigation.

The preliminary Round 1 chemical results indicated that there were numerous exceedances of the DMMP screening level for PCBs. However, Aroclor 1232, which had not been detected previously on the Duwamish, was reported in numerous DMMUs. In addition, total PCB concentrations were significantly higher than seen previously on this part of the Duwamish. The suspect PCB identification and quantification ultimately led the Corps – after Round 2 of testing – to seek data validation by EcoChem, an independent laboratory.

The dioxin analysis revealed generally higher concentrations at depth, both within the navigation channel and at the side-slope stations. Dredging of the -16 to -17 foot layer would expose elevated concentrations of dioxin in the Z-samples, thus representing a degradation of conditions in comparison to the predredge surface. In consideration of this, the Corps decided after the first round of testing not to pursue dredging of the -16 to -17 foot layer.

On the basis of the preliminary data (prior to validation) - which indicated a number of exceedances of the screening level for PCBs and a single exceedance for DDT - bioassays were conducted on those DMMUs exceeding SL, with the exception of the -16 to -17 foot layer, which was to be left in place due to the elevated dioxin concentrations in the underlying z-layer.

During Round 1 bioassay testing, the larval test was not aerated due to a communication failure, despite high bulk sulfides and ammonia concentrations. All DMMUs scored hits under the 1-hit rule, which would normally make the dredged material unsuitable for open-water disposal. However, based on past experience, the Corps believed that ammonia may have played a role in producing the responses seen in the test samples.

The DMMP agencies considered the circumstances surrounding the first round of testing: 1) the larval test had not been aerated despite high bulk sulfides and ammonia concentrations; 2) the turning basin material had never failed testing previously; 3) the PCB results were suspect given the reported presence of Aroclor 1232 - a PCB mixture not seen previously on the Duwamish River - and concentrations much higher than those previously found.

In light of these concerns and issues, the DMMP agencies authorized the Corps to resample and retest the DMMUs that had been subjected to bioassays. Resampling would include vibracore samples in Section A to better represent the entire dredge prism (Van Veen samples had been used in Round 1). Full chemistry (with the exception of dioxin) and bioassays would be required in Section A. Retesting in Section B would focus on PCBs and the larval test. The larval test would be aerated for both Section A and B samples.

The preliminary Round 2 PCB data from Section B were generally lower than those reported in Round 1. However, Aroclor 1232 was again reported in the majority of samples. At this point, the Corps had the PCB data for Rounds 1 and 2 reviewed by EcoChem, which rejected both sets of data. The Corps had a second lab analyze archived samples from Rounds 1 and 2. These data were validated and found acceptable for use. Aroclor 1232 was not found by the second lab and PCB concentrations were more consistent with what had been seen historically in this part of the Duwamish.

Despite aeration of the sediment larval test in Round 2, all of the DMMUs tested from Section B failed the suitability guidelines.

The bioassay failures in Rounds 1 and 2 created a situation in which Section B DMMUs were either unsuitable for open-water disposal or were not economically feasible to dredge. However, one large shoal in Section B presented an immediate hazard to navigation. Therefore, the Corps of Engineers proposed characterization of just the top three feet of sediment in this shoal. The DMMP agencies agreed to the testing, but stipulated that bioassays would need to be run concurrently with chemical analysis for both the proposed dredged material and the material to be exposed by dredging (the Z-sample). The Round 3 bioassays resulted in failure for the shoal material.

4.1.3 USACE Snohomish

The project was last sampled in 2003 (downstream) and 2004 (upstream). There were no DMMP screening level exceedances in either characterization and all material was found suitable for open-water disposal. Although the frequency periods for the downstream and upstream portions of the project would not expire until September 2010 and March 2011 respectively, dioxin analysis was not conducted in either characterization event. Because of increased concern over dioxin in recent years, the DMMP agencies required that dioxin testing be conducted prior to the next dredging cycle.

4.1.4 Boyer Towing

There were no SL exceedances for this project. However, when carbon-normalized, there was a single detected exceedance of SQS. The concentration of bis(2-ethylhexyl)phthalate was 58.8 parts per million organic-carbon-normalized (ppm OC). The SQS is 47 ppm oc.

The DMMP antidegradation guidelines (DMMP, 2008) state that chemical analysis of the Z-sample is required if the testing results for the overlying sediment are a) found to be unsuitable for unconfined aquatic disposal, or b) if any other project in the same waterbody has shown evidence of subsurface sediments with greater contamination than surface sediments, or c) if there is any other site-specific reason to believe that the SED may fail to meet the antidegradation policy. Other projects on the Duwamish River had provided evidence of greater contamination in subsurface sediments than surface sediments. Therefore, the DMMP agencies agreed that the Z-sample should be analyzed for bis(2-ethylhexyl)phthalate.

Analysis of the Z-sample resulted in a bis(2-ethylhexyl)phthalate concentration of 520 ug/kg on a dry weight basis, approximately one-half the concentration (1,000 ug/kg dry weight) found in the proposed dredged material. The Z-sample was predominantly sand, with a TOC of only 0.13%. Carbon-normalization is not recommended when the TOC is less than 0.5%, so the DMMP agencies agreed to use the dry-weight concentrations to form the basis for a decision. On the basis of the dry-weight concentrations, the agencies determined that the surface to be exposed by dredging will not be degraded relative to the existing surface sediment. Therefore, the project was in compliance with the State of Washington anti-degradation policy.

4.1.5 Weyerhaeuser Longview

The preliminary chemical results included a single exceedance of a SEF freshwater screening level. Bis(2-ethylhexyl)phthalate (BEHP) was detected in DMMU 1 at a concentration of 270 ug/kg (the SL1 is 220 ug/kg).

Because BEHP was the only chemical exceeding the screening level and because phthalates are common laboratory contaminants, ARI proactively re-extracted all DMMUs on their own, including DMMUs 1 and 5 in duplicate. The results were highly variable. The DMMP agencies then requested that ARI analyze the archived sample for DMMU 1 in duplicate, along with the Z-samples associated with DMMU 1. BEHP was detected at low concentrations in DMMU 1 and was also found at a low level in the method blank. The results for the 0-1 ft Z-sample were highly variable.

The DMMP agencies discussed the results at length vis-à-vis the need to do bioassays. After much discussion the DMMP agencies agreed that the risk in not doing bioassays for this DMMU was small while the navigational impacts of requiring bioassays were very real (Weyerhaeuser would have missed the work window entirely). Based on the overall evaluation of the chemical data and application of best professional judgment, bioassay testing was not required for the dredged material.

4.1.6 Percival Landing

The project area, in Lower Budd Inlet, includes dredging 19,100 cy of material for navigation and habitat creation. The dredged material will be disposed at a Subtitle D landfill. Because this project does not involve in-water disposal, a DMMP suitability determination was not required.

Sediment sampling and testing were not coordinated with the DMMP agencies. In November 2009, Anchor QEA informed the DMMP agencies about the project and requested that the DMMP agencies review the data in order to make an antidegradation determination. The original design called for dredging in three areas to provide adequate water depth for planned floating elements. Sediment sampling was based on this preliminary design. The design was later changed to include tidal inlet and habitat restoration areas. The dredging depth was also changed.

While the sediment characterization reflected the original design and not the revised proposal, the data provided sufficient information for the DMMP agencies to make a determination. The data indicated that the post-dredge surface in the vicinity of two sampling stations would likely be degraded relative to the existing surface sediment. In addition, the sediment in the vicinity of the third sampling station, while no longer slated for dredging, included elevated levels of mercury and dioxin.

On the basis of this determination, the DMMP agencies requested that Anchor QEA confer with the City of Olympia Parks, Art and Recreation Department on design modifications that would address the sediment quality issues. Anchor QEA submitted a dredge-and-cover design that would result in a one-foot layer of clean surface sediment in the areas to be dredged and a six-inch cover in the vicinity of the third station. The DMMP agencies agreed that the modified design met the intent of the antidegradation guidelines.

4.1.7 Former Scott Paper Mill

The project is located in a MTCA cleanup and habitat restoration area, at the Former Scott Paper Company Mill Site in Anacortes, Washington. The cleanup/restoration project is being accomplished under a Consent Decree with the implementing parties (Kimberly Clark) and the Department of Ecology, as part of the "Puget Sound Initiative".

A portion of the proposed project was excluded from the DMMP characterization, after DMMP agencies reviewed the MTCA RI data, which noted biological testing exceedance of the CSL (Cleanup Screening Level) in proposed Dredged Material Management Unit-1 (DMMU-1). Six of the remaining seven DMMUs exhibited CSL exceedances for Total Volatile Solids (TVS) and/or wood waste debris, but no CSL level exceedances for other chemicals of concern or biological testing CSL exceedances. One DMMU (DMMU-2) also exhibited a CSL exceedance for 4-Methylphenol, quantitated at 680 ppb, which is above the DMMP screening level of 670 ppb, but well below the DMMP maximum level of 3,600 ppb). The DMMP agencies concluded that DMMP testing of these seven DMMUs would be allowed, consistent with the existing program policy requirements for testing wood waste (see DMMP 1997).

The initial proposed volume of 29,670 cy was reduced by 4,030 cy, reflecting the removal of DMMU-1 from testing for the reasons noted above, which made the effective volume 25,640 cy for DMMP characterization. The DMMP requires biological testing of all material with TVS greater than 25% by weight. The applicant elected to conduct concurrent chemical and toxicity testing.

The project was ranked High for DMMP characterization. A SAP was prepared and submitted to DMMP for review on April 28, 2009. The DMMP agencies asked for additional background data relative to dioxin concentrations surrounding and within the proposed dredging/cleanup area.

After completing this review, the DMMP agencies concluded that the DMMP characterization of this material would be allowed, and stipulated a 3 ft vertical testing horizon from the mud-water interface, with the first 2 ft evaluated for potential dredging and open-water disposal at the Port Gardner non-dispersive site, and the 2-3 ft vertical horizon designated as the Z-layer, to be archived, pending DMMP review of analysis results.

The conventional and chemical analyses results summarized demonstrated that no chemicals exceeded DMMP screening level guidelines or bioaccumulation triggers with the exception of dioxins. However, Total Volatile Solids (TVS) were quantitated at or exceeded the DMMP wood waste threshold of 25% by weight in DMMU-4, DMMU-5, and DMMU-8. The remaining DMMUs were under the TVS threshold. All seven DMMUs underwent concurrent DMMP toxicity testing, and the results of those analyses are described below.

A summary of the validated dioxin/furan congener specific testing results for the seven DMMUs indicated that the TEQ (Toxicity Equivalence) concentrations ranged from a low of 0.31 pptr (DMMU-6) to a high of 11.9 pptr (DMMU-4). Except for a single DMMU (DMMU-4), the remaining DMMUs depicted relatively low dioxin concentrations of up to 5.0 pptr-TEQ. The volume weighted average summary of the dioxin/furan data is summarized below.

As summarized above, dioxin in six of the seven DMMUs were quantitated below the site maximum of 5.2 pptr-TEQ. DMMU-4 was quantitated at 11.9 pptr-TEQ, which exceeds the Port Gardner offsite maximum concentration of 5.2 pptr-TEQ, and is not suitable for disposal at the Port Gardner site under the interim guidelines. The volume weighted average concentration for the six DMMUs below 5.2 pptr-TEQ (cumulative total volume of 21,660 cy) was 2.76 pptr-TEQ, which is below the interim Port Gardner offsite average of 4.1 pptr-TEQ. Therefore, these six DMMUs are suitable for open-water disposal at the Port Gardner non-dispersive site based on the former interim Dioxin Guidelines.

Toxicity testing was initiated concurrently with the chemical analysis of sediment samples by NewFields Northwest. The tests included the 10-day Amphipod mortality test (*Eohaustorius estuarius*), ~48-hour Sediment Larval Test (*Dendraster excentricus*), and 20-day juvenile polychaete growth bioassay (*Neanthes arenaceodentata*).

Because of concerns about how the Sediment Larval Test might perform in sediments with a relatively large amount of wood waste, the DMMP agencies reviewed and approved the use of a side-by-side comparison using a slight protocol variation of the Puget Sound Estuary Program (PSEP) sediment larval protocol, which utilizes a screen tube (25 um mesh) within each test beaker. For the amended Sediment Larval Protocol, the DMMP agencies were concerned about achieving a statistical Power of >0.80 in discriminating between the test results and reference sediment, and NewFields recommended increasing the within test replication requirement from 5 to 7 for this protocol to achieve that objective. The DMMP agencies agreed using Best-Professional-Judgment (BPJ) to increase the within sample replication requirement.

Reference samples were collected in Carr Inlet, and the test sediments were matched with appropriate reference sediments to evaluate the grain-size effect on bioassays. Due to the influence of woody debris on grain size results, the test sediments and reference samples were subjected to grain size analysis on an as-received bases and an organic-free basis after removal of organic matter after processing in a muffle furnace (440 °C). The samples exhibited 43 to 81% fines in the standard as-received evaluation, as compared to 55 to 89% in the organic-free samples. All of the samples were more closely matched with Carr Reference (CR-1) which contained 80 to 81% fines in both the standard and organic-free grain size determinations.

The control and reference sediments generally met the DMMP performance requirements for all three bioassays, except the CR-1 reference did not meet the DMMP performance standard for the Neanthes Bioassay; thus, for the *Neanthes* bioassay, all treatments were compared to CR-22 reference instead of the CR-1 reference. Testing results are summarized below.

- Amphipod Bioassay. Test results for the seven DMMUs compared to Carr Inlet Reference (CR-1) indicated that DMMU-7 exhibited a 2-Hit response relative to DMMP Non-Dispersive Interpretative Guidelines, whereas the other six DMMUs passed the interpretative guidelines for non-dispersive sites.

- Neanthes-20-day Growth Bioassay. The CR-1 reference sample did not meet the performance standard for this bioassay, and all test sediments were compared to Carr Reference Station CR-22. All seven DMMUs passed the interpretative guidelines for non-dispersive sites, and no hits were recorded.

- Echinoderm (Sand-Dollar)-Sediment Larval Bioassay. All seven DMMUs utilizing the standard PSEP protocol passed the interpretative guidelines for non-dispersive sites, and no hits were recorded. The data collected for the screen-tube variation of the PSEP protocol were similar to those from the standard assay (all DMMUs passed non-dispersive site guidance) but were not used for decision-making for this suitability determination. The modified bioassay results may be used by the DMMP agencies to evaluate the potential use of this protocol for future DMMP projects in wood waste areas.

Based on these chemical and biological testing results, the DMMP agencies concluded that analyses of archived Z-samples underlying each of the six DMMUs meeting the DMMP open-water disposal guidelines

would not be required. The DMMP agencies will require Z-sample analysis for DMMU-4 to verify compliance with the Washington State antidegradation policy, if post-dredge capping is not in the plans for the project. The dredging and upland disposal of DMMU-1, which was not evaluated further in this suitability determination, will be accomplished under Ecology TCP oversight and direction.

4.1.8 South Lake Union (Seattle Parks Department)

This project evaluated sediment quality testing results of surface sediments at the South end of Lake Union in Waterways 3 and 4. These testing results were also fully coordinated with the Ecology Toxics Cleanup Program's (TCP) project manager for the Model Toxics Control Act (MTCA) cleanup site for the South Lake Union Park. The sediment quality (e.g., Nature and Extent) testing results were summarized in the DMMP memorandum for record performed at the request of the DMMP and Ecology's Toxics Cleanup Program (TCP) to evaluate Phase I and II work by the City of Seattle Parks and Recreation Department to redevelop South Lake Union Park area along Waterway Number's 3 and 4. This work was accomplished under Model Toxics Control Act (MTCA) cleanup authority and oversight. The proposed park is approximately 12 acres in size, and is located at least 500 feet north of the former shoreline of Lake Union, on a former U.S. Naval Reserve site. The Park has two Washington State Department of Natural Resources waterways (Waterway Nos. 3 and 4), which extend into and border the Park. The historical southern shoreline along South Lake Union was gradually filled in during the turn of the century (e.g., early 1900s). The early site industrial use included saw mill, wood burner operation, and U.S. Navy armory, an asphalt company, and glass company, which all contributed to potential sediment quality degradation concerns. The pre-Phase II in-water work required the "nature and extent" and DMMP evaluation documented in the DMMP testing data summary memorandum.

The initial results utilized incorrect interpretative guidelines, and were subsequently reinterpreted with the proper Sediment Management Standards (SMS) guidelines, which are the Freshwater screening level (SL1) and screening level (SL2) guidelines, and for chemicals with no Freshwater guidelines, the SMS Marine Guidelines: Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSL) were used. Comparison of the testing results for Waterway 3 and Waterway 4 show that these results demonstrate that there are exceedances (detected and/or undetected) at every tested location in both Waterways. The DMMP reanalysis of these data showed that detected chemicals exceeding guidelines in Waterway 3 are Hg, Zn, TBT, Bis(2,ethyl,hexyl)phthalate, and in Waterway 4 are Cu, Hg, Zn, Ag, TBT, Benzo(b,k)fluoranthenes, total LPAHs, Bis(2,ethyl,hexyl)-phthalate, PCBs (note: all detected SL2/CSL exceedances are bolded).

Based on this review, the Corps Regulatory Branch following Ecology/DMMP review required special conditions to Corps Permit (NWS-2005-00969-WRD) as required actions before the project dredging/excavation began, and required follow-up sampling and testing of the exposed sediment surface after cleanup excavation/dredging is completed, before commencing Phase II work.

Subsequent to SAP approval the Seattle Parks and Recreation Department notified the DMMP agencies that the Phase 2 shoreline work below OHWL (Ordinary High Water Line) would be limited with only one station (WW3-5) in Waterway No. 3, and no work in Waterway No. 4.

Table 4-1. South Lake Union Sediment Sampling Approach prior to Excavation

Samples to be collected	Type of sample	Analysis to be performed prior to excavation starting	Sample Archived
5 previous sample location from Waterway 3 and 2 previous sample locations from Waterway 4	Grab Sample of top 10 cm of soil	No immediate analysis	Yes, Hold for 1 year for potential dioxin/furans analysis
After Excavation			
Samples to be collected	Type of sample	Analysis to be performed	Sample Archived
5 previous sample location from Waterway 3 and 2 previous sample locations from Waterway 4	Grab Sample of top 10 cm of soil	Sediment conventional analysis (total solids, total volatile solids, total organic carbon, and grain size)	Yes, Hold for 1 year for potential dioxin/furans analysis
		*Freshwater toxicity testing (10-day *Hyalella* Mortality and 20-day *Chironomus* mortality/growth test)	
Previous Sample Location W3-4	Grab Sample of top 10 cm of soil	No immediate analysis	Yes for TBT
Previous Sample Location W4-1	Grab Sample of top 10 cm of soil	No immediate analysis	Yes for PCB and TBT

* freshwater toxicity testing will be performed after sediment conventional analysis has been completed

Due to the reduced scope of inwater work, grab samples of post-excavation surface sediment (e.g., 0-10 cm) were limited to those collected and archived at WW3-5, which included a non-archived sample for freshwater toxicity testing to evaluate the surface sediment quality, as specified as a Permit Condition requirement as part of the Phase 2 construction. As specified in the permit, if no toxicity is expressed the archived sediment sample would be analyzed for dioxin.

Toxicity testing. On October 2, 2009 samples were collected from WW3-5 for toxicity testing with *Chironomus dilutus* 20-day survival and growth bioassay (USEPA 2000 and ASTM 2000), and the *Hyalella azteca* 10-day survival bioassay (USEPA 2000 and ASTM 2000). Reference samples were collected from Lake Washington on November 2, 2009, and Reference 3 was selected for testing with WW3-5 samples based on grain size similarity. Test chambers were aerated one day prior to test initiation after allowing sediments to settle in testing chambers. All tests met positive and negative control criteria. Tests were initiated on November 20, 2009 within the 8-week holding time requirement. The reference sediment met RSET acceptability criteria for both test species. The results of the testing demonstrated that test sample WW3-05 failed the RSET 1-Hit test interpretation guidelines for survival for the *Chironomus dilutus* test. The testing results for the *Hyalella azteca* 10-day survival test demonstrated a no-hit response, with no significant difference in mortality expressed between test sediment and reference and control sediment.

The DMMP/MTCA determination noted: “if the bioassay results show toxicity being expressed, at some or all of stations, those stations showing toxicity will be subject to placement of a cap under the direction of

Ecology Toxics Cleanup Program". Therefore, Waterway Station W3-5 required the placement of a cap under TCP direction. The applicant submitted a plan for capping at this location to Ecology TCP and Corp's Regulatory Branch for review and approval. After approving the Capping plan, Ecology TCP provided oversight on the placement of the cap, as required by the special condition to the Corps permit.

4.1.8 Georgia-Pacific Camas Slough

In the original DMMP suitability determination - dated August 2, 2007 - the z-layer underlying DMMU 3 was found to have contamination that violated the state's antidegradation policy. To prevent degradation of surface sediments, DMMU 3 was not permitted for dredging. In a letter dated March 11, 2009, the permittee (Georgia-Pacific Consumer Products LLC in Camas) reported that 3,217 cy in DMMU 3 had been dredged in violation of the permit. As part of the response to this violation, GP was required to conduct a post-dredge survey of the exposed surface to determine whether anti-degradation had actually occurred.

Three core sediment samples were collected from the area that had been overlain by DMMU 3. Samples were collected from each core at the 0-1 ft. interval, 2-3 ft. interval, and 4-5 ft. interval to evaluate not only the exposed surface but, if further remediation should be necessary, to determine whether contamination continued to increase with depth below the exposed sediment surface.

The nine resulting samples (three from each core) were analyzed separately for the chemicals of concern found elevated in the previous z-layer analysis: metals, PCBs and dioxins/furans. Results were compared to freshwater screening levels from the 2006 Interim Final Sediment Evaluation Framework (SEF). In all three cores, the top one foot of material had no exceedances of either SL1 or SL2 for any COCs, though deeper samples exhibited increased detections and in some cases exceeded the screening levels.

Since the top foot of each of 3 separate Z-samples showed no exceedances of target chemicals, there was no evidence of degradation to the surface occurring subsequent to dredging at DMMU 3 and no further action was recommended by the DMMP agencies.

4.1.9 Fairweather Bay

This project involves maintenance dredging of up to 10,000 cy of material from the access channel into the boat basin. The dredged material will be dewatered and then trucked to an upland disposal site. Because this project does not involve in-water disposal, only a permit issued pursuant to Section 10 of the Rivers and Harbors Act is required from the Corps of Engineers. The DMMP analysis was thus only for anti-degradation concerns.

To evaluate the concern for post dredging surface degradation, chemical results of the proposed dredged material were compared with interim freshwater guidelines from the RSET Sediment Evaluation Framework (RSET 2009). No exceedances of freshwater guidelines for the chemicals of concern were found in the dredged material, and there were no indications of increasing contamination with depth. Some DMMP chemicals of concern were not analyzed for in this characterization, including PCBs and dioxins. Tier 1 analysis of the dredge area showed little reason-to-believe for post-dredge surface contamination of either of those classes of chemicals, so no additional sampling was required to verify compliance with state antidegradation standards.

4.1.10 Port of Everett 10th Street Boat Launch and Settling Basin PC

The 10th Street Boat Launch and the Lower Snohomish Settling Basin are located in the Snohomish River at Everett, Washington. The 10th Street Boat Launch sediments were ranked moderate and the area has

been previously characterized and dredged. The proposed Settling Basin Realignment Area is also ranked moderate. The Port proposed sampling under DMMP Partial Characterization (PC) Guidelines to evaluate the feasibility within both areas of down-ranking two levels to a Low Rank, as outlined in the 1988 Evaluation Procedures Technical Appendix (Section 5.2.5).

The PC evaluation was divided into three areas. Core samples were taken from three locations using the MudMole^{R} sampler. Surface samples (0-4 feet) were taken in area A and B and subsurface samples (-4 to -8 feet) were taken in Areas B and C. Samples were not composited and Z-samples were not collected.

The results of the full Chemical-of-Concern list, including dioxins, indicated that all chemicals except dioxin were below screening guidelines. Dioxin concentrations ranged from 0.1 to 1.87 pptr-TEQ (Non-detects were expressed at ½ detection limit), which are below the former interim dioxin guidelines for Port Gardner, and well below the new interim dioxin guideline (4 pptr-TEQ). Based on these testing results, the DMMP agencies suitability determination determined that the Port of Everett 10th Street Boat Launch and the Settling Basin Re-alignment areas meet the downranking requirements from Moderate to Low Ranking. Both project subareas will need to undergo full characterization prior to any dredging or disposal of material at a DMMP disposal site.

4.1.11 Port of Seattle T5

This project is located in a High Concern CERCLA cleanup designated site within the Harbor Island Operational Unit, and portions of this project were previously characterized under DMMP guidelines in 1992 and 1997, and all material were found suitable for open-water disposal at the Elliott By disposal site. The project underwent a DMMP characterization for 10,410 cy of maintenance material in 2008, and the results of that characterization are documented in April 27, 2010 suitability determination, which corrects volume and dioxin errors. The initial 2008 characterization proposed maintenance dredging of an estimated 10,410 cy along 2,900 linear feet of container cargo pier margin (e.g., estimated dredging prism thickness of 3-7 ft, within the berthing area which has authorized depth of 45 ft MLLW + 2 ft of allowable overdredge depth (South end of berthing area), and 50 ft MLLW + 2 feet allowable overdredge depth (Northern end of berthing area dredging prism).

Subsequent to the initial SDM the Port of Seattle elected to expand the dredge area at Berth 2 in both the horizontal and vertical directions, therefore requiring additional characterization data are required. Also, with this engineering redesign of their maintenance dredging requirements, the estimated total project volume remained at 10,410 cy, although the volumes for DMMUs 2 and 3 changed based on reconfigured boundary delineations. The characterization area at Berth 2 now would extend from stations 9+00 to 19+00 (1,000 linear feet), so that an additional 300 feet (from stations 16+00 to 19+00) section required characterization through this supplemental sampling effort. In the vertical dimension, the Port of Seattle also required an elevation of -51 ft, plus 2 ft of allowable overdepth, for a total characterization elevation of -53 ft, MLLW, which is one foot deeper than the depth characterized in 2008. To achieve this objective, two archived Z-samples (-52' to -53' MLLW) from 2008 characterization effort were composited for analysis, as DMMU-S2b, and an additional Z-sample (S2-01a) was collected and archived at the southern end of DMMU-2 (2008 SDM), and two core samples were collected at the new northern addition to DMMU-2 and analyzed as DMMU-S3a and 4. The two core stations for DMMU-S3a also had Z-samples collected and archived. The Supplemental SAP was submitted to DMMP agencies, and approved on September 10, 2009.

The vibracore collected samples/testing results included evaluation of dioxins/furans, as well as the PSDDA/DMMP Chemical of Concern list, including TBT. For the archived Z-sample analysis of DMMU-S2b (S2-CS2) bulk-TBT analysis was conducted due to insufficient pore-water. The approved sampling and analysis plan was generally followed. The sampling and analysis characterization report was submitted on February 1, 2010 to the DMMP agencies for review, and a revised report was submitted on April 26, 2010, which corrected dioxin testing results. After reviewing, the DMMP agencies concluded that the quality assurance/quality control guidelines specified by the DMMP were generally complied with, and these data were deemed suitable for decision-making using best-professional-judgment.

A summary of chemical analysis results demonstrates that the archived DMMU-S2b (S2-CS2) had no detected or undetected chemicals exceeding DMMP-Marine guidelines. The results summary for DMMU-3a (S2-CS3) had a TBT pore water Screening Level (SL)/Bioaccumulation Trigger exceedance quantitated at 0.73 ppb, and Fluoranthene and Total PCB exceedances of the SL and SQS. The applicant elected not to conduct either toxicity testing or bioaccumulation testing for TBT, and therefore DMMU-S3a is unsuitable for open-water disposal without that testing.

The dioxin testing summary for the two DMMUs, were as follows: DMMU-S2b (S2-CS2) = 0.271 pptr-TEQ, and DMMU-S3a (S2-CS3) = 6.65 pptr-TEQ (U = ½ detection limit).

As summarized above, DMMU-S2b was quantitated below the site maximum of 12.2 pptr-TEQ. As noted in the initial updated 2009 suitability determination, DMMU-S1 (12.1 pptr-TEQ) and DMMU-S2a (3.93 pptr-TEQ) were both quantitated below 12.2 pptr-TEQ. The volume weighted average concentration for the three DMMUs (S1, S2a, and S2b) totaling 4,020 cy of characterized material is 8.25 pptr-TEQ, which is below the previous interim Elliott Bay offsite average of 8.7 pptr-TEQ, and all three DMMUs would be suitable for disposal at the Elliott Bay disposal site based on these dioxin testing results, with the stipulation that DMMU-1 must be dredged during the same dredging cycle as DMMUs S2a and S2b.

Because DMMU-S3a is unsuitable for open-water disposal, Z-sample analysis was required. The Port elected to analyze one of the two archived Z-samples (S2-Z3) for the constituents exceeding DMMP guidelines in overlying DMMU-S3a, and those results indicate that Fluoranthene was quantitated under the SL and SQS. PCBs in the Z-sample, however, were quantitated above the SL and SQS (229 ppb, and 22 ppm-OC-normalized, respectively) and were higher than PCBs quantitated in the overlying dredge prism (152 ug/kg). TBT was analyzed as bulk TBT, rather than porewater TBT, because of the limited amount of porewater in the archived Z-sample. As a result, the results of the Z-sample analysis cannot be directly compared to that of the dredge prism in order to evaluate whether degradation will occur. The results of the Z-sample analysis quantified bulk TBT at 99 ug/kg, which is 1.3 times the DMMP bulk TBT SL (73.2 ug/kg). The overlying sediment had a porewater TBT concentration of 0.73 ug/L, which is 4.9 times the porewater TBT SL (0.15 ug/L). Based on the PCB and TBT results, the DMMP concluded that the Z-sample results are not in compliance with the antidegradation standard.

Due to elevated dioxins at DMMU-S1 (12.1 pptr-TEQ) insuring compliance with the antidegradation standard is required. The Z-samples underlying this DMMU are out of the one-year holding time (e.g., collected in September 2008), and therefore to address the antidegradation concern, the Port of Seattle proposed the following:

a. Dredge between 0+00 to 9+00 an additional one-foot of material (-47 to -48' MLLW) beyond the required maintenance depth (-45' + 2 ft of allowable overdepth MLLW).

b. Collect grab samples of the newly exposed post-construction surface sediment at the two previously occupied core stations (S1-01, and S1-02) and analyzed for dioxin/furans, TBT, PCBs, and Fluoranthene.
c. If the results of these analyses show that the newly exposed surface is not in compliance with the antidegradation standard, the Port of Seattle will place a 0.5 ft clean sand cover over the exposed surface.

The adjusted volume weighted average testing outcomes for DMMU's S1, which includes an additional foot of dredging at S1b, and S2a from initial 2009 revised suitability determination and characterization, and the two tested DMMU-2b and DMMU-3a in the supplemental suitability determination. Based on the supplemental chemical testing results for DMMU-S2b this DMMU is suitable for unconfined-open-water-disposal, and can be added to the overlying material that was previously found to be suitable in DMMU-2a, as can the 2,260 cy from DMMU-S1 for a total suitable volume of 4,320 cy (2,260 cy + 300 cy + 1,460 cy + 300 cy). The supplemental testing outcome for DMMU-S3a demonstrated that the 1,210 cy of material characterized in this DMMU is not suitable for open-water disposal and must be disposed at an Ecology approved upland site.

4.2 Dredging Year 2011

4.2.1 Bellingham Cold Storage

This project was evaluated under the former interim guidelines for dioxin. The two DMMUs from the project had dioxin concentrations of 1.7 and 10.6 pptr, making them eligible for disposal only at the Elliott Bay site.

4.2.2 Chinook Ventures (also known as Millennium Bulk Terminals)

Concurrent with the DMMP characterization of maintenance dredged material, the Department of Ecology conducted an investigation into a petroleum coke spill that was alleged to have occurred from the loading facilities at Chinook Ventures/Millennium Bulk. One of the areas of investigation was adjacent to the area proposed for maintenance dredging. Hence, the proposed dredging area was ranked "high" by the DMMP agencies for this round of characterization. The purpose of this ranking was to increase sampling density to investigate the presence or absence of petroleum coke.

The sampling and analysis plan originally included 60,500 cy in 15 DMMUs. Subsequent to approval of the SAP, Chinook Ventures/Millennium Bulk decided to scale back the dredging to a total of 7 DMMUs.

All sediment samples, including grab samples from the area of investigation and the cores taken from the proposed dredging area, were visually screened for petroleum coke, alumina and cement during sampling. Quantitative estimates were also made during the grain-size analysis. The results did provide evidence of spillage approximately 150 feet from the dredging area. However, the consequences for the dredging area itself were minimal. Only minute amounts of petroleum coke were found in the dredged material samples. On the basis of the evidence, the DMMP agencies determined there was little risk posed by the dredging and disposal of the proposed dredged material.

4.2.3 Port of Bellingham Gate 3

Sampling for this project first took place in March 2007. Dioxins in the dredged material were analyzed twice, by different labs using different methods. In the first round of dioxin testing, Frontier Analytical Laboratory – using EPA method 8290 – reported concentrations of 10.6, 6.2, 27.3 and 47.1 parts per trillion

(pptr) toxicity equivalents (TEQ, with undetects = ½ estimated detection limit) for POB 1 through POB 4 respectively. The Port of Bellingham independently initiated a second round of dioxin testing for POB 1 and POB 2 to verify the first-round results and to achieve better spatial resolution of the dioxin concentrations in those DMMUs. The second round of testing was conducted by Analytical Perspectives, using EPA method 1613B. The concentrations for POB 1 and POB 2 were 22.4 and 9.6 pptr TEQ respectively. The individual cores from both DMMUs were also analyzed. The results ranged from 15.4 to 23.6 pptr TEQ for the POB 1 cores and 7.3 to 14.2 pptr TEQ for the POB 2 cores.

Due to the unexpectedly high concentrations of dioxin found in 2007, the project was put on hold by the Port of Bellingham. In early 2010 the Port resumed discussions with the DMMP agencies regarding disposal alternatives. Supplemental sampling and testing were conducted in May 2010 to provide dioxin data for an antidegradation determination.

The dioxin results were evaluated under the former interim guidelines for dioxin. None of the composited DMMUs was determined to be eligible for open-water disposal at any of the DMMP disposal sites. However, because the individual core samples from POB 2 had been analyzed separately, the DMMP agencies were able to make a more granular determination with regard to this DMMU. The dioxin concentrations for POB-2 cores S06, S07 and S08 were low enough (mean = 8.6 pptr TEQ, maximum = 10.8 pptr TEQ) to be eligible for disposal at the Elliott Bay site under the interim guidelines. None of the material would be eligible for disposal at any of the other sites.

4.2.4 Hat Island Marina

Hat Island Community, Inc. proposes to upgrade and expand its marina facilities. The total volume of dredging/excavation is 70,500 cubic yards, which includes approximately 3,500 cubic yards of maintenance dredging in the existing boat basin; 1,200 cubic yards of maintenance dredging in the entrance channel; 9,900 cubic yards of excavation for breakwater rehabilitation; and 55,900 cubic yards of excavation associated with marina expansion. Most of the material will be placed in a gravel quarry on the island. However, in order to provide enough navigation depth to transport the heavy equipment needed for the project into the marina, up to 1,000 cubic yards of sediment may first need to be dredged from the entrance channel. This material may be loaded on a barge and disposed at the Port Gardner dredged material disposal site.

Emergency dredging of the entrance channel was performed in 2008. Approximately 650 cubic yards of material was dredged and disposed at the Port Gardner disposal site. The DMMP agencies requested that samples of the dredged material be taken during the emergency removal action and tested for grain size and total organic carbon. The results indicated that the material was predominantly sand, with low organic carbon content, thereby meeting the exclusionary criteria. Based on testing from 2008, the DMMP agencies agreed that additional testing of the entrance-channel material would not be required for the current project.

In order to ascertain the nature of the other material being dredged/excavated for this project, and to determine whether the sediment to be exposed by dredging/excavation would require testing, the DMMP agencies requested that Hat Island Community, Inc. provide additional information for the site. A geotechnical report (GeoEngineers, 2008) for the expansion project was submitted, along with historical photos. Additional on-line documentation, including a history of Hat Island, was also reviewed. Nothing from this review provided any indication that the sediment to be exposed by dredging/excavation might be contaminated. The soil borings consisted primarily of sand, with a maximum of 10% silt. There has been

no industrial or commercial development on the island and there is no fueling facility at the marina. The material being removed for the marina expansion consists largely of dredged material from excavation of the existing boat basin. Photos of dredged material from the existing basin show that it consisted of sand and gravel.

While the existing information provided no indication of potential problems with sediment quality, the DMMP agencies agreed that - due to the size of the project - at least some testing should be conducted. Sampling of the sediment to be exposed by excavation of the marina expansion area would have required drilling equipment due to the depth of the planned excavation. The DMMP agencies agreed that the existing information did not warrant this expense. Instead, the agencies requested that the maintenance material to be dredged from the existing boat basin and the area in the existing boat basin directly adjacent to the expansion area be sampled and tested for grain-size and total organic carbon to verify its exclusionary status.

Dredged material samples were taken from both the area to be maintenance dredged and from the area adjacent to the proposed expansion. Three field samples were collected from each area. The composited samples were submitted to a testing laboratory for analysis of grain size and TOC. The grain-size analysis showed that the dredged material was predominantly medium-to-coarse sand (79-94 percent) and gravel (4-19 percent) with very low fines content. The TOC results were well below 0.5%. The DMMP agencies have traditionally used 20 percent fines and a TOC of 0.5% as the upper limits for determining eligibility for exclusionary status. The fines content from the Hat Island project met the grain-size criterion for exclusionary status, as did the TOC content. With respect to the potential for sediment contamination, the DMMP agencies determined that Hat Island Marina is sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material is not a carrier of contaminants. The DMMP agencies determined that dredged/excavated material from the Hat Island Marina meets the exclusionary criteria under the Clean Water Act and did not require additional chemical testing.

4.2.5 South Park Bridge

The South Park Bridge crosses the Lower Duwamish Waterway (LDW) between Tukwila (northern side) and an unincorporated area of King County (southern side). The existing bridge has reached the end of its useful life and must be demolished. King County plans on constructing a new bridge adjacent to the existing bridge after funding is secured. The new bridge requires the installation of deep caissons as part of the bascule foundation for the replacement bridge. The caissons would be approximately 60 ft square and extend to depths of 75 feet for the south bascule and 100 feet for the north bascule. Sediment will be dredged in preparation for the caisson installation and during caisson construction, with an estimated total volume of sediment to be dredged from both areas of 26,237cy.

King County Department of Transportation conducted an investigation in 2008 to evaluate the geotechnical characteristics of the sediment in the area of the LDW where the caissons would be installed. Sediment borings were collected and subsequently assessed for sediment quality as a screening level evaluation of potential dredged material disposal alternatives. The results of those analyses were coordinated with the DMMP for review, and feedback from DMMP, and were used by WSDOT and their consultants to subsequently design the Sampling and Analysis Plan (SAP) Approach for DMMP characterization articulated in the SAP approved by the DMMP

A sand blanket will be placed on top of the contaminated sediments at the pile driving locations prior to installing the work trestles and cofferdams. An estimated 30.2 cy of sand blanket (up to 1 foot in depth)

would subsequently removed inside each of the two cofferdams as part of the excavation process and disposed at an approved upland site along with the underlying contaminated material at both bascules). The purpose of the sand blanket is to minimize re-suspension of underlying contaminated sediments, while piles are being driven and later removed.

Following the initial excavation within the two 71-ft. by 71-ft. cofferdams, they will be backfilled to depth of approximately 42 ft. to support the initial caisson construction. The volume required will be 15,710 cy (7,855 cy within each cofferdam), which will be upland sourced material, and therefore not suitable for unconfined open-water disposal. An estimated 5,415 cy will be removed within each bascule cofferdam for bascule pier construction. Once the caissons are in place, the backfill material remaining between the caissons and the interior walls of the cofferdams will be removed down to the riverbed prior to removing the cofferdam structures. That volume would represent an additional volume of backfill material of 1,040 cy per pier (2,080 cy total).

Table 4-2. Sediment Characterization Details, South Park Bridge Project

Location	Depth Interval (ft) Below mudline	DMMU ID	Original Estimated Volume (cy)	Revised Volume Estimate (cy)	Testing Rationale
South bascule	0 – 6	None	1,100	1,150.2 (includes 30.2 cy sand blanket)	Unsuitable based on previous testing results (Wilbur, 2004)
	6 – 10	SB-1	750	*	DMMP testing (this SDM)
	10 – 14	SB-2	750	*	DMMP testing (this SDM)
	14 – 18	SB-3	750	*	Archive pending review of overlying sediment quality
	18 – 75	None	8,000	*	Native (no testing required)
	Cofferdam backfill Material to be excavated for caisson construction	None	Omitted	5,415 (total volume placed: 7,855)	Not tested. Upland material, unsuitable for DMMP disposal
	Backfill Material removed prior to cofferdam removal	None	Omitted	1,040	Unsuitable for DMMP disposal
North bascule	0 – 10	None	1,850	1,897.2 (includes 30.2 cy sand blanket)	Unsuitable based on previous testing results (Wilbur, 2004)
	10 – 14	NB-1	750	*	DMMP testing (this SDM)
	14 – 18	NB-2	750	*	Archive pending review overlying sediment quality; PCBs analyzed in Phase II
	18 – 100	None	11,500	*	Native (no testing required)
	Cofferdam backfill Material to be excavated for caisson construction	None	Omitted	5,415 (total volume placed: 7,855)	Not tested. Upland material, unsuitable for DMMP disposal
	Backfill Material removed prior to cofferdam removal	None	Omitted	1,040	Unsuitable for DMMP disposal
Total estimated volume (Tested)			26,200	26,237	Testing outcome in SDM
Backfill Material (Upland)			Omitted	12,910	Unsuitable for DMMP disposal

*Estimated volumes are unchanged or lower than the original volume estimates

The Phase 1 testing for DMMU's SB-2 and NB-1 included evaluation of dioxins/furans and the PSDDA/DMMP Chemical of Concern list, including TBT. The characterization report also contained the Phase 2 bioaccumulation testing results as well as NB-1 sediment chemistry for the 14 to 18 ft depths.

A summary of Phase 1 and 2 chemical analysis results for all COC except dioxins/furans demonstrates that all chemicals were either detected or undetected under the DMMP Guidelines except PCBs and Total DDT within DMMU-NB-1 (10 to 14 ft depth). PCBs in this sample (91 mg/kg-organic carbon normalized) exceeded both SL and Bioaccumulation Trigger in this sample, and DDT was undetected over the SL (28 ug/kg U). Based on these testing results, DMMU-NB-1 was first subject to toxicity testing described below, and subsequently to bioaccumulation testing for PCBs described below.

The results of dioxin/furan testing results for two DMMUs were as follows: DMMU-SB-2 = 0.685 pptr-TEQ and DMMU-NB-1 = 1.57 pptr-TEQ (U = ½ detection limit). The volume weighted average for these two DMMUs is 1.13 pptr-TEQ, which is well below the Elliott Bay offsite average of 8.7 pptr-TEQ (old interim dioxin guidelines).

The toxicity testing summary for DMMU-NB-1 due to PCB SL exceedances was conducted within the 8-week holding time, and the three toxicity tests met all data quality objectives and test acceptability guidelines specified by the DMMP, including control and reference sediment (Carr Inlet). The bivalve larval test (*Mytilus galloprovincialis*) exhibited a 2-hit response under the non-dispersive site guidelines, and a 1-hit response under the dispersive site guidelines. No other hits were recorded for the other two toxicity tests (e.g., 10-acute toxicity test with *Eohaustorius estuaries*; and the 20-day juvenile polychaete survival and growth bioassay with *Neanthes arenaceodentata*). Therefore, based on these testing results, DMMU-NB-1 is suitable for non-dispersive site disposal at the Elliott Bay site.

Subsequent bioaccumulation testing of DMMU-NB-1 was performed with *Macoma nasuta*, a facultative deposit feeding/suspension feeding bivalve and *Nephtys caecoides*, a burrowing facultative deposit feeding/carnivorous polychaete. The two species were tested together in the same 10-gallon aquaria. The standard PSDDA bioaccumulation test duration is 28 days, but was extended to 45-days to provide a better approximation of steady-state tissue concentrations for the tested chemical (total PCBs).

As called for in the bioaccumulation protocol, five replicate 10-gallon aquaria were utilized for the negative control, the reference sediment, and for the single tested DMMU-NB-1. Routine water quality metrics (temperature, salinity, dissolved oxygen, pH) were monitored during the exposure period, and the testing conditions employed were Temperature: 15 $\pm$ 1°C; Salinity: >25 ^{o}/oo $\pm$ 2 ^{o}/oo; Photoperiod: 16 hours/Light: 8 hours/Dark; with gentle aeration to insure that dissolved oxygen does not fall below 40% saturation. All surviving test organisms at the end of the test were depurated 24-hours prior to storing for analysis. During the exposure period, supplemental sediment additions of 0.175 L/week were added to each replicate aquarium, beginning on day 7 of the test. No supplemental feeding of test species was conducted during the 45-day exposure period.

The following deviations from the standard DMMP bioaccumulation testing protocol occurred and were not brought to the attention of the DMMP agencies until the conclusion of the test:

a) In resampling to collect the sediment required to conduct the bioaccumulation test for DMMU-NB-1, the applicant failed to collect sufficient volume of test sediment as prescribed by the bioaccumulation protocol. Therefore, the testing laboratory (Northwestern Aquatic Sciences) utilized 3.4 L of sediment/aquaria, rather than the 4.0 L / aquaria called for by the protocol.

b) As a result of the lower volume of sediment available for bioaccumulation testing, the initial stocking density of both test species (Macoma, *Nephtys*) was lower than recommended by the protocol

(*Macoma*: stocked with 12 clams rather than 15 recommended; *Nephtys*: stocked with 20 worms rather than 60 recommended by protocol).

c) The lower stocking density combined with weight loss during the 45-day testing exposure period resulting in insufficient biomass for both species to accomplish the 5-replicate analysis per treatment (e.g., control, reference, test sediment) recommended by the bioaccumulation protocol. For *Nephtys*, there was sufficient biomass to conduct only single un-replicated analyses of initial and 45-day control, reference, and test sediment. For *Macoma*, 3 replicate analyses were conducted for Day 0 (control), 45-Day control, and test sediment, with sufficient biomass for the full five replicate analyses for the *Macoma* reference treatment.

Survival was generally good for both test species, with higher survival noted for *Nephtys*. The comparative initial and final biomass for both *Macoma* and *Nephtys* on day 0 and day 45 of the test shows that both species lost weight during the exposure period, with *Macoma* averaging 79% of the initial weight. Forty-five-day *Nephtys* lost more weight compared to *Macoma*, weighing 51% of the initial worm weight in controls. Weight losses observed in reference and treatment (NB-1) were 67% and 62%, respectively, as compared to the initial weights, which were somewhat higher than the control worms.

As noted earlier, there was insufficient biomass for both species at the end of the 45-day exposure period to conduct the full five replicate analyses per treatment (e.g., control, reference, test sediment) as required by the DMMP bioaccumulation protocol.

Tissue concentrations of PCB from the 45-day exposures were compared statistically to the appropriate reference sediment for *Macoma* only. As noted in Table 4.3 below the calculated ratios of initial to retested sediment PCB concentrations were used to adjust the observed tissue concentrations, as the retested PCBs were lower than the initial result by a 5.1 ratio. Statistical comparisons of the test DMMU and reference tissue concentrations for the final interpretation "worst case" analyses were based on the adjusted tissue concentrations. The summary PCB tissue data interpretation is provided in Table 4.3 below.

The DMMP agencies agreed that comparing statistical differences from reference is a necessary, but not sufficient condition to determine a DMMU unsuitable for open-water disposal. For those DMMUs that were statistically greater than reference, a more in depth evaluation was required to determine the significance of the bioaccumulation that had occurred. This evaluation focused on a) Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food; b) DMMP target tissue concentration value for chemicals of concern to human health.

a) The FDA guidelines for PCBs is as follows: 2.0 ppm wet weight
b) The DMMP TTL for PCBs: 750 ppb (0.75 ppm) wet weight

The DMMP agencies re-evaluated the PCB TTL for human health in December 1999 MFR. Recalculation of the PCB TTL for the Elliott Bay disposal site included using an updated cancer slope factor, recent fish consumption data, and consideration of PCB biomagnification due to trophic transfer. Based on this analysis, an interim TTL for total PCBs (Aroclor) of 750 ppb (0.75 ppm) wet weight was used to interpret bioaccumulation data for the South Bridge Project. These guidelines will likely change in the future as the DMMP review the bioaccumulation testing and TTLs guidance for Puget Sound.

The bioaccumulation testing results for both species using sediments from DMMU-NB-1 were compared to the TTL interpretation guideline. The single DMMU was quantitated less than the TTL for both species, and was subjected to a one-tailed one-sample t-test for the replicated *Macoma* tissue. An alpha level (the probability of making a Type I error, rejecting the null hypothesis of no difference between test, reference, and TTL responses when, in fact, they are not different) of 0.1 was selected for these statistical comparisons by the DMMP agencies to reflect the higher within sample variability, and to increase the power of the test to discriminate between reference, TTL and test responses. The test results for *Macoma* were statistically greater than the reference sediment, but below the TTL. Therefore, based on these bioaccumulation testing results DMMU-NB-1 sediments are suitable for open-water disposal at the Elliott Bay site.

Table 4-3. Bioaccumulation summary for South Park Bridge project

Sediment: Initial and Retested Total PCB Ratio for DMMU-NB-1

DMMU-NB-1 (10 -14 ft) North Bascule				
Chemical	Units	Initial (I)	Retest (R)	Ratio: I/R
Total PCB (dry weight)	ug/kg	910	180	5.1
Total PCBs (TOC normalized)	mg/kg	91.0	24	3.8
TOC	%	1.0	0.738	

Bioaccumulation Testing Results Summary for DMMU-NB-1*

			DMMU_NB-1 (10 - 14 ft)											
			Macoma nasuta						Nephtys caecoides					
CHEMICAL NAME	Units	Guideline	DMMU tissue (initial)(m	DMMU tissue (unadjusted)	DMMU tissue (adjusted)	Reference (CR-23 Mod)	Statistically different from reference	statistically below guideline	DMMU tissue (initial)	DMMU tissue (unadjusted)	DMMU tissue (adjusted)	Reference (CR-23 Mod)	Statistically different from reference	statistically below guideline
Total PCBs	ug/kg-ww	750	5 (u)	121	617	4 (u)	Yes	Yes	8 (u)	65	332	4 (u)	ND	ND

Note: (1) All tissue concentrations for Total PCBs were analyzed on a wet weight basis to facilitate guideline
(2) Adjustments to tissue concentrations based on initial sediment versus retested sediment concentration ratios (see Table 8).
Concentration ratios greater than 1 were adjusted.
ND = Not Determined

Target Tissue Guideline exceeded

NFAR **No further Action Required, DMMU Unsuitable for unconfined-open water disposal**

***Attachment 1** provides full Bioaccumulation Tissue PCB Aroclor Testing Summary

The testing results summary for four tested DMMUs (SB-1, SB-2, NB-1, and NB-2) amounting to 3,000 cy. DMMU-SB-3 (750 cy) underlying tested DMMU's SB-1 and SB-2 was found to be suitable based on best professional judgment, after reviewing the overlying sediment quality results for SB-1 and SB-2. Native material underlying South and North bascules, amounting to 8,000 cy and 11,500cy respectively was found to be suitable based on best professional judgment after reviewing the overlying sediment quality results at both locations. The results summarized in this suitability determination indicate that a total volume of 23,250 cy is suitable for unconfined-open-water disposal at the Elliott Bay nondispersive site.

Surface material amounting to a total cumulative volume of 3,057.4 cy at both bascules (includes 60.4 cy of sand blanket material), which was not tested during this characterization effort, but 2004 sediment quality results (Wilbur Consulting, 2004) were previously reviewed by DMMP, and found to be unsuitable for unconfined-open-water disposal. At the South bascule, the top 6 feet of material (cumulative volume = 1,150.2 cy, which also includes removal of 30.2 cy sand blanket), and at the North bascule, the top 10 feet of material (cumulative volume = 1,897.2 cy, which also includes removal of 30.2 cy sand blanket) is unsuitable for open-water disposal, and must be disposed at an Ecology approved upland disposal site.

The 5,415 cy of backfilled upland sourced material will be removed within each bascule cofferdam after bascule pier construction for a total of 10,830 cy. Once the caissons are in place, the backfill material remaining between the caissons and the interior walls of the cofferdams will be removed down to the riverbed prior to removing the cofferdam structures. That volume would represent an additional volume of backfill material of 1,040 cy per pier, or 2,080 cy total.

4.2.6 Port of Everett Marina.

The former Everett Shipyard, a Puget Sound Initiative (PSI) cleanup site, occupies a portion of the Everett Marina. The dredged material characterized under DMMP lies adjacent to, but outside, the boundaries of the cleanup site. Because of heightened concern for sediment near the cleanup site, the DMMP agencies required more field samples and smaller DMMUs in this area.

Dioxins were analyzed in two rounds of testing. The DMMP agencies initially required dioxin testing in the three DMMUs adjacent to the PSI cleanup area (DMMUs 4, 6 and 7). Composited samples representing these DMMUs were tested by Analytical Resources Incorporated using EPA method 1613B. Results from this first round of testing revealed elevated dioxin concentrations, ranging from 6.6 to19.4 ng/kg. The elevated concentrations near the PSI site prompted the DMMP agencies to require a second round of testing, including composited samples from each of the remaining DMMUs, as well as some composited and some uncomposited Z-samples from select locations. The second round of testing was conducted on archived sediment by Axys Analytical using EPA method 1613B. Concentrations from this round of testing ranged from 3.9 to 11.4 ng/kg for DMMUs 1, 2, 3, 5 and 8 and from 0.2 to 17.2 ng/kg for the Z-samples.

Due to complications posed by the dioxin data for the Port of Everett's original dredging plan, and the need to complete at least some dredging in the next dredging year (June 16, 2011 to June 15, 2012), the Port decided to pursue dredging of DMMU 1 immediately and asked the DMMP agencies to hold in abeyance any decision regarding the remainder of the project with respect to dioxin. A redesign or additional dioxin analysis may be needed to pursue dredging beyond DMMU 1. A decision about the remaining material with respect to dioxin will be documented in a future supplement to the suitability determination.

4.2.7 Wanapum Dam Upper Boat Launch

This project is located on the eastern shoreline of the Columbia River, within Wanapum Lake, north of Wanapum Dam along State route (SR) 243 in Grant County, Washington. A Level 1 assessment was initiated by the applicant, without coordination with the DMMP, to evaluate the initial sediment quality within the proposed dredging footprint of an estimated <1,000 cy in the boat launch area to determine if additional testing is warranted to evaluate potential upland or in-water beneficial reuse. Chemical and conventional analyses were conducted on diver-collected cores. Although the grain size analysis used a 200 mesh sieve instead of a 230 mesh sieve, data was considered adequate for decision purposes.

In summary, the results of the Level-1 chemical analyses results after comparison to DMMP guidelines indicated that all <1,000 cy of proposed dredged material is suitable for upland and in-water beneficial reuse alternatives at approved locations, and no additional characterization was required.

CHAPTER 5. DISPOSAL SITE USE AND MONITORING

5.1 Disposal Activity and Site Use

The Washington State Department of Natural Resources issues site-use authorizations to project proponents electing to dispose of suitable dredged material at PSDDA and Grays Harbor/Willapa Bay designated disposal sites[1]. These authorizations are issued for sediments that are 1) suitable for unconfined open-water disposal as determined by the Dredged Material Management Program 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 activities for dredging years 2010 and 2011.

5.1.1 Dredging Year 2010

In DY10, a total of 489,522 cubic yards (cy) of dredged material were deposited at four Puget Sound sites. The Port Gardner site received the bulk of the material with 371,497 cy from three projects, including 329,594 cy from the Corps/Port of Everett dredging of the Snohomish River navigation channel. The Elliott Bay disposal site received 96,046 cy from three projects.

In Grays Harbor 1,054,847 cy were disposed at the Point Chehalis estuarine disposal site. An additional 91,720 cy were placed at the Half Moon Bay beneficial use site, and 118,182 cy were placed at the South Beach beneficial use site. An estimated 25,000 cy of dredged material were disposed from Tokeland Marina in the flow lane at Toke Point. The Port of Willapa recently purchased a small hydraulic dredge to get critical maintenance dredging accomplished in the marina and entrance channel, as Federal funding for maintenance dredging has decreased for smaller dredging projects. Along the Pacific coast, at the Quillayute federal channel and boat basin, 10,000 cy were dredged and placed at the beneficial-use Site A, and 54,900 cy were dredged and placed at the beneficial-use Site 2A at Rialto Beach, utilizing a portable hydraulic pipeline dredge. The volumes disposed at the Puget Sound and Grays Harbor sites in DY10 are graphically presented in Figure 5-1 and Figure 5-2, and are summarized in Tables 5-1 and 5-2.

5.1.2 Dredging Year 2011

The Puget Sound sites were effectively closed for a period of six months due to a lengthy formal ESA consultation on impacts to rockfish. However, several projects in advanced stages of preparation were allowed to go forward by NMFS during this period. Because of the site closures, disposal during DY11 was limited, with a cumulative total disposal volume of 280,707 cy being placed at four Puget Sound sites. The bulk of the material disposed came from one project in Blair Waterway (Port of Tacoma, Washington United Terminal cutback project), where ~~179,160~~ cy were disposed of at the Commencement Bay site. Additionally, the Corps placed 111,598 cy at the upland sand-rehandling site "O" from routine Snohomish River maintenance dredging.

In Grays Harbor 1,814,173 cy were disposed at the two estuarine disposal sites – Pt. Chehalis and South Jetty – from Corps maintenance dredging and several Port of Grays Harbor maintenance dredging projects (T1, T2, T3, and T4). A total of 177,150 cy were placed at the Half Moon Bay beneficial use site, and 298,251 cy were placed at the South Beach beneficial use site. Additionally, approximately 30,000 cy of material were placed at the Tokeland Marina flow-lane disposal site in Willapa Bay. The DY11 volumes

[1] There are no designated disposal sites on the Lower Columbia River, with flow-lane disposal being the principal means of open-water disposal; therefore DNR does not issue site-use authorizations there.

disposed at Puget Sound and Grays Harbor sites are graphically presented in Figure 5-3 and Figure 5-4, and are summarized in Tables 5-3 and 5-4.

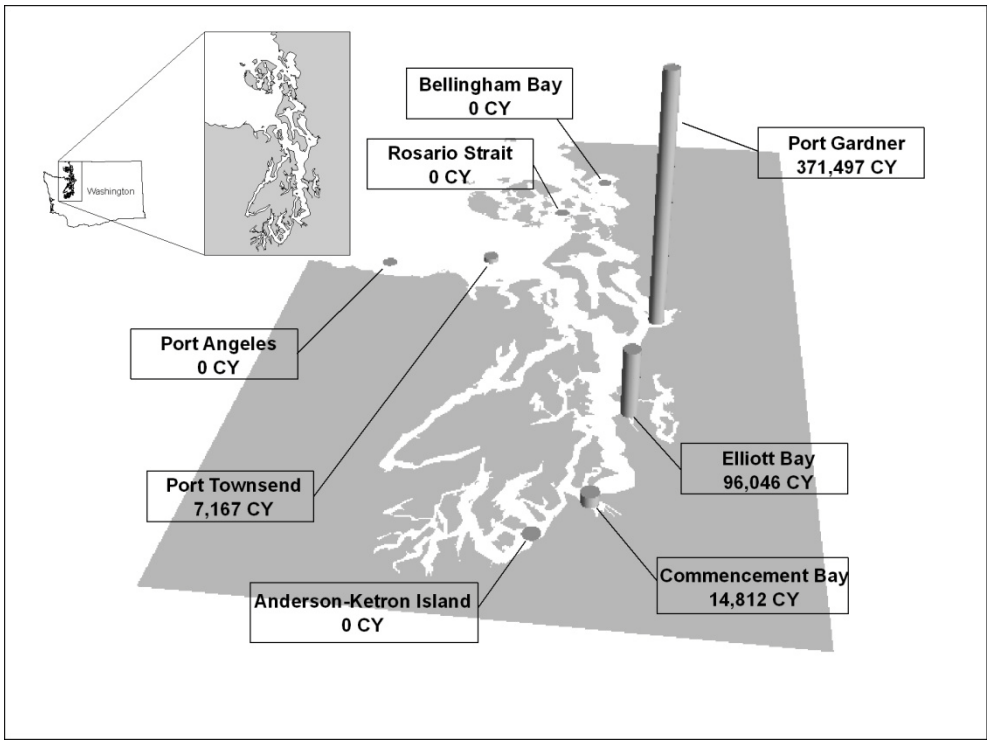

Figure 5-1. DY10 disposal volumes in Puget Sound

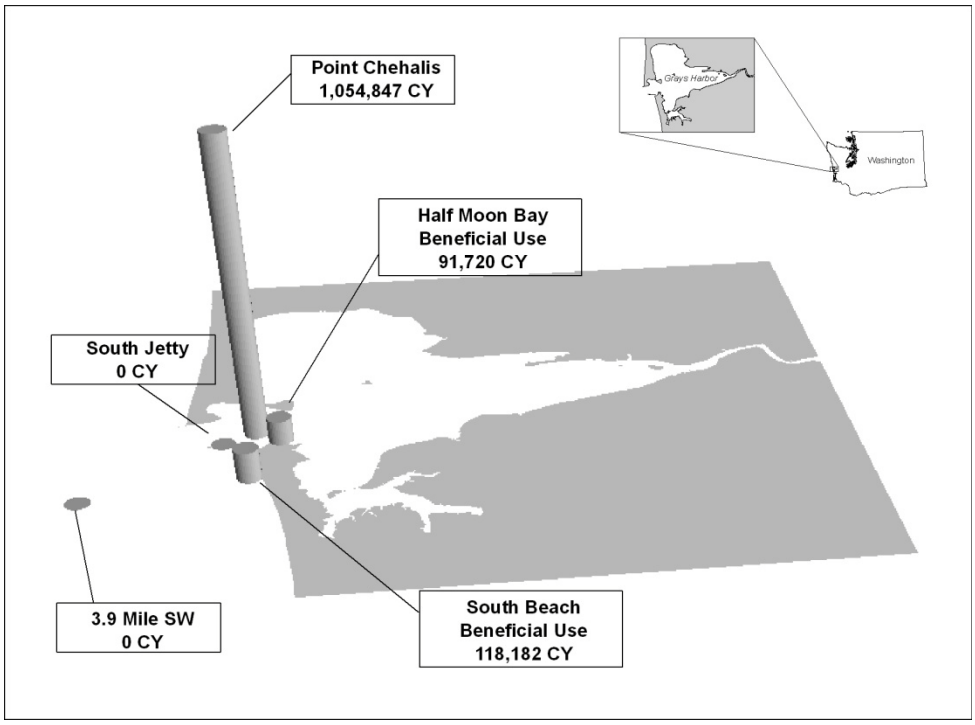

Figure 5-2. DY10 disposal volumes in Grays Harbor

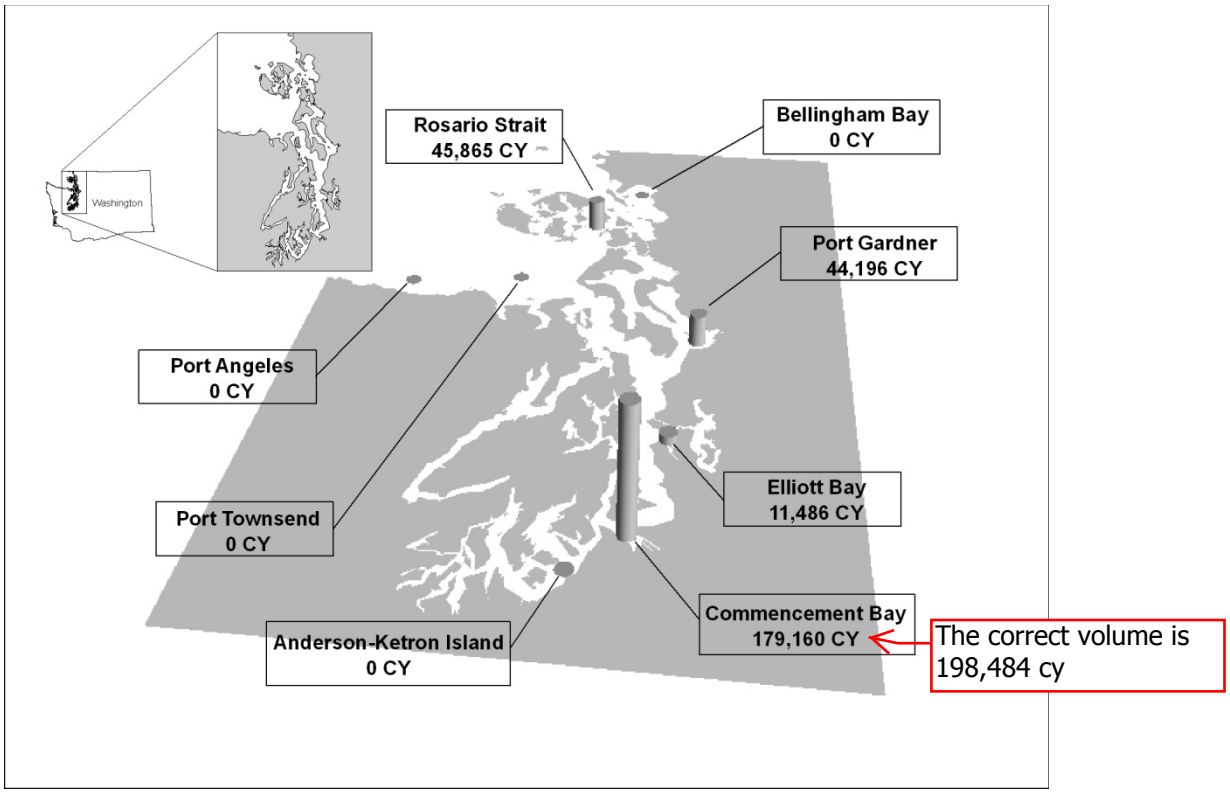

Figure 5-3. DY11 disposal volumes in Puget Sound

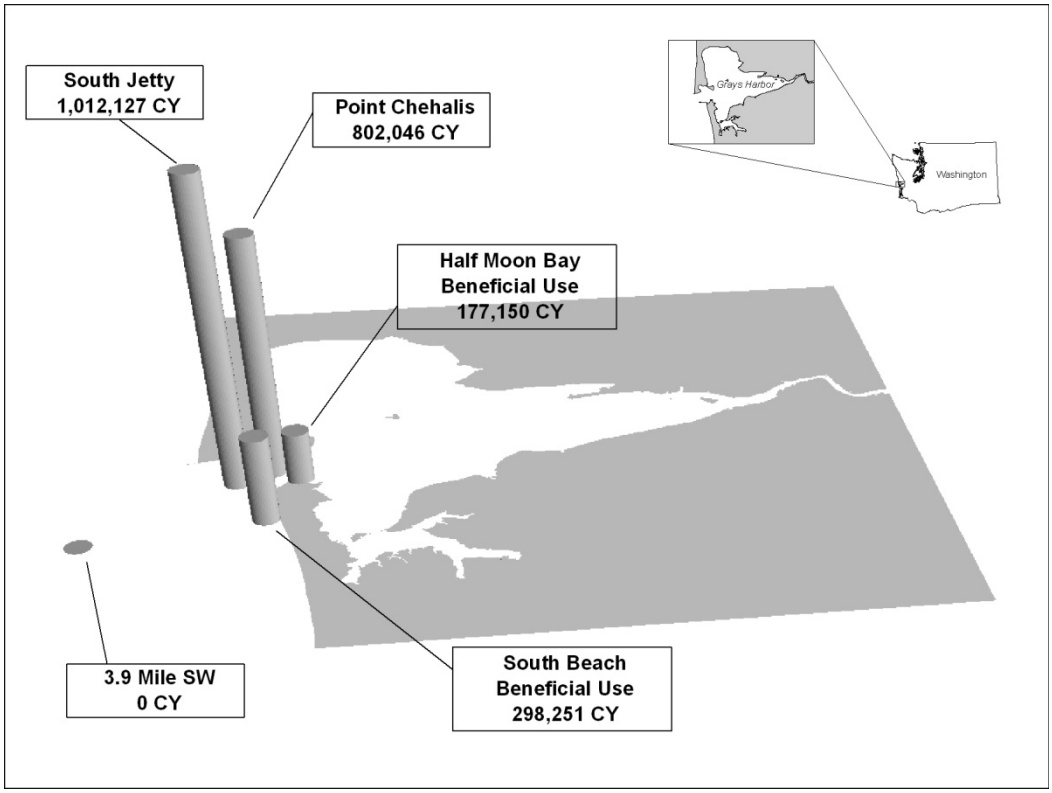

Figure 5-4. DY11 disposal volumes in Grays Harbor

Table 5-1. Disposal-Site Activity Summary, DY10

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Commencement Bay	PSDDA	1	14,812
Elliott Bay	PSDDA	3	96,046
Port Gardner	PSDDA	3	371,497
Port Townsend	PSDDA	1	7,167
Point Chehalis	Grays Harbor	3	1,054,847
Half Moon Bay-BU	Grays Harbor	1	91,720
South Beach-BU	Grays Harbor	1	118,182
Flowlane Disposal (Tokepoint)	Willapa Bay	1	25,000
Quillayute (Rialto Beach)-BU	Coastal Washington	1	64,900
All Sites within Puget Sound Jurisdiction	PSDDA sites	8	489,522
All Sites within GH/WB/CW Jurisdiction	Grays Harbor Estuarine sites Grays Harbor BU Willapa Bay sites Quillayute - Rialto Beach BU	3 2 1 1	1,054,847 209,902 25,000 64,900
Grand Total	All sites	15	1,844,171

Legend: BU = Beneficial Use; CW = Coastal Washington; GH = Grays Harbor; WB = Willapa Bay
PSDDA = Puget Sound Dredged Disposal Analysis

Table 5-2. Project-Specific Disposal Activity, DY10

Site	Proponent/Project	SD DY	Dredger	Dredge Type	Disposal Volume (cy)	Number of Barge Loads	Number Off Site	Disposal Dates
PT	Bridge Haven Community Club	2007	Caicos Corporation	CD	7,167	12	0	8-31-09 to 11-17-09
EB	City of Mercer Island Lake Line Replacement	2006	Manson Construction	CD	31,242	31	0	7-6-09 to 2-14-10
EB	Delta Marine	2008	Manson Construction	CD	4,869	2	0	1-22-09 to 2-14-10
PG	Port of Anacortes, Former Scott Mill Site	2010	Pacific Pile and Marine	CD	19,671	33	0	9-20-09 to 11-2-09
PG	Port of Everett – 10th Street Boat Launch	2010	KC Equipment	CD	22,232	113	0	1-27-10 to 2-14-10
PC	Port of Grays Harbor – T1 Expansion	2010	Hickey Marine	CD	41,757	64	0	12-8-09 to 12-26-09
PC	Port of Grays Harbor – T2	2008	Hickey Marine	CD	35,819	51	0	12-2-09 to 12-15-09
CB	Port of Tacoma – WUT cutback	2009	Manson Construction	CD	14,812	10	0	1-18-10 to 2-1-10
FLD	Port of Willapa Tokeland Marina	2009	Pipeline Dredge (Port of Willapa owned)	PD	25,000	NA	0	10-9-09 to 3-5-10
EB	USACE Duwamish O&M	2010	American Construction	CD	59,935	37	0	1-16-10 to 2-7-10
SB	USACE Grays Harbor Bar	2008	USACE Essayons	HD	118,182	23	0	4-16-10 to 5-2-10
PC	USACE Grays Harbor Entrance	2008	USACE Yaquina	HD	213,173	217	0	4-1-10 to 5-1-10
HMB	USACE Grays Harbor Entrance	2008	USACE Yaquina	HD	91,720	93	0	4-1-10 to 5-1-10
PC	USACE Grays Harbor Entrance	2008	USACE Essayons	HD	342,427	67	0	4-16-10 to 5-2-10
PC	USACE Grays Harbor Inner Harbor	2009	American Construction	CD	421,671	160	0	12-2-09 to 1-12-10
Site A	USACE Quillayute O&M	2005	Nehalem	CD	10,000	NA	0	11-1-09 to 2-28-10
Site 2A	USACE Quillayute O&M	2005	Nehalem	CD	54,900	NA	0	11-1-09 to 2-28-10
PG	USACE/POE Snohomish O&M	2010	General Construction	CD	329,594	227	0	1-5-10 to 2-12-10

Legend: CB = Commencement Bay; EB = Elliott Bay; FLD = Flow Lane Disposal; HMB = Half Moon Bay beneficial use; PC = Point Chehalis; PG = Port Gardner; PT = Port Townsend; RS = Rosario Strait; SB = South Beach beneficial use; Site A and Site 2A = Rialto Beach beneficial use; CD = Clamshell Dredge; HD = Hopper Dredge; PD = Pipeline Dredge; NA = Not Applicable; DY = Dredge Year; SD = Suitability Determination

Table 5-3. Disposal-Site Activity Summary, DY11

Disposal Site	Jurisdiction	Number of Projects	Total Volume (cy)
Commencement Bay	PSDDA	1	~~179,160~~
Elliott Bay	PSDDA	3	11,486
Port Gardner	PSDDA	1	44,196
Everett – Upland Site "O"	PSDDA	1	111,598
Rosario Strait	PSDDA	1	45,865
Point Chehalis	Grays Harbor	4	802,046
South Jetty	Grays Harbor	1	1,012,127
Half Moon Bay BU	Grays Harbor	1	177,150
South Beach BU	Grays Harbor	1	298,251
Flowlane Disposal (Tokepoint)	Willapa Bay	1	30,000
All Sites within Puget Sound Jurisdiction	PSDDA sites Upland Site "O" (Everett)	6 1	280,707 111,598
All Sites within GH/WB Jurisdiction	Grays Harbor Estuarine sites Grays Harbor BU Willapa Bay sites	5 2 1	1,814,173 475,401 30,000
Grand Total	All sites	15	2,711,879

Legend: BU = Beneficial Use; CW = Coastal Washington; GH = Grays Harbor; WB = Willapa Bay
PSDDA = Puget Sound Dredged Disposal Analysis

Table-5-4. Project-Specific Disposal Activity, DY11

Site	Proponent/Project	SD DY	Dredger	Dredge Type	Disposal Volume (cy)	Number of Barge Loads	Number Off Site	Disposal Dates
EB	Boyer Towing Company	2010	Pacific Pile & Marine	CD	2,076	5	0	2-12-11 to 2-14-11
RS	City of Anacortes, Skyline Marina, Flounder Bay	2010	Pacific Pile & Marine	CD	45,865	77	0	8-2-10 to 10-15-10
EB	City of Mercer Island Lake Line Replacement	2006	Manson Construction	CD	1,712	1	0	8-23-10
PG	City of Oak Harbor Marina	2007	NW Marine Construction	CD	44,196	37	0	12-2-10 to 2-13-11
EB	MJB Properties, Anacortes	2009	Pacific Pile & Marine	CD	7,698	11	0	1-21-11 to 2-3-11
PC	Port of Grays Harbor – T1	2008	Hickey Marine	CD	5,924	2	0	1-8-11 to 1-9-11
PC	Port of Grays Harbor – T2 & T4	2008	Hickey Marine	CD	54,213	16	0	1-4-11 to 1-8-11
PC	Port of Grays Harbor – T3	2009	Hickey Marine	CD	32,367	13	0	1-3-11 to 1-10-11
CB	Port of Tacoma WUT cutback	2009	Manson Construction	CD	~~179,160~~	119	0	9-8-10 to 12-1-10
FLD	Port of Willapa Tokeland Marina	2009	Pipeline Dredge (Port of Willapa owned)	PD	30,000	NA	0	10-11 to 2-11
Site O	USACE/Port of Everett Upper Settling Basin	2010	Portable Hydraulic Dredge (port owned)	PD	111,598	N/A	0	2-14-11 to 3-15-11
PC	USACE Inner Grays Harbor	2009	American Construction	CD	530,358	197	0	7-16-10 to 12-31-10
SJ	USACE Inner Grays Harbor	2009	American Construction	CD	862,039	327	0	7-16-10 to 9-25-10
PC	USACE Outer Grays Harbor	2008	USACE Portland (Yaquina)	HD	48,853	50	0	4-19-11 to 5-19-11
SJ	USACE Outer Grays Harbor	2008	USACE Portland (Yaquina)	HD	138,837	140	0	4-19-11 to 5-19-11
HMB	USACE Outer Grays Harbor	2008	USACE Portland (Yaquina)	HD	177,150	178	0	4-19-11 to 5-19-11
PC	USACE Outer Grays Harbor	2008	USACE Portland (Essayons)	HD	130,331	25	0	5-2-11 to 5-18-11
SJ	USACE Outer Grays Harbor	2008	USACE Portland (Essayons)	HD	11,251	2	0	5-2-11 to 5-18-11
SB	USACE Outer Grays Harbor	2008	USACE Portland (Essayons)	HD	298,251	57	0	5-2-11 to 5-18-11

Legend: CB = Commencement Bay; EB = Elliott Bay; FLD = Flow Lane Disposal; HMB = Half Moon Bay beneficial use; PC = Point Chehalis; PG = Port Gardner; RS = Rosario Strait; SB = South Beach beneficial use; SJ = South Jetty; Site O = upland sand-rehandling site; CD = Clamshell Dredge; HD = Hopper Dredge; PD = Pipeline Dredge; NA = Not Applicable; DY = Dredge Year; SD = Suitability Determination

5.2 Post-Disposal Site Monitoring (2010 – 2011)

During the two year period covered by this biennial report the cumulative volume disposed at each of the non-dispersive sites was relatively low and cumulative volumes were below the nominal soft-triggers for initiating routine environmental monitoring as summarized in Table 5-5. However, a tiered-full monitoring evaluation of the Port Gardner disposal site was completed during 2010. Additionally, as a response to the 2010 ESA consultation and Biological Opinion relative to rockfish, the DMMP agencies committed to a limited rockfish larvae study at six of the DMMP disposal sites, which will be summarized later. Additionally, as a response to concerns expressed by the Lower Elwha Klallam Tribe, the DMMP agencies initiated a fate and transport study to evaluate the relative dispersal patterns at the three dispersive disposal sites in north Puget Sound, which will be summarized later in this chapter.

Table 5-5. Monitoring History[2] relative to Soft Triggers[3] and Site-Use Disposal

Site: (Monitoring Soft Triggers)	A/K (300 kcy)	CB (500 kcy)	EB (500 kcy)	PG (500 kcy)	BB (300 kcy)
Last Monitoring date(s)	Partial 2005 SS 2007/2008 (dioxin)	Full 2007 SS 2007 (dioxin)	Partial 2002 SS 2005 SS 2007 (dioxin)	Tiered-Full 2010 Dioxin, PCB, PBDE congeners	Partial 1993 SS 2007 (dioxin)
Cumulative volume since last monitoring event	107,717	~~427,633~~	422,155	44,196	46,000
Cumulative volume since SS (dioxin)	0	~~427,633~~	305,509	NA	0

Legend: A/K = Anderson/Ketron; CB = Commencement Bay; EB = Elliott Bay; PG = Port Gardner; BB = Bellingham Bay; SS = Special Study

5.2.1 Port Gardner Tiered Full Monitoring Survey (2010)

During spring of 2010, the DMMP agencies were informed that a flat-top barge was being utilized for disposal of material from a Port of Everett project rather than using a bottom dump barge. The DMMP requires bottom dump barges, and does not sanction the use of flat top barges at non-dispersive sites, due to concerns about the potential for wider dispersion of material with a flat top barge. The documentation of this deviation from DMMP requirements triggered monitoring at the Port Gardner site to verify compliance with the site management objectives. A number of changes to the existing monitoring plan were implemented during this monitoring effort. The changes included moving up the SPI survey three weeks prior to the chemical and biological monitoring effort to better discriminate the dredged material footprint at the disposal site. The DMMP agencies also implemented updated onsite dioxin monitoring, which added seven floating stations to the three established fixed onsite stations, to provide a more robust onsite evaluation of dioxin relative to meeting the site management objective implemented in December 2010. Chemical changes included evaluating PCB and PBDE congeners at onsite and perimeter stations to begin gathering data to assess these chemicals at DMMP disposal sites. The DMMP agencies conducted a Tiered-Full monitoring survey, where the analyses focused on addressing the first two monitoring questions

[2] See Table 5-10 for full chronology of monitoring history over the life of the DMMP.
[3] Clarification Paper 2002 SMARM: http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/dmmo/volume_trigger1.pdf

and four testable hypotheses (Table 5-6). Samples were collected and subsequently archived to address the remaining third monitoring question and remaining two testable hypotheses (Table 5-6).

The Sediment Profile Imagery (SPI) survey was conducted during end of April 2010 using a Benthos® Model 3731 Sediment Profile Imaging System equipped with an Ocean Imaging Systems digital camera. A total of 183 images were collected from 61 stations including 14 onsite, 16 perimeter, 18 transect, 11 central cross, and 2 benchmark stations over a 2-day survey, with 102 images collected at 34 stations during a "quick look" survey on the first day. The dredged material footprint highlighted from this survey is depicted in Figure 5-5, and shows that the recent dredged material footprint was consistent with the DMMP monitoring objectives (<3 cm at the Perimeter Stations), and was largely within the disposal site boundary. Chemical and biological features (apparent RPD depth, benthic infaunal successional stage, and calculation of the Organism-Sediment-Index (OSI)) delineated from the SPI images provide an assessment of the overall health of the benthic habitat at the Port Gardner disposal site. The apparent RPD depth estimates the depth of oxygenation in the upper sediment column, and is used to evaluate the biological mixing depth by infaunal organisms. The mean apparent RPD depth ranged from 1.16 to 5.28 cm, with an average depth of 3.18 cm (Figure 5-6). Benthic infaunal communities generally follow a three-stage successional paradigm following a physical disturbance on the seafloor (Figure 5-7) (Pearson and Rosenberg 1978, Rhoads and Germano 1986). After a disturbance, which displaces the existing benthic community, Stage I infauna colonize the sediment surface, and Stage I species are frequently opportunistic organisms, consisting of small, tubicolous, surface-dwelling polychaetes. Stage II organisms are typically shallow-dwelling bivalves or tube-dwelling amphipods, and are considered transitional communities over time, which are ultimately replaced by Stage III species, which are long-lived, infaunal deposit feeding organisms, frequently head-down deposit feeding organisms, creating distinctive "feeding voids" visible in SPI images. It should be noted, that over 20 years of SPI monitoring at DMMP disposal sites and SPI surveys worldwide (Don Rhoads, personal communication), have generally observed that relatively shallow <10 cm depths of dredged material cover, result in many Stage III (equilibrium) species re-establishing their burrow connections to the surface, as an adaptive response, so that most of the Stage III species are not permanently displaced. This is dramatically evidenced by the 2010 SPI survey, where Stage III benthic communities were observed at all onsite stations at Port Gardner, with the exception of only three stations within the disposal zone (PGC02, PGC03, and PGC05), where recent dredged material is present (Figure 5-8). Moreover, the organism-sediment-index (OSI) calculated from the SPI survey (Table 5-7) demonstrated relatively high OSI values in all areas of the Port Gardner disposal site, given the deep apparent RPD depths and the prevalence of Stage III communities. Only the three onsite stations mentioned previously had lower OSI values slightly below +6. The presence of the relatively high OSI values (>+6) with a major mode of +10 (Figure 5-9) suggest a healthy and robust benthic community that is resilient to physical disturbance from dredged material disposal.

The evaluation of sediment chemistry at onsite stations and perimeter stations indicated DMMP metals were either detected at low levels or undetected below screening levels (SLs) and sediment quality standards (SQS). Butyltins were undetected in bulk sediment samples, and porewater analyses quantitated low levels of monobutyltins, whereas dibutyltin and tributyltin were undetected well below the DMMP SL for TBT.

Table 5-6. 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.

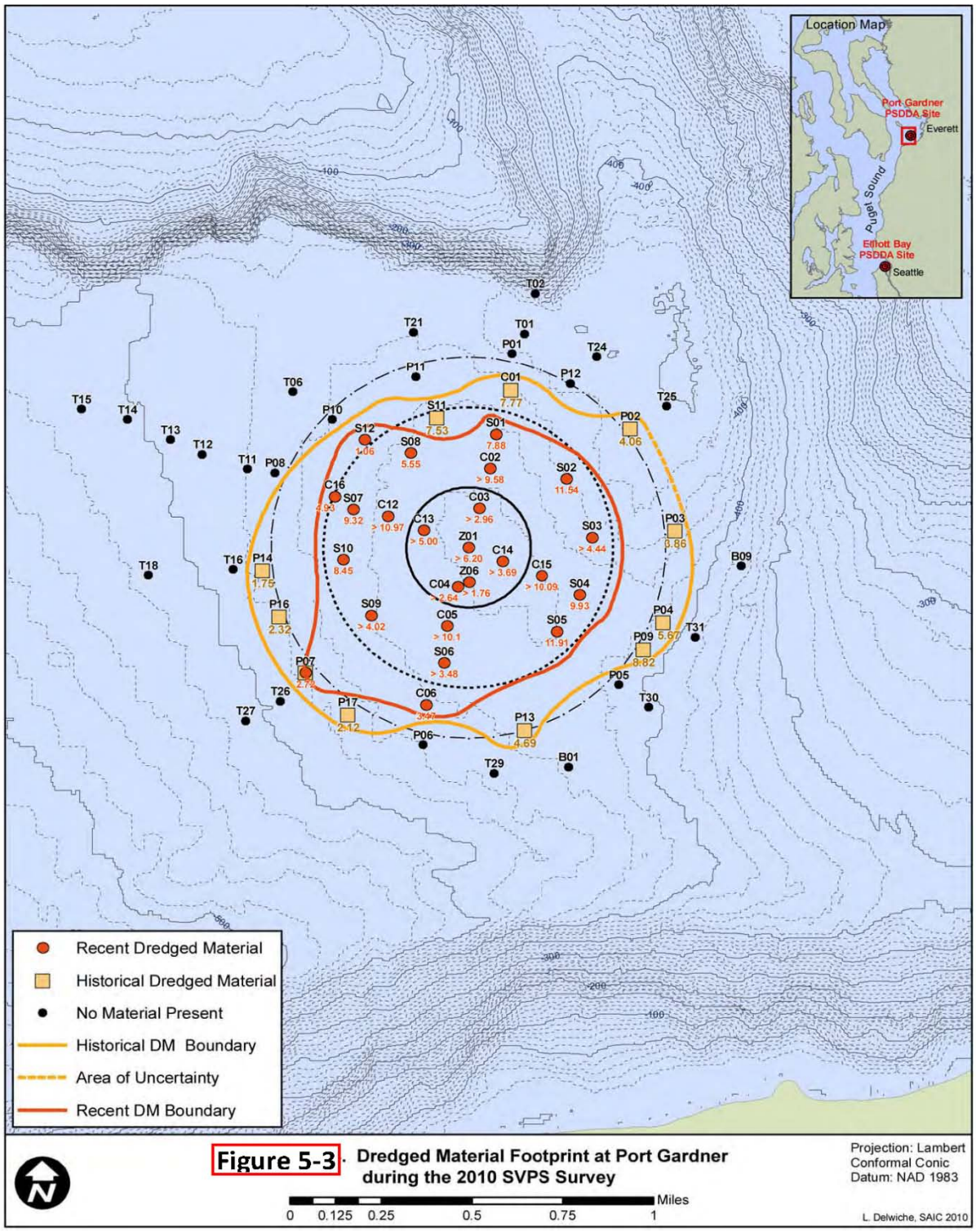

Figure 5-5. Dredged Material Footprint at Port Gardner

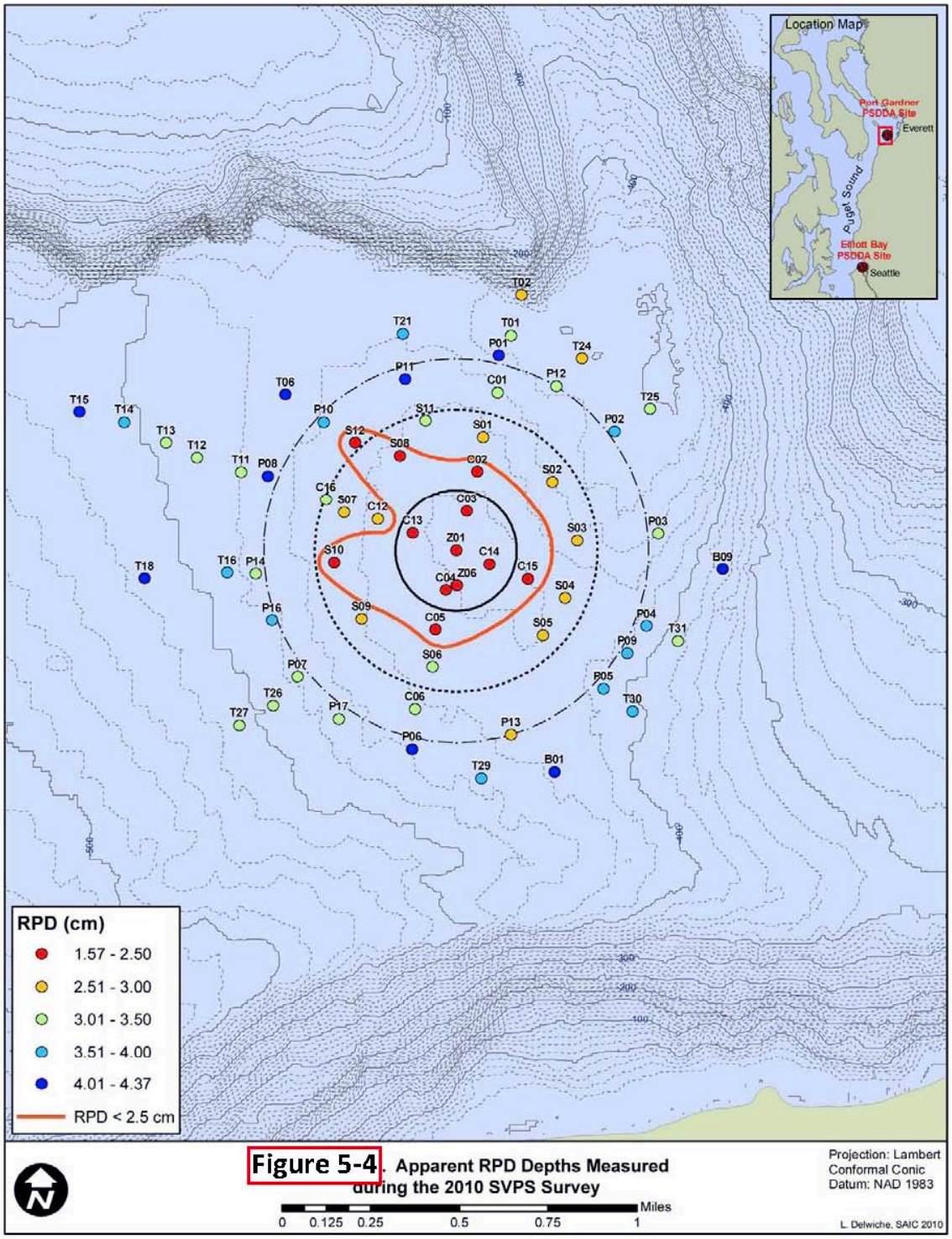

Figure 5-6. Apparent RPD Depths Measured during 2010 SPI survey

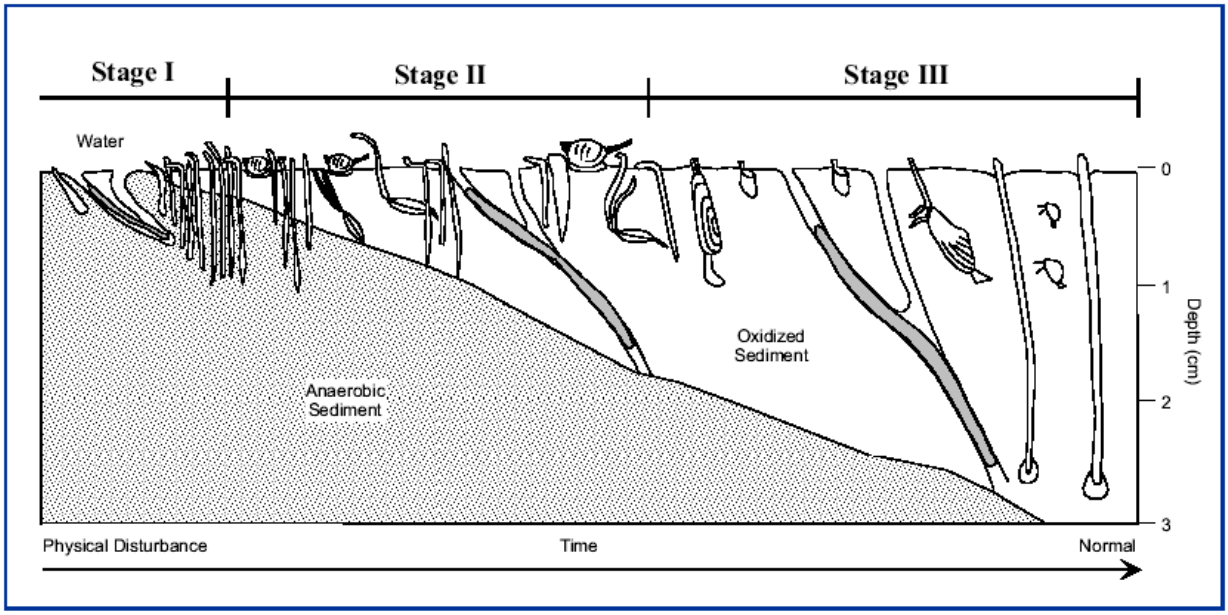

Figure 5-7. Idealized Infaunal benthic successional paradigm over Time following a Physical Disturbance (Rhoads and Germano, 1986; modified from Pearson and Rosenberg, 1978).

Analyses of organic compounds in Port Gardner sediments found volatile organic compounds, chlorinated aromatic hydrocarbons, miscellaneous extractable, and PCBs (Aroclors) were undetected in all samples below SLs and SQS levels. Phthalates, phenols, high molecular polycyclic aromatic hydrocarbons (HPAHs), low molecular polycyclic aromatic hydrocarbons (LPAHs), and pesticide compounds were detected a low or trace levels in perimeter and onsite sediment samples. Fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate were detected at all perimeter stations well below SLs and SQS. An evaluation of List 1 bioaccumulative chemicals of concern (BCOC) found all BCOC chemical concentrations generally either detected or undetected well below DMMP BT concentrations.

An analysis of dioxin concentrations at the three fixed onsite stations, and at seven additional randomly placed onsite stations and at perimeter stations indicated the onsite dioxin concentrations were generally low, ranging from a low of 1.25 to a high of 2.4 pptr-TEQ, with an onsite mean concentration of 1.95 pptr-TEQ (Non-detects = ½ detection limit), whereas the dioxin concentrations measured at the four perimeter stations ranged from 2.7 to 4.1 pptr-TEQ, with a mean concentration of 3.3 pptr-TEQ. The dioxin concentrations were well within the former interim and new interim onsite/offsite guidelines (former interim: 4.1/5.2 pptr-TEQ; new interim: 4.0/10 pptr-TEQ).

An analysis of PCB congeners at the four perimeter stations, two benchmark stations, and three onsite stations was conducted to assess PCB congeners normalized to the toxicity of 2,3,7,8-TCDD using TEFs updated by the WHO in 2005 (Van den berg et al. 2006). The onsite PCB congener TEQs ranged from 0.08 to 0.09 pg/g (dry weight) with a mean concentration of 0.056 pptr-TEQ, whereas, the offsite (perimeter, benchmark) PCB congener's ranged from 0.05 to 0.165, with a mean concentration of 0.11 pptr-TEQ.

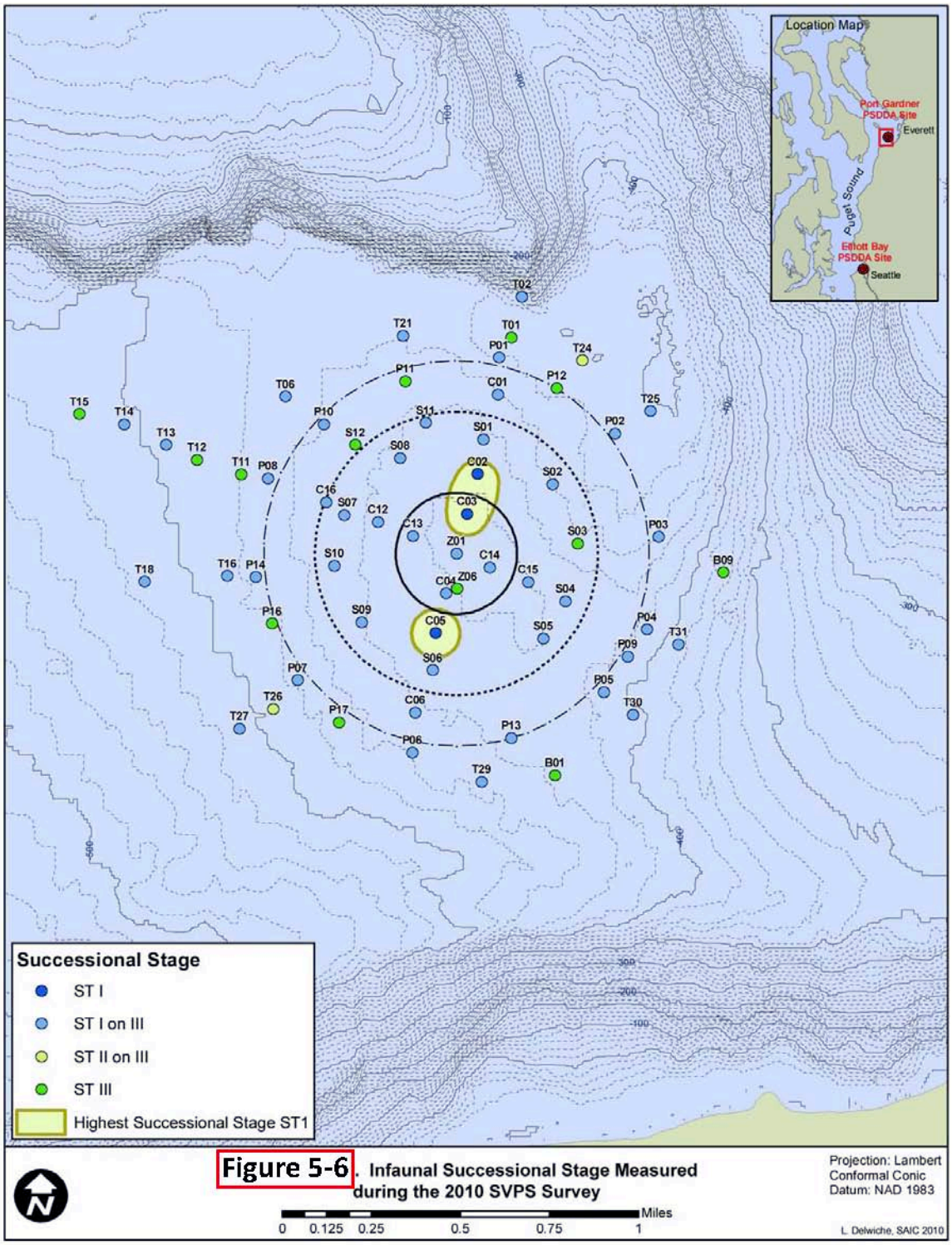

Figure 5-8. Infaunal Successional Stage Measured during the 2010 SPI survey.

Table 5-7. Calculation of the Organism-Sediment Index

	Mean RPD Depth Classes	Index Value
Choose One Value:	0.00 cm	0
	> 0 - 0.75 cm	1
	0.76 - 1.50 cm	2
	1.51 - 2.25 cm	3
	2.26 - 3.00 cm	4
	3.01 - 3.75 cm	5
	< 3.75 cm	6
Choose One Value:	Successional Stage	Index Value
	Azoic	-4
	Stage I	1
	Stage I - II	2
	State II	3
	Stage II - III	4
	Stage III	5
	Stage I on III	5
	State II on III	5
Choose One or Both if Appropriate:	Chemical Parameters	Index Value
	Methane Present	-2
	No/Low Dissolved Oxygen	-4
Organism - Sediment Index =	Range:	- 10 to + 11

An analysis of 46-PBDE congeners at onsite and offsite perimeter and perimeter stations were conducted to assess PBDE congener specific concentrations. This chemical has been identified by NMFS as a chemical of concern for ESA listed species. The DMMP agencies will be evaluating this group of chemicals at DMMP disposal sites, and will be developing regulatory guidelines for evaluating PBDEs in dredged material in the future. The results of these analyses indicated that 33-congeners out of 46-congeners were quantitated with PBDE-209 being the highest measured, ranging from 615 to 1,440 pg/g-DW, and averaging 893 pg/g-DW at onsite, 1224 pg/g-DW at perimeter, and 1225 pg/g-DW at benchmark stations, respectively. Figure 5-10 depicts the concentrations observed within the thirty-three detected PBDE congeners depicted within the three sampling subareas.

The results of onsite bioassay tests at the three onsite fixed stations (Z06, S04, and S08) indicated that all three bioassay tests passed the interpretative guidelines for non-dispersive sites. For the larval test, this included the standard bivalve larval test interpretation, and the modified resuspension endpoint protocol. For the *Neanthes* growth bioassay, the standard protocol, and the ash-free dry weight (AFDW) endpoint evaluation were evaluated, and both passed the non-dispersive site interpretative guidelines.

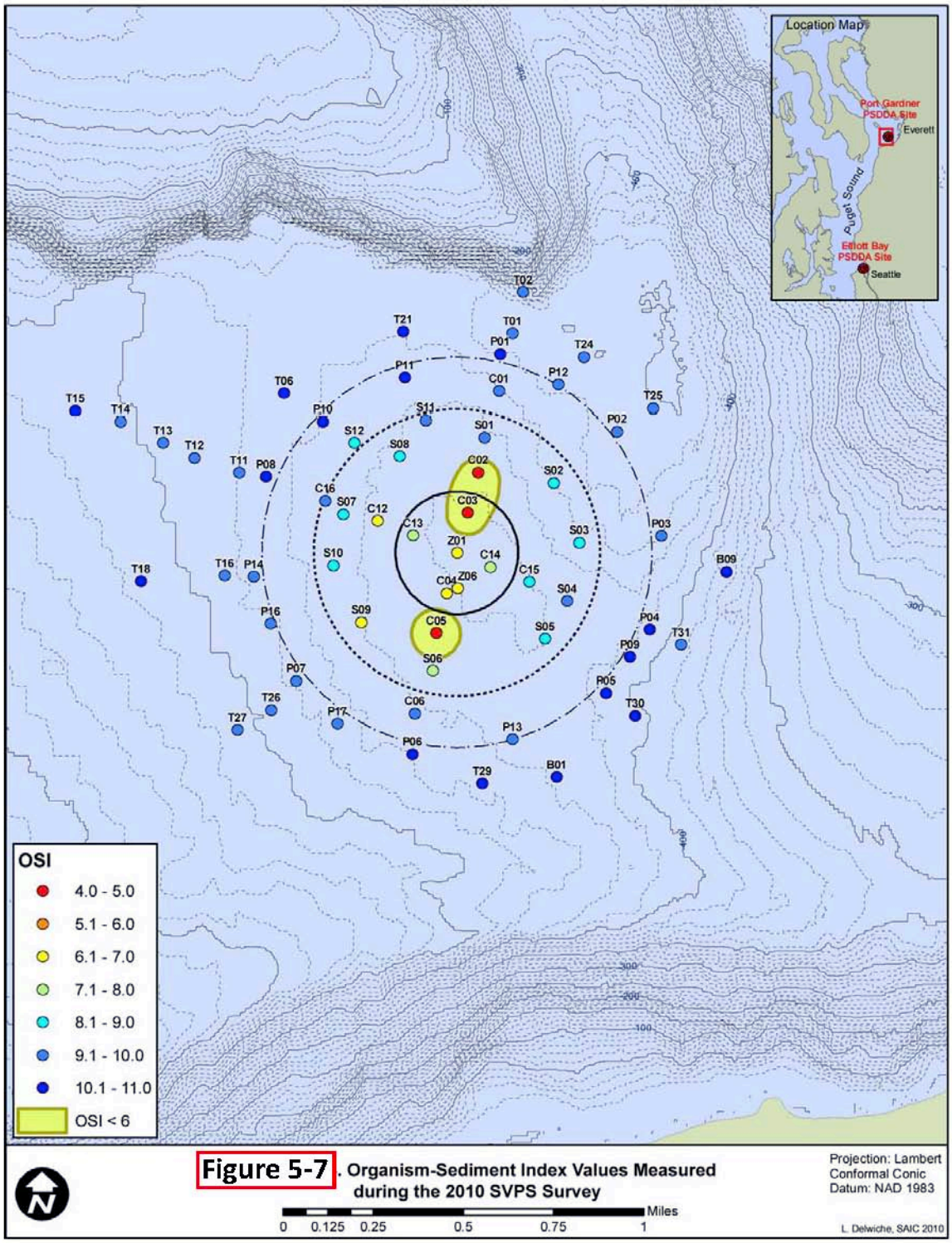

Figure 5-9. Organism-Sediment Index Values Measured during the 2010 SPI Survey.

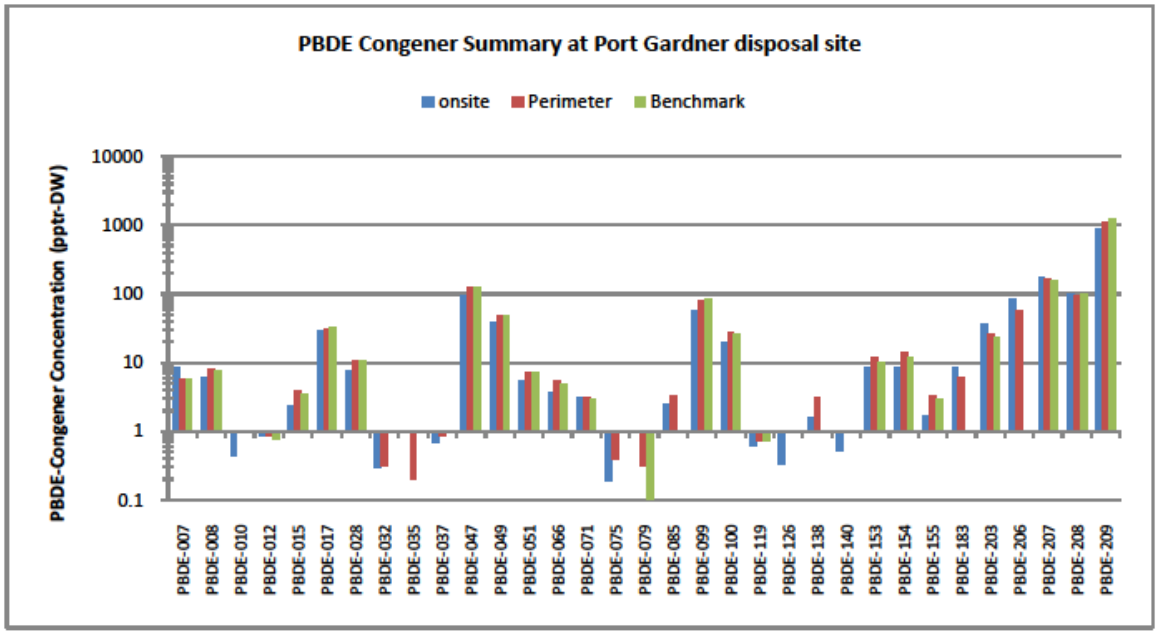

Figure 5-10. PBDE Congener summary at the Port Gardner disposal site during 2010 monitoring survey (logarithmic scale)

The monitoring data were evaluated relative to answering the first two monitoring questions and four testable hypotheses depicted in Table 5-6.

Question 1: Does the Dredged Material Stay On Site?

Hypothesis No. 1: Dredged Material remains within the disposal site boundary.

The 2010 SPI survey at Port Gardner did not identify the presence of recent dredged material beyond the disposal site perimeter exceeding the 3 cm DMMP interpretive criteria. Therefore, Hypothesis No. 1 is accepted.

Hypothesis No. 2: Chemical concentrations at offsite stations (perimeter) do not measurably increase over time due to dredged material disposal.

A review of the 2010 perimeter station chemistry demonstrated that all detected chemicals were well below the Washington State SQS criteria. Likewise, statistical time-trend analyses were conducted, and the maximum likelihood results showed both increases and decreases in chemical groups at the perimeter stations since 1988. At Station PGP01, all the chemical groups show decreases in COCs over time with the exception of phthalates group (+5.4% increase per year) and phenols (+0.9% increase per year). At perimeter station PGP07, all the chemical groups show decreases with the exception of slight increases in the HPAHs and phthalates, both of which were statistically insignificant or inadequate to evaluate statistically. The phenols group showed an increase of 140% per year, but this is driven by a single observation in 2010 and will need additional data to confirm. At Station PGP08, the conventionals, the phthalates group, and the LPAHs (phenanthrene only) all showed decreases; the metals, HPAHs, and phenols (phenol only) showed small increases. At Station PGP09, all of the chemicals groups show

decreases with the exception of the phthalates group and a statistically significant increase in LPAHs group (+2.7% per year).

Therefore, base on the comparison of perimeter chemistry results to the SQS criteria and CTS time-trends analysis, Hypothesis No. 2 is accepted.

Question 2: Has dredged material disposal caused the biological effects condition for site management to be exceeded at the site (Site Condition II)?

Hypothesis No. 3: Sediment chemical concentrations at the onsite monitoring stations do not exceed chemical concentrations associated with PSDDA Site Condition II guidelines due to dredged material disposal.
Site Condition II is evaluated by comparing the onsite chemical concentrations to the DMMP MLs. DMMP MLs are chemical concentrations above which adverse biological effects are expected to occur. The onsite chemistry results did not exceed the ML values; therefore, Hypothesis No. 3 is accepted.

Hypothesis No. 4: Sediment toxicity at the onsite stations does not exceed the PSDDA Site Condition II biological response guidelines due to dredged material disposal.

The results of onsite toxicity testing confirmed that the onsite stations did not exceed the Site Condition II biological response guidelines due to dredged material disposal. Therefore, Hypothesis No. 4 is accepted.

Monitoring Question 3: Are Unacceptable adverse effects due to dredged material disposal occurring to biological resources offsite?

Because the first four hypotheses were accepted, analysis of the archived samples collected to address the third monitoring question and last two testable hypotheses was not necessary, based on answers to the first two questions.

5.3 Larval Rockfish Assessment (April 2011 – February 2012)

An ongoing DMMMP assessment of rockfish larvae at six of the eight DMMP disposal sites (excluding the Port Angeles and Port Townsend disposal sites) is an outcome of the 2010 NMFS Biological Opinion (BO) relative to Essential Fish Habitat (EFH) Conservation recommendations. The subsequent NMFS Biological Opinion (BO): (http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/NMFS_PSDDA_rockfish_biological_opinion.pdf) concluded: "the proposed action is not likely to jeopardize the continued existence of the Puget Sound/Georgia Basin Distinct Population Segments (DPSs) of yelloweye rockfish, canary rockfish, and bocaccio. No critical habitat has been designated for these species, therefore, none will be affected." However, BO concluded that the disposal could impact larval fish, and estimated extent of Take for 3 species at nondispersive sites:

- 88,092 yelloweye rockfish larvae
- 37,519 canary rockfish larvae
- 781 bocaccio rockfish larvae

The BO recommended as one of the EFH conservation recommendations that the Corps/DMMP agencies "conduct or support comprehensive ichthyoplankton surveys near each of the PSDDA program dispersive and non-dispersive sites within the Puget Sound/Georgia Basin." In response to this recommendation the DMMP agencies are working cooperatively with the NMFS on an EPA funded comprehensive study to broadly assess the ecological health of Puget Sound's pelagic food web. As part of this study monthly ichthyoplankton surveys are being conducted at six of the eight disposal sites over an eleven month period (April 2010 – February 2012). The DMMP Cooperative Agreement with NMFS and DNR (on behalf of the DMMP agencies) to participate in the disposal site evaluations included the following:

1) Fund field and laboratory technician for 7 month field effort at 102 Stations, including 6 disposal sites. The number of stations was subsequently reduced from 102 to 92 (Figure 4-11).
2) Fund field and laboratory technician for an additional 4 month field effort restricted to 6 DMMP disposal sites (November – February).
3) Enumerate all rockfish larvae collected at DMMP sites.
4) If rockfish larvae abundances at sites exceed Take totals, DMMP agencies may fund genetic analyses to differentiate species collected at sites. Identifying rockfish larvae to species generally requires genetic analysis.

The study is ongoing and fieldwork will be completed following the February 2012 cruise. The samples collected at the DMMP sites will be worked up to assess total rockfish larvae abundance in the vicinity of the six DMMP disposal sites within each monthly sampling interval. The DMMP agencies will then evaluate the cumulative monthly larvae abundance relative to take totals during the disposal windows at each of the six disposal sites as compared to the closure periods. The sites are generally closed to disposal from February 15 to June 15 to protect fisheries and outmigrating salmon larvae resources. If significant total rockfish larvae are enumerated at a given site based on cumulative and individual monthly abundances during the disposal windows (June 16 – February 15), the DMMP agencies may decide to conduct limited genetic analyses on specific monthly samples collected at targeted disposal sites to identify which rockfish larvae species are found at the sites. The focus of these analyses would be to determine whether or not observed larvae are represented by any of the three listed species.

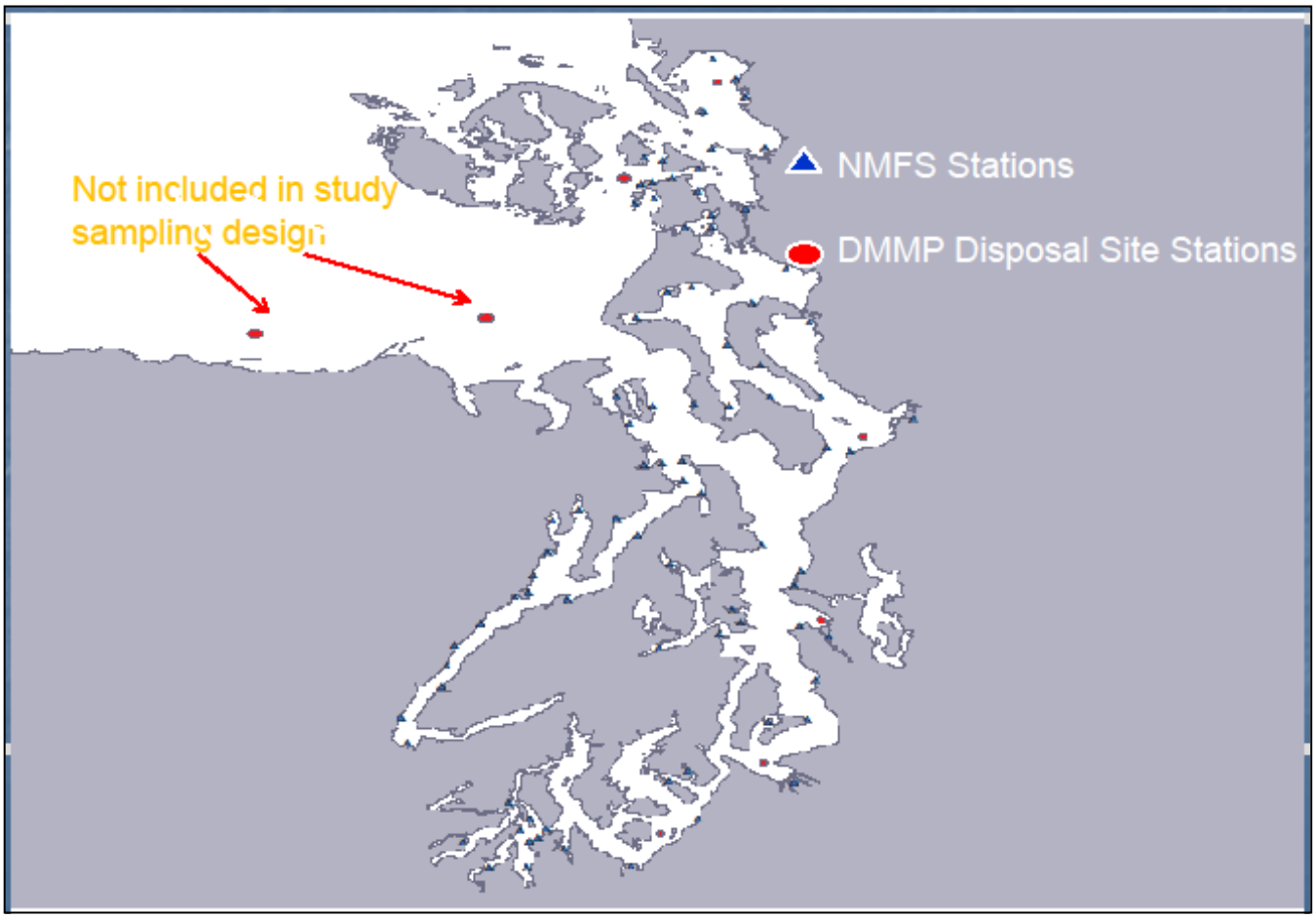

Figure 5-11. Proposed Sampling Stations for Ichthyoplankton Study

5.4 Fate and Transport Study – Puget Sound Dispersive Sites

The USACE Seattle District Coastal Engineering Unit is conducting a fate and transport study of the PSDDA dispersive sites in response to concerns expressed by tribes regarding potential impacts to tribal shellfish resources. This study began in DY11 and will be completed in DY12. A CMS-FLOW hydrodynamic model was developed for greater Puget Sound, including the Strait of Juan de Fuca, Hood Canal and the northern straits. In order to calibrate and verify the hydrodynamic model, DNR paid for an acoustic Doppler current profile (ADCP) survey in the vicinity of the three dispersive disposal sites. The survey was conducted in August 2011 during spring-tide conditions, with currents at each site measured over a 24-hour period. The survey track lines are illustrated in Figure 5-10. Once the hydrodynamic model was verified and calibrated using the resulting current data, a particle tracking model was set up and run. Historical disposal event logs from DNR were used to simulate disposal. Remaining work includes documentation in the form of a technical report outlining the sediment transport pathways at the Port Angeles, Port Townsend, and Rosario Strait dispersive sites and the implications for impacts to sensitive ecological shellfish harvesting areas identified by the Lower Elwha Klallam Tribe.

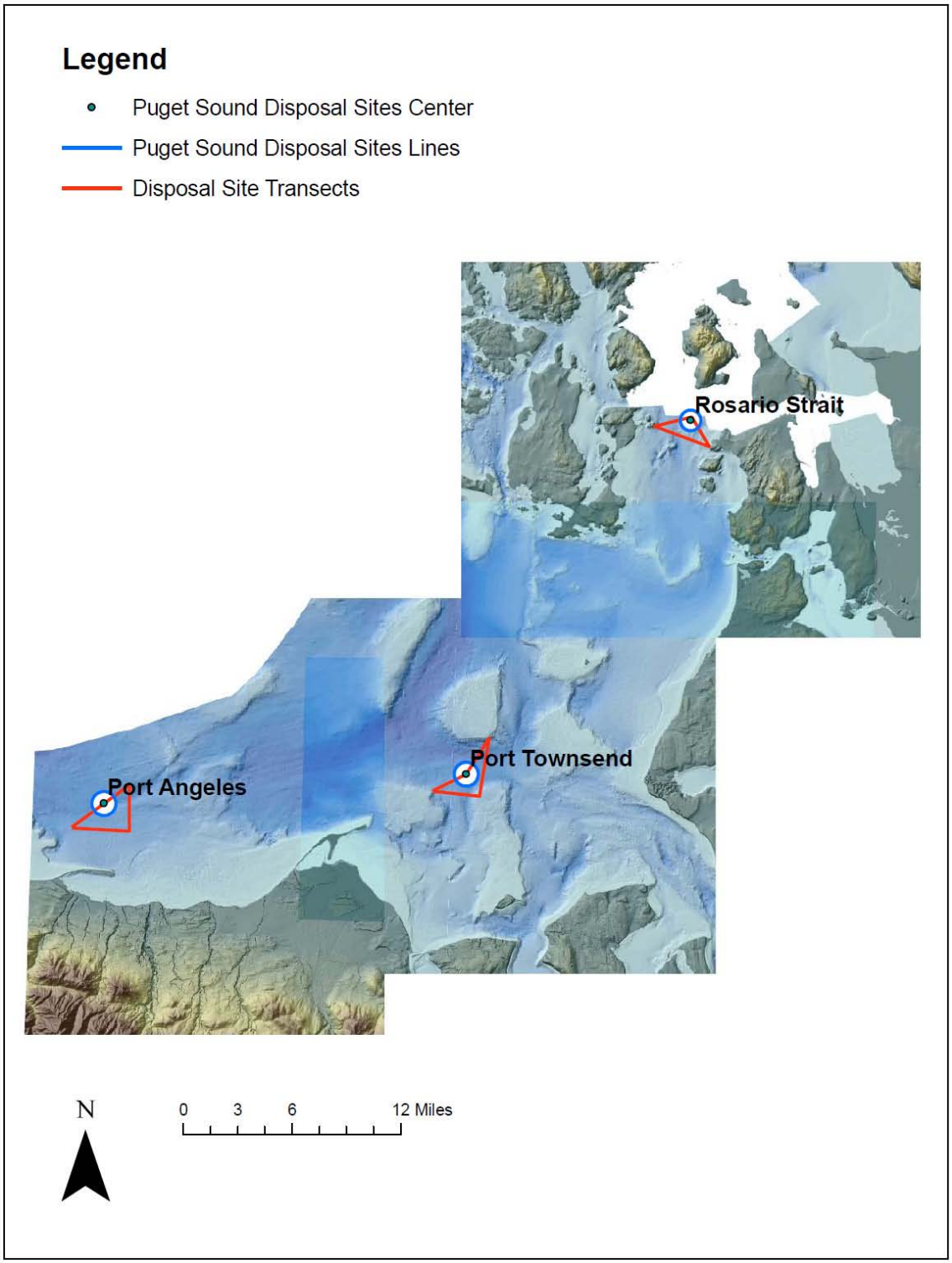

Figure 5-12. ADCP Transect Locations (—) at PSDDA Dispersive Dredged Material Disposal Sites

5.5 Summary: DMMP Disposal Site Use, Activities, and Monitoring Frequency

The cumulative dredged material volumes disposed at each Puget Sound and Grays Harbor/Willapa Bay site since program implementation are depicted in Figures 5-11 and 5-12 and listed in Table 5-8. Twenty-three-year summaries of site use for the Puget Sound sites show that site capacities[4] used in the FEIS appear to be sufficient to last at least 40 years, including the Commencement Bay site, which underwent a NEPA/SEPA SEIS in 2009, which increased the site capacity limit for this site to 23 million-cubic yards. (Table 5-9).

The PSDDA Management Plan Reports (MPR, 1998, 1989) recognized 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. None of the monitoring events to date have detected adverse impacts at any of the non-dispersive sites. 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 to 500,000 cy at the Commencement Bay site, Elliott Bay site, and the Port Gardner site 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). The monitoring triggers are soft triggers, and may be relaxed at the discretion of the DMMP agencies based on best-professional-judgment.

Table 5-10 summarizes the completed DMMP disposal site monitoring surveys at the Puget Sound non-dispersive and dispersive sites. To date, the DMMP agencies have conducted multiple post-disposal monitoring surveys at non-dispersive sites, four post-disposal bathymetric surveys at the Rosario Strait dispersive site, and four bathymetric surveys at the Commencement Bay site. Monitoring has also involved side-scan surveys at the Bellingham Bay and Elliott Bay sites to evaluate debris disposal concerns onsite. Additionally, the DMMP agencies have conducted special studies as needed to gather information pertinent to program policy development needs (e.g., dioxin) or special assessments.

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 are 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 consistent with the goals of the Puget Sound Partnership. 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.

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[4] 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 has just been completed by the DMMP agencies with the finalization of the 2009 Supplemental Environmental Impact Statement (SEIS) and 2010 Record of Decision Amendment (RODA), a supplement to the original 1988 EIS, which supports a revised site capacity limit up to 23 mcy for this site.

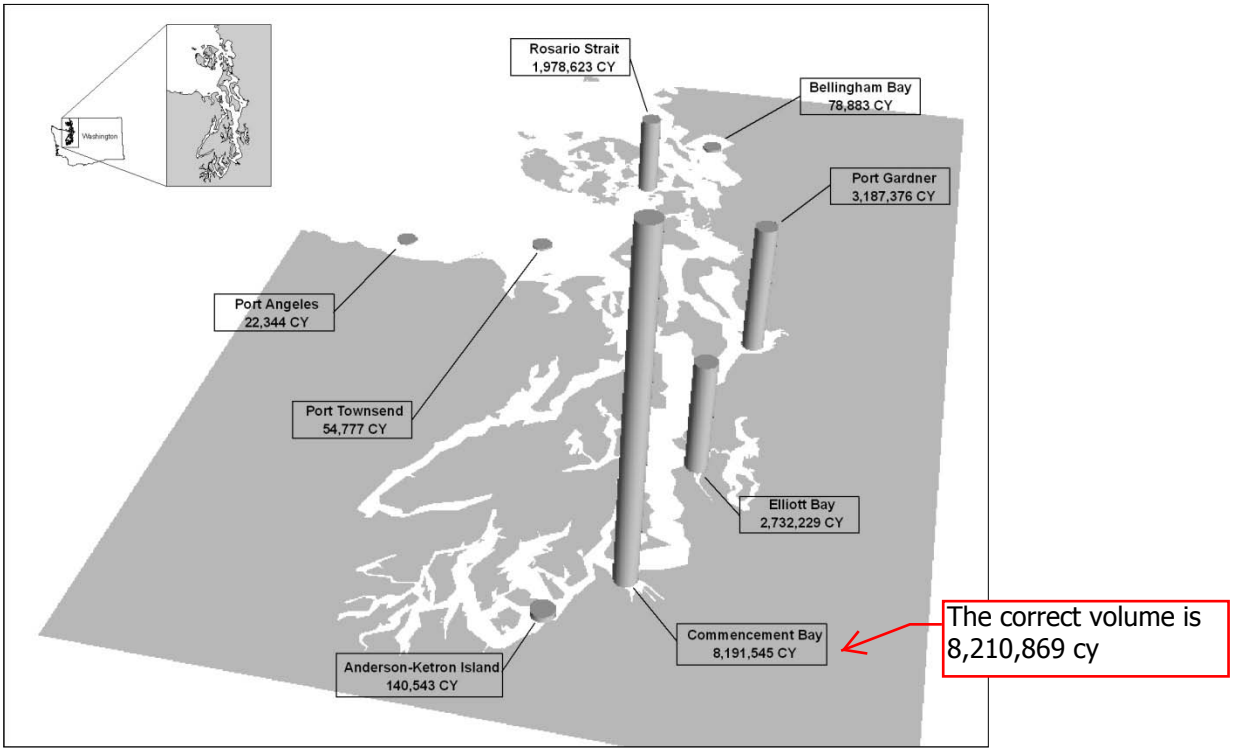

Figure 5-13. DMMP cumulative disposal volumes in Puget Sound 1989 – 2011

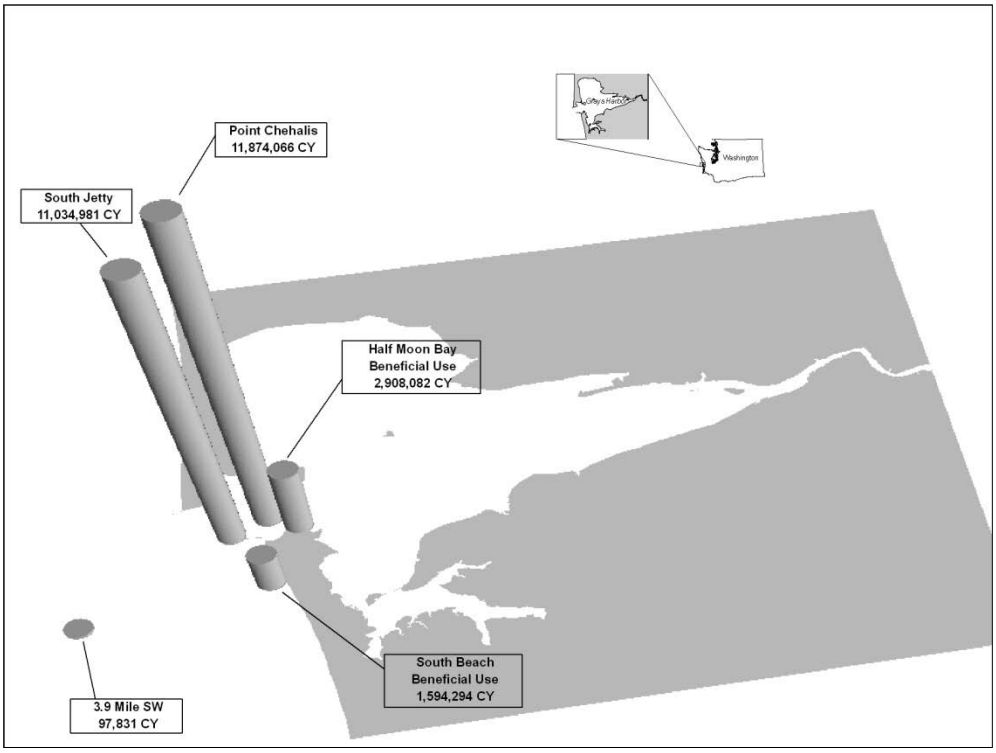

Figure 5-14. DMMP cumulative disposal volumes in Grays Harbor 1996 – 2011

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 - 2011)		
Port Gardner (ND)	90, 91, 93, 94, 95, 96, 97, 02, 06, 07, 08, 09, 10, 11	3,187,376	144,881
Elliott Bay (ND)	90, 91, 92, 93, 94, 95, 96, 97,98, 99, 00, 01, 02, 04, 05, 06, 07, 08, 09, 10, 11	2,732,229	124,192
Commencement Bay (ND)	89, 91, 95, 96, 98, 99, 00, 01, 03, 04, 05, 06, 07, 08, 09, 10, 11	~~8,191,545~~	372,343
PSDDA (North / South)	(1990 – 2011)		
Bellingham Bay (ND)[10]	93, 96, 98	78,883	3,756
Anderson/Ketron (ND)	93, 95, 04, 05, 07, 08	140,543	6,693
Rosario Strait (D)	91, 92, 93, 94, 95, 96, 98, 99, 02, 03, 04, 05, 06, 07, 09, 11	1,978,623	94,220
Port Townsend (D)	93, 98, 99, 07, 09, 10	54,777	2,608
Port Angeles (D)	96	22,344	1,064
Total cumulative volume		16,386,320	744,833
GRAYS HARBOR	(1996 – 2011)		
Point Chehalis (D)	96, 97, 98, 99, 00, 01, 02, 03, 04, 05, 06, 07,08, 09, 10, 11	11,874,066	742,129
South Jetty (D)	96, 97, 98, 99, 00, 01, 02, 03, 04, 05, 06, 07, 09, 11	10,896,144	681,009
Half Moon Bay (beneficial uses site)	96, 97, 98, 99, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11	2,908,082	181,755
Southwest beach nourishment site	01, 02, 04, 05, 06, 09, 10, 11	1,594,294	144,936 (AVG: 01-11)
3.9 Mile Ocean (D)[5]	03, 04	97,831	6,114
Total cumulative volume		27,370,417	1,710,651
WILLAPA BAY	(1996 – 2011)		
Cape Shoalwater (D)	00, 03	251,095	15,693
Goose Point (D)	99, 03, 06	205,977	12,874
Tokepoint (FLD)	10, 11	55,000	27,500 (AVG: 10-11)
QUILLAYUTE	(2008 – 2011)		
Site A, Site 2A (beach nourishment)	08, 10	119,184	29,796
Total cumulative volume (WB,Q)		631,256	85,863
Totals (all sites)		44,387,993	2,541,347

Legend: ND = nondispersive; D = dispersive; FLD = Flowlane Disposal

[5] Site is currently deactivated

Table 5-9. Puget Sound Site-Use Summary 1989 – 2011

Non-dispersive Disposal Site	Cumulative Volumes (CY)	Average Volume per Year (CY/YR)	15-Year Predictions MPR[6] Phase I/II (CY)	Percent of 15-Year Prediction	Estimated Time to Exceed Site Capacity[7] (Years)
Port Gardner (1989-2011)	3,187,376	144,881	8,243,000	38.7	40.1
Elliott Bay (1989-2011)	2,732,229	124,192	10,525,000	26.0	50.5
Bellingham Bay[8] (1990-2011)	78,883	3,756	1,181,500	6.7	2,375
Commencement Bay (1989-2011)	~~8,191,545~~	372,343	3,929,000 23,000,000[9]	208.5 35.6[9]	~40[9]
Anderson/Ketron Island (1990-2011)	140,543	6,693	785,000	17.9	1,324
SUBTOTALS:	14,330,576	651,865	24,763,500	57.9	N/A
Dispersive Disposal Site	**Cumulative Volumes (CY)**	**Average Volume per Year (CY/YR)**	**15-Year[10] Predictions MPR Phase I/II (CY)**	**Percent of 15-Year Prediction**	**Estimated Time to Exceed Site Capacity[11] (Years)**
Rosario Strait (1990-2011)	1,978,623	94,220	1,801,000	110	N/A
Port Townsend (1990-2011)	54,777	2,608	687,000	8.0	N/A
Port Angeles (1990-2011)	22,344	1,064	285,000	7.8	N/A
SUBTOTALS:	2,055,744	97,892	2,773,000	74.1	N/A
GRAND TOTALS:	16,386,320	786,593	27,536,500	59.5	N/A

[6] MPR = Management Plan Reports, Phase I (Central Puget Sound), Phase II (North and South Puget sound)
[7] 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.
[8] The Bellingham Bay disposal site has not been used since 1998, and is currently deactivated and not available for disposal pending renewal of shoreline permit. The DMMP agencies expect to make a decision within the next year whether to re-open the site or to close the site permanently.
[9] Based on 2010 NEPA/SEPA SEIS, new site capacity volume increased from 9 to 23 million cubic yards (http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=DMMO&pagename=CB_SEIS)
[10] 1990-2004
[11] 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[12]

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)[13]
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
2008	Anderson/Ketron Island	Dioxin/furan post-disposal special survey (offsite disposal evaluation): OSV Bold Survey
2009	Rosario Strait	Multibeam Bathymetric Survey
2010	Port Gardner	Tiered Full, dioxin, PCB & PBDE Congeners (onsite/offsite)
2011	All 5 Nondispersive Sites, Rosario Strait	Rockfish larvae assessment (11-month study – DNR/NMFS IAG)
2011	Port Angeles, Port Townsend, Rosario Strait	Fate and Transport Study (Modeling and Field Validation)

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

[12] The DMMP agencies elected to forego monitoring between 1997 and 2000 due to funding requirements for a DNR R&D contract to evaluate the potential development of *Leptocheirus* sp. as a potential chronic/sublethal bioassay.

[13] 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.

5.6 Endangered Species act (ESA) Consultation

Previous ESA coordination in 2005 and 2007 was summarized in the 2006/2007 Biennial Report (available on the DMMP website, at http://www.nws.usace.army.mil – Dredged Material Management). The Corps on behalf of the DMMP agencies reinitiated ESA consultation during August 2010 on the Puget Sound disposal sites. The Corps submitted programmatic biological evaluation (PBE) to National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) initiating formal consultation on all threatened and listed species, including assessing impacts to three listed species of rockfish (canary: *Sebastes pinniger*, yellow-eye: *S. ruberrimus*, and bocaccio: *S. paucispinis*) relative to dredged material disposal at the eight Puget Sound disposal.

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)). The NMFS informed the DMMP agencies that a formal; consultation would be required to evaluate Essential Fish Habitat (EFH) Conservation recommendations for listed rockfish species, which necessitated closing the DMMP disposal sites pending the NMFS Biological Opinion (BO) issued on December 22, 2010. The Corps on behalf of the DMMP agencies responded in January 6, 2011 letter back to NMFS BO, accepting the EFH Conservation recommendations. The USFWS issued a concurrence letter on January 11, 2011 on the DMMP PBE and agreed with the PBE Determination that the action "may affect, not likely to adversely affect" determination on listed species. The NMFS issued its concurrence letter on November 29, 2011 on the 2010 DMMP PBE on the remaining listed species (e.g., non-rockfish species), that the proposed action (disposal at DMMP sites) “may affect, not likely to adversely affect listed species” as determined in the Corp’s DMMP PBE.

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APPENDICES

Dredging Years 2010/2011

APPENDIX A - DY10/11GUIDELINE VALUES

Note: These guidelines values expired at the end of DY11.

		Marine				Freshwater	
CHEMICAL NAME	Units	SL	BT	ML	(SL+ ML)/2	SL1	SL2
METALS							
Antimony	mg/kg	150	---	200	175	---	---
Arsenic	mg/kg	57	507.1	700	378.5	20	51
Cadmium	mg/kg	5.1	11.3	14	9.55	1.1	1.5
Chromium	mg/kg	---	267	---	---	95	100
Copper	mg/kg	390	1,027	1,300	845	80	830
Lead	mg/kg	450	975	1,200	825	340	430
Mercury	mg/kg	0.41	1.5	2.3	1.355	0.28	0.75
Nickel	mg/kg	140	370	370	255	60	70
Selenium	mg/kg	---	3	---	---	---	---
Silver	mg/kg	6.1	6.1	8.4	7.25	2.0	2.5
Zinc	mg/kg	410	2,783	3,800	2,105	130	400
ORGANOMETALLICS							
TBT ion (porewater)	ug/L	0.15	0.15	---	---	---	---
TBT ion (bulk)	ug/kg	73	73	---	---	---	---
LPAH							
Naphthalene	ug/kg	2,100	---	2,400	2,250	500	1,300
Acenaphthene	ug/kg	500	---	2,000	1,250	1,100	1,300
Acenaphthylene	ug/kg	560	---	1,300	930	470	640
Fluorene	ug/kg	540	---	3,600	2,070	1,000	3,000
Phenanthrene	ug/kg	1,500	---	21,000	11,250	6,100	7,600
Anthracene	ug/kg	960	---	13,000	6,980	1,200	1,600
2-Methylnaphthalene[1]	ug/kg	670	---	1,900	1,285	470	560
Total LPAHs	ug/kg	5,200	---	29,000	17,100	6,600	9,200
HPAH							
Fluoranthene	ug/kg	1,700	4,600	30,000	15,850	11,000	15,000
Pyrene	ug/kg	2,600	11,980	16,000	9,300	8,800	16,000
Benzo(a)anthracene	ug/kg	1,300	---	5,100	3,200	4,300	5,800
Benzofluoranthenes (sum of b,j,k)	ug/kg	3,200	---	9,900	6,550	600	4,000
Chrysene	ug/kg	1,400	---	21,000	11,200	5,900	6,400
Benzo(a)pyrene	ug/kg	1,600	---	3,600	2,600	3,300	4,800
Indeno(1,2,3-c,d)pyrene	ug/kg	600	---	4,400	2,500	4,100	5,300
Dibenzo(a,h)anthracene	ug/kg	230	---	1,900	1,065	800	840
Benzo(g,h,i)perylene	ug/kg	670	---	3,200	1,935	4,000	5,200
Total HPAHs	ug/kg	12,000	---	69,000	40,500	31,000	55,000
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	SL1	SL2
PHTHALATES							
Bis(2-ethylhexyl) phthalate	ug/kg	1,300	---	8300	4,800	220	320
Butylbenzyl phthalate	ug/kg	63	---	970	517	260	370
Di-n-butyl phthalate	ug/kg	1,400	---	5100	3,250	---	---
Di-n-octyl phthalate	ug/kg	6,200	---	6200	6,200	26	45
Diethyl phthalate	ug/kg	200	---	1200	700	---	---
Dimethyl phthalate	ug/kg	71	---	1400	736	46	440
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	400	440
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	60	120

[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	$MIG_T/MIG_R < 0.50$	$MIG_T/MIG_R < 0.70$

Subscripts: R = reference sediment, C = negative control, T = test sediment

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

PROJECT:	Former Scott Paper Mill Site							POS T5 Supplement			USACE Duwamish O&M - Round 1								
DMMU ID:	DMMU 2	DMMU 3	DMMU 4	DMMU 5	DMMU 6	DMMU 7	DMMU 8	S2b	S3a	S3a-Z	DMMU 1	DMMU 2	DMMU 3	DMMU 4	DMMU 5	DMMU 6	DMMU 7	DMMU 8	DMMU 9
Assessment Rank:	H	H	H	H	H	H	H	H	H	-	LM	LM	H	H	H	H	H	H	H
METALS (mg/kg)																			
Cadmium																			
Zinc																			
HPAH (ug/kg)																			
Fluoranthene									1,800										
PESTICIDES AND PCBs (ug/kg)																			
Total DDT																			8.05 J
Total PCBs									152.0	229.0									
Total PCBs (carbon-normalized)																			
OTHER CHEMICALS OF CONCERN																			
Tributyltin (ug/l porewater)									0.73										
Tributyltin (ug/kg bulk)										99.0									
Dioxins/Furans (pptr TEQ; u=1/2 DL)	5.0	4.0	11.9	3.5	0.31	0.46	3.0	0.271	6.65	-	1.99	2.77	1.66	4.72	-	4.43	-	2.89	-
BIOASSAYS																			
Amphipod (marine)	NH	NH	NH	NH	NH	2H	NH				NH	NH	NH	NH		NH			NH
Larval (marine)	NH	NH	NH	NH	NH	NH	NH				1H	1H	1H	1H		1H			1H
Neanthes Growth Rate (marine)	NH	NH	NH	NH	NH	NH	NH				NH	NH	NH	NH		NH			NH
Chironomus (freshwater)																			
Hyalella (freshwater)																			
Bioassay Result:	PASS	PASS	PASS	PASS	PASS	PASS	PASS				FAIL	FAIL	FAIL	FAIL		FAIL			FAIL
BIOACCUMULATION																			
Bioaccumulation tests conducted																			
Bioaccumulation result (P/F)																			
OVERALL PASS/FAIL:	PASS	PASS	FAIL	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL[AD]	RETEST	RETEST	RETEST	RETEST	PASS	RETEST	PASS	PASS	RETEST
VOLUME (CY):	4,020	3,780	3,980	3,030	3,440	3,680	3,710	300	1,210	NA	51,592	16,580	3,394	3,467	3,405	3,785	3,339	3,459	3,982
HIGHEST RANKING (based on testing):	M[D]	L[D]	H[D]	L[D]	L[D]	L[D]	L[D]	L[D]	H	-	-	-	-	-	L	-	L	L	-

PROJECT:	USACE Duwamish O&M - Round 1, cont.									USACE Duwamish O&M - Round 2							USACE Duwamish O&M - Round 3	
DMMU ID:	DMMU 10	DMMU 11	DMMU 12	DMMU 13	DMMU 14	6 Z	8 Z	10 Z	12 Z	DMMU 1	DMMU 2	DMMU 3	DMMU 4	DMMU 6	DMMU 9	DMMU 11	DMMU 15	15 Z
Assessment Rank:	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
METALS (mg/kg)																		
Cadmium																		
Zinc																		
HPAH (ug/kg)																		
Fluoranthene																		
PESTICIDES AND PCBs (ug/kg)																		
Total DDT																		7.8
Total PCBs																	186	
Total PCBs (carbon-normalized)																		
OTHER CHEMICALS OF CONCERN																		
Tributyltin (ug/l porewater)																		
Tributyltin (ug/kg bulk)																		
Dioxins/Furans (pptr TEQ; u=1/2 DL)	2.59	-	2.79	3.46	4.30	6.67	10.75	2.57	5.27									
BIOASSAYS																		
Amphipod (marine)		NH								NH	NH	-	-	-	-	-	NH	NH
Larval (marine)		1H								NH	2H	1H	1H	1H	1H	1H	2H	NH
Neanthes Growth Rate (marine)		NH								NH	2H	-	-	-	-	-	2H	NH
Chironomus (freshwater)																		
Hyalella (freshwater)																		
Bioassay Result:		FAIL								PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS
BIOACCUMULATION																		
Bioaccumulation tests conducted																		
Bioaccumulation result (P/F)																		
OVERALL PASS/FAIL:	PASS	RETEST	PASS	PASS	PASS	FAIL[AD]	FAIL[AD]	PASS[AD]	FAIL[AD]	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS[AD]
VOLUME (CY):	3,414	3,181	3,370	3,094	3,473	NA	NA	NA	NA	51,592	16,580	3,394	3,467	3,785	3,982	3,181	1,575	NA
HIGHEST RANKING (based on testing):	L[D]	-	L[D]	L[D]	LM[D]	-	-	-	-	L	H[B]	H[B]	H[B]	H[B]	H[B]	H[B]	H[B]	-

PROJECT:	Crescent Bar, Columbia River		King County DOT, South Park Bridge, Duwamish River				Port of Bellingham Gate 3 - Round 1 (dioxin via Method 8290)				Port of Bellingham Gate 3 - Round 2 (dioxin via Method 1613B)			Port of Bellingham Gate 3 - Round 3 (Z-layer dioxin via Method 1613B)			
DMMU ID:	DMMU 2	DMMU 3	SB-1	SB-2	NB-1	NB-2	POB 1	POB 2	POB 3	POB 4	POB 1	POB 2A	POB 2B	POB 1-Z	POB 2-Z	POB 3-Z	POB 4-Z
Assessment Rank:	LM	M	H	H	H	H	M	M	M	M	M	M	M	NA	NA	NA	NA
METALS (mg/kg)																	
Cadmium	2.9[FW2]	1.6[FW2]															
Zinc	266[FW1]	164[FW1]															
HPAH (ug/kg)																	
Fluoranthene																	
PESTICIDES AND PCBs (ug/kg)																	
Total DDT					28												
Total PCBs					910												
Total PCBs (carbon-normalized)					91												
OTHER CHEMICALS OF CONCERN																	
Tributyltin (ug/l porewater)																	
Tributyltin (ug/kg bulk)																	
Dioxins/Furans (pptr TEQ; u=1/2 DL)				0.685	1.57		10.6	6.2	27.3	47.1	22.4	8.6	9.6	21.0, 18.5	11.4	28.9	85.3
BIOASSAYS																	
Amphipod (marine)					NH												
Larval (marine)					2H												
Neanthes Growth Rate (marine)					NH												
Chironomus (freshwater)		NH															
Hyalella (freshwater)		NH															
Bioassay Result:		PASS			PASS												
BIOACCUMULATION																	
Bioaccumulation tests conducted					Yes												
Bioaccumulation result (P/F)					PASS												
OVERALL PASS/FAIL:	FAIL[C]	PASS	PASS	PASS	PASS	PASS	RETEST	RETEST	FAIL	FAIL	FAIL	PASS	FAIL	PASS[AD]	PASS[AD]	PASS[AD]	FAIL[AD]
VOLUME (CY):	7,025	4,083	750	750	750	750	14,122	10,737	15,867	9,158	14,122	5,200	5,537	NA	NA	NA	NA
HIGHEST RANKING (based on testing):	H[FW]	H[FW]	L	L[D]	LM	L	-	-	H[D]	H[D]	H[D]	M[D]	M[D]	-	-	-	-

PROJECT:	Port of Everett Marina													Port of Seattle Terminal 18 (Anti-degradation)		
DMMU ID:	MC 1	MC 2	MC 3	MC 4	MC 4-Z	MC 5	MC 5-Z	MC 6	MC 6-Z	MC 7	MC 7-Z	MC 8	MC 8-Z	#133	#202	#132
Assessment Rank:	LM	LM	LM	LM	NA	LM	NA	LM	NA	LM	NA	LM	NA	NA	NA	NA
METALS (mg/kg)																
Cadmium																
Zinc																
HPAH (ug/kg)																
Fluoranthene																
PESTICIDES AND PCBs (ug/kg)																
Total DDT																
Total PCBs																
Total PCBs (carbon-normalized)																
OTHER CHEMICALS OF CONCERN																
Tributyltin (ug/l porewater)														1.53	0.55	0.83
Tributyltin (ug/kg bulk)																
Dioxins/Furans (pptr TEQ; u=1/2 DL)	3.9	6.65	5.34	6.61	0.24	7.35	1.58	9.65	17.2	19.4	3.44	11.4	3.36			
BIOASSAYS																
Amphipod (marine)																
Larval (marine)																
Neanthes Growth Rate (marine)																
Chironomus (freshwater)																
Hyalella (freshwater)																
Bioassay Result:																
BIOACCUMULATION																
Bioaccumulation tests conducted																
Bioaccumulation result (P/F)																
OVERALL PASS/FAIL:	PASS	no determination; dredging proposal rescinded												FAIL[AD]	FAIL[AD]	FAIL[AD]
VOLUME (CY):	29,000	28,400	28,000	2,500	NA	7,600	NA	10,500	NA	1,700	NA	24,000	NA	NA	NA	NA
HIGHEST RANKING (based on testing):	L[D]	M[D]	M[D]	M[D]	L[D]	M[D]	L[D]	M[D]	H[D]	H[D]	L[D]	H[D]	L[D]	-	-	-

APPENDIX C - LEGEND

S	=	reported concentration exceeds the marine screening level
S^{FW1}	=	reported concentration exceeds the freshwater screening level 1
S^{FW2}	=	reported concentration exceeds the freshwater screening level 2
B	=	reported concentration exceeds the bioaccumulation trigger (and SL, if it exists for that COC)
M	=	reported concentration exceeds maximum level
BM	=	reported concentration exceeds bioaccumulation trigger and maximum level
D	=	reported dioxin concentration exceeds the interim dioxin maximum guideline for proposed disposal site
D^{VWA}	=	reported dioxin concentration drives the volume-weighted average
U	=	detection limit exceeds either screening level, bioaccumulation trigger, or maximum level
J	=	estimate
NA	=	not applicable
VWA	=	volume weighted average (pertains to project-wide dioxin concentrations)
NH	=	no hit
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
$PASS^{AD}$	=	test sediment meets the antidegradation guideline
$PASS^{N}$	=	native portion of the DMMU passed guidelines for open-water unconfined disposal
$PASS^{ND}$	=	test sediment passes DMMP guidelines for open-water unconfined disposal only at a NON-DISPERSIVE site
FAIL	=	test sediment fails DMMP guidelines for open-water unconfined disposal
$FAIL^{AD}$	=	test sediment fails to meet the antidegradation guideline
$FAIL^{C}$	=	DMMU found unsuitable for open-water disposal in the absence of bioassay testing data
RETEST	=	DMMU retested due to lab/test unreliability
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 or BT
H^{B}	=	the sediment rank is based on biological testing results
L^{D}	=	the sediment rank is based on dioxin results; both highest reported concentration and VWA <4 ppt
LM^{D}	=	the sediment rank is based on dioxin results; highest reported concentration <10 ppt and VWA <4 ppt
M^{D}	=	the sediment rank is based on dioxin results; highest reported concentration was <10 ppt and VWA >4 ppt
H^{D}	=	the sediment rank is based on dioxin results; reported concentration exceeded 10 ppt
L^{FW}	=	the highest reported concentration was below SL1
M^{FW}	=	the highest reported concentration was between SL1 and SL2
H^{FW}	=	the highest reported concentration exceeded SL2
more than 1 value	=	analytical duplicate

APPENDIX D – DY10/DY11 DIOXIN DATA

PROJECT	DMMU ID	VOLUME	TEQ	DETERMINATION
Boyer Towing	DMMU 1	3,900	5.16	PASS[FIG]
Former Scott Paper Mill	DMMU 2	4,020	5.0	PASS[FIG]
	DMMU 3	3,780	4.0	PASS[FIG]
	DMMU 4	3,980	11.9	FAIL[FIG]
	DMMU 5	3,030	3.5	PASS[FIG]
	DMMU 6	3,440	0.31	PASS[FIG]
	DMMU 7	3,680	0.46	PASS[FIG]
	DMMU 8	3,710	3.0	PASS[FIG]
Georgia-Pacific Camas Slough (post-dredge surface)	B13-0-1	NA	1.41	PASS[AD]
	B13-2-3	NA	1.53	NA[1]
	B13-4-5	NA	2.32	NA[1]
	B14-0-1	NA	2.06	PASS[AD]
	B14-2-3	NA	9.63	NA[1]
	B14-4-5	NA	16.56	NA[1]
	B15-0-1	NA	1.45	PASS[AD]
	B15-2-3	NA	1.11	NA[1]
	B15-4-5	NA	1.55	NA[1]
Nippon Paper Industries Outfall	125-02	166	0.09	PASS[FIG]
	135-02	166	0.04	PASS[FIG]
Port of Everett 10th Street Boat Launch and Settling Basin Realignment PC	SBC-1	100,000	1.75	PASS[FIG]
	SBC-2	100,000	0.46	PASS[FIG]
	SBC-3	100,000	0.47	PASS[FIG]
	SBC-4	100,000	0.02	PASS[FIG]
Port of Everett Pacific Terminal	DMMU 1	3,702	0.35	PASS[FIG]
	DMMU 2	3,237	1.74	PASS[FIG]
	DMMU 3	3,253	0.34	PASS[FIG]
Port of Seattle T5	DMMU S2b	300	0.27	PASS[FIG]
	DMMU S3a	1,210	6.65	FAIL[OT]
Skyline Marina	DMMU-1	15,800	0.47	PASS[FIG]
	DMMU-2	15,400	0.41	PASS[FIG]
	DMMU-3	11,700	0.92	PASS[FIG]
	DMMU-4	11,600	1.23	PASS[FIG]
	DMMU-6	10,600	1.17	PASS[FIG]
	DMMU-7	10,700	1.80	PASS[FIG]
	DMMU-8	1,300	1.43	PASS[FIG]
	DMMU-9	1,900	0.84	PASS[FIG]
	DMMU-10	16,000	0.21	PASS[FIG]
	DMMU-11	600	0.65	PASS[FIG]
	DMMU-12	1,900	1.58	PASS[FIG]
	DMMU-13	8,200	2.29	PASS[FIG]

PROJECT	DMMU ID	VOLUME	TEQ	DETERMINATION
USACE Duwamish	DMMU 1	51,592	1.99	PASS[FIG]
	DMMU 2	16,580	2.77	FAIL[OT]
	DMMU 3	3,394	1.66	FAIL[OT]
	DMMU 4	3,467	4.72	FAIL[OT]
	DMMU 6	3,785	4.43	FAIL[OT]
	DMMU 8	3,459	2.89	PASS[FIG]
	DMMU 10	3,414	2.59	PASS[FIG]
	DMMU 12	3,370	2.79	PASS[FIG]
	DMMU 13	3,094	3.46	PASS[FIG]
	DMMU 14	3,473	4.30	PASS[FIG]
	DR08-B-D06-Z	NA	6.67	FAIL[AD]
	DR08-B-D08-Z	NA	10.75	FAIL[AD]
	DR08-B-D10-Z	NA	2.57	PASS[AD]
	DR08-B-D12-Z	NA	5.27	FAIL[AD]
USACE Snohomish	DMMU 2	85,560	0.16	PASS[FIG]
	DMMU 3	85,559	0.19	PASS[FIG]
	DMMU 4	85,559	0.16	PASS[FIG]
	DMMU 5	85,559	0.16	PASS[FIG]
	DMMU 6	55,685	0.19	PASS[FIG]
	DMMU 7	40,351	0.50	PASS[FIG]
	DMMU 8	40,351	0.70	PASS[FIG]
	DMMU 9	40,351	0.44	PASS[FIG]
	DMMU 10	40,351	0.41	PASS[FIG]
	DMMU 11	40,351	0.38	PASS[FIG]
	DMMU 12	40,351	0.65	PASS[FIG]
	DMMU 13	40,350	0.49	PASS[FIG]
	DMMU 14	37,009	0.50	PASS[FIG]
	DMMU 15	32,209	0.90	PASS[FIG]
	DMMU 16	28,067	1.06	PASS[FIG]
Port of Bellingham Gate 3	POB-1; Round 1	NA	10.6	see Round 2
	POB-2; Round 1	NA	6.2	see Round 2
	POB-3; Round 1	15,867	27.3	FAIL[FIG]
	POB-4; Round 1	9,158	47.1	FAIL[FIG]
	POB-1-CMP; Round 2	14,122	22.4	FAIL[FIG]
	POB-1-S1-A uncomposited - Rnd 2	---	19.7	FAIL[FIG]
	POB-1-S2-A uncomposited - Rnd 2	---	17.1	FAIL[FIG]
	POB-1-S3-A uncomposited - Rnd 2	---	15.4	FAIL[FIG]
	POB-1-S4-A uncomposited - Rnd 2	---	23.6	FAIL[FIG]
	POB-2-CMP; Round 2	---	19.6	see uncomposited
	POB-1-S5-A uncomposited - Rnd 2	5,537	14.2	FAIL[FIG]
	POB-1-S6-A uncomposited - Rnd 2	1,733	7.3	PASS[FIG]
	POB-1-S7-A uncomposited - Rnd 2	1,733	10.8	PASS[FIG]
	POB-1-S8-A uncomposited - Rnd 2	1,733	7.6	PASS[FIG]

PROJECT	DMMU ID	VOLUME	TEQ	DETERMINATION
Port of Bellingham Gate 3 (continued)	POB-1-Z	---	21	PASS[AD]
	POB-2-Z	---	11.4	PASS[AD]
	POB-3-Z	---	28.9	PASS[AD]
	POB-4-Z	---	85.3	FAIL[AD]
Port of Everett Marina	DMMU 1	29,000	3.90	PASS
	DMMU 2	28,400	6.65	DHIA
	DMMU 3	28,000	5.34	DHIA
	DMMU 4	2,500	6.61	DHIA
	DMMU 5	7,600	7.35	DHIA
	DMMU 6	10,500	9.65	DHIA
	DMMU 7	1,700	19.4	DHIA
	DMMU 8	24,000	11.4	DHIA
	DMMU 4-Z	NA	0.24	DHIA
	DMMU 5-Z	NA	1.58	DHIA
	DMMU 6-Z	NA	17.2	DHIA
	DMMU 7-Z	NA	3.44	DHIA
Bellingham Cold Storage	BCS-1	3,190	1.7	PASS[FIG]
	BCS-2	3,470	10.6	PASS[FIG]
	BCS-1-Z	NA	2.9	PASS[AD]
	BCS-2-Z	NA	5.6	PASS[AD]
South Park Bridge	DMMU NB-1	750	1.57	PASS[FIG]
	DMMU SB-2	750	0.69	PASS[FIG]
SR520 Pontoon	DMMU S1	3,900	0.43	PASS[GH]
	DMMU S2	3,800	0.86	PASS[GH]
	DMMU S3	3,900	0.28	PASS[GH]
	DMMU S4	4,000	2.41	PASS[GH]
	DMMU S5	4,000	1.75	PASS[GH]
	DMMU S6	3,500	6.24	PASS[GH]
	DMMU S7	3,800	3.65	PASS[GH]
	DMMU B1	5,400	0.77	PASS[GH]
	DMMU B2	7,500	1.35	PASS[GH]
	DMMU B3	10,100	1.62	PASS[GH]
	DMMU B4	10,700	6.99	PASS[GH]
	DMMU B5	11,700	1.26	PASS[GH]
	DMMU B6	7,500	5.74	PASS[GH]
	DMMU B7	7,500	6.65	PASS[GH]
	DMMU B8	8,600	1.30	PASS[GH]
USACE Swinomish	C1	62,000	0.16	PASS[FIG]
	C2	39,500	0.17	PASS[FIG]
	C3	50,500	0.17	PASS[FIG]
Thatcher Bay Restoration	DMMU 1	12,900	0.34	PASS[FIG]

PROJECT	DMMU ID	VOLUME	TEQ	DETERMINATION
USACE Grays Harbor	CX1	194,935	2.75	PASS[GH]
	CX2	196,236	3.28	PASS[GH]
	CX3	207,431	2.90	PASS[GH]
	CX4	200,845	3.24	PASS[GH]
	NC5	584,614	3.33	PASS[GH]
	HO6	554,539	5.57	PASS[GH]
	CP7	207,464	5.97	PASS[GH]
	CP8	223,160	7.45	PASS[GH]
	CP9	217,597	7.99	PASS[GH]

Notes:

- Volumes are in cubic yards
- DHIA = determination held in abeyance per a request from the Port of Everett until more work can be done
- DMMU = dredged material management unit
- FAIL[AD] = failed antidegradation guidelines
- FAIL[D] = failed dispersive guidelines
- FAIL[FIG] = failed former interim guidelines
- FAIL[OT] = would have passed dioxin guidelines but failed due to other testing
- FAIL[VWA] = failed volume-weighted averaging
- NA = not applicable
- NA[1] = Deeper material was tested post-dredging in case remedial action became necessary, but remedial action was not necessary.
- PASS[AD] = passed antidegradation guidelines
- PASS[FIG] = passed former interim guidelines
- PASS[GH] = passed Grays Harbor guidelines
- TEQ = toxic equivalents in parts per trillion dry-weight