MEMORANDUM FOR RECORD

SUBJECT: SUPPLEMENTAL DETERMINATION ON THE SUITABILITY OF DREDGED MATERIAL TESTED FOR DIOXIN/FURANS WITHIN THE OLYMPIA HARBOR FEDERAL/PORT NAVIGATION PROJECT EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR OPEN-WATER DISPOSAL AT THE ANDERSON/KETRON ISLAND NON-DISPERSIVE DISPOSAL SITE, AND FOR BENEFICIAL USE.

1. The following summary reflects the consensus suitability determination of the Agencies that comprise the regional Dredged Material Management Program (DMMP) for the State of Washington on supplemental testing conducted for the maintenance dredging of the Olympia Harbor Federal/Port of Olympia deep-draft navigation project. The agencies include the Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency. The agencies are charged with determining the suitability of the proposed 458,734 cy of dredged material from the Olympia Harbor joint Federal/Port of Olympia project, located in Budd Inlet, Olympia, Washington for open-water disposal at the Anderson/Ketron Island disposal site and/or for beneficial use at the proposed beneficial uses placement site.

2. **Table 1** documents the regulatory tracking information and dates for the supplemental testing conducted.

Table 1. Regulatory Tracking Information and Dates

Corps Public Notice #:	CENWS-OD-TS-NS-23
Initial Suitability Determination (635,000 cy Project)	May 17, 2000
Recency Extension Determination (478,000 cy Project)	May 24, 2005
Final SAP submittal date:	February 28, 2006
SAP approval letter date:	March 3, 2006
Sampling date(s):	March 6-10, 2006
Initial Phase 1 data characterization data report submittal: Validation Report on Phase 1 Dioxin Data	April 7, 2006 May 8, 2006
Phase 2 data characterization report submittal: Validation Report on Phase 2 Dioxin Analyses:	June 8, 2006 July 19, 2006
Volume Tested (# DMMUs), Sampling Method:	458,734 cy; (29 DMMUs + 2 analyses at proposed BU placement site); Vibracorer
DAIS Tracking Number	OHDSD-1-A-F-224
Recency Determination Date(s): **High: (Berthing Area, Navigation channel including minor widening) = 2 + 2 (BPJ) = 4**	March 2010 (**High**)

3. The Project was initially ranked Low for the 1999 characterization, but the berthing area was re-ranked moderate/high for supplemental dioxin/furans testing. The DMMP agencies have assigned a high rank to entire project based on recent test results. The Agencies have agreed to extend the 2 year recency on high ranked areas for this project only by 2 years to 4 years. The rationale for the Agencies' decision to extend the recency for this project's data is recognition that the conditions represented by the data are unlikely to change in this time frame.

Specifically, the likely source (e.g., Cascade Pole) for dioxins/furans to the project area is no longer active. Furthermore, the horizontal and vertical distribution of dioxins/furans in the 2006 dataset reflect activities ongoing in the harbor area (e.g., resuspension of surface sediments due to shipping traffic and natural deposition of sediments from the Deschutes River and Capital Lake system) that are unlikely to change significantly in the recency timeframe. Additional considerations for extending the recency are documented in 2002 DMMP clarification paper on this topic (http://www.nws.usace.army.mil/publicmenu/DOCUMENTS/dmmo/Recencyclarification1.pdf).

Background:

4. A white paper (**Attachment 1**) provides a review summary of previous testing conducted for the Olympia Harbor Project in 1988 and 1999, and describes data gaps leading to supplemental testing, required by the DMMP, the results of which are described in detail in this supplemental suitability determination. Concerns about data gaps and area ranking for previous testing led to a requirement by the DMMP agencies to require supplemental testing for dioxins/furans within the entire project area and to conduct limited PAH retesting in several locations.

5. The revised 458,734 cy project was subjected to dioxin/furans testing. The method for determining estimated volumes for dredged material management units is based on the original DMMP approved Sampling and Analysis Plan (SAP) for the 1999 characterization that delineated dredged materials management unit boundaries. After initial sampling in 1999, Olympia Harbor volume estimates were decreased because advance maintenance dredging depth was not justified in the Federal channel. The Supplemental Suitability Determination estimated volumes were calculated from current bathymetric survey information with surface (top 4 ft) volumes and subsurface volumes correlated to the dredging prism and subsequent sediment analysis data that required the recapitulation of suitable and unsuitable volumes.

Sampling:

6. The DMMP consensus determination on supplemental testing (see **Attachment 1** White Paper) required collection of Vibracore samples at 21 locations within the joint Federal/Port project area (**Table 2**, **Figures 1** and **2** for Station locations, and **Figure 3** for DMMU boundaries). The sampling collected surface, subsurface DMMUs, and Z-samples at each location, for a total of 29 DMMUs. The Sampling and Analysis Plan was submitted to the DMMP agencies on February 28, 2006, and approved on March 3, 2006.

7. The vibracore sampling was initiated on March 6, 2006 and completed on March 10, 2006. Samples were submitted for sediment conventionals, PAHs, and Dioxins/Furans analyses. Samples slated for dioxin/furans analyses using U.S. EPA Method 1613B were sent to Alta Analytical Laboratory, Inc in El Dorado Hills, California. Five samples were submitted for PAH analyses. Forty-five dioxin/furan analyses were performed on the 29 DMMUs in 2 phases (Phase 1 = 20; Phase 2 = 25), including 8 Z-sample analyses. The emphasis of the Phase 1 analyses was evaluation of the surface DMMUs for dioxins/furans and limited PAHs. Based on the Phase 1 results the DMMP agencies required additional analyses to further elucidate the extent of the dioxin/furan concentrations in surface composited samples, subsurface samples, and Z-samples to complete the data necessary to make the suitability determination (**Table 2**).

Chemical Testing Results:

8. The analyses were conducted in two phases, initially focusing on the surface sediments (**Table 2**). **Table 3** contains a summary of the sediment conventional results for the samples collected for dioxin analyses[1] and **Table 5** provides conventional data for the samples collected for PAH analyses. The Phase 1 analyses consisted of a subset of composited analyses from the federally maintained harbor area and uncomposited analyses at all other locations including the Port's berthing area, which was sampled at a moderate/high rank (see **Attachment 1**). After reviewing Phase I results, the DMMP agencies determined that additional analyses would be required on archived samples to complete the data analysis requirements for the DMMP Suitability Determination. The Phase 2 analyses focused on breaking apart the composited samples from the Harbor Channel area into uncomposited archived surface samples; analyzing subsurface samples from the berthing area and Turning Basin widening area, not analyzed during Phase I, and analyzing all Z-samples with contaminated overlying sediments, as noted in **Table 2**.

9. **Tables 4a** and **4b** provides summaries of the validated dioxin/furan congener specific testing results for both testing phases, with TEQ (Toxicity Equivalence) concentrations ranging from a low of 0.14 pptr (SZ-12 at core location 12) to a high of 52.6 pptr (Port Berthing area S4, core location 4). The limited PAH analyses at Port Berthing area (Station 4: surface and subsurface) and at Olympia Harbor surface Stations 9 and 10 (composited surface Sample ID = C3; and at Z Stations SZ-9 and SZ-10) showed low concentrations well below DMMP screening level guidelines (**Table 5a**) and SMS Guidelines (**Table 5b**).

10. The dioxin data underwent an independent QA/QC review (by D.M.D., Inc.) to validate the data. The quality assurance/quality control guidelines specified by the EPA method, EPA Function guidelines, and the DMMP Users Manual were generally complied with. The data gathered were deemed sufficient and acceptable for decision-making by the DMMP agencies based on best-professional-judgment (BPJ).

11. Biological testing would only be necessary for samples undergoing PAH analyses if screening levels were exceeded for this chemical, and were not deemed appropriate by the DMMP for dioxin testing results because there are no established screening levels for this chemical (see **Attachment 2**, dioxin white paper). Based on the low levels of PAH observed in the limited retesting conducted (**Table 5**), no biological testing was deemed necessary by the DMMP agencies using BPJ.

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

[1] Sediment Conventionals were performed on composited Phase 1 samples (C1 –C4), and not analyzed on the uncomposited samples (S18, S19, S20, S21, S22, S23, S28, S29) that were subsequently analyzed during Phase 2 testing. Sediment conventionals were not analyzed on subsurface samples from the Turning Basin Expansion (S16, S17) and subsurface samples from the Port berthing area (S24, S25, S26, S27) using BPJ.

Dioxin Interpretation Summary:

13. The DMMP agencies have developed an interim interpretative approach for PCDD/F based on maintaining "background" concentrations currently existing at and in the vicinity of the Anderson-Ketron site. The use of this approach was supported by the results of a risk-screening exercise that considered the best available information for the proposed disposal site, as well as updated modeling approaches and exposure information for highly exposed human populations. **Attachment 2** provides the White Paper entitled: "Analysis to Support Suitability Determination of Dredged Material with Polychlorinated Dibenzo-p-dioxins and Furans for Disposal at the Anderson/Ketron Island Dredged Material Disposal Site". The purpose of the exercise was to evaluate the plausibility of setting risk-based guidelines while meeting the needs of the applicant's time constraints. While this screening exercise and the resulting interim approach received internal and some external review, it has not been thoroughly vetted with the stakeholder community. Such a review will be necessary and will be pursued before the DMMP develops a broader approach for establishing interpretative guidelines for Puget Sound on a programmatic basis. The culmination of this effort should be the presentation of an agreed-on approach to setting limits for dioxin at both dispersive and non-dispersive sites at the 2007 Sediment Management Annual Review Meeting.

14. The following abbreviated summary explains the interim approach that the DMMP has developed to interpret polychlorinated dibenzodioxins and furans (PCDD/F) testing results for the Olympia Harbor joint Federal/Port Project. We reiterate that this interpretative framework was developed specifically for the Olympia Harbor Project and is only applicable to dredged material proposed for disposal at the Anderson/Ketron Island Disposal Site.

15. The goal of the interpretive approach is to insure that disposal of project sediments does not increase "background" concentrations of dioxin at the Anderson/Ketron site. The "background" dioxin concentration at the site is defined using a set of recently-collected sediment data from both onsite and the immediate vicinity. This case-specific approach is based on a two-tiered process. Tier 1 focuses on evaluating the project PCDD/F data relative to the Anderson/Ketron Island disposal site maximum observed sediment value 7.3 pptr TEQ. This concentration is used as a site specific ceiling value not to be exceeded. Every DMMU above this value would be unsuitable for unconfined open-water disposal, whereas, all DMMUs with PCDD/F concentrations below this value would then proceed to the second tier of interpretive framework. Tier 2 focuses on comparing the volume-weighted mean concentration of all project sediments within a given DMMU at or below 7.3 pptr TEQ maximum, to the disposal site mean concentration (3.8 pptr TEQ). If the volume-weighted mean concentration exceeds the disposal site mean concentration, the project proponent could eliminate DMMUs contributing to the volume-weighted mean exceedance until the volume-weighted mean is at or below the disposal site mean concentration.

16. **Table 6** provides a summary of the Tier 1 evaluation for all 29 DMMUs. It shows that 13 DMMUs (S2, S3, S4, S23, S22, S21, S20, S19, S18, S29, S5, S6, S10) exceeded the bright line Anderson/Ketron Island Disposal site maximum concentration of 7.3 pptr, and are unsuitable for unconfined-open water disposal at the Anderson/Ketron Island Disposal site. The remaining 16 DMMUs (S1, S27, S26, S25, S24, SZ5, SZ6, S28, S16, S17, S14, S7, S8, S15, S9, S11) were below the site maximum concentration and proceeded to the Tier 2 analysis.

17. **Table 7** provides a summary of the **Tier 2** weighted mean loading calculations for the 16 remaining DMMUs. The total volume of material below the Tier 1 bright line standard of 7.3 pptr is 220,500 cy, and the calculated weighted mean concentration for this material is 2.2 pptr TEQ, which is below the Anderson/Ketron Island Mean concentration of 3.8 pptr TEQ. Therefore, all 220,500 cy of material meeting the **Tier 1** standard is suitable for unconfined-open-water disposal at the Anderson/Ketron Island non-dispersive disposal site. A second iteration of the **Tier 2** analysis was conducted to evaluate the weighted mean concentration of material that would be likely to be dredged and disposed at the Anderson/Ketron Island disposal site after approximately 60,000 cy of material (DMMU S8, S15, and a portion: 6,645 cy of DMMU S7) is removed for use in a potential beneficial uses placement site located in Olympia Harbor (see **Figure 2**). The weighted mean concentration for PCDD/F for the revised 160,500 cy project is 2.8 pptr TEQ, which is below the Mean disposal site concentration of 3.8 pptr TEQ. The weighted mean concentration for the 60,000 cy of material likely to be used for the beneficial uses project is 0.47 pptr TEQ PCDD/F.

Suitability Determination:

18. The results of these analyses in summary indicate that all 220,500 cy of material below the **Tier 1** standard (7.3 pptr TEQ) were subsequently evaluated below the **Tier 2** Anderson/Ketron Island disposal site mean concentration (<3.8 pptr TEQ) and are suitable for unconfined open-water disposal at this site. The revised suitable volume, after removing material for a potential beneficial uses project also meets the **Tier 2** guideline of < 3.8 pptr TEQ and is suitable for unconfined-open-water disposal at the Anderson/Ketron Island site.

19. The results indicate that 238,234 cy of material exceed the DMMP dioxin interpretation framework Tier 1 maximum level of 7.3 pptr TEQ and are unsuitable for unconfined-open-water disposal, and must be disposed at an Ecology-approved upland disposal site or in-water confined disposal site.

20. The proposed dredged material evaluated for beneficial uses is suitable for an appropriate BU project based on BPJ. This determination does not make any DMMP judgments about the suitability of the BU location or BU project. There will be a separate process to determine if and where material will be used beneficially.

21. Evaluation of the Z-samples (**Table 6**) demonstrated that all the exposed surfaces represented by these analyses were significantly lower that the overlying surfaces, and would meet the Washington State anti-degradation policy. However, the Z-sample represented by SZ10 (**Table 6**) at Core location 10 exhibited a concentration of PCDD//F of 9.3 pptr TEQ, above the disposal site maximum concentration, but below the overlying surface concentration of 25.6 pptr TEQ.

22. This memorandum documents the suitability of material proposed for dredging from the Joint Federal/Port of Olympia Olympia Harbor Dredging Project, for open-water disposal at the Anderson/Ketron Island disposal site and for beneficial use. However, this suitability determination does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under Section 404(b)(1) of the Clean Water Act.

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Concur:

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Figure 1. Coring Locations in the Turning Basin and the Port of Olympia's Berthing Area (Figure prepared by the USACE Seattle District, Navigation Section)

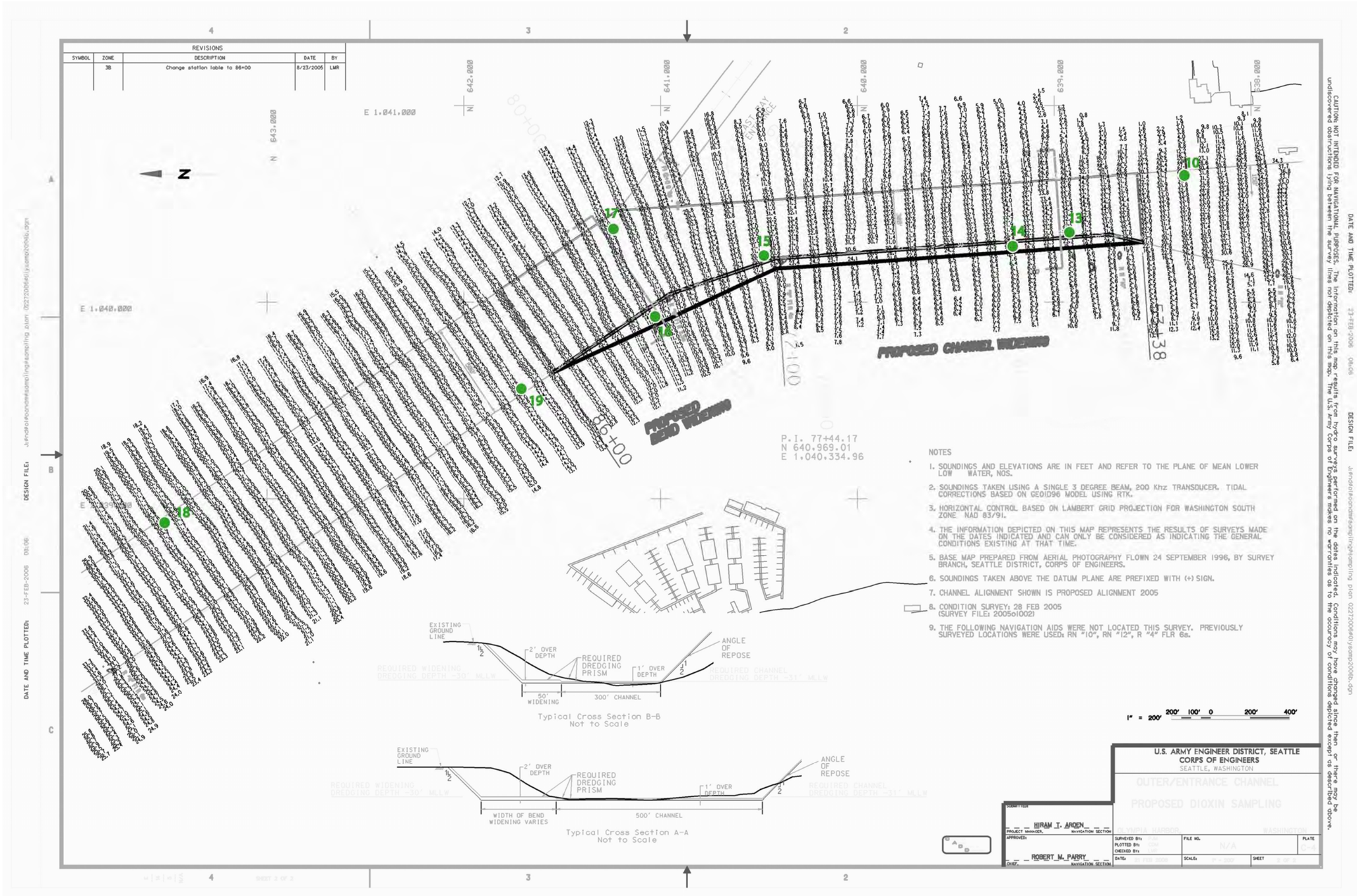


Figure 2. Coring Locations in the Olympia Navigation Channel (Figure prepared by the USACE Seattle District, Navigation Section)

Figure 3: DMMU Boundaries for Olympia Harbor Project with Core Sampling Locations noted.

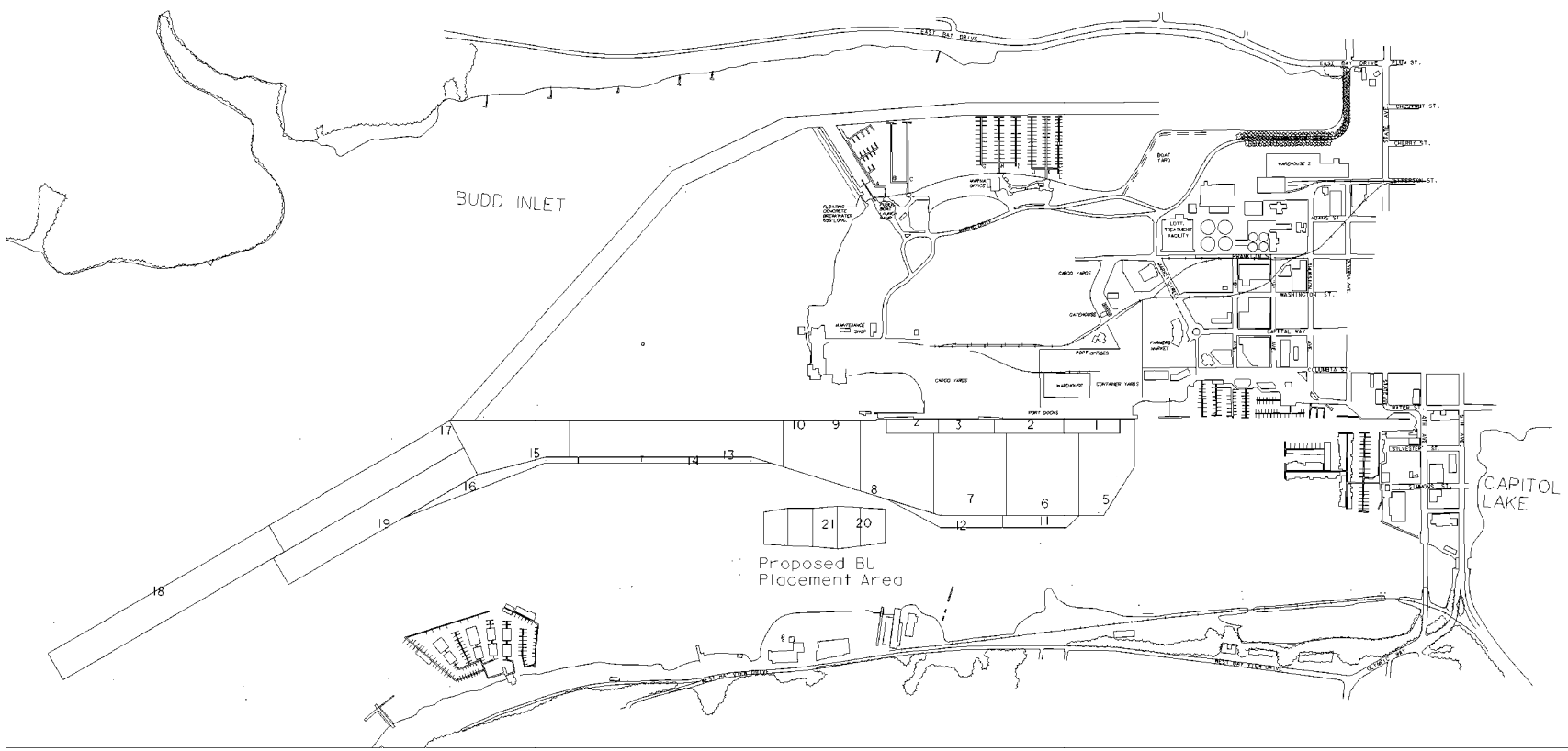


Table 2. DMMP Sampling Strategy for the Olympia Harbor Federal/Port of Olympia Project for Dioxin/Furans and PAHs[1] (Shaded = Analyzed).

DMMU Subarea	Station ID[1]	Depth	Analysis ID	Analytes	Disposition
Port's Berthing Area	1a	0-4 ft	S1 (P1)	Dioxin	Analyze
Port's Berthing Area	1b	4-9 ft	S27 (A)[2]	Dioxin	Archived
Port's Berthing Area	1c	9-10 ft	Z-sample (A)	Dioxin	Archived
Port's Berthing Area	2a	0-4 ft	S2 (P1)	Dioxin	Analyze
Port's Berthing Area	2b	4-10 ft	S26 (P2)	Dioxin	Analyze
Port's Berthing Area	2c	10-11 ft	Z-sample (A)	Dioxin	Archived
Port's Berthing Area	3a	0-4 ft	S3 (P1)	Dioxin	Analyze
Port's Berthing Area	3b	4-10 ft	S25 (P2)	Dioxin	Analyze
Port's Berthing Area	3c	10-11 ft	Z-sample (A)	Dioxin	Archived
Port's Berthing Area	4a	0-4 ft	S4 (P1)	Dioxin, PAHs	Analyze
Port's Berthing Area	4b	4-13 ft	S24 (P2)	Dioxin, PAHs	Analyze
Port's Berthing Area	4c	13-14 ft	Z-sample (A)	Dioxin	Archived
Turning Basin	5a	0-4 ft	C1 (P1) S23 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin	5b	4-5 ft	Z-Sample: SZ5 (P2)	Dioxin	Analyze
Turning Basin	6a	0-4 ft	C1 (P1) S22 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin	6b	4-5 ft	Z-Sample: SZ6 (P2)	Dioxin	Analyze
Turning Basin	7a	0-2 ft	C2 (P1) S21 (P2)	Dioxin	Analyze Analyze
Turning Basin	7b	2-3 ft	Z-Sample: SZ7 (P2)	Dioxin	Analyze
Turning Basin	8a	0-2 ft	C2 (P1) S20 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin	8b	2-3 ft	Z-Sample: SZ8 (P2)	Dioxin	Analyze
Main Channel	9a	0-2 ft	C3 (P1) S19 (P2)	Dioxin, PAHs Dioxin	Analyze Analyze
Main Channel	9b	2-3 ft	Z-Sample: SZ9 (P2)	Dioxin, PAH's	Analyze
Main Channel	10a	0-2 ft	C3 (P1) S18 (P2)	Dioxin, PAHs Dioxin	Analyze Analyze
Main Channel	10b	2-3 ft	Z-Sample: SZ10 (P2)	Dioxin	Analyze
Turning Basin Widening	11a	0-4 ft	C4 (P1) S29 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin Widening	11b	4-8 ft	S16 (P2)	Dioxin	Analyze
Turning Basin Widening	11c	8-9 ft	Z-sample: SZ11 (P2)	Dioxin	Analyze
Turning Basin Widening	12a	0-4 ft	C4 (P1) S28 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin Widening	12b	4-17 ft	S17 (P2)	Dioxin	Analyze
Turning Basin Widening	12c	17-18 ft	Z-sample: SZ12 (P2)	Dioxin	Analyze
Main Channel	13a	0-4 ft	S5 (P1)	Dioxin	Analyze
Main Channel	13b	4-5 ft	Z-Sample: SZ13 (P2)	Dioxin	Analyze
Main Channel Widening	14a	0-4 ft	S6 (P1)	Dioxin	Analyze
Main Channel Widening	14b	4-9 ft	S14 (P1)	Dioxin	Analyze
Main Channel Widening	14c	9-10 ft	Z-sample (A)	Dioxin	Archived
Main Channel	15a	0-3 ft	S7 (P1)	Dioxin	Analyze
Main Channel	15b	3-4 ft	Z-sample (A)	Dioxin	Archived
Channel Bend Widening	16a	0-4 ft	S8 (P1)	Dioxin	Analyze
Channel Bend Widening	16b	4-19 ft	S15 (P1)	Dioxin	Analyze
Channel Bend Widening	16c	19-20 ft	Z-sample (A)	Dioxin	Archived
Outer Channel	17a	0-3 ft	S9 (P1)	Dioxin	Analyze
Outer Channel	17b	3-4 ft	Z-sample (A)	Dioxin	Archived
Outer Channel	18a	0-3 ft	S10 (P1)	Dioxin	Analyze
Outer Channel	18b	3-4 ft	Z-Sample: SZ18 (P2)	Dioxin	Analyze
Outer Channel	19	0-4 ft	S11 (P1)	Dioxin	Analyze
Outer Channel	19	4-5 ft	Z-sample (A)	Dioxin	Archived
BU Placement Area.	20	0-10 cm	S12 (P1)	Dioxin	Analyze
BU Placement Area	21	0-10 cm	S13 (P1)	Dioxin	Analyze

Legend: S = uncomposited samples; C = composited for initial analysis during P1 (analyzed as uncomposited samples in P2); P1 = Initial Phase of analyses; P2 = Second Phase of analyses; A = Archived sample

[1] Z-samples were collected and archived at each Core location

[2] The surface sample (S1) overlying S27 met the Tier 1 guideline (see Table 6), and the DMMP agencies using BPJ determined that analysis of this sample was not required.

Table 3. Olympia Harbor Project Sediment Chemistry Results - Conventionals

DMMU Core Location Number:			5a + 6a (0-4 ft)	7a + 8a (0-4 ft)	9a + 10a (0-4 ft)	11a + 12a (0-4 ft)	1a (0-4 ft)
Analysis ID			C1	C2	C3	C4	S1
Collection Date	DMMP SL	DMMP ML	03/09/2006	03/09/2006	03/08/2006	03/07/2006	03/08/2006
Conventionals							
Total Organic Carbon (% DW)	–	–	3.09	2.54	3.09	2.28	0.25
Total Sulfides (mg/kg DW)	–	–	–	–	626	–	–
Ammonia (mg-N/kg DW)	–	–	–	–	89.5	–	–
TVS (%)	–	–	8.29	7.21	9.76	6.23	1.23
Total Solids (%)	–	–	41.8	44.9	37.1	51.7	83.1
Grain Size							
Percent Gravel (>2.0 mm)	–	–	6.34	2.31	0	2.1	54.8
Percent Sand (<2.0 mm - 0.06 mm)	–	–	21.57	24.45	10.9	27.85	45.68
Percent Silt (0.06 mm - 0.004 mm)	–	–	42.84	46.4	50.4	43.93	1.68
Percent Fines (<0.06 mm)	–	–	74.57	77.66	89.95	68.67	3.12
Percent Clay (<0.004 mm)	–	–	31.73	31.26	39.55	24.74	1.44

DMMU Core Location Number:			2a (0-4ft)	3a (0-4 ft)	4a (0-4 ft)	13a (0-4 ft)	14a (0-4 ft)
Analysis ID:			S2	S3	S4	S5	S6
Collection Date	DMMP SL	DMMP ML	03/08/2006	03/08/2006	03/08/2006	03/07/2006	03/07/2006
Conventionals							
Total Organic Carbon (% DW)	–	–	2.94	3.15	2.67	4.18	3.31
Total Sulfides (mg/kg DW)	–	–	–	–	575	–	–
Ammonia (mg-N/kg DW)	–	–	–	–	195	–	–
TVS (%)	–	–	8.86	9.54	7.75	9.31	9.36
Total Solids (%)	–	–	40.4	39.8	46.9	36.7	38.7
Grain Size							
Percent Gravel (>2.0 mm)	–	–	0.14	6.11	4.26	0	0.02
Percent Sand (<2.0 mm - 0.06 mm)	–	–	11.1	20.33	31.63	7.66	12.04
Percent Silt (0.06 mm - 0.004 mm)	–	–	51.57	41.67	36.33	50.89	47.61
Percent Fines (<0.06 mm)	–	–	89.42	74.18	66.18	94.49	89.21
Percent Clay (<0.004 mm)	–	–	37.85	32.51	29.85	43.6	41.6

DMMU Core Location Number:			15a (0-3 ft)	16a (0-4 ft)	17a (0-3 ft)	18a (0-3 ft)	19a (0-4 ft)
Analysis ID:			S7	S8	S9	S10	S11
Collection Date	DMMP SL	DMMP ML	03/07/2006	03/07/2006	03/07/2006	03/07/2006	03/07/2006
Conventionals							
Total Organic Carbon (% DW)	–	–	0.66	0.6	1.3	3.33	1.39
Total Sulfides (mg/kg DW)	–	–	–	–	–	–	–
Ammonia (mg-N/kg DW)	–	–	–	–	–	–	–
TVS (%)	–	–	2.26	2.44	5	9.99	4.52
Total Solids (%)	–	–	69.6	71.1	50.7	28.1	53.5
Grain Size							
Percent Gravel (>2.0 mm)	–	–	2.68	3.19	0.97	0	2.41
Percent Sand (<2.0 mm - 0.06 mm)	–	–	74.63	73.34	50.26	1.93	41.38
Percent Silt (0.06 mm - 0.004 mm)	–	–	13.89	17.88	25.91	50.67	29.25
Percent Fines (<0.06 mm)	–	–	22	25.76	48.99	102.67	52.35
Percent Clay (<0.004 mm)	–	–	8.11	7.88	23.08	52	23.1

DMMU Core Location Number:			20 (0-10 cm)	21 (0-10 cm)	14b (4-9 ft)	16b (4-19 ft)	4b (4-13 ft)
Analysis ID:			S12	S13	S14	S15	S24
Collection Date	DMMP SL	DMMP ML	03/10/2006	03/10/2006	03/07/2006	03/07/2006	03/08/2006
Conventionals							
Total Organic Carbon (% DW)	–	–	3.92	4.25	0.64	0.75	0.35
Total Sulfides (mg/kg DW)	–	–	652	537	–	–	16.9
Ammonia (mg-N/kg DW)	–	–	14.3	14.6	–	–	19.2
TVS (%)	–	–	12.1	12.4	2.28	2.96	1.5
Total Solids (%)	–	–	32.7	33.1	75	70.8	84.5
Grain Size							
Percent Gravel (>2.0 mm)	–	–	0	0	5.76	6.3	51
Percent Sand (<2.0 mm - 0.06 mm)	–	–	5.51	5.25	74.72	58.17	43.57
Percent Silt (0.06 mm - 0.004 mm)	–	–	65.53	69.6	12.69	23.08	4.98
Percent Fines (<0.06 mm)	–	–	96.34	97.54	19.3	34.83	8.13
Percent Clay (<0.004 mm)	–	–	30.81	27.94	6.61	11.75	3.15

DMMU Core Location Number:			9b (2-3 ft)	10b (2-3 ft)
Analysis ID:			Z9	Z10
Collection Date	DMMP SL	DMMP ML	03/08/2006	03/08/2006
Conventionals				
Total Organic Carbon (% DW)	–	–	2.4	1.7
Total Sulfides (mg/kg DW)	–	–	172	45.1
Ammonia (mg-N/kg DW)	–	–	147	113
TVS (%)	–	–	7.48	5.49
Total Solids (%)	–	–	45.3	51.9
Grain Size				
Percent Gravel (>2.0 mm)	–	–	0.38	2.04
Percent Sand (<2.0 mm - 0.06 mm)	–	–	11.31	30.61
Percent Silt (0.06 mm - 0.004 mm)	–	–	57.1	44.17
Percent Fines (<0.06 mm)	–	–	90.72	65.98
Percent Clay (<0.004 mm)	–	–	33.62	21.81

Table 4a. Validated Dioxin/Furan Phase I Testing Results for the Olympia Harbor Project.

		S1			S2			S3			S4		
Analyte	**TEF**	**ng/kg-dw**	**LQ**	**TEQ**	**ng/kg-dw**	**LQ**	**TEQ**	**ng/kg-dw**	**LQ**	**TEQ**	**ng/kg-dw**	**LQ**	**TEQ**
2,3,7,8-TCDD	1	0.125	U	0.0625	2.08		2.08	1.05		1.05	1.15		1.15
1,2,3,7,8-PeCDD	1	0.232	U	0.116	4.49		4.49	3.9		3.9	3.98		3.98
1,2,3,4,7,8-HxCDD	0.1	0.416	J	0.0416	8.4		0.84	6.33		0.633	5.35		0.535
1,2,3,6,7,8-HxCDD	0.1	2.11	J	0.211	53.9		5.39	42.5		4.25	48		4.8
1,2,3,7,8,9-HxCDD	0.1	0.745	J	0.0745	20.4		2.04	14.7		1.47	13.3		1.33
1,2,3,4,6,7,8-HpCDD	0.01	46.2		0.462	1820		18.2	918		9.18	1080		10.8
OCDD	0.0001	326		0.0326	19700	JE	1.97	5890		0.589	6700		0.67
2.3.7.8-TCDF	0.1	0.149	J	0.0149	3.58		0.358	3.7		0.37	3.96		0.396
1,2,3,7,8-PeCDF	0.05	0.227	J	0.01135	4.83		0.2415	4.79		0.2395	6.37		0.3185
2,3,4,7,8-PeCDF	0.5	0.479	J	0.2395	11.1		5.55	13.2		6.6	25.8		12.9
1,2,3,4,7,8-HxCDF	0.1	2.15	J	0.215	32.9		3.29	31		3.1	61		6.1
1,2,3,6,7,8-HxCDF	0.1	1.38	J	0.138	14		1.4	10.2		1.02	15.1		1.51
2,3,4,6,7,8-HxCDF	0.1	0.757	J	0.0757	15.3		1.53	13.9		1.39	21.5		2.15
1,2,3,7,8,9-HxCDF	0.1	0.291	J	0.0291	5.75		0.575	1.81	J	0.181	13.1		1.31
1,2,3,4,6,7,8-HpCDF	0.01	15.9		0.159	399		3.99	324		3.24	431		4.31
1,2,3,4,7,8,9-HpCDF	0.01	0.75		0.0075	22.3		0.223	14.2		0.142	25.9		0.259
OCDF	0.0001	29.5		0.00295	1390		0.139	639		0.0639	1160		0.116
Total TEQ (u = 1/2):				1.8932			52.307			37.418			52.635
Total TEQ (u = 0):				1.7147			52.307			37.418			52.635
Total TOC, %:				0.25			2.94			3.15			2.67

		S5			S6			S7			S8		
Analyte	**TEF**	**ng/kg-dw**	**LQ**	**TEQ**	**ng/kg-dw**	**LQ**	**TEQ**	**ng/kg-dw**	**LQ**	**TEQ**	**ng/kg-dw**	**LQ**	**TEQ**
2,3,7,8-TCDD	1	0.949		0.949	0.902		0.902	0.144	UE	0.072	0.035	U	0.0175
1,2,3,7,8-PeCDD	1	4.11		4.11	3.5		3.5	0.495	J	0.495	0.059	U	0.0295
1,2,3,4,7,8-HxCDD	0.1	6.97		0.697	4.51		0.451	0.633	J	0.0633	0.069	U	0.00345
1,2,3,6,7,8-HxCDD	0.1	37.5		3.75	22		2.2	2.99		0.299	0.077	U	0.00385
1,2,3,7,8,9-HxCDD	0.1	14.9		1.49	8.99		0.899	1.23	J	0.123	0.069	U	0.00345
1,2,3,4,6,7,8-HpCDD	0.01	792		7.92	390		3.9	55.6		0.556	1.14	J	0.0114
OCDD	0.0001	4880		0.488	2060		0.206	330		0.033	8.54		0.000854
2.3.7.8-TCDF	0.1	3.32		0.332	3.5		0.35	0.585		0.0585	0.056	U	0.0028
1,2,3,7,8-PeCDF	0.05	3.54		0.177	2.91		0.1455	0.483	J	0.02415	0.081	U	0.002025
2,3,4,7,8-PeCDF	0.5	8.04		4.02	8.08		4.04	1.15	J	0.575	0.08	U	0.02
1,2,3,4,7,8-HxCDF	0.1	20.9		2.09	15.3		1.53	2.06	J	0.206	0.034	U	0.0017
1,2,3,6,7,8-HxCDF	0.1	8.8		0.88	5.76		0.576	0.859	J	0.0859	0.31	U	0.0155
2,3,4,6,7,8-HxCDF	0.1	11.9		1.19	8.98		0.898	1.3	J	0.13	0.033	U	0.00165
1,2,3,7,8,9-HxCDF	0.1	4.13		0.413	0.925	J	0.0925	0.416	J	0.0416	0.044	U	0.0022
1,2,3,4,6,7,8-HpCDF	0.01	254		2.54	143		1.43	41.5		0.415	0.228		0.00228
1,2,3,4,7,8,9-HpCDF	0.01	9.65		0.0965	6.78		0.0678	0.928	J	0.00928	0.04	U	0.0002
OCDF	0.0001	440		0.044	280		0.028	45.3		0.00453	0.394	J	0.0000394
Total TEQ (u = 1/2):				31.187			21.216			3.1913			0.118
Total TEQ (u = 0):				31.187			21.216			3.1913			0.015
Total TOC, %:				4.18			3.31			0.66			0.60

		S9			S10			S11			S12		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.271	J	0.271	0.825		0.825	0.229	UE	0.1145	0.657		0.657
1,2,3,7,8-PeCDD	1	1.01	J	1.01	4.18		4.18	0.985	J	0.985	3.01		3.01
1,2,3,4,7,8-HxCDD	0.1	1.5	J	0.15	6.95		0.695	1.46	J	0.146	4.44		0.444
1,2,3,6,7,8-HxCDD	0.1	7.44		0.744	43.6		4.36	7.45		0.745	29.2		2.92
1,2,3,7,8,9-HxCDD	0.1	3.27		0.327	18.9		1.89	2.95		0.295	9.99		0.999
1,2,3,4,6,7,8-HpCDD	0.01	160		1.6	892		8.92	136		1.36	448		4.48
OCDD	0.0001	1000		0.1	5710		0.571	796		0.0796	2560		0.256
2.3.7.8-TCDF	0.1	1.07		0.107	4.2		0.42	1.06		0.106	2.57		0.257
1,2,3,7,8-PeCDF	0.05	0.873	J	0.04365	3.72		0.186	0.862	J	0.0431	2.56		0.128
2,3,4,7,8-PeCDF	0.5	2.11	J	1.055	7.52		3.76	1.96	J	0.98	5.3		2.65
1,2,3,4,7,8-HxCDF	0.1	4.05		0.405	18.6		1.86	3.99		0.399	9.71		0.971
1,2,3,6,7,8-HxCDF	0.1	1.67	J	0.167	7.88		0.788	1.75	J	0.175	5.56		0.556
2,3,4,6,7,8-HxCDF	0.1	2.55		0.255	10.8		1.08	2.65		0.265	8.4		0.84
1,2,3,7,8,9-HxCDF	0.1	0.931	J	0.0931	3.65		0.365	0.886	J	0.0886	2.46	J	0.246
1,2,3,4,6,7,8-HpCDF	0.01	56.8		0.568	230		2.3	59.1		0.591	147		1.47
1,2,3,4,7,8,9-HpCDF	0.01	1.85	J	0.0185	8.61		0.0861	1.95	J	0.0195	5.36		0.0536
OCDF	0.0001	77.4		0.00774	375		0.0375	76.1		0.00761	193		0.0193
Total TEQ (u = 1/2):				6.9220			32.3			6.4			19.957
Total TEQ (u = 0):				6.9220			32.3			6.3			19.957
Total TOC, %:				1.30			3.33			1.39			3.92

Table 4a. Validated Dioxin/Furan Phase I Testing Results for the Olympia Harbor Project.

		S13			S13 (duplicate)			S14			S15		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.699		0.699	0.744		0.744	0.136	U	0.068	0.066	U	0.033
1,2,3,7,8-PeCDD	1	3.47		3.47	3.11		3.11	0.117	UE	0.0585	0.088	U	0.044
1,2,3,4,7,8-HxCDD	0.1	5.43		0.543	4.8		0.48	0.126	U	0.0063	0.099	U	0.00495
1,2,3,6,7,8-HxCDD	0.1	37.2		3.72	33.3		3.33	0.416	J	0.0416	0.109	U	0.00545
1,2,3,7,8,9-HxCDD	0.1	12.9		1.29	11.2		1.12	0.233	J	0.0233	0.099	U	0.00495
1,2,3,4,6,7,8-HpCDD	0.01	619		6.19	593		5.93	7.49		0.0749	0.729	J	0.00729
OCDD	0.0001	3600		0.36	3310		0.331	48.3		0.00483	10.4		0.00104
2.3.7.8-TCDF	0.1	2.76		0.276	2.73		0.273	0.15	UE	0.0075	0.068	U	0.0034
1,2,3,7,8-PeCDF	0.05	2.77		0.1385	2.64		0.132	0.161	U	0.004025	0.083	U	0.002075
2,3,4,7,8-PeCDF	0.5	5.75		2.875	5.49		2.745	0.323	J	0.1615	0.075	U	0.01875
1,2,3,4,7,8-HxCDF	0.1	11.5		1.15	10		1	0.468	J	0.0468	0.079	U	0.00395
1,2,3,6,7,8-HxCDF	0.1	6.64		0.664	5.83		0.583	0.304	J	0.0304	0.038	U	0.0019
2,3,4,6,7,8-HxCDF	0.1	10.2		1.02	9.33		0.933	0.299	J	0.0299	0.036	U	0.0018
1,2,3,7,8,9-HxCDF	0.1	2.71		0.271	2.56		0.256	0.081	U	0.00405	0.04	U	0.002
1,2,3,4,6,7,8-HpCDF	0.01	192		1.92	158		1.58	17.2		0.172	0.057	J	0.00057
1,2,3,4,7,8,9-HpCDF	0.01	6.85		0.0685	6.15		0.0615	0.147	U	0.000735	0.043	U	0.000215
OCDF	0.0001	252		0.0252	235		0.0235	10.4		0.00104	0.158	UE	0.0000079
Total TEQ (u = 1/2):				24.6802			22.632			0.7354			0.1353
Total TEQ (u = 0):				24.6802			22.632			0.5863			0.0089
Total TOC, %:				4.25						0.64			0.75
		C1			**C2**			**C3**			**C4**		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	**TEQ**
2,3,7,8-TCDD	1	0.806		0.806	0.543		0.543	0.717		0.717	0.558		0.558
1,2,3,7,8-PeCDD	1	2.51		2.51	1.71	J	1.71	2.64		2.64	1.97	J	1.97
1,2,3,4,7,8-HxCDD	0.1	3.22		0.322	2.13	J	0.213	3.8		0.38	3.42		0.342
1,2,3,6,7,8-HxCDD	0.1	18.6		1.86	11.2		1.12	21.7		2.17	17.9	J	1.79
1,2,3,7,8,9-HxCDD	0.1	7.11		0.711	3.8		0.38	8.27		0.827	7.25		0.725
1,2,3,4,6,7,8-HpCDD	0.01	323		3.23	170		1.7	401		4.01	365		3.65
OCDD	0.0001	1830		0.183	886		0.0886	2390		0.239	2320		0.232
2.3.7.8-TCDF	0.1	3.01		0.301	2.02		0.202	2.58		0.258	1.75		0.175
1,2,3,7,8-PeCDF	0.05	2.61		0.1305	1.7	J	0.085	2.57		0.1285	2	J	0.1
2,3,4,7,8-PeCDF	0.5	7.15		3.575	4.61		2.305	6.28		3.14	4.29		2.145
1,2,3,4,7,8-HxCDF	0.1	12.3		1.23	7.59		0.759	12.2		1.22	9.05		0.905
1,2,3,6,7,8-HxCDF	0.1	4.87		0.487	5.27		0.527	4.83		0.483	4.17		0.417
2,3,4,6,7,8-HxCDF	0.1	7.51		0.751	4.17		0.417	7.22		0.722	5.65		0.565
1,2,3,7,8,9-HxCDF	0.1	0.769	J	0.0769	0.313	J	0.0313	2.95		0.295	1.87	J	0.187
1,2,3,4,6,7,8-HpCDF	0.01	146		1.46	67.8		0.678	150		1.5	131		1.31
1,2,3,4,7,8,9-HpCDF	0.01	5.45		0.0545	2.76		0.0276	5.78		0.0578	4.64		0.0464
OCDF	0.0001	223		0.0223	96.4		0.00964	215		0.0215	199		0.0199
Total TEQ (u = 1/2):				17.710			10.796			18.809			15.137
Total TEQ (u = 0):				17.710			10.796			18.809			15.137
Total TOC, %:				3.09			2.54			3.09			2.28

LQ = lab qualifier code
U = undetected at the specified method detection limit
UE = Nondetected at the associated value due to possible chemical interference
J = Associated value is considered an estimate due to concentration less than verifiable linear concentration range
JE = Associated value is considered an estimate due to concentration greater than verifiable linear concentration range
Analytical Method = U.S. EPA Method 1613B
* Undetected Congeners were summed in TEQ by dividing the DL by 2 and multiplying by TEF

Table 4b. Validated Dioxin/Furan Results for Phase II Archived Samples for the Olympia Harbor Project.

Analyte	TEF	S24			S25			S26			S26 (dup)		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.175	J	0.175	0.15	U	0.075	0.153	U	0.0765	1.85	U	0.925
1,2,3,7,8-PeCDD	1	0.256	J	0.256	0.117	U	0.0585	0.165	U	0.0825	1.31	U	0.655
1,2,3,4,7,8-HxCDD	0.1	0.347	U	0.0347	0.456	U	0.0228	0.206	U	0.0103	2.36	U	0.118
1,2,3,6,7,8-HxCDD	0.1	3.04		0.304	1.58	J	0.158	0.218	U	0.0109	2.51	U	0.1255
1,2,3,7,8,9-HxCDD	0.1	0.901	J	0.0901	0.431	U	0.02155	0.222	J	0.0222	3.19	U	0.1595
1,2,3,4,6,7,8-HpCDD	0.01	77.4		0.774	40.8		0.408	2.32	J	0.0232	46.3		0.463
OCDD	0.0001	585		0.0585	313		0.0313	31.1		0.00311	714		0.0714
2.3.7.8-TCDF	0.1	0.309	JN	0.0309	0.124	U	0.0062	0.103	U	0.00515	0.78	U	0.039
1,2,3,7,8-PeCDF	0.05	0.432	J	0.0216	0.207	U	0.005175	0.106	U	0.00265	1.3	U	0.0325
2,3,4,7,8-PeCDF	0.5	2.08	J	1.04	0.816	J	0.408	0.1	U	0.025	1.21	U	0.3025
1,2,3,4,7,8-HxCDF	0.1	4.92		0.492	2.03	J	0.203	0.039	U	0.00195	0.58	U	0.029
1,2,3,6,7,8-HxCDF	0.1	1.28	J	0.128	0.548	J	0.0548	0.037	U	0.00185	0.524	U	0.0262
2,3,4,6,7,8-HxCDF	0.1	1.88	J	0.188	0.8	J	0.08	0.039	U	0.00195	0.565	U	0.02825
1,2,3,7,8,9-HxCDF	0.1	0.946	J	0.0946	0.386	J	0.0386	0.058	U	0.0029	0.817	U	0.04085
1,2,3,4,6,7,8-HpCDF	0.01	84.9		0.849	43		0.43	0.093	U	0.000465	1.06	U	0.0053
1,2,3,4,7,8,9-HpCDF	0.01	2.45	J	0.0245	1.08	J	0.0108	0.114	U	0.00057	0.63	U	0.00315
OCDF	0.0001	132		0.0132	67.1		0.00671	0.237	U	0.00001185	1.74	U	0.000087
Total TEQ (u = 1/2):				4.5741			2.018			0.271			3.024
Total TEQ (u = 0):				4.5741			2.018			0.049			0.534
Total TOC, %:				0.35			NA			NA			NA

Analyte	TEF	S23			S22			S21			S20		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.934		0.934	0.809		0.809	0.681		0.681	0.636	U	0.318
1,2,3,7,8-PeCDD	1	3.26		3.26	2.59		2.59	2.44	J	2.44	3		3
1,2,3,4,7,8-HxCDD	0.1	4.9		0.49	2.9		0.29	2.78		0.278	4.19		0.419
1,2,3,6,7,8-HxCDD	0.1	24.7		2.47	19.1		1.91	14.8		1.48	20.7		2.07
1,2,3,7,8,9-HxCDD	0.1	9.51		0.951	6.31		0.631	6.1		0.61	8.89		0.889
1,2,3,4,6,7,8-HpCDD	0.01	406		4.06	289		2.89	264		2.64	365		3.65
OCDD	0.0001	1940		0.194	1590		0.159	1530		0.153	2000		0.2
2.3.7.8-TCDF	0.1	3.32		0.332	3.22		0.322	2.48		0.248	2.95		0.295
1,2,3,7,8-PeCDF	0.05	3.21		0.1605	2.59		0.1295	2.14	J	0.107	2.92		0.146
2,3,4,7,8-PeCDF	0.5	8.42		4.21	6.98		3.49	5.94		2.97	7.46		3.73
1,2,3,4,7,8-HxCDF	0.1	16.4		1.64	9.93		0.993	9.85		0.985	13.6		1.36
1,2,3,6,7,8-HxCDF	0.1	6.3		0.63	4.45		0.445	3.92		0.392	5.38		0.538
2,3,4,6,7,8-HxCDF	0.1	9.38		0.938	6.72		0.672	5.92		0.592	7.2		0.72
1,2,3,7,8,9-HxCDF	0.1	3.56		0.356	2.59		0.259	2.03	J	0.203	2.8		0.28
1,2,3,4,6,7,8-HpCDF	0.01	142	JD	1.42	127		1.27	144		1.44	149		1.49
1,2,3,4,7,8,9-HpCDF	0.01	7.99		0.0799	4.63		0.0463	4.45		0.0445	6.13		0.0613
OCDF	0.0001	298		0.0298	169		0.0169	200		0.02	244		0.0244
Total TEQ (u = 1/2):				22.155			16.923			15.284			19.191
Total TEQ (u = 0):				22.155			16.923			15.284			18.873
Total TOC, %:				3.09			3.09			2.54			2.54

Analyte	TEF	S19			S18			S29			S28		
		ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.841		0.841	0.75		0.75	1.1		1.1	0.238	U	0.119
1,2,3,7,8-PeCDD	1	3.68		3.68	3.29		3.29	4.78		4.78	0.884	J	0.884
1,2,3,4,7,8-HxCDD	0.1	6.19		0.619	5.43		0.543	7.92		0.792	1.24	J	0.124
1,2,3,6,7,8-HxCDD	0.1	39		3.9	32.1		3.21	41		4.1	6.27		0.627
1,2,3,7,8,9-HxCDD	0.1	15.8		1.58	12.6		1.26	16.7		1.67	2.35	J	0.235
1,2,3,4,6,7,8-HpCDD	0.01	806		8.06	647		6.47	833		8.33	103		1.03
OCDD	0.0001	5170		0.517	4080		0.408	5180		0.518	556		0.0556
2.3.7.8-TCDF	0.1	3.36		0.336	2.65		0.265	4.37		0.437	0.949		0.0949
1,2,3,7,8-PeCDF	0.05	3.66		0.183	3.14		0.157	4.35		0.2175	0.805	J	0.04025
2,3,4,7,8-PeCDF	0.5	8.16		4.08	7.11		3.555	10.8		5.4	1.86	J	0.93
1,2,3,4,7,8-HxCDF	0.1	18.1		1.81	16.2		1.62	25.2		2.52	3.39		0.339
1,2,3,6,7,8-HxCDF	0.1	7.69		0.769	6.18		0.618	9.99		0.999	1.41	J	0.141
2,3,4,6,7,8-HxCDF	0.1	10.5		1.05	9.21		0.921	14.1		1.41	2.17	J	0.217
1,2,3,7,8,9-HxCDF	0.1	3.86		0.386	3.56		0.356	4.58		0.458	0.811	J	0.0811
1,2,3,4,6,7,8-HpCDF	0.01	280		2.8	209		2.09	330		3.3	38.4		0.384
1,2,3,4,7,8,9-HpCDF	0.01	9.01		0.0901	8.38		0.0838	12		0.12	1.45	J	0.0145
OCDF	0.0001	413		0.0413	357		0.0357	647		0.0647	61.2		0.00612
Total TEQ (u = 1/2):				30.742			25.6			36.2			5.322
Total TEQ (u = 0):				30.742			25.6			36.2			5.203
Total TOC, %:				3.09			3.09			2.28			2.28

Table 4b. Validated Dioxin/Furan Results for Phase II Archived Samples for the Olympia Harbor Project.

		S16			S17			S17 dup			SZ5		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.215	J	0.215	0.091	U	0.0455	0.074	U	0.037	0.08	U	0.04
1,2,3,7,8-PeCDD	1	0.44	J	0.44	0.117	U	0.0585	0.092	U	0.046	0.115	U	0.0575
1,2,3,4,7,8-HxCDD	0.1	0.248	J	0.0248	0.102	U	0.0051	0.066	U	0.0033	0.16	J	0.016
1,2,3,6,7,8-HxCDD	0.1	0.739	J	0.0739	0.106	U	0.0053	0.132	J	0.0132	0.709	J	0.0709
1,2,3,7,8,9-HxCDD	0.1	0.458	J	0.0458	0.099	U	0.00495	0.109	J	0.0109	0.411	J	0.0411
1,2,3,4,6,7,8-HpCDD	0.01	6.04		0.0604	1.33	J	0.0133	1.43	J	0.0143	15.9		0.159
OCDD	0.0001	23.2		0.00232	8.34		0.000834	11.3		0.00113	115		0.0115
2.3.7.8-TCDF	0.1	0.749	JN	0.0749	0.043	U	0.00215	0.052	U	0.0026	0.09	U	0.0045
1,2,3,7,8-PeCDF	0.05	0.419	J	0.02095	0.084	U	0.0021	0.082	U	0.00205	0.113	U	0.002825
2,3,4,7,8-PeCDF	0.5	0.869	J	0.4345	0.078	U	0.0195	0.073	U	0.01825	0.253	J	0.1265
1,2,3,4,7,8-HxCDF	0.1	0.407	J	0.0407	0.03	U	0.0015	0.022	U	0.0011	0.582	J	0.0582
1,2,3,6,7,8-HxCDF	0.1	0.4	J	0.04	0.029	U	0.00145	0.019	U	0.00095	0.216	J	0.0216
2,3,4,6,7,8-HxCDF	0.1	0.512	J	0.0512	0.033	U	0.00165	0.022	U	0.0011	0.302	J	0.0302
1,2,3,7,8,9-HxCDF	0.1	0.096	U	0.0048	0.047	U	0.00235	0.034	U	0.0017	0.116	J	0.0116
1,2,3,4,6,7,8-HpCDF	0.01	8.73		0.0873	0.392	J	0.00392	0.463	J	0.00463	7.56		0.0756
1,2,3,4,7,8,9-HpCDF	0.01	0.181	J	0.00181	0.042	U	0.00021	0.043	U	0.000215	0.291	J	0.00291
OCDF	0.0001	4.92		0.000492	0.566	J	5.7E-05	0.586	J	0.0000586	14.9		0.00149
Total TEQ (u = 1/2):				1.619			0.1684			0.1585			0.7314
Total TEQ (u = 0):				1.614			0.0181			0.0442			0.6266
Total TOC, %:				NA			NA			NA			NA

		SZ6			SZ7			SZ8			SZ9		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.222	J	0.418	0.075	U	0.0375	0.079	U	0.0395	0.055	U	0.0275
1,2,3,7,8-PeCDD	1	0.418	J	0.263	0.084	U	0.042	0.094	U	0.047	0.19	J	0.19
1,2,3,4,7,8-HxCDD	0.1	0.263	U	0.01315	0.083	U	0.00415	0.166	U	0.0083	0.314	J	0.0314
1,2,3,6,7,8-HxCDD	0.1	0.816	J	0.0466	0.192	U	0.0096	0.423	J	0.0423	1.62	J	0.162
1,2,3,7,8,9-HxCDD	0.1	0.466	J	0.776	0.152	J	0.0152	0.216	J	0.0216	0.594	J	0.0594
1,2,3,4,6,7,8-HpCDD	0.01	7.76		0.368	3.03		0.0303	6.51		0.0651	32.6		0.326
OCDD	0.0001	36.8		0.000079	23.1		0.00231	42.6		0.00426	235		0.0235
2.3.7.8-TCDF	0.1	0.79	JN	0.0474	0.048	U	0.0024	0.069	U	0.00345	0.174	JN	0.0174
1,2,3,7,8-PeCDF	0.05	0.474	J	0.056	0.078	U	0.00195	0.0751	U	0.0018775	0.196	J	0.0098
2,3,4,7,8-PeCDF	0.5	1.12	J	0.2775	0.071	U	0.01775	0.125	J	0.0625	0.502	J	0.251
1,2,3,4,7,8-HxCDF	0.1	0.555	J	0.0505	0.068	U	0.0034	0.181	J	0.0181	0.944	J	0.0944
1,2,3,6,7,8-HxCDF	0.1	0.505	J	0.0721	0.029	U	0.00145	0.113	J	0.0113	0.411	J	0.0411
2,3,4,6,7,8-HxCDF	0.1	0.721	J	0.0142	0.033	U	0.00165	0.15	J	0.015	0.61	J	0.061
1,2,3,7,8,9-HxCDF	0.1	0.142	J	3.46	0.046	U	0.0023	0.04	U	0.002	0.221	J	0.0221
1,2,3,4,6,7,8-HpCDF	0.01	34.6		0.00195	0.891	J	0.00891	2.47	J	0.0247	17.4		0.174
1,2,3,4,7,8,9-HpCDF	0.01	0.195	J	0.134	0.041	U	0.000205	0.104	J	0.00104	0.42	J	0.0042
OCDF	0.0001	13.4		0.0013	1.11	J	0.000111	3.05	J	0.000305	21.9		0.00219
Total TEQ (u = 1/2):				6.000			0.1812			0.3683			1.497
Total TEQ (u = 0):				5.987			0.0416			0.2011			1.469
Total TOC, %:				0.041631			NA			NA			2.4

		SZ10			SZ11B			SZ12B			Z13B		
Analyte	TEF	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ	ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.289	J	0.289	0.17	J	0.17	0.079	U	0.0395	0.065	U	0.0325
1,2,3,7,8-PeCDD	1	1.06	J	1.06	2.27	J	2.27	0.103	U	0.0515	0.086	U	0.043
1,2,3,4,7,8-HxCDD	0.1	1.5	J	0.15	0.391	J	0.0391	0.06	U	0.003	0.103	U	0.00515
1,2,3,6,7,8-HxCDD	0.1	7.39		0.739	0.944	J	0.0944	0.075	U	0.00375	0.114	U	0.0057
1,2,3,7,8,9-HxCDD	0.1	2.99		0.299	2.51		0.251	0.066	U	0.0033	0.11	U	0.0055
1,2,3,4,6,7,8-HpCDD	0.01	165		1.65	8.86		0.0886	0.373	J	0.00373	1.1	J	0.011
OCDD	0.0001	985		0.0985	60.8		0.00608	3.08	J	0.000308	7.85		0.000785
2.3.7.8-TCDF	0.1	0.988	JN	0.0988	0.819	JN	0.0819	0.052	U	0.0026	0.086	U	0.0043
1,2,3,7,8-PeCDF	0.05	1.21	J	0.0605	0.237	U	0.005925	0.086	U	0.00215	0.059	U	0.001475
2,3,4,7,8-PeCDF	0.5	3.88		1.94	0.274	J	0.137	0.075	U	0.01875	0.055	U	0.01375
1,2,3,4,7,8-HxCDF	0.1	9.34		0.934	0.303	J	0.0303	0.101	U	0.00505	0.039	U	0.00195
1,2,3,6,7,8-HxCDF	0.1	2.65		0.265	0.146	J	0.0146	0.093	U	0.00465	0.037	U	0.00185
2,3,4,6,7,8-HxCDF	0.1	4.05		0.405	0.147	J	0.0147	0.03	U	0.0015	0.043	U	0.00215
1,2,3,7,8,9-HxCDF	0.1	1.63	J	0.163	0.072	U	0.0036	0.043	U	0.00215	0.059	U	0.00295
1,2,3,4,6,7,8-HpCDF	0.01	105		1.05	2.26	J	0.0226	0.039	U	0.000195	0.305	J	0.00305
1,2,3,4,7,8,9-HpCDF	0.01	4.01		0.0401	0.131	J	0.00131	0.045	U	0.000225	0.075	U	0.000375
OCDF	0.0001	201		0.0201	5.43		0.000543	0.124	U	0.0000062	0.499	J	0.0000499
Total TEQ (u = 1/2):				9.262			3.232			0.1424			0.1355
Total TEQ (u = 0):				9.262			3.222			0.0040			0.0173
Total TOC, %:				1.7			NA			NA			NA

Table 4b. Validated Dioxin/Furan Results for Phase II Archived Samples for the Olympia Harbor Project.

Analyte	TEF	SZ18B		
		ng/kg-dw	LQ	TEQ
2,3,7,8-TCDD	1	0.054	U	0.027
1,2,3,7,8-PeCDD	1	0.088	U	0.044
1,2,3,4,7,8-HxCDD	0.1	0.049	U	0.00245
1,2,3,6,7,8-HxCDD	0.1	**0.147**	J	**0.0147**
1,2,3,7,8,9-HxCDD	0.1	**0.163**	J	**0.0163**
1,2,3,4,6,7,8-HpCDD	0.01	**2.94**		**0.0294**
OCDD	0.0001	**24.2**		**0.00242**
2.3.7.8-TCDF	0.1	0.075	U	0.00375
1,2,3,7,8-PeCDF	0.05	0.045	U	0.001125
2,3,4,7,8-PeCDF	0.5	0.043	U	0.01075
1,2,3,4,7,8-HxCDF	0.1	0.039	U	0.00195
1,2,3,6,7,8-HxCDF	0.1	0.041	U	0.00205
2,3,4,6,7,8-HxCDF	0.1	0.044	U	0.0022
1,2,3,7,8,9-HxCDF	0.1	0.059	U	0.00295
1,2,3,4,6,7,8-HpCDF	0.01	**0.756**	J	**0.00756**
1,2,3,4,7,8,9-HpCDF	0.01	0.049	U	0.000245
OCDF	0.0001	**1.16**	**J**	**0.000116**
Total TEQ (u = 1/2):				**0.1690**
Total TEQ (u = 0):				**0.0705**
Total TOC, %:				**NA**

NA = Not Analyzed
B = This Compound detected in the method blank;
U = undetected at the detection limit
J = The amount detected is below the lower claibration limit of the instrument;
JN =Associated value is considered an estimate due to concentration not verified confirmatory/second column
*** Undetected Congeners were summed in TEQ by dividing the DL by 2 and multiplying by TEF**

Table 5a. Olympia Harbor Navigation Project Phase 1 Sediment non-Dioxin Chemistry Results

DMMU Location Number			4a (0-4 ft)			4b (4-13 ft)			9a + 10a (0-4 ft)			9b (2-3 ft)			10b (2-3 ft)				
Station Number			S4			S24			C3			Z9			Z10				
Lab Number	DMMP	DMMP																	
Collection Date	SL	ML	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LV	VQ	03/08/2006	LQ	VQ	Mean	%RSD
Conventionals																			
Total Organic Carbon (% DW)	–	–	2.67			0.35			3.09			2.4			1.7			2.0	52.5%
Total Sulfides (mg/kg DW)	–	–	575			16.9			650			172			45.1			291.8	102.7%
Ammonia (mg-N/kg DW)	–	–	195			19.2			90			147			113			112.8	58.1%
TVS (%)	–	–	7.75			1.5			9.76			7.48			5.49			6.4	48.9%
Total Solids (%)	–	–	46.9			84.5			37.1			45.3			51.9			53.1	34.5%
Grain Size																			
Percent Gravel (>2.0 mm)	–	–	4.26			51			0			0.38			2.04			11.5	191.8%
Percent Sand (<2.0 mm - 0.06 mm)	–	–	31.63			43.97			10.9			11.31			30.61			25.7	55.7%
Percent Silt (0.06 mm - 0.004 mm)	–	–	36.33			4.98			50.4			57.1			44.17			38.6	52.6%
Percent Fines (<0.06 mm)	–	–	66.18			8.13			89.95			90.72			65.98			64.2	52.4%
Percent Clay (<0.004 mm)	–	–	29.85			3.15			39.55			33.62			21.81			25.6	55.1%
LPAH in ug/kg DW																			
Naphthalene	2100	2400	91			35			16			37			23			40.4	73.2%
Acenaphthylene	560	1300	15			4.5	J		16			11			6.4			10.6	48.1%
Acenaphthene	500	2000	94			39			16			8.4			**3.3**	J		32.1	115.7%
Fluorene	540	3600	93			38			24			16			5.3			35.3	97.6%
Phenanthrene	1500	21000	310			120			320			58			23			166.2	84.4%
Anthracene	960	13000	100			35			36			23			11			41.0	84.2%
2-Methylnaphthalene	670	1900	21			10			4.8		J	11			4.3	J		10.2	65.9%
Total LPAH*	5200	29000	724			281.5			432.8			164.4			76.3			335.8	75.9%
HPAH in ug/kg DW																			
Fluoranthene	1700	30000	540			200			450			62			31			256.6	89.2%
Pyrene	2600	16000	470			170			370			90			42			228.4	80.7%
Benzo(a)anthracene	1300	5100	170			56			73			28			15			68.4	89.5%
Chrysene	1400	21000	260			82			170			36			24			114.4	87.0%
Benzofluoranthenes*	3200	9900	260			70			160			63			22			115.0	83.0%
Benzo(a)pyrene	1600	3600	120			31			63			30			10			50.8	84.8%
Indeno(1,2,3-cd)pyrene	600	4400	64			17			41			21			6.7			29.9	76.0%
Dibenz(a,h)anthracene	230	1900	16			3.2	J		9.2			4.0	J		1.3	J		6.7	88.2%
Benzo(g,h,i)perylene	670	3200	63			17			41			21			9.6			30.3	71.4%
Total HPAH*	12000	69000	1963			646.2			1377.2			355			161.6			900.6	83.5%

Table 5b. TOC Normalized - Olympia Harbor Navigation Project Phase 1 Sediment non-Dioxin Chemistry Results

DMMU Location Number			4a (0-4 ft)			4b (4-13 ft)			9a + 10a (0-4 ft)			9b (2-3 ft)			10b (2-3 ft)		
Station Number	WA SMS	WA SMS	S4			S24			C3			Z9			Z10		
Lab Number	Chem	Max Chm															
Collection Date	Criteria	Criteria	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ
Conventionals																	
Total Organic Carbon (% DW)	–	–	2.67			0.35			3.09			2.67			0.35		
Total Sulfides (mg/kg DW)	–	–	575			16.9			650			575			16.9		
Ammonia (mg-N/kg DW)	–	–	195			19.2			90			195			19.2		
TVS (%)	–	–	7.75			1.5			9.76			7.75			1.5		
Total Solids (%)	–	–	46.9			84.5			37.1			46.9			84.5		
Grain Size																	
Percent Gravel (>2.0 mm)	–	–	4.26			51			0			4.26			51		
Percent Sand (<2.0 mm - 0.06 mm)	–	–	31.63			43.97			10.9			31.63			43.97		
Percent Silt (0.06 mm - 0.004 mm)	–	–	36.33			4.98			50.4			36.33			4.98		
Percent Fines (<0.06 mm)	–	–	66.18			8.13			89.95			66.18			8.13		
Percent Clay (<0.004 mm)	–	–	29.85			3.15			39.55			29.85			3.15		
LPAH in mg/kg TOC																	
Naphthalene	99	170	3.41			10.00			0.52			1.54			1.35		
Acenaphthylene	66	66	0.56	J		1.29			0.52			0.46			0.38		
Acenaphthene	16	57	3.52			11.14			0.52			0.35			0.19	J	
Fluorene	23	79	3.48			10.86			0.78			0.67			0.31		
Phenanthrene	100	480	11.61			34.29			10.36			2.42			1.35		
Anthracene	220	1200	3.75			10.00			1.17			0.96			0.65		
2-Methylnaphthalene	38	64	0.79			2.86	J		0.16			0.46			0.25	J	
Total LPAH*	370	780	27.12			80.43			14.01			6.85			4.49		
HPAH in mg/kg TOC																	
Fluoranthene	160	1200	20.22			57.14			14.56			2.58			1.82		
Pyrene	1000	1400	17.60			48.57			11.97			3.75			2.47		
Benzo(a)anthracene	110	270	6.37			16.00			2.36			1.17			0.88		
Chrysene	110	460	9.74			23.43			5.50			1.50			1.41		
Benzofluoranthenes*	230	450	9.74			20.00			5.18			2.63			1.29		
Benzo(a)pyrene	99	210	4.49			8.86			2.04			1.25			0.59		
Indeno(1,2,3-cd)pyrene	34	88	2.40			4.86			1.33			0.88			0.39		
Dibenz(a,h)anthracene	12	33	0.60	J		0.91			0.30			0.17			0.08	J	
Benzo(g,h,i)perylene	31	78	2.36			4.86			1.33			0.88			0.56		
Total HPAH*	960	5300	73.52			184.63			44.57			14.79			9.51		

Table 6. Tier 1 Dioxin Analysis Summary for the Olympia Harbor Project*

2006 Location ID	2006 DMMU ID	1999 DMMU ID	Depth (ft)	Volume (cy)	Phase 1: Initial Dioxin/Furan pptr, TEQ	Phase 2: Supplemental Dioxin/Furan pptr, TEQ	Phase 2: Z-Sample Dioxin/Furan pptr, TEQ
1a	S1	B1	0-4	7,547	S1 =1.864		
1b	S27	B2	4-9	3,674	Archive	Not analyzed (BPJ)	Not Analyzed (BPJ)
2a	S2	B1	0-4	11,643	S2 = 54.21		
2b	S26	B2	4-10	6,752	Archive	S26 = 0.266, 3.033	Not Analyzed (BPJ)
3a	S3	B1	0-4	8,310	S3 = 35.99		
3b	S25	B2	4-10	5,898	Archive	S25 = 1.929	Not Analyzed (BPJ)
4a	S4	B1	0-4	8,403	S4 = 48.92		
4b	S24	B2	4-13	9,264	Archive	S24 = 4.293	Not Analyzed (BPJ)
5a	C1 / S23	MC1	0-4	26,079	C1 = 16.64	S23 = 22.855	
6a	C1 / S22	MC2	0-4	29,434		S22 = 15.827	
5b	SZ5	MC8	Z: 4-5	4,144			SZ5 =0.706
6b	SZ6	MC8	Z: 4-5	2,599			SZ6 = 1.843
7	C2 / S21	MC3	0-2; Z: 2-3	25,277	C2 = 10.04	S21 = 15.3	SZ7 = 0.1781
8	C2 / S20	MC4	0-2; Z: 2-3	21,716		S20 = 18.089	SZ8 = 0.3517
9	C3 / S19	MC5	0-2; Z: 2-3	18,422	C3 = 18.02	S19 = 30.154	SZ9 = 1.444
10	C3 / S18	MC5	0-2; Z: 2-3	29,062		S18 = 25.0	SZ10 = 8.699
11a	C4 / S29	TBW1	0-4	9,952	C4 = 14.74	S29 = 35.1	SZ11 = 3.188
12a	C4 / S28	TBW1	0-4	13,827		S28 = 5.058	SZ12 = 0.1346
11b	S16	TBW2	4-8; Z: 8-9	13,926	Archive	S16 = 1.442	Not Analyzed (BPJ)
12b	S17	TBW2	4-17; Z: 17-18	27,864	Archive	S17 = 0.1615, 0.1527	Not Analyzed (BPJ)
13	S5	MC6	0-4; Z: 4-5	20,774	S5 = 30.57		SZ13 = 0.1311
14a	S6	MCW1	0-4	20,148	S6 = 20.01		
14b	S14	MCW2	4-9; Z: 9-10	24,056	S14 = 0.681		Not Analyzed (BPJ)
15	S7	MC7	0-3; Z: 3-4	21,283	S7 = 3.027		Not Analyzed (BPJ)
16a	S8	MCW1	0-4	21,584	S8 = 0.111		
16b	S15	MCW2	4-19; Z: 19-20	31,771	S15 = 0.129		Not Analyzed (BPJ)
17	S9	OC1	0-3; Z: 3-4	18,359	S9 = 6.698		Not Analyzed (BPJ)
18	S10	OC2	0-3; Z: 3-4	9,014	S10 = 32.0		SZ18 = 0.1693
19	S11	OC3	0-4; Z: 4-5	7,952	S11 = 6.2		Not Analyzed (BPJ)
20 (BUP)			0-10 cm		S12 = 19.40		Not Collected
21 (BUP)			0-10 cm		S13 = 24.24, 22.19		Not Collected
Total:				458,734			

BUP = potential beneficial use placement area; TEQ concentrations, ppt (u = 1/2 detection limit)

Volume Passing Tier 1:	220,500	48.1%
Volume Failing Tier 1:	238,234	51.9%

* Regulatory Limit = 7.3 pptr TEQ

Table 6. Tier 1 Dioxin Analysis Summary for the Olympia Harbor Project*

2006 Location ID	2006 DMMU ID	1999 DMMU ID	Depth (ft)	Volume (cy)	Phase 1: Initial Dioxin/Furan pptr, TEQ	Phase 2: Supplemental Dioxin/Furan pptr, TEQ	Phase 2: Z-Sample Dioxin/Furan pptr, TEQ
1a	S1	B1	0-4	7,547	S1 =1.89		
1b	S27	B2	4-9	3,674	Archive	Not analyzed (BPJ)	Not Analyzed (BPJ)
2a	S2	B1	0-4	11,643	S2 = 52.3		
2b	S26	B2	4-10	6,752	Archive	S26 = 0.271, 3.024	Not Analyzed (BPJ)
3a	S3	B1	0-4	8,310	S3 = 37.4		
3b	S25	B2	4-10	5,898	Archive	S25 = 2.018	Not Analyzed (BPJ)
4a	S4	B1	0-4	8,403	S4 = 52.6		
4b	S24	B2	4-13	9,264	Archive	S24 = 4.574	Not Analyzed (BPJ)
5a	C1 / S23	MC1	0-4	26,079	C1 = 17.7	S23 = 22.2	
6a	C1 / S22	MC2	0-4	29,434		S22 = 16.9	
5b	SZ5	MC8	Z: 4-5	4,144			SZ5 =0.73
6b	SZ6	MC8	Z: 4-5	2,599			SZ6 = 6.0
7	C2 / S21	MC3	0-2; Z: 2-3	25,277	C2 = 10.8	S21 = 15.3	SZ7 = 0.18
8	C2 / S20	MC4	0-2; Z: 2-3	21,716		S20 = 19.2	SZ8 = 0.37
9	C3 / S19	MC5	0-2; Z: 2-3	18,422	C3 = 18.8	S19 = 30.7	SZ9 = 1.5
10	C3 / S18	MC5	0-2; Z: 2-3	29,062		S18 = 25.6	SZ10 = 9.3
11a	C4 / S29	TBW1	0-4	9,952	C4 = 15.1	S29 = 36.2	SZ11 = 3.2
12a	C4 / S28	TBW1	0-4	13,827		S28 = 5.32	SZ12 = 0.14
11b	S16	TBW2	4-8; Z: 8-9	13,926	Archive	S16 = 1.62	Not Analyzed (BPJ)
12b	S17	TBW2	4-17; Z: 17-18	27,864	Archive	S17 = 0.17, 0.16	Not Analyzed (BPJ)
13	S5	MC6	0-4; Z: 4-5	20,774	S5 = 31.2		SZ13 = 0.14
14a	S6	MCW1	0-4	20,148	S6 = 21.2		
14b	S14	MCW2	4-9; Z: 9-10	24,056	S14 = 0.735		Not Analyzed (BPJ)
15	S7	MC7	0-3; Z: 3-4	21,283	S7 = 3.19		Not Analyzed (BPJ)
16a	S8	MCW1	0-4	21,584	S8 = 0.118		
16b	S15	MCW2	4-19; Z: 19-20	31,771	S15 = 0.135		Not Analyzed (BPJ)
17	S9	OC1	0-3; Z: 3-4	18,359	S9 = 6.92		Not Analyzed (BPJ)
18	S10	OC2	0-3; Z: 3-4	9,014	S10 = 32.3		SZ18 = 0.17
19	S11	OC3	0-4; Z: 4-5	7,952	S11 = 6.4		Not Analyzed (BPJ)
20 (BUP)			0-10 cm		S12 = 20		Not Collected
21 (BUP)			0-10 cm		S13 = 24.7, 22.6		Not Collected
Total:				458,734			

BUP = potential beneficial use placement area; TEQ concentrations, ppt (u = 1/2 detection limit)

Volume Passing Tier 1:	220,500	48.1%
Volume Failing Tier 1:	238,234	51.9%

* Regulatory Limit = 7.3 pptr TEQ

Table 7. Tier 2 Weighted Mean Loading Calculations for Suitable Olympia Harbor Dredged Material

DMMU Core ID	Depth, ft	Analysis ID*	1999 DMMU ID	Volume (CY)	TCDD/F TEQ	ng/kg-dw	Product (Vol x TEQ)	ng x cy/kg x DMMU	Product/total	Loading contribution/Suitable DMMU
1a	0-4	S1	B1	7,547	1.89	ng/kg-dw	14,263.83	ng x cy/kg	0.0647	ng/kg-dw/DMMU
1b	4-9	S27	B2	3,674	NA +	ng/kg-dw	6,943.86	ng x cy/kg	0.0315	ng/kg-dw/DMMU
2a	0-4	S2	B1	11,643	52.3		608,928.90			
2b	4-10	S26	B2	6,752	0.271, 3.024	ng/kg-dw	11,123.92	ng x cy/kg	0.050	ng/kg-dw/DMMU
3a	0-4	S3	B1	8,310	37.4		310,794.00			
3b	4-10	S25	B2	5,898	2.018	ng/kg-dw	11,902.16	ng x cy/kg	0.0540	ng/kg-dw/DMMU
4a	0-4	S4	B1	8,403	52.6		441,997.80			
4b	4-13	S24	B2	9,264	4.574	ng/kg-dw	42,373.54	ng x cy/kg	0.1922	ng/kg-dw/DMMU
5a	0-4	C1 /S23	MC1	26,079	22.2 (17.7)		578,953.80			
5b	Z: 4-5	Z5	MC8	4,144	0.73	ng/kg-dw	3,025.12	ng x cy/kg	0.0137	ng/kg-dw/DMMU
6a	0-4	C1 / S22	MC2	29,434	16.9 (17.7)		653,434.80			
6b	Z: 4-5	Z6	MC8	2,599	6	ng/kg-dw	15,594.00	ng x cy/kg	0.0707	ng/kg-dw/DMMU
7	0-2	C2 / S21	MC3	25,277	15.3 (10.8)		386,738.10			
8	0-2	C2 / S20	MC4	21,716	19.2 (10.8)		416,947.20			
9	0-2	C3 / S19	MC5	18,422	30.7 (18.8)		565,555.40			
10	0-2	C3 / S18	MC5	29,062	25.6 (18.8)		743,987.20			
11a	0-4	C4 / S29	TBW1	9,952	36.2 (15.1)		360,262.40			
12a	0-4	C4 / S28	TBW1	13,827	5.32 (15.1)	ng/kg-dw	73,559.64	ng x cy/kg	0.3336	ng/kg-dw/DMMU
11b	4-8	S16	TBW2	13,926	1.62	ng/kg-dw	22,560.12	ng x cy/kg	0.1023	ng/kg-dw/DMMU
12b	4-17	S17	TBW2	27,864	0.17, 0.16	ng/kg-dw	4,597.56	ng x cy/kg	0.0209	ng/kg-dw/DMMU
13	0-4	S5	MC6	20,774	31.2		648,148.80			
14a	0-4	S6	MCW1	20,148	21.2		427,137.60			
14b	4-9	S14	MCW2	24,056	0.735	ng/kg-dw	17,681.16	ng x cy/kg	0.0802	ng/kg-dw/DMMU
15	0-3	S7	MC7 (BU-partial*)	21,283	3.19	ng/kg-dw	67,892.77	ng x cy/kg	0.3079	ng/kg-dw/DMMU
16a	0-4	S8	MCW1 (BU)	21,584	0.118	ng/kg-dw	2,546.91	ng x cy/kg	0.01155	ng/kg-dw/DMMU
16b	4-19	S15	MCW2 (BU)	31,771	0.135	ng/kg-dw	4,289.09	ng x cy/kg	0.0195	ng/kg-dw/DMMU
17	0-3	S9	OC1	18,359	6.92	ng/kg-dw	127,044.28	ng x cy/kg	0.5762	ng/kg-dw/DMMU
18	0-3	S10	OC2	9,014	32.3		291,152.20			
19	0-4	S11	OC3	7,952	6.4	ng/kg-dw	50,892.80	ng x cy/kg	0.2308	ng/kg-dw/DMMU
20 (BUP)	0-10 cm	S12			20					
21 (BUP)	0-10 cm	S13			24.7 / 22.6					
Totals (Suitable + Unsuitable):				458,734	cy		6,910,328.96	ng x cy/kg	15.06	ng/kg-dw/Project (Total Loading: S + U)
Total (Suitable):				220,500	cy		476,290.76	ng x cy/kg	2.16	ng/kg-dw/Project (Total Loading S only)
Total (Suitable - BU volume):				160,500	cy		447,987.07	ng x cy/kg	2.79	ng/kg-dw/Project (Loading S - BU)
Total BU Project:				60,000	cy		28,032.12	ng x cy/kg	0.47	ng/kg-dw/BU Project Material (Loading)

Tier 2 Comparison to Disposal Site Mean Concentration = 3.8 pptr TEQ

*** Only uncomposited analysis results used in loading calculations; Green = Suitable; Red = Unsuitable**

BUP = potential beneficial use placement area

+ not analyzed, surface concentration (1.89 ng/kg) used in loading calculation

*** 6,645cy/21,283 cy = 0.3122 (proportion of total for BU)**

Suitable:	Port of Olympia	33,135	cy	7.2%
Unsuitable:	Port of Olympia	28,356	cy	6.2%
Suitable:	USACE	187,365	cy	40.8%
Unsuitable:	USACE	209,878	cy	45.8%
Totals:		458,734	cy	100%

CENWS-OD-TS-DM

MEMORANDUM FOR RECORD 31 January 2006
(updated 11 July 2006)

ATTACHMENT 1. SUBJECT: WHITE PAPER SUMMARY OF THE PREVIOUS PSDDA/DMMP TESTING FOR THE OLYMPIA HARBOR FEDERAL/PORT NAVIGATION PROJECT, EXISTING DATA GAPS AND DMMP CONSENSUS ON SUPLEMENTAL TESTING REQUIREMENTS.

1. The purpose of this memorandum is to review the previous testing conducted for the Olympia Harbor Project, discuss the data gaps that have been recently identified by the Dredged Material Management Program (DMMP), and present the agencies' consensus determination on what testing will be required to complete the suitability determination for this joint Federal/Port dredging action.

2. The Olympia Harbor Navigation project underwent two rounds of testing in 1988, a Partial Characterization, for purposes of considering a down-ranking, followed by a Full Characterization for the 535,185 cy project. In 1999, the Olympia Harbor Navigation project was expanded to 624,000 cy with the inclusion of the Port of Olympia's berthing area and underwent another round of testing. The results of the 1988 and 1999 testing are described in more detail in Sections 3 and 4 below. The results of the 1999 characterization were subject to a DMMP review and Recency Extension during 2005. That review included a tier-1 review of all activities and sources in the project area that might affect sediment quality since the 1999 characterization. Based on available sediment quality data and information on circulation patterns in lower Budd Inlet, the DMMP agencies did not believe that was sufficient likelihood of dioxins/furans being present in the project area at levels of concern to warrant new sampling and testing. Subsequent to the Recency Extension the DMMP agencies were notified about dioxin concerns in the Olympia Harbor/Budd Inlet area and dioxin data resulting from the post-cleanup monitoring investigation at the Cascade Pole MTCA site. After reviewing these data the DMMP agencies determined that additional testing for dioxin would be required to evaluate this concern throughout the proposed project area. The concerns raised and the proposed sampling/testing approach recommended by the DMMP agencies are discussed below in Section 5.

3. **Background/Summary: 1988 Testing Summary .** The Olympia Harbor Navigation Project initially underwent Puget Sound Dredged Disposal Analysis (PSDDA) testing in 1988. Because the ranking for the Olympia Harbor in the Phase II Management Plan Report (**Table A.1,** page A-11) ranked this area High for testing purposes, the federal project manager elected to undergo a Partial Characterization (PC) (see Evaluation Procedures Technical Appendix, pages II-63 to II-65) to evaluate the potential for down-ranking the project to a lower rank. Nine samples were collected /analyzed during the PC, five within the Turning Basin, and four within the Navigation channel (**Figure 1, Table 1**). The data from the PC resulted in a re-ranking of the proposed project area into 4 subareas ranked high, low-moderate, moderate, and low-moderate (see **Table 2**, **Figure 2**) for the full characterization. Analysis of the full characterization (FC) data for the 23 Dredged Material Management Units (DMMU) interpreted with the more conservative 1988 SL guidelines indicated that 12 of 23 DMMUs had SL exceedances[1] (nickel, cadmium, mercury, copper, naphthalene, pyrene, and 2-methylphenol), and were subject to bioassay testing (**Figure 2, Table 3**). The results of the bioassay testing confirmed that one DMMU (DMMU-Z: 9,000 cubic yards) subsequently failed the non-dispersive interpretation guidelines and was unsuitable for unconfined open-water disposal. The bioassays were problematic and, due to QA/QC performance problems with the negative controls and reference samples, the Geoduck bioassay[2] and Sea Urchin larval bioassay results were unusable for decision-making. The data for the amphipod bioassay and saline Microtox test were suitable for decision-making and were the basis for

[1] It should be noted that reinterpreting these data with the 1999 DMMP chemical guidelines results in no chemicals exceeding the screening levels (SLs).

[2] The Geoduck bioassay was abandoned by the PSDDA agencies after 2 years of trying to get it to work in the PSDDA program. It was subsequently replaced by the Neanthes acute bioassay, and later the Neanthes (biomass) Growth bioassay in 1992.

the suitability determination with both showing a hit response for DMMU Z. Thus, the 1988 FC indicated that 526,185 cy were suitable and 9,000 cy were unsuitable for unconfined open-water disposal.

4. **Background/Summary: 1999 Testing Summary.** The 1999 SAP referenced the 1988 PC/FC in the Tier I review of previous testing conducted. The March 23, 1999 SAP submitted to the DMMP for review stated (page 2, second paragraph, last sentence) "The area received a low-moderate ranking for future dredging projects (Kendall 1989)". However, the SAP misquoted the context of this quote[3], which was not an actual re-ranking of the project, but an indication that the FC data suggested that future testing of the Olympia harbor area might consider a lower rank, but these data should be used with extreme caution, due to previous test results during the PC showing elevated 4-methylphenol. The SAP then discussed the comparison of the 1988 FC data using 1998 SLs, which indicated that there were no SL exceedances. The SAP went on to conclude that the project would fit a Low Rank based on these data, and the lack of historic sources in the project area.

   At the time of review, the DMMP agencies did not challenge or question the ranking proposed in the 1999 SAP and the 624,000 cy project was ranked Low for the full characterization with 17 DMMUs being tested (**Figures 3, 4, 5, 6**, **Tables 4** for **DMMP** and **5 for SMS**). However, based on a reanalysis of the existing information, the DMMP has now identified the following omissions/misinterpretations in the 1999 SAP:

   - No discussion of the bioassay hit in one DMMU at the head of the Turning Basin (DMMU-Z, see **Figure 2**), which would indicate a high ranking for future testing in this area.
   - There had been no testing performed in the Port's berthing area portion of the project to corroborate the re-rank from high (PSDDA Management Plan Report, Phase II: Page A-11) to low for the subsequent testing. This portion of the project should have been tested at either a moderate or high rank.

   The results of the 1999 analysis are summarized in the DMMP suitability determination dated 17 May 2000 (**Attachment 1**). The results of the testing of the 17 DMMUs (e.g., 13 surface DMMUs and 4 subsurface DMMUs) indicated that all Chemicals-of-Concern (COC) were detected or reported below the detection limits Screening Levels (SLs), except TBT. TBT exceeded the SL in surface DMMU's in the Port's berthing area (B1) and in the Turning Basin Widening area (TBW1). These two DMMU's subsequently underwent 45 day bioaccumulation testing, and the tissue levels of TBT were quantitated well below the risk based Target Tissue Levels (TTL's) used by the DMMP for interpretation (TTL = 3.0 ug/g-dry weight; 0.6 ug/g-wet weight).

   The data collected in 1999 had a seven year recency for DMMP. The Port of Olympia subsequently requested a data extension consideration by the DMMP. The DMMP reviewed the previous testing data that were readily available and other factors that could have resulted in changed conditions in the Olympia Harbor navigation channel and Port berthing areas, including localized spills and other actions The agencies determined in a 24 May 2005 recency extension memorandum (**Attachment 2**) that the recency of the data could be extended to May 2008. However, subsequent to this recency extension, the DMMP learned of post-construction dioxin monitoring data from the Cascade Pole MTCA cleanup effort. Based on our review of the Cascade Pole Dioxin monitoring data and

[3] Quote from Kendall, D., 1989 (page 8-9 of the "Dredged Material Sampling, Testing, and Disposal Guidelines Application Report") states as follows: "Lastly, results from the FC for the Olympia harbor Navigation Improvement Feasibility Study generally supported a Low-Moderate area ranking for future dredged material testing. However, some elevated chemicals were noted during the PC within the uncomposited samples collected within the surface sediment layer. The highest chemical noted was 4-methylphenol, where a single analysis in the PC exceeded the ML (117 percent) and approached it in another sample (92 percent) from the south end of the turning basin (this area subsequently ranked "high" for FC); but, subsequent analyses of project sediments during FC failed to document a problem with this chemical in uncomposited samples. The differences noted in analyses conducted during PC and FC from the south end of the turning basin surface sediment layer **suggest caution in reranking at this time.**" (Emphasis added in bold and underline)

recognizing that there has been no dioxin testing performed during the 1988 and 1999 sediment testing events conducted by the Port of Olympia, the DMMP decided that dioxin testing was a data gap for the proposed project.

5. **Background/Summary: Data Gaps and Proposed Sampling/Testing Strategy.** This section reviews the adequacy of past sampling and analyses efforts for the Olympia Harbor Project and Port of Olympia berthing area, as well as the conceptual design for additional testing for dioxins and PAHs within the project area to address data gaps for the DMMP. Re-evaluating the data collected in 1988 and 1999 for the Olympia Harbor Project, generally indicate that the outer harbor and main channel and most of the Turning Basin (except the Turning Basin Widening area) did support a low rank for testing, given that all chemicals tested were detected/undetected below the SL. The Turning Basin widening section (DMMU TBW1) and the Port of Olympia's berthing area (B1) exhibited generally similar chemistry to the rest of the characterized area except a TBT exceedance within the surface DMMU's at both these locations (these areas were subsequently found suitable for unconfined-open-water disposal after conducting 45-day bioaccumulation testing) and these two areas would generally fit within the general ranking guidelines for a low-moderate rank (i.e., one or more chemicals of concern > SL but less than (SL + ML)/2; EPTA, 1988, pages II-64). The data in hand for the Inner Harbor and Port berthing area for the 1999 characterization did not show any significant sediment quality problems, and all material was found suitable for unconfined-open water disposal. Admittedly, these areas of the project should have been ranked higher for the 1999 FC testing. Given the biological response during the 1988 FC, the inner harbor area should have been ranked either moderate or high for testing purposes. Similarly, the berthing area (because of the lack of previous testing) should have been ranked either moderate or high for FC.

6. Concerns over the lack of dioxin/furan testing at the Port of Olympia and in the navigation channel were raised during the January 5, 2006 DMMP monthly meeting. The DMMP agencies have since reviewed the available dioxin data for the Budd Inlet area (**Attachment 3**) contained within the report entitled: Post-Remedial Dioxin Testing and Fish Tissue Monitoring, Cascade Pole Sediment Remediation Site, Olympia, Washington (report date, January 2003, prepared by Landau Associates for the Port of Olympia). These data showed elevated sediment dioxin levels in the Olympia Harbor and Budd Inlet area, indicating that dioxin is a chemical that must be evaluated before the DMMP agencies can finalize their suitability determination for this project. Also, data from a 1991/1992 Cascade Pole Remedial Investigation (Remedial Investigation Report, Sediments Operable Unit, Cascade Pole Site, Port of Olympia, Washington Volume 1, Feb 28, 1992. Prepared by Landau Associates, Inc. for the Port of Olympia) showed a background station adjacent to the Turning Basin, across from the Port of Olympia berthing area with a TEQ (Toxicity Equivalent Quotient) of 22 pptr Dioxins/Furans. This same station was reoccupied during the 2003 monitoring effort and found to have dropped to 3.99 pptr TEQ (e.g., Station CP-27-S' see **Figure 3** of **Attachment 3**). The apparent drop in dioxin/furan concentrations may be due to burial through sedimentation after source control measures were implemented.

7. The DMMP agencies have determined that dioxin/furans[4] must be analyzed within each of the federal Navigation Channel/Turning Basin and Port of Olympia berthing area DMMUs to evaluate the dioxin/furan concentrations relative to human health and ecological health concern levels. **Figures 7 and 8** show the proposed core sampling locations that will be occupied for dioxin/furan testing, based on potential dredging depth depicted in **Table 6,** and **Table 7** summarizes the sampling, analysis, and archival requirements to accomplish the analyses. The DMMP agencies have determined that a more intensive sampling/analysis effort at the Port of Olympia's berthing area will be required to address dioxin/furans to provide the requisite data based on a moderate-high rank, rather than the low rank

[4]Definitive analysis for dioxin/furans, should use EPA Method 1613 rather than 8290. The main difference between the two methods is that EPA Method 1613 has additional labeled internal standards so that each 2,3,7,8-substituted PCDD/PCDF isomer can be related to an internal standard for identification and quantification purposes.

assigned during the 1999 characterization. The DMMP agencies also required PAH analyses at three core locations to further assess PAH concerns[5].

8. **Postscript** (7/11/2006): The sampling and analysis strategy initially involved a tiered Phase I testing strategy that focused on the analysis of surface (0-4 ft) samples. The results of Phase I testing led to a Phase II second tier of analyses to analyze individual uncomposited samples (archived) comprising composited Phase I analyses from the Federal Project Turning Basin, analyses of subset of selected subsurface archived samples, and analyses of archived Z-samples underlying contaminated sediments for dioxins/furans and PAHs (see Table 7). After all the testing and data quality control/assurances have been completed, the DMMP agencies will prepare a supplemental suitability determination. The supplemental suitability determination will document the DMMP determination on the testing outcome, and conclude whether or not the material is suitable for unconfined open-water disposal and/or beneficial use.

9. The proposed sampling and testing strategy was fully coordinated with DMMP agency staff, and all concurred with these recommendations to complete the required sampling/testing for this project.

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office

Copies Furnished:
Port of Olympia
Hiram Arden, Corps Navigation Project Manager
George Hart, Corps
Erika Hoffman, EPA
Jonathan Freedman, EPA
Ted Benson, Ecology
Loree Randall, Ecology
Russ McMillan, Ecology
Peter Leon, DNR
DMMO File

[5] Lower Budd Inlet, and especially the industrial peninsula, has been the site of past industrial activity that is known to have caused contaminant releases to the inlet. The industrial activities include a wood treating operation and bulk petroleum storage and transfer area. The general effects of these potential sources on the sediments proposed for dredging appear to be below existing DMMP standards based on 1988 and 1999 testing. However, to ensure appropriate protection of Budd Inlet and the Anderson/Ketron disposal site, additional sampling will be performed to further target PAHs and dioxin/furans within selected portions of the dredging prism in closest proximity to these potential source areas.

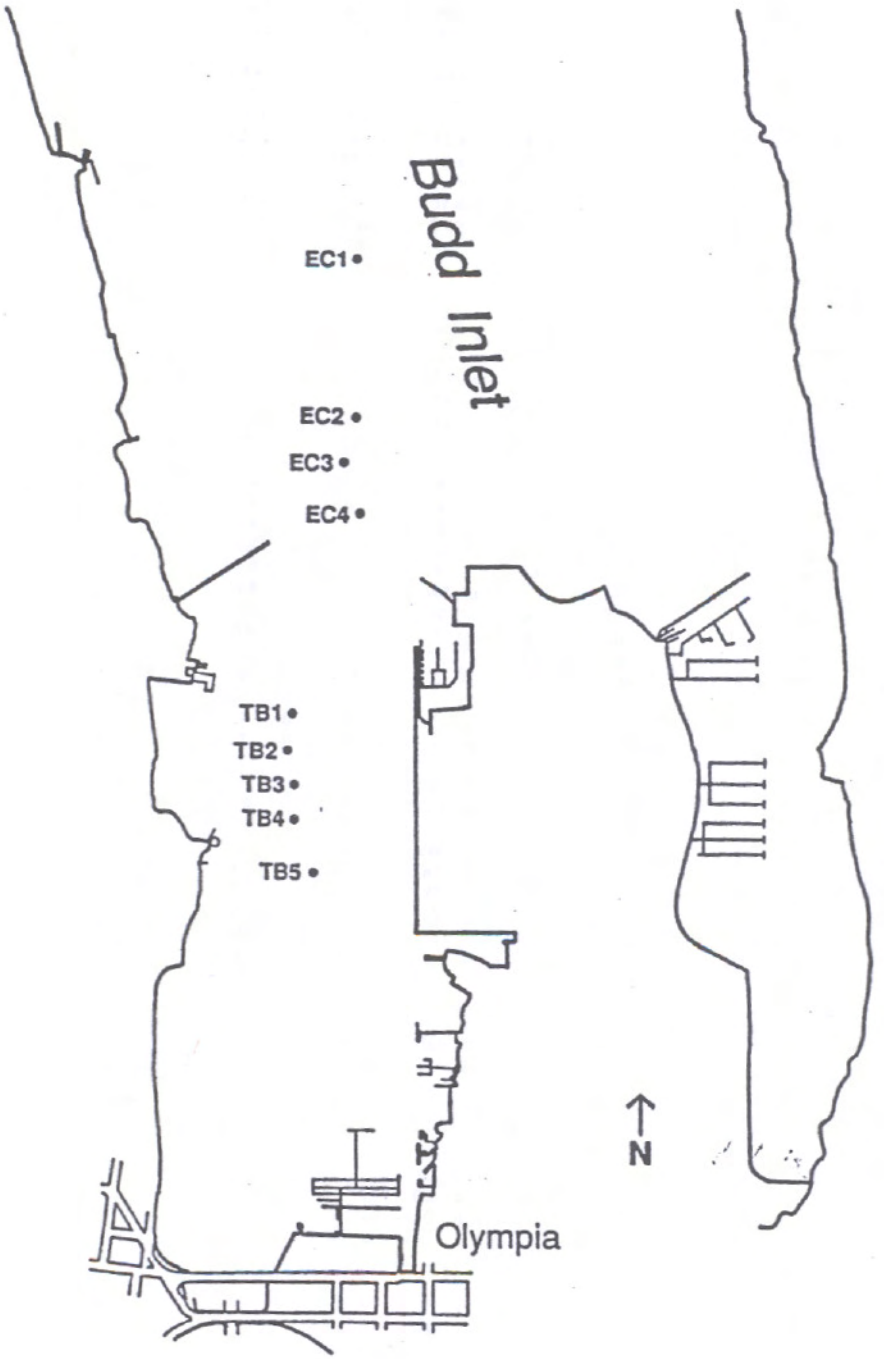


Figure 1. Sampling stations for the Partial Characterization of Olympia Harbor Navigation Improvement Project, August, 1988

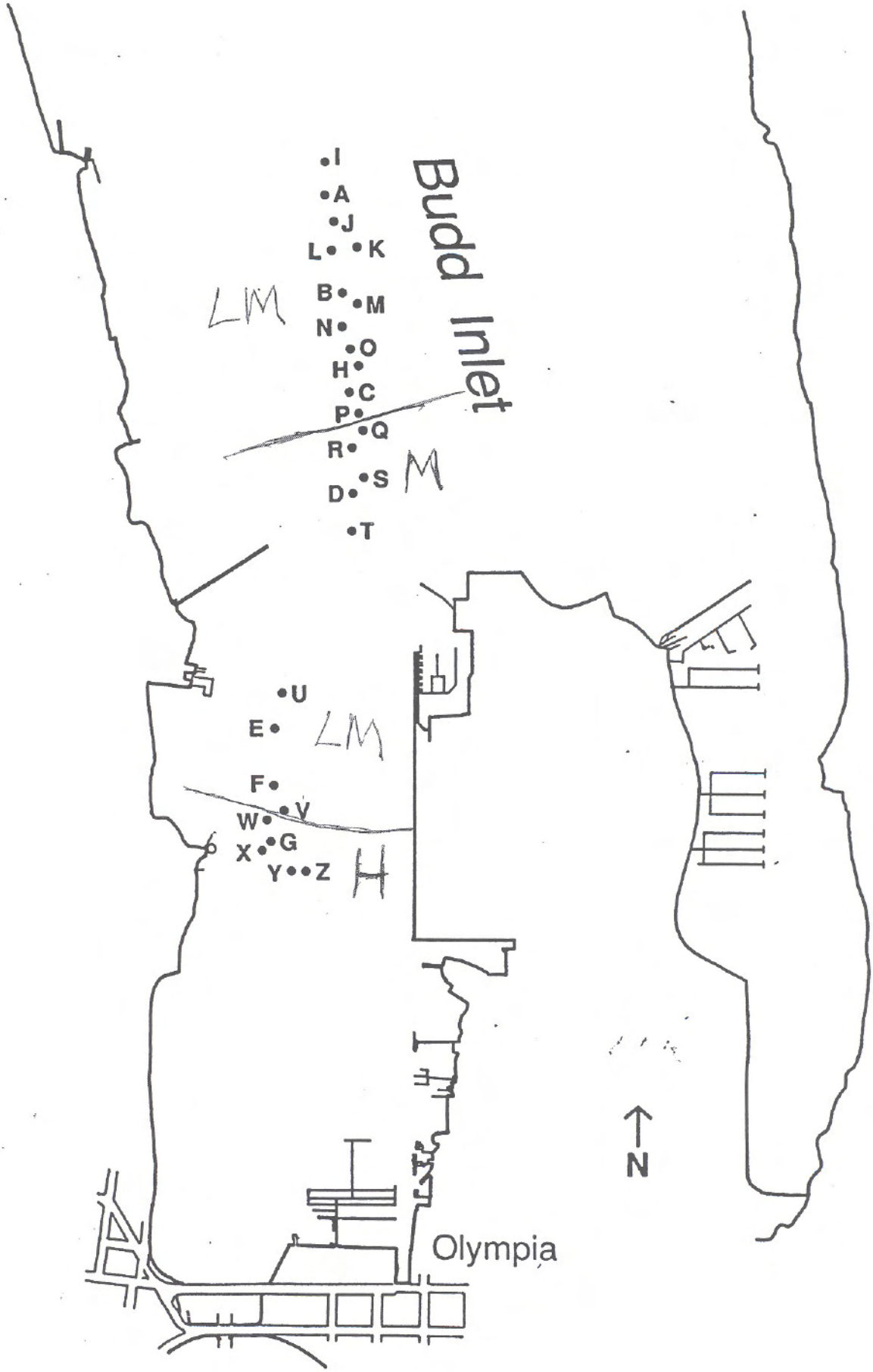


FIGURE 2

Sampling stations for the Olympia Harbor Navigation Improvement Project, November 1988.

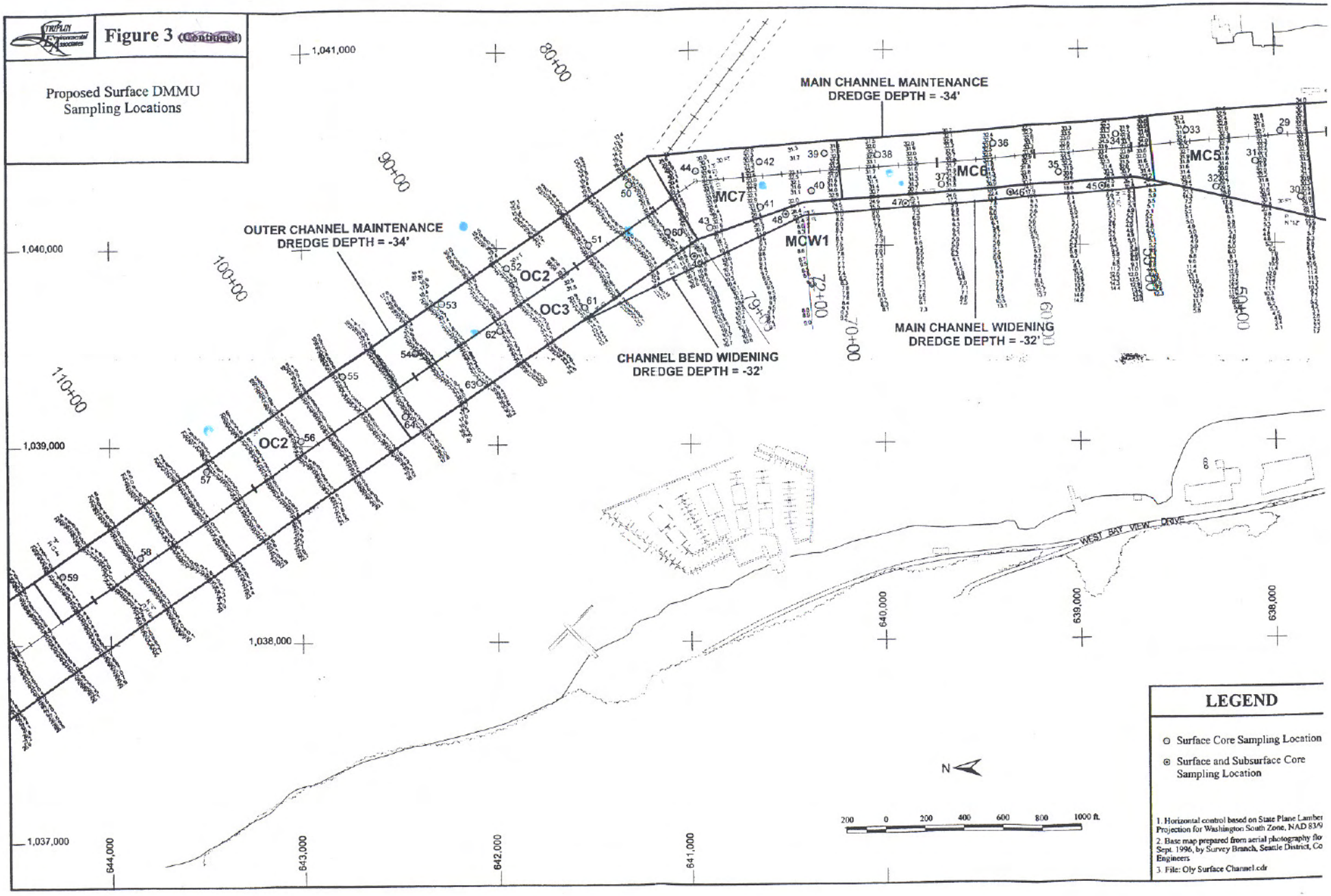


Figure 3 (Continued)
Proposed Surface DMMU Sampling Locations
MAIN CHANNEL MAINTENANCE DREDGE DEPTH = -34'
OUTER CHANNEL MAINTENANCE DREDGE DEPTH = -34'
CHANNEL BEND WIDENING DREDGE DEPTH = -32'
MAIN CHANNEL WIDENING DREDGE DEPTH = -32'
MC5
MC6
MC7
MCW1
OC2
OC3
80+00
90+00
100+00
110+00
70+00
60+00
1,041,000
1,040,000
1,039,000
1,038,000
1,037,000
644,000
643,000
642,000
641,000
640,000
639,000
638,000
WEST BAY VIEW DRIVE
N
200 0 200 400 600 800 1000 ft.
LEGEND
Surface Core Sampling Location
Surface and Subsurface Core Sampling Location
1. Horizontal control based on State Plane Lamber Projection for Washington South Zone, NAD 83/9
2. Base map prepared from aerial photography flo Sept. 1996, by Survey Branch, Seattle District, Co Engineers
3. File: Oly Surface Channel.cdr

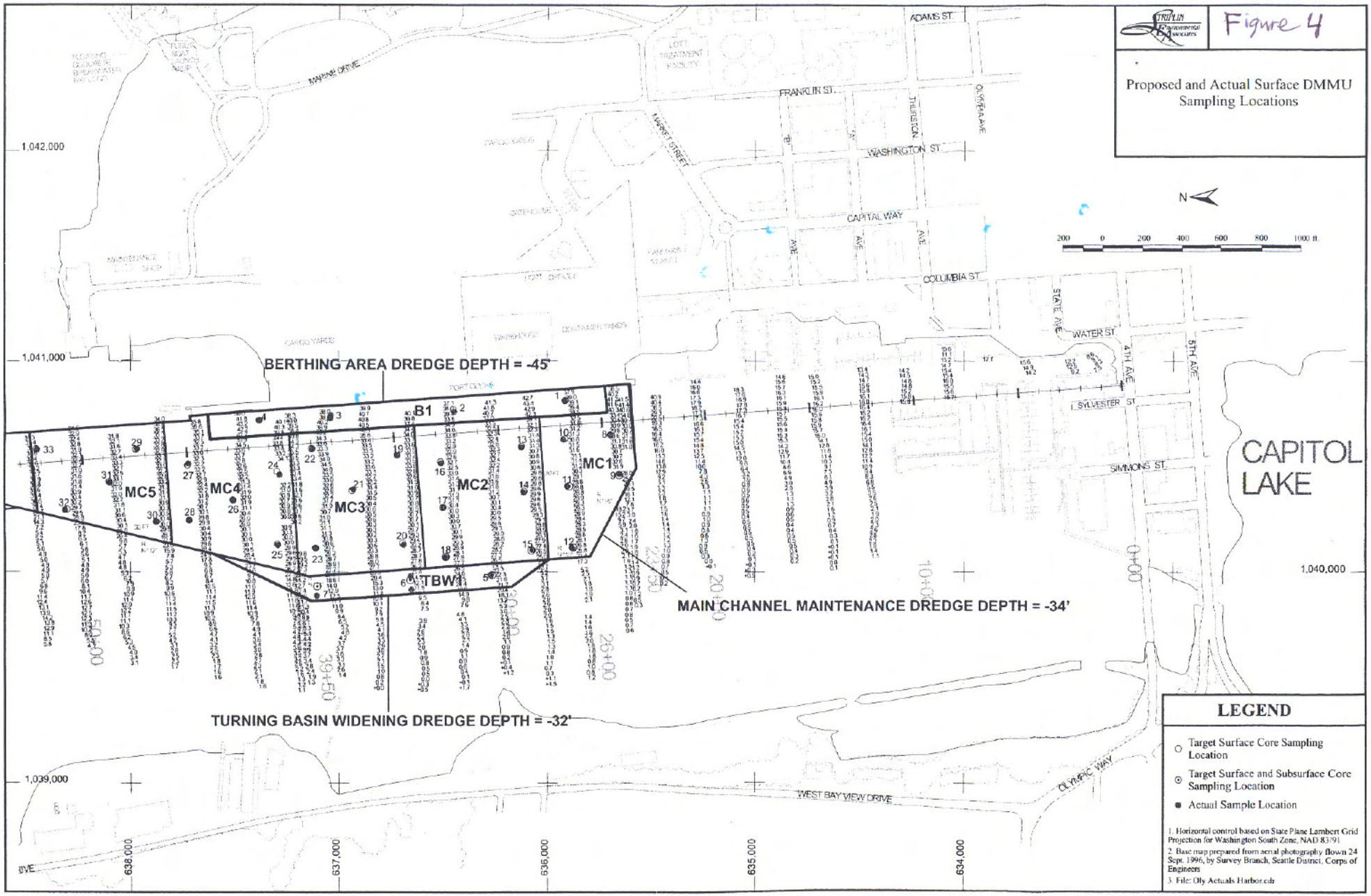


Figure 4
Proposed and Actual Surface DMMU Sampling Locations
BERTHING AREA DREDGE DEPTH = -45'
MAIN CHANNEL MAINTENANCE DREDGE DEPTH = -34'
TURNING BASIN WIDENING DREDGE DEPTH = -32'
B1
MC1
MC2
MC3
MC4
MC5
TBW1
CAPITOL LAKE
ADAMS ST.
FRANKLIN ST.
WASHINGTON ST.
CAPITAL WAY
COLUMBIA ST.
WATER ST.
SYLVESTER ST.
SIMMONS ST.
MARINE DRIVE
WEST BAY VIEW DRIVE
OLYMPIC WAY
1,042,000
1,041,000
1,040,000
1,039,000
638,000
637,000
636,000
635,000
634,000
N
200 0 200 400 600 800 1000 ft.
LEGEND
Target Surface Core Sampling Location
Target Surface and Subsurface Core Sampling Location
Actual Sample Location
1. Horizontal control based on State Plane Lambert Grid Projection for Washington South Zone, NAD 83/91
2. Base map prepared from aerial photography flown 24 Sept. 1996, by Survey Branch, Seattle District, Corps of Engineers
3. File: Oly Actuals Harbor.cdr

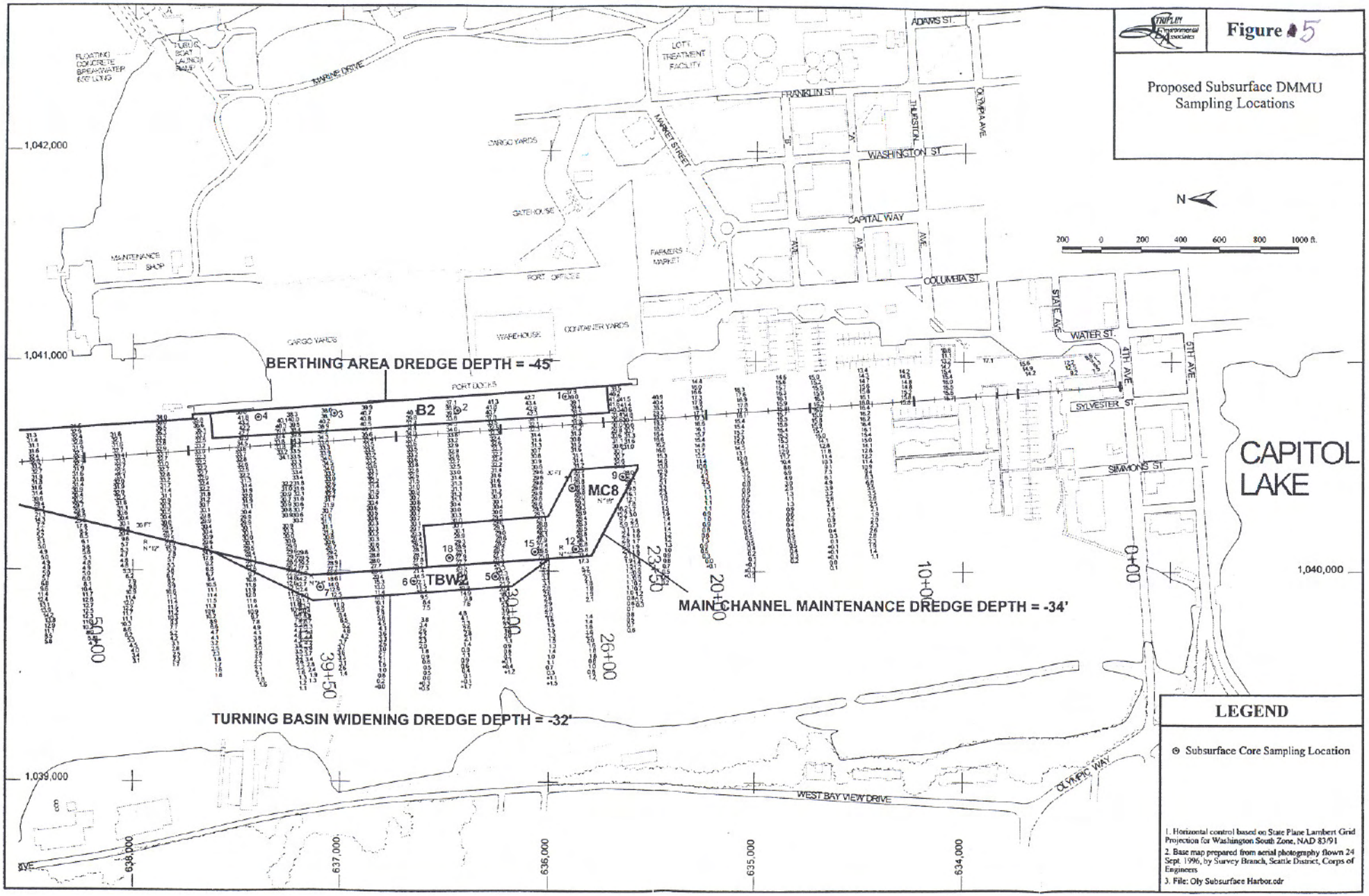
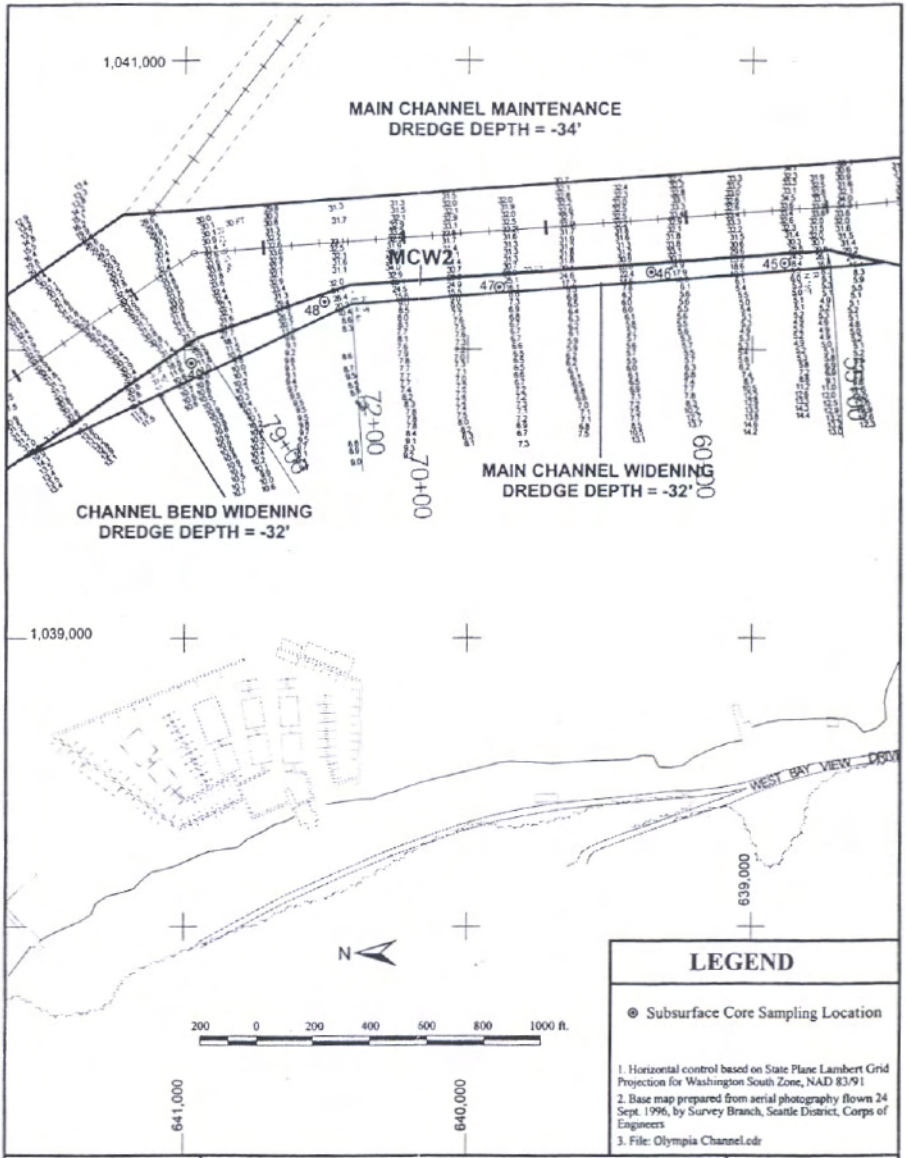


Figure 5
Proposed Subsurface DMMU Sampling Locations
N
200 0 200 400 600 800 1000 ft.
BERTHING AREA DREDGE DEPTH = -45'
MAIN CHANNEL MAINTENANCE DREDGE DEPTH = -34'
TURNING BASIN WIDENING DREDGE DEPTH = -32'
B2
MC8
TBW2
CAPITOL LAKE
1,042,000
1,041,000
1,040,000
1,039,000
638,000
637,000
636,000
635,000
634,000
50+00
39+50
30+00
26+00
23+50
20+00
10+00
0+00
MARINE DRIVE
FLOATING CONCRETE BREAKWATER
PUBLIC BOAT LAUNCH RAMP
LOTT TREATMENT FACILITY
ADAMS ST.
FRANKLIN ST.
THURSTON
OLYMPIA AVE
WASHINGTON ST.
CAPITAL WAY
COLUMBIA ST.
MARKET STREET
CARGO YARDS
GATEHOUSE
MAINTENANCE SHOP
PORT OFFICE
FARMERS MARKET
WAREHOUSE
CONTAINER YARDS
PORT DOCKS
STATE AVE
WATER ST.
4TH AVE
5TH AVE
SYLVESTER ST.
SIMMONS ST.
WEST BAY VIEW DRIVE
OLYMPIC WAY
LEGEND
Subsurface Core Sampling Location
1. Horizontal control based on State Plane Lambert Grid Projection for Washington South Zone, NAD 83/91
2. Base map prepared from aerial photography flown 24 Sept. 1996, by Survey Branch, Seattle District, Corps of Engineers
3. File: Oly Subsurface Harbor.cdr



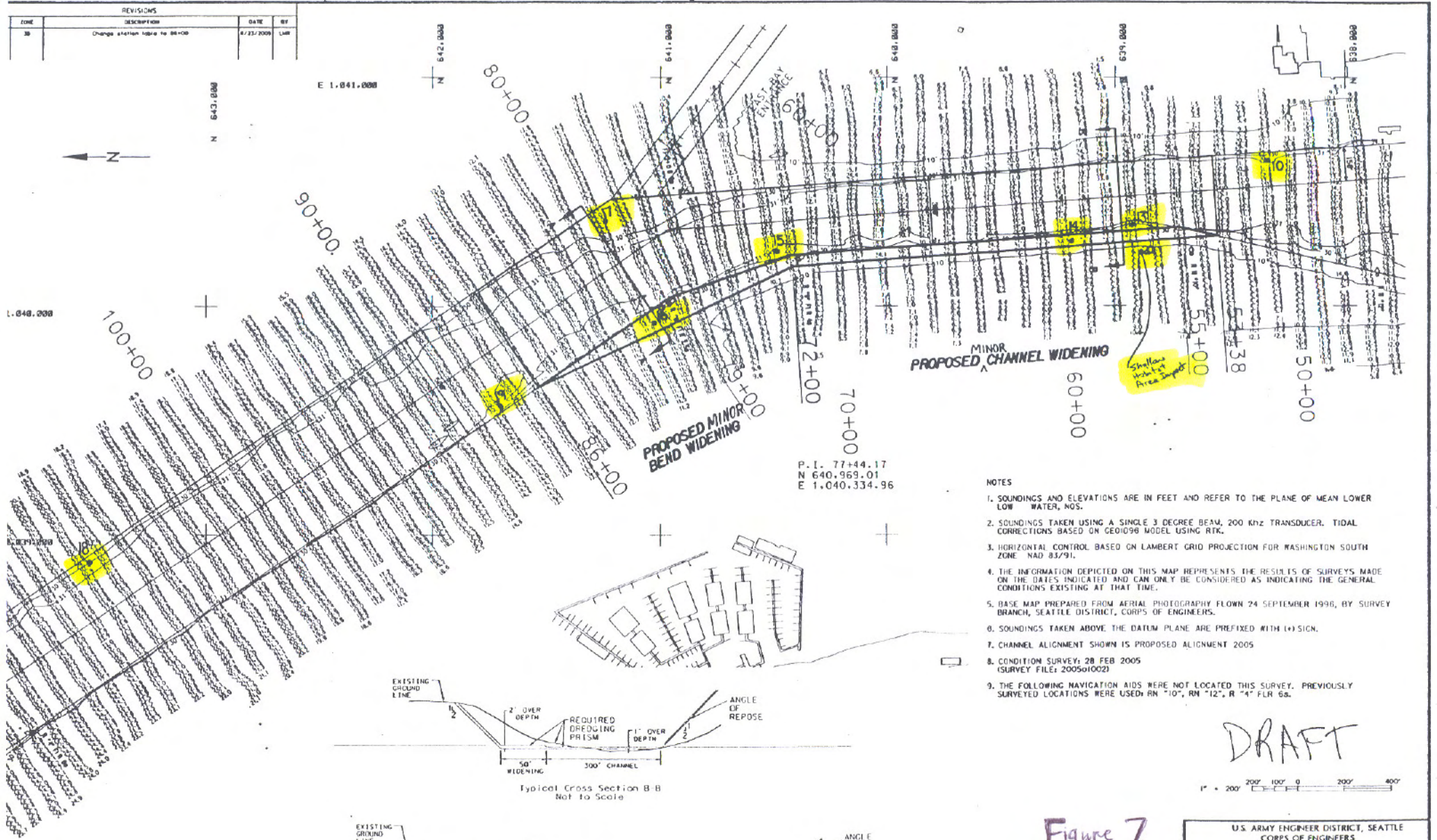
TRIPLIN Environmental Associates

Figure 6 (Continued)

Proposed Subsurface DMMU Sampling Locations

Olympia Harbor
3/23/99
Oly Subsurface Channel.cdr

REVISIONS			
ZONE	DESCRIPTION	DATE	BY
38	Change station table to 86+00	8/23/2005	LMR



Typical Cross Section B-B
Not to Scale

Typical Cross Section A-A
Not to Scale

NOTES

1. SOUNDINGS AND ELEVATIONS ARE IN FEET AND REFER TO THE PLANE OF MEAN LOWER LOW WATER, NOS.
2. SOUNDINGS TAKEN USING A SINGLE 3 DEGREE BEAM, 200 Khz TRANSDUCER. TIDAL CORRECTIONS BASED ON GEO1096 MODEL USING RTK.
3. HORIZONTAL CONTROL BASED ON LAMBERT GRID PROJECTION FOR WASHINGTON SOUTH ZONE NAD 83/91.
4. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.
5. BASE MAP PREPARED FROM AERIAL PHOTOGRAPHY FLOWN 24 SEPTEMBER 1996, BY SURVEY BRANCH, SEATTLE DISTRICT, CORPS OF ENGINEERS.
6. SOUNDINGS TAKEN ABOVE THE DATUM PLANE ARE PREFIXED WITH (+) SIGN.
7. CHANNEL ALIGNMENT SHOWN IS PROPOSED ALIGNMENT 2005
8. CONDITION SURVEY: 28 FEB 2005 (SURVEY FILE: 2005o1002)
9. THE FOLLOWING NAVIGATION AIDS WERE NOT LOCATED THIS SURVEY. PREVIOUSLY SURVEYED LOCATIONS WERE USED: RN "10", RN "12", R "4" FLR 6s.

DRAFT

1" = 200' 200' 100' 0 200' 400'

Figure 7.

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

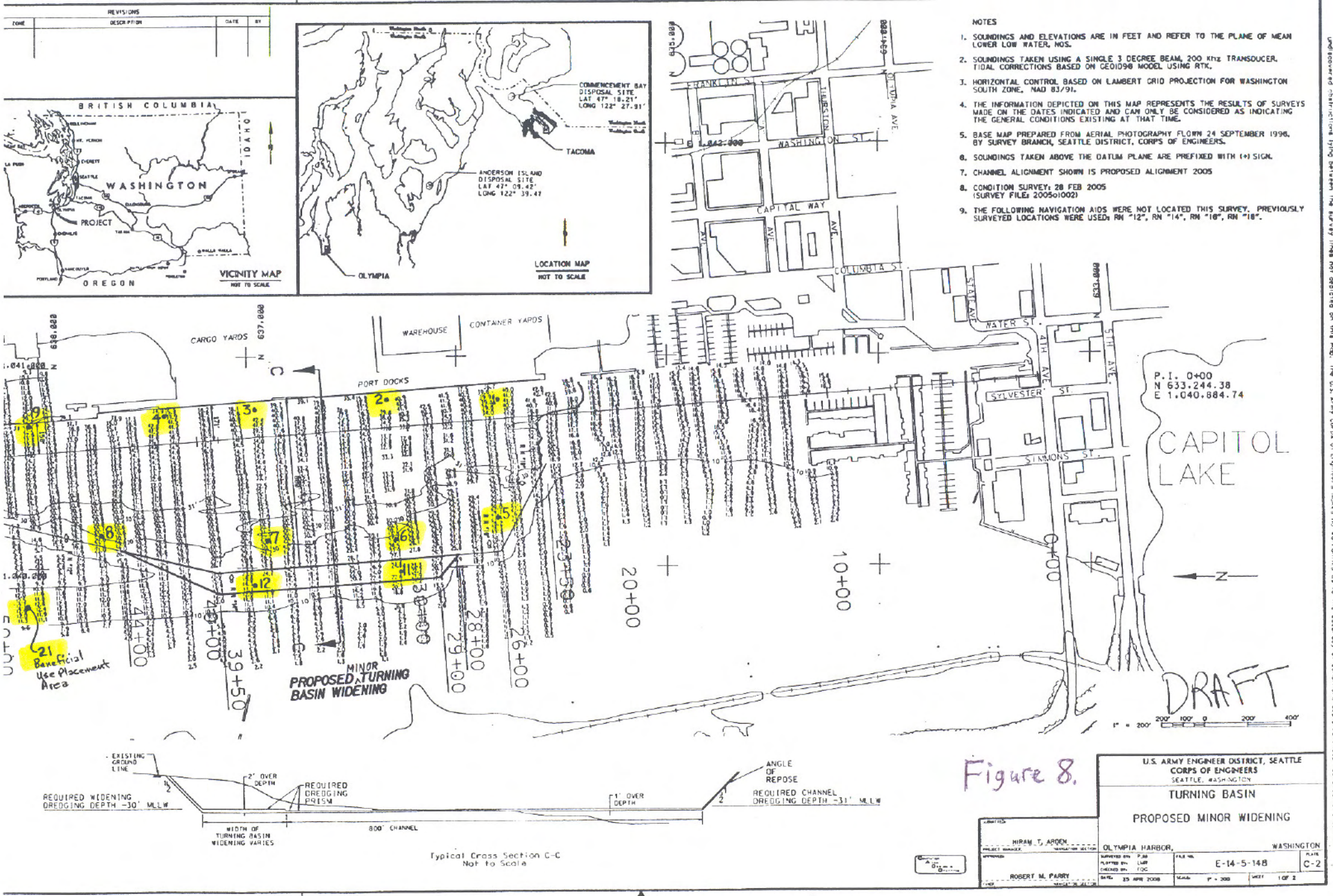
OUTER/ENTRANCE CHANNEL

PROPOSED MINOR WIDENING

OLYMPIA HARBOR, WASHINGTON

HIRAM T. ARDEN
ROBERT M. PARRY

SURVEYED BY: PJM
PLOTTED BY: LMR
CHECKED BY: FOG
DATE: 25 APR 2005
FILE NO. E-14-5-148
SCALE: 1" = 200'
SHEET 2 OF 2
PLATE C-4



NOTES

1. SOUNDINGS AND ELEVATIONS ARE IN FEET AND REFER TO THE PLANE OF MEAN LOWER LOW WATER, NOS.
2. SOUNDINGS TAKEN USING A SINGLE 3 DEGREE BEAM, 200 Khz TRANSDUCER. TIDAL CORRECTIONS BASED ON GEOID96 MODEL USING RTK.
3. HORIZONTAL CONTROL BASED ON LAMBERT GRID PROJECTION FOR WASHINGTON SOUTH ZONE, NAD 83/91.
4. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.
5. BASE MAP PREPARED FROM AERIAL PHOTOGRAPHY FLOWN 24 SEPTEMBER 1996, BY SURVEY BRANCH, SEATTLE DISTRICT, CORPS OF ENGINEERS.
6. SOUNDINGS TAKEN ABOVE THE DATUM PLANE ARE PREFIXED WITH (+) SIGN.
7. CHANNEL ALIGNMENT SHOWN IS PROPOSED ALIGNMENT 2005
8. CONDITION SURVEY: 28 FEB 2005 (SURVEY FILE: 2005o1002)
9. THE FOLLOWING NAVIGATION AIDS WERE NOT LOCATED THIS SURVEY. PREVIOUSLY SURVEYED LOCATIONS WERE USED: RN "12", RN "14", RN "16", RN "18".

Figure 8.

DAIS Value Table - Dry Weight Basis

Table 1. Olympia Harbor 1988 PC Characterization

	EC1 S1	EC2 S2	EC3 S3	EC4 S4	TB1 S5	TB2 S6	TB3 S7	TB4 S8	TB5 S9
SEDIMENT CONVENTIONALS									
Total Solids	61.1	55.5	54.1	68.9	42.9	21.6	41.6	39.8	39.9
Total Volatile Solids	2.22	2.92	2.89	2.82	2.95	2.89	2.76	2.81	2.93
Total Organic Carbon	2.19	4.74	3.86	2.07	3.8	3.83	3.78	4.03	4
Ammonia	28.8	40.2	39.5	15.7	73.9	112	53.8	47.7	35.6
Total Sulfides	130	170	150	96	410	560	360	430	570
METALS									
Antimony	0.45	0.49	0.45	0.32	0.56	0.59	0.54	0.55	0.55
Arsenic	11	14	12	10	11	11	11	11	11
Cadmium (1)	1.1	1.7	2.1	1.2	2.3	2.2	2.3	2.3	2.1
Copper (1)	25.3	39.1	42.9	42.6	13.9	68.8	86.4	91.7	98.3
Lead (1)	10.9	15.5	18.8	12.9	22.1	23.9	20.5	19.6	20.1
Mercury	0.03	0.1	0.11	0.07	0.11	0.11	0.21	0.21	0.23
Nickel	27.8	33.3	37.4	34.1	34.6	36.7	36.3	38.9	38.2
Silver	0.18	0.37	0.42	0.23	0.82	0.82	0.94	0.81	0.86
Zinc (1)	57	78	82	60	124	121	124	128	130
LPAH									
2-Methylnaphthalene (1)	0.7 u	0.6 u	1	2	16	7	14	0.6 u	17
Acenaphthene (1)	0.7 u	0.6 u	2	0.6	8	2	17	0.7 u	10
Acenaphthylene (1)	0.4 u	2	0.3 u	1	9	2	11	0.5 u	11
Anthracene (1)	0.3 u	0.5 u	1	3	22	8	29	5	35
Fluorene (1)	0.5 u	0.5 u	0.4 u	0.7	11	0.9 u	20	1 u	16
Naphthalene (1)	3	17	19	18	67	44	76	11	69
Phenanthrene (1)	3	24	12	16	110	37	120	31	93
Total LPAH (1)	6	43	35	41.3	243	100	287	47	251
HPAH									
Benzo(a)anthracene (1)	0.4 u	9	4	10	61	38	62	54	93
Benzo(a)pyrene	0.4 u	6	4	9	58	39	61	37	86
Benzo(g,h,i)perylene (1)	0.6 u	5	2	7	55	29	58	13	64
Benzofluoranthenes (1)	0.6 u	16	10	26	160	100	160	88	230
Chrysene (1)	0.9 u	22	9	13	82	56	85	56	150
Dibenzo(a,h)anthracene (1)	0.6 u	0.5 u	0.3 u	0.3 u	6	0.6 u	4	0.5 u	6
Fluoranthene	1 u	59	20	28	210	86	140	100	260
Indeno(1,2,3-c,d)pyrene (1)	0.6 u	3	1	5	46	26	43	16	64
Pyrene (1)	3	57	22	41	250	110	220	97	310
Total HPAH (1)	3	177	72	139	928	484	833	461	1263
CHLORINATED HYDROCARBONS									
1,2,4-Trichlorobenzene (1)	1 u	1 u	1 u	1 u	1 u	2 u	1 u	1 u	1 u
1,2-Dichlorobenzene	2 u	2 u	2 u	2 u	3 u	3 u	2 u	3 u	3 u
1,3-Dichlorobenzene (2)	2 u	2 u	2 u	2 u	3 u	3 u	2 u	3 u	3 u
1,4-Dichlorobenzene	2 u	2 u	2 u	2 u	3 u	3 u	2 u	3 u	3 u
Hexachlorobenzene	0.9 u	0.1 u	0.1 u	0.4	2	0.2 u	1	0.8	1
PHTHALATES									
Bis(2-ethylhexyl)phthalate (2)	170	180	280	180	660	770	820	840	1100
Butyl benzyl phthalate (3)	47	84	87	68	130	190	220	180	320
Di-n-butyl phthalate (2)	37	21	27	32	74	85	69	90	110
Di-n-octyl phthalate (3)	20	4	12	9	59	60	94	86	37
Diethyl phthalate (3)	46	4	13	31	34	55	27	45	36
Dimethyl phthalate (2)	2 u	2 u	2 u	2	3 u	5 u	4 u	12	3 u
PHENOLS									
2 Methylphenol (1)	1 u	1 u	1 u	1 u	1 u	2 u	3 u	1 u	1 u
2,4-Dimethylphenol (1)	2 u	3	1 u	4 u	1 u	2 u	2 u	5 u	1 u
4 Methylphenol (1)	390	500	1100	450	340	83	420	760	1400
Pentachlorophenol	1 u	1 u	1 u	1 u	3 u	4 u	2 u	2 u	2 u
Phenol	160	110	230	72	330	71	48	100	75
MISCELLANEOUS EXTRACTABLES									
Benzoic acid (1)	22	32	6	22	70	71	86	70	84
Benzyl alcohol (1)	6	8	6 u	6	16	10	16	27	21
Dibenzofuran (1)	11	27	10	4	15	11	20	24	24
Hexachlorobutadiene	0.3 u	0.2 u	0.2 u	0.2 u	0.4 u	0.6 u	0.4 u	0.3 u	0.3 u
Hexachloroethane	8 u	8 u	10 u	8 u	13 u	15 u	12 u	14 u	14 u
N-Nitrosodiphenylamine	1 u	3 u	1 u	1 u	4 u	9 u	2 u	2 u	4 u
VOLATILE ORGANICS									
Ethylbenzene	2 u	1 u	2 u	1 u	2 u	2 u	2 u	2 u	2 u
Tetrachloroethene	4 u	0.9 u	1 u	0.8 u	1 u	2 u	1 u	1 u	1 u
Total Xylene (1)	3 u	3 u	3 u	3 u	5 u	5 u	4 u	5 u	5 u
Trichloroethene	1 u	1 u	1 u	1 u	2 u	2 u	2 u	2 u	2 u
PESTICIDES AND PCBs									
Aldrin (2)	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u
Chlordane (2)	0.1 u	0.1 u	0.1 u	0.3 u	0.8	0.6	0.9	0.1 u	1
Dieldrin (2)	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u
Heptachlor (2)	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u	0.1 u	0.1 u	0.1 u
Lindane (2)	0.1	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u	0.1 u	0.1 u	0.1 u
Total DDT	0.1 u	0.3	0.1 u	0.7	1.7	1.4	2	0.2 u	2
Total PCBs	4	27	23	30	72	58	130	22	140
ORGANOMETALLICS									
Tributyltin (2)	-	-	-	-	-	-	-	-	-

END OF REPORT

Table-2. Dredged Material Ranking Guidelines.

RANK	GUIDELINES
Low	Few or no sources of chemicals of concern. Data are available to verify low chemical concentrations (below DMMP screening levels) and no significant response in biological tests.
Low-Moderate	Available information indicates a "low" rank, but there are insufficient data to confirm the ranking.
Moderate	Sources exist in the vicinity of the project, or there are present or historical uses of the project site, with the potential for producing chemical concentrations within a range associated historically with some potential for causing adverse biological impacts.
High	Many known chemical sources, high concentrations of chemicals of concern, and/or biological testing failures in one or both of the two most recent cycles of testing.

Table 3. Olympia Harbor 1988 - FC Characterization

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
SEDIMENT CONVENTIONALS															
Total Solids	54.5	63.4	74.5	77.3	58	62.9	62.8	71.6	71.2	72.8	75.5	70.9	60.2	72.8	49
Total Volatile Solids	5.08	3.06	1.72	1.74	4.06	3.83	3.6	2.18	2.64	1.91	1.57	2.59	4.9	2.2	7.09
Total Organic Carbon	1.63	1.53	1.55	0.44	1.21	1.23	1.02	0.63	0.87	0.62	0.34	1.33	1.67	0.51	0.97
Ammonia	168	907	95.2	106	4060	101	1290	95.2	146	140	67.2	118	146	84	263
Total Sulfides	66.9	30.6	5 u	5 u	45.6	23.8	11.9	5 u	5 u	5 u	5 u	11.3	48.3	10.7	81.5
METALS															
Antimony	0.29	0.27	0.01 u	0.01 u	0.23	0.13	0.12	0.14	0.25	0.04	0.01 u	0.16	0.15	0.32	0.01
Arsenic	3.99	3.85	5.95	3.92	6.93	6.01	4.89	1.96	4.02	4.02	3.18	3.37	8.48	4.42	6.91
Cadmium (1)	1.29	1.28	0.71	0.19	1.22	1.31	1.28	0.76	1.08	0.81	0.53	0.82	0.95	0.48	1.75
Copper (1)	33.9	17.5	0.05 u	0.05 u	30.1	17.1	18.6	15.2	2.87	0.05 u	0.05 u	7.05	23.3	12.5	51.6
Lead (1)	6.9	2.9	0.07 u	0.46	6.1	2.3	2.8	5.1	3.1	2.1	0.37	0.07 u	5.7	1.2	18.6
Mercury	0.12	0.1	0.26	0.16	0.02 u	0.02 u	0.02 u	0.05	0.04	0.02	0.05	0.15	0.37	0.19	0.1
Nickel	29	21.9	23.8	26.7	24.5	22.8	23	28.4	23.8	20.8	21.5	24.5	45	25.7	38.9
Silver	0.22	0.12	0.05	0.03	0.17	0.17	0.13	0.03	0.49	0.1	0.1	0.03	0.08	0.07	0.24
Zinc (1)	62	44	39	41	57	50	50	47	41	39	35	35	59	48	85
LPAH															
2-Methylnaphthalene (1)	9	4	2 u	2 u	7	5	2	2 u	2 u	2 u	2 u	2 u	9	2 u	14
Acenaphthene (1)	5	2	2 u	2 u	3	2 u	2 u	2 u	2 u	2 u	2 u	2 u	6	2 u	8
Acenaphthylene (1)	10	5	1 u	1 u	6	8	7	1 u	2 u	1 u	1 u	1 u	24	1 u	26
Anthracene (1)	11	3	0.9 u	0.7 u	6	3	3	0.9 u	1 u	0.7 u	0.9 u	0.8 u	14	0.7 u	24
Fluorene (1)	6	2	2 u	1 u	4	1 u	1 u	2 u	2 u	1 u	2 u	1 u	8	1 u	9
Naphthalene (1)	63	32	2 u	1 u	40	62	18	2	2 u	1 u	2 u	3	120	1 u	180
Phenanthrene (1)	43	17	0.9 u	2	26	21	25	2	2	1	2	3	76	1	120
Total LPAH (1)	147	65	2 u	2	92	99	55	4	2	1	2	6	257	1	381
HPAH															
Benzo(a)anthracene (1)	13	4	0.6 u	0.5 u	8	3	1	0.6 u	0.7 u	0.6 u	0.6 u	0.6 u	18	1	35
Benzo(a)pyrene	15	5	2	0.4 u	10	6	4	1	1	0.4 u	3	0.5 u	20	6	37
Benzo(g,h,i)perylene (1)	26	8	0.8	0.5 u	11	7	2	0.6 u	0.7 u	0.5 u	0.6 u	0.6 u	30	5	43
Benzofluoranthenes (1)	29	15	0.9	0.5 u	22	11	2	0.6 u	0.6 u	0.5 u	2	0.5 u	44	6	96
Chrysene (1)	19	8	0.6	0.5 u	12	5	3	1	0.8	0.5 u	2	0.9	27	4	47
Dibenzo(a,h)anthracene (1)	5	2	0.6 u	0.5 u	0.8 u	0.8 u	0.9 u	0.6 u	0.7 u	0.5 u	0.9	0.6 u	0.8 u	3	1
Fluoranthene	69	27	0.7 u	0.6 u	35	23	16	1	0.9 u	0.6 u	2	0.7 u	110	1	170
Indeno(1,2,3-c,d)pyrene (1)	29	10	0.7	0.5 u	11	5	2 u	0.6 u	0.6 u	0.5 u	0.5 u	0.5 u	13	5	25
Pyrene (1)	87	33	0.7 u	0.6 u	46	31	18	0.9	0.8 u	0.6 u	2	2	130	2	230
Total HPAH (1)	292	112	5	0.6 u	155	91	36	3.9	1.8	0.6 u	12.4	2.9	392	33	684
CHLORINATED HYDROCARBONS															
1,2,4-Trichlorobenzene (1)	1 u	1 u	0.8 u	0.9 u	1 u	1 u	1 u	0.8 u	0.9 u	0.8 u	0.8 u	0.9 u	1 u	0.7 u	1 u
1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene (2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexachlorobenzene	0.2 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u
PHTHALATES															
Bis(2-ethylhexyl)phthalate (2)	120	30	40	34	22	49	13	40	49	35	21	47	76	51	200
Butyl benzyl phthalate (3)	16 u	19	0.5 u	0.4 u	11 u	7 u	9 u	0.3	0.4	20	0.6 u	2	19	0.4 u	40
Di-n-butyl phthalate (2)	4	3	0.4	0.3	3 u	2 u	2 u	0.8	1	0.8	0.2	0.8	3	0.3	9
Di-n-octyl phthalate (3)	12	4 u	0.2 u	0.2 u	5 u	3 u	4 u	0.5	0.2	0.2	0.3 u	0.4	8	0.2 u	85
Diethyl phthalate (3)	4 u	3 u	0.8	0.8	4 u	2 u	3 u	2	1	1	2	1	3	1	3 u
Dimethyl phthalate (2)	5 u	4 u	0.3 u	0.3 u	4 u	3 u	3 u	0.2	0.2 u	0.2 u	0.4 u	0.2 u	0.3 u	0.2 u	4 u
PHENOLS															
2 Methylphenol (1)	34	4 u	5	2	5 u	3 u	3 u	0.6 u	6	3	2	1	7	6 u	4 u
2,4-Dimethylphenol (1)	3 u	2 u	0.5 u	0.5 u	2 u	1 u	2 u	0.4 u	0.5 u	0.4 u	0.5 u	0.5 u	0.7 u	0.4 u	2 u
4 Methylphenol (1)	76	2 u	2	2	14 u	3	3	5	5	3	2	6	63	1	78
Pentachlorophenol	11 u	13 u	0.3 u	0.3 u	13 u	6 u	8 u	0.2 u	0.3 u	0.2 u	0.4 u	0.3 u	0.4 u	0.3 u	10 u
Phenol	2 u	16	42	17	11	15	11	41	20	22	15	32	24	13	20
MISCELLANEOUS EXTRACTABLES															
Benzoic acid (1)	4 u	0.9 u	0.1 u	0.1 u	1 u	2 u	0.8 u	4	4	2	0.1 u	2	0.2 u	2	6
Benzyl alcohol (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran (1)	2 u	3 u	0.1 u	0.1 u	3 u	1 u	2 u	0.1 u	0.09 u	0.08 u	0.1 u	0.09 u	9	0.1 u	12
Hexachlorobutadiene	0.2 u	0.2 u	0.3 u	0.3 u	0.2 u	0.2 u	0.2 u	0.3 u	0.3 u	0.3 u	0.2 u	0.3 u	0.4 u	0.3 u	0.2 u
Hexachloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N-Nitrosodiphenylamine	4 u	5 u	0.2 u	0.1 u	5 u	2 u	3 u	0.1 u	0.1 u	0.1 u	0.2 u	0.1 u	0.2 u	0.1 u	6 u
VOLATILE ORGANICS															
Ethylbenzene	1 u	1 u	1 u	0.9 u	1 u	1 u	1 u	1 u	1 u	1 u	1 u	1 u	1 u	1 u	2 u
Tetrachloroethene	0.9 u	0.6 u	0.5 u	0.6 u	0.7 u	0.8 u	0.8 u	0.6 u	0.6 u	0.7 u	0.7 u	0.7 u	0.7 u	0.5 u	1 u
Total Xylene (1)	3 u	2 u	2 u	2 u	3 u	2 u	3 u	2 u	2 u	2 u	2 u	2 u	3 u	2 u	4 u
Trichloroethene	1 u	0.8 u	0.7 u	0.8 u	0.9 u	0.8 u	0.9 u	0.7 u	0.7 u	0.8 u	0.8 u	1 u	0.8 u	0.7 u	1 u
PESTICIDES AND PCBs															
Aldrin (2)	0.2 u	0.2 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	1 u
Chlordane (2)	0.2 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.5
Dieldrin (2)	0.2 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u
Heptachlor (2)	0.2 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u
Lindane (2)	0.2 u	0.1 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.1 u	0.2 u
Total DDT	0.5 u	0.2 u	0.2 u	0.2 u	0.3 u	0.3 u	0.3 u	0.2 u	0.2 u	0.2 u	0.2 u	0.2 u	0.2 u	0.2 u	1.6
Total PCBs	27	7	2	2	13	13	9	5	3	2	3	3	9	1	36
ORGANOMETALLICS															
Tributyltin (2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table 3. Olympia Harbor 1988 -

	C16	C17	C18	S1	S2	S3	S4	S5
SEDIMENT CONVENTIONALS								
Total Solids	53.6	74.9	77.2	52.5	41.5	57.7	37.4	37.6
Total Volatile Solids	7.01	1.89	1.98	9.42	11.08	4.75	10.95	10.3
Total Organic Carbon	2.34	0.44	0.4	3.18	3.83	3.15	3.8	3.57
Ammonia	1930	78.4	146	347	263	84	218	151
Total Sulfides	56.3	5 u	5 u	77.8	101	45	127	141
METALS								
Antimony	0.15	0.15	0.19	0.15	0.15	0.1	0.29	0.32
Arsenic	5.54	3.31	1.85	5.66	8.65	3.72	8.62	10
Cadmium (1)	1.52	0.42	0.24	1.62	2.19	1.33	2.09	2.58
Copper (1)	40.2	5.95	13.5	28.1	63.9	17.1	83.9	103
Lead (1)	13.2	5.6	5.2	13.7	22.9	5.2	31.5	33.5
Mercury	0.09	0.02 u	0.02 u	0.02 u	0.12	0.02 u	0.32	0.37
Nickel	29.1	29.8	42.6	26.3	33.3	17.5	31.7	39.9
Silver	0.15	0.06	0.05	0.09	0.24	0.08	0.58	0.68
Zinc (1)	67	43	51	60	97	40	109	129
LPAH								
2-Methylnaphthalene (1)	9	2 u	2 u	19	23	2	14	18
Acenaphthene (1)	2	2 u	2 u	6	15	1 u	6	8
Acenaphthylene (1)	13	1 u	1 u	24	32	1 u	4	10
Anthracene (1)	21	0.7 u	0.8 u	19	48	3	28	36
Fluorene (1)	8	1 u	1 u	7	17	1 u	10	6
Naphthalene (1)	130	3	1 u	230	180	32	73	130
Phenanthrene (1)	100	3	0.8 u	110	180	22	110	120
Total LPAH (1)	283	6	2 u	415	495	59	245	328
HPAH								
Benzo(a)anthracene (1)	28	0.5 u	0.6 u	23	130	9	89	70
Benzo(a)pyrene	36	2	0.5 u	24	110	8	84	91
Benzo(g,h,i)perylene (1)	27	1	0.6 u	22	83	2 u	56	66
Benzofluoranthenes (1)	87	1	0.5 u	56	270	16	230	240
Chrysene (1)	36	1	0.6 u	28	140	16	150	94
Dibenzo(a,h)anthracene (1)	1 u	0.5 u	0.6 u	1 u	4	2 u	4 u	1
Fluoranthene	140	2	0.7 u	150	410	33	180	200
Indeno(1,2,3-c,d)pyrene (1)	21	0.5 u	0.5 u	10	55	3 u	64	54
Pyrene (1)	210	2	0.6 u	180	760	38	270	320
Total HPAH (1)	585	9	0.7 u	493	1962	120	1123	1136
CHLORINATED HYDROCARBONS								
1,2,4-Trichlorobenzene (1)	1 u	0.7 u	0.7 u	1 u	2 u	2 u	4 u	0.8 u
1,2-Dichlorobenzene	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene (2)	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-	-	-
Hexachlorobenzene	0.2 u	0.1 u	0.1 u	0.2 u	0.2 u	0.2 u	0.5 u	0.2 u
PHTHALATES								
Bis(2-ethylhexyl)phthalate (2)	190	22	22	180	400	76	26	490
Butyl benzyl phthalate (3)	16	0.4 u	0.4 u	43	200	8 u	10	100
Di-n-butyl phthalate (2)	9	0.9	0.9	7	22	2 u	1	21
Di-n-octyl phthalate (3)	9	0.4 u	0.4 u	16	98	4 u	9	98
Diethyl phthalate (3)	3 u	1	1	3 u	4 u	2	0.2 u	5 u
Dimethyl phthalate (2)	3 u	0.2 u	0.2 u	4 u	5 u	3 u	0.3 u	6 u
PHENOLS								
2 Methylphenol (1)	4 u	2	10	5 u	6 u	3 u	4 u	6 u
2,4-Dimethylphenol (1)	2 u	0.4 u	0.4 u	2 u	3 u	1 u	2 u	3 u
4 Methylphenol (1)	25	2	3	110	71	90	56	46
Pentachlorophenol	7 u	0.2 u	0.3 u	7 u	10 u	5 u	7 u	11 u
Phenol	12	17	18	32	31	28	26	2 u
MISCELLANEOUS EXTRACTABLES								
Benzoic acid (1)	9	0.1 u	2	16	31	0.6 u	3	1 u
Benzyl alcohol (1)	-	-	-	-	-	-	-	-
Dibenzofuran (1)	5 u	0.09 u	0.1 u	14	17	1 u	8	3 u
Hexachlorobutadiene	0.3 u	0.2 u	0.2 u	0.3 u	0.3 u	0.3 u	0.7 u	0.4 u
Hexachloroethane	-	-	-	-	-	-	-	-
N-Nitrosodiphenylamine	4 u	0.1 u	0.1 u	4 u	5 u	2 u	3 u	6 u
VOLATILE ORGANICS								
Ethylbenzene	2 u	0.9 u	0.9 u	1 u	2 u	1 u	2 u	2 u
Tetrachloroethene	0.9 u	0.5 u	0.5 u	1 u	1 u	0.8 u	1 u	1 u
Total Xylene (1)	3 u	2 u	2 u	3 u	4 u	3 u	4 u	4 u
Trichloroethene	1 u	0.7 u	0.7 u	1 u	1 u	1 u	1 u	1 u
PESTICIDES AND PCBs								
Aldrin (2)	2 u	0.1 u	0.1 u	3 u	1 u	0.3 u	0.6 u	2 u
Chlordane (2)	0.5	0.1 u	0.1 u	0.2 u	0.6	0.2 u	0.5 u	0.3 u
Dieldrin (2)	0.2 u	0.1 u	0.1 u	0.2 u	0.2 u	0.3 u	0.5 u	0.2 u
Heptachlor (2)	0.2 u	0.1 u	0.1 u	0.3 u	0.3 u	0.3 u	0.6 u	0.3 u
Lindane (2)	0.2 u	0.1 u	0.1 u	0.2 u	0.2 u	0.3 u	0.5 u	0.2 u
Total DDT	1.6	0.2 u	0.2 u	0.4 u	0.4 u	0.4 u	5	2
Total PCBs	40	3	2	30	38	21	68	75
ORGANOMETALLICS								
Tributyltin (2)	-	-	-	-	-	-	-	-

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Table 4 Olympia Harbor Sediment Characterization Data Summary Compared to PSDDA Guidelines[a].

PARAMETER	PSDDA CHEMICAL GUIDELINES			OLYMPIA HARBOR																
	Screening Level (SL)	Bioaccumulation Level (BT)	Maximum Level (ML)	B1	B2	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8	MCW1	MCW2	OC1	OC2	OC3	TBW1	TBW2
CONVENTIONALS																				
Total Solids (%)	---	---	---	49.9	72.2	40.4	40.8	45.7	42	38.6	38.2	44.1	61.6	57.7	72.0	40.6	39.8	53.3	43	71.7
Total Volatile Solids (mg/kg)	---	---	---	69,000	33,000	87,000	88,000	74,000	84,000	98,000	86,000	69,000	42,000	42,000	23,000	79,000	77,000	49,000	100,000	27,000
N-Ammonia (mg/L)	---	---	---	7.8	58	4.8	4.9	87	9.2	78	68	77	69	43	50	92	56	40	94	50
Sulfides (mg/L)	---	---	---	360	0.62 U	460	90	19	430	900	170	960	48	430	1.3U	950	1100	46	130	26
Total Organic Carbon (%)	---	---	---	2.7	1.6	2.9	2.8	2.3	2.5	2.7	2.7	2.3	1.9	1.4	0.74	2.4	2.3	1.7	3.2	1.0
Grain Size																				
% gravel	---	---	---	22.5	32.7	7.5	0.9	1.4	2.2	0.6	1.5	1.8	14.1	4	6.5	2.9	5	3.8	2.8	4.5
% sand	---	---	---	39	50.3	26.9	25	27.1	20.1	19.2	28.5	30.8	52.8	52.1	65.8	28.5	22.3	49.6	18.3	71.3
% silt	---	---	---	20.6	10.7	36.9	42.1	43.4	45.7	46.4	38.6	38.9	21.6	27.9	18.8	39.7	42.5	28.2	49.8	16.8
% clay	---	---	---	18	6.3	28.6	31.8	28	31.9	33.9	31.5	28.5	11.6	16.1	9	29	29.9	18.4	29.2	7.5
METALS (mg/kg dry weight)																				
Antimony	150	150	200	5 U	3 U	6 U	6 U	6 U	6 U	6 U	7 U	6 U	4 U	8 U	7 U	6 U	6 U	5 U	6 U	3 U
Arsenic	57	507	700	5	6	7	6	9	6	6	7	8	8	9	7 U	8	8	7	9	5
Cadmium	5.1	---	14	1.6	0.7	1.8	1.8	1.7	1.5	2	1.7	1.4	0.7	0.9	0.7	1.8	1.7	1.2	2	0.6
Chromium	---	---	---	34.9	27.3	41.7	43.7	39.6	38.8	42.9	39.6	38.6	27.7	28.9	24.6	42	43.5	31.1	40.9	22.3
Copper	390	---	1,300	55.8	28.4	66.5	66.5	60.4	52.4	64.6	60.6	49.9	29.1	27.6	16.6	63.2	50.7	32.2	63.9	17.3
Lead	450	---	1,200	20	14	21	22	2	2	3	3	2	7	5	3 U	20	3	8	20	3
Mercury	0.41	1.5	2.3	0.16	0.1	0.23	0.22	0.18	0.16	0.18	0.19	0.14	0.09	0.08 U	0.06U	0.24	0.13	0.09	0.21	0.02
Nickel	140	370	370	32	25.8	35	36	34	32	37	33	32	27.2	23	20	35	36	25	34	21.2
Silver	6.1	6.1	8.4	1	0.6	1.3	1.3	1	0.7	1.2	1	0.8	0.5	0.5 U	0.4 U	1.2	0.7	0.4	1.1	0.3
Zinc	410	---	3,800	93.3	59.6	95.9	98.9	87.7	79.4	91.8	91.3	74.9	50.3	45.7	31.6	92	80.1	52.5	92	34.9
ORGANICS (ug/kg dry weight)																				
Naphthalene	2,100	---	2,400	33	51	19 U	20 U	20 U	20 U	20	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	38	19 U
Acenaphthylene	560	---	1,300	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Acenaphthene	500	---	2,000	20	340	19 U	20 U	20 U	20 U	19 U	40	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Fluorene	540	---	3,600	20	290	19 U	20 U	20 U	20 U	19 U	31	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Phenanthrene	1,500	---	21,000	280	880	35	26	23	22	35	380	20	19 U	19 U	20 U	22	35	20 U	49	19 U
Anthracene	960	---	13,000	20	20	19 U	20 U	20 U	20 U	19 U	87	19 U	19 U	19 U	20 U	20 U	20 U	20 U	21	19 U
2-Methylnaphthalene	670	---	1,900	20 U	30	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Total LPAH	5,200	---	29,000	373	1611	35	26	23	22	55	538	20	19 U	19 U	20 U	22	35	20 U	108	19 U
Fluoranthene	1,700	4,600	30,000	620	20	83	67	57	51	76	20	39	31	19 U	20 U	42	35	22	84	22
Pyrene	2,600	---	16,000	630	860	19	20	84	85	19	250	63	42	33	20 U	76	58	35	20	28
Benzo(a)anthracene	1,300	---	5,100	240	270	41	47	24	23	34	36	19 U	19 U	19 U	20 U	20 U	20 U	20 U	33	19 U
Chrysene	1,400	---	21,000	310	300	61	76	38	41	53	57	25	19 U	19 U	20 U	25	20	20 U	49	19 U
Benzofluoranthenes	3,200	---	9,900	20	20	64	70	40	41	67	37	33	19 U	19 U	20 U	44	36	20 U	54	19 U
Benzo(a)pyrene	1,600	3,600	3,600	20	20	46	50	27	33	47	30	23	19 U	19 U	20 U	25	20	20 U	38	19 U
Indeno(1,2,3-cd)pyrene	600	---	4,400	56	44	25	29	20 U	20	27	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	23	19 U
Dibenz(a,h)anthracene	230	---	1,900	21	25	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Benzo(g,h,i)perylene	670	---	3,200	52	44	29	31	20 U	22	31	20 U	22	19 U	19 U	20 U	21	20 U	20 U	29	19 U
Total HPAH	12,000	---	69,000	1,969	1,603	368	390	270	316	354	430	205	73	33	20 U	233	169	57	330	50
1,2-Dichlorobenzene	35	37	110	1.0 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1.0 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2.0 U	1.0 U
1,3-Dichlorobenzene	170	---	---	1.0 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1.0 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2.0 U	1.0 U
1,4-Dichlorobenzene	110	120	120	1.0 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1.0 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2.0 U	1.0 U
1,2,4-Trichlorobenzene	31	---	64	5.1 U	4.2 U	11 U	11 U	6.2 U	6.7 U	11 U	14 U	14 U	5.0 U	8.7 U	4.5 U	11 U	12 U	7.3 U	9.8 U	4.8 U
Hexachlorobenzene	22	168	230	1.0 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1.0 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2.0 U	1.0 U
Dimethylphthalate	1,400	1,400	---	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Diethylphthalate	1,200	---	---	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U

Table 4 Olympia Harbor Sediment Characterization Data Summary Compared to PSDDA Guidelines[a].

PARAMETER	PSDDA CHEMICAL GUIDELINES			OLYMPIA HARBOR																
	Screening Level (SL)	Bioaccumulation Level (BT)	Maximum Level (ML)	B1	B2	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8	MCW1	MCW2	OC1	OC2	OC3	TBW1	TBW2
Di-n-butylphthalate	5,100	10,220	---	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Butylbenzylphthalate	970	---	---	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Bis(2-ethylhexyl)phthalate	8,300	13,870	---	76	55	50	34	30	35	64	28	26	19 U	30	20 U	28	29	20 U	38	19 U
Di-n-octyl phthalate	6,200	---	---	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Phenol	420	876	1,200	20 U	20 U	19 U	20 U	20	20 U	19 U	20 U	38	19 U	24	22	20 U	20 U	20 U	20 U	19 U
2-Methylphenol	63	---	77	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
4-Methylphenol	670	---	3,600	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
2,4-Dimethylphenol	29	---	210	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Pentachlorophenol	400	504	690	98 U	98 U	97 U	100 U	98 U	100 U	97 U	98 U	97 U	94 U	95 U	98 U	99 U	99 U	99 U	98 U	96 U
Benzyl Alcohol	57	---	870	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Benzoic Acid	650	---	760	200 U	200 U	190 U	200 U	200 U	200 U	190 U	200 U	220	190 U	190 U	200 U	200 U	200 U	200 U	200 U	190 U
Dibenzofuran	540	---	1,700	27	59	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Hexachloroethane	1,400	10,220	14,000	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Hexachlorobutadiene	540	212	270	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
N-Nitrosodiphenylamine	28	130	130	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Trichloroethene	160	1,168	1,600	1 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2 U	1 U
Tetrachloroethene	57	102	210	1 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2 U	1 U
Ethylbenzene	10	27	50	1 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2 U	1 U
Total Xylene	40	---	160	1 U	0.8 U	2.3 U	2.2 U	1.2 U	1.3 U	2.1 U	2.8 U	2.8 U	1 U	1.7 U	0.9 U	2.2 U	2.5 U	1.5 U	2 U	1 U
Total DDT	6.9	50	69	3.9	1.7	2.6	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.3 U	1.8 U	1.9 U	2.0 U	1.3 U	2 U	1.9 U	1.9 U	2
4,4'-DDE	---	---	---	1.3	1.3 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.3 U	1.8 U	1.9 U	2.0 U	1.3 U	2 U	1.9 U	1.9 U	1.8 U
4,4'-DDD	---	---	---	1.5 UY	1.5 UY	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.3 U	1.8 U	1.9 U	2.0 U	1.3 U	2 U	1.9 U	1.9 U	1.8 U
4,4'-DDT	---	---	---	2.6	1.7	2.6	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.3 U	1.8 U	1.9 U	2.0 U	1.3 U	2 U	1.9 U	1.9 U	2
Aldrin	10	37	---	0.65 U	0.65 U	0.93 U	0.94 U	0.97 U	0.95 U	0.92 U	0.93 U	0.64 U	0.88 U	0.95 U	0.98 U	0.63 U	0.99 U	0.94 U	0.97 U	0.92 U
Chlordane	10	37	---	1.2 UY	1 UY	0.93 U	0.94 U	0.97 U	0.95 U	0.92 U	0.93 U	0.73 UY	0.88 U	0.95 U	0.98 U	0.8 UY	0.99 U	0.94 U	0.97 U	0.92 U
Dieldrin	10	37	---	1.3 U	1.3 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U	1.3 U	1.8 U	0.95 U	0.98 U	1.3 U	2 U	1.9 U	1.9 U	1.8 U
Heptachlor	10	37	---	0.65 U	0.65 U	0.93 U	0.94 U	0.97 U	0.95 U	0.92 U	0.93 U	0.64 U	0.88 U	0.95 U	0.98 U	0.63 U	0.99 U	0.94 U	0.97 U	0.92 U
gamma-BHC (Lindane)	10	---	---	0.65 U	0.65 U	0.93 U	0.94 U	0.97 U	0.95 U	0.92 U	0.93 U	0.64 U	0.88 U	0.95 U	0.98 U	0.63 U	0.99 U	0.94 U	0.97 U	0.92 U
Total PCBs	130	38[b]	3,100	35	51	37 U	38 U	39 U	38 U	37 U	27	18	18 J	38 U	39 U	20	20 J	19 J	25	24
Aroclor 1016	---	---	---	13 U	13 U	19 U	19 U	19 U	19 U	18 U	19 U	13 U	18 U	19 U	20 U	13 U	20 U	19 U	19 U	18 U
Aroclor 1242	---	---	---	13 U	13 U	19 U	19 U	19 U	19 U	18 U	19 U	13 U	18 U	19 U	20 U	13 U	20 U	19 U	19 U	18 U
Aroclor 1248	---	---	---	13 U	13 U	19 U	19 U	19 U	19 U	18 U	19 U	13 U	18 U	19 U	20 U	13 U	20 U	19 U	19 U	18 U
Aroclor 1254	---	---	---	35	28	27	28	24	25	18 U	27	18	18 J	19 U	20 U	20	20 J	19 J	25	24
Aroclor 1260	---	---	---	13 U	23	19 U	19 U	19 U	19 U	18 U	19 U	13 U	18 U	19 U	20 U	13 U	20 U	19 U	19 U	18 U
Aroclor 1221	---	---	---	26 U	26 U	37 U	38 U	39 U	38 U	37 U	37 U	26 U	35 U	38 U	39 U	25 U	39 U	37 U	39 U	37 U
Aroclor 1232	---	---	---	13 U	13 U	19 U	19 U	19 U	19 U	18 U	19 U	13 U	18 U	19 U	20 U	13 U	20 U	19 U	19 U	18 U
Tributyl Tin (ug/L porewater)	---	0.15	---	0.28	0.13	0.04	0.02	0.03 M	0.05	0.05 M	0.02 M	0.04	0.05	0.02 U	0.02 U	0.02 J	0.02 U	0.02	0.16	0.02 MJ

[a]All units are dry weight based unless otherwise noted.
[b]Total PCBs BT value in ppm carbon-normalized.
M=Indicates an estimated value of analtye found and confirmed by analyst but with low spectral match.
U=Chemical is undetected and is reported at the detection limit.
Y=Indicates raised reporting limit due to background interference. Compound is still not detected at or above the raised level.
J = Indicates an estimated value.

[ ] = BT Exceedance

Table 5. Olympia Harbor Sediment Characterization Data Summary Compared to Marine Sediment Quality Standards (WAC 173-204).

PARAMETER	SEDIMENT QUALITY CRITERIA			OLYMPIA HARBOR									
	1995 SQS	1995 MCUL	Draft 1998 SQS	B1	B2	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8
CONVENTIONALS													
Total Solids (%)	---	---	---	49.9	72.2	40.4	40.8	45.7	42	38.6	38.2	44.1	61.6
Total Volatile Solids (mg/kg)	---	---	---	69,000	33,000	87,000	88,000	74,000	84,000	98,000	86,000	69,000	42,000
N-Ammonia (mg/L)	---	---	---	7.8	58	4.8	4.9	87	9.2	78	68	77	69
Sulfides (mg/L)	---	---	---	360	0.62 U	460	90	19	430	900	170	960	48
Total Organic Carbon (%)	---	---	---	2.7	1.6	2.9	2.8	2.3	2.5	2.7	2.7	2.3	1.9
Grain Size													
% gravel	---	---	---	22.5	32.7	7.5	0.9	1.4	2.2	0.6	1.5	1.8	14.1
% sand	---	---	---	39	50.3	26.9	25	27.1	20.1	19.2	28.5	30.8	52.8
% silt	---	---	---	20.6	10.7	36.9	42.1	43.4	45.7	46.4	38.6	38.9	21.6
% clay	---	---	---	18	6.3	28.6	31.8	28	31.9	33.9	31.5	28.5	11.6
METALS (mg/kg dry weight)													
Arsenic	57	93	57	5	6	7	6	9	6	6	7	8	8
Cadmium	5.1	6.7	2.7	1.6	0.7	1.8	1.8	1.7	1.5	2	1.7	1.4	0.7
Chromium	260	270	62	34.9	27.3	41.7	43.7	39.6	38.8	42.9	39.6	38.6	27.7
Copper	390	390	270	55.8	28.4	66.5	66.5	60.4	52.4	64.6	60.6	49.9	29.1
Lead	450	530	360	20	14	21	22	2	2	3	3	2	7
Mercury	0.41	0.59	0.41	0.16	0.1	0.23	0.22	0.18	0.16	0.18	0.19	0.14	0.09
Silver	6.1	6.1	3.3	1	0.6	1.3	1.3	1	0.7	1.2	1	0.8	0.5
Zinc	410	960	410	93.3	59.6	95.9	98.9	87.7	79.4	91.8	91.3	74.9	50.3
ORGANICS (mg/kg OC)													
Naphthalene	99	170	39	1.2	3.1	0.7 U	0.7 U	0.8 U	0.8 U	0.8	0.7 U	0.9 U	1.0 U
Acenaphthylene	66	66	5.4	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Acenaphthene	16	57	16	6.7	20	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	1.5	0.9 U	1.0 U
Fluorene	23	79	23	5.0	17	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	1.1	0.9 U	1.0 U
Phenanthrene	100	480	100	10	53	1.2	0.9	1.0	0.9	1.3	14	0.9	1.0 U
Anthracene	220	1,200	93	4.0	10	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	3.2	0.9 U	1.0 U
2-Methylnaphthalene	38	64	13	0.7 U	1.8	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Total LPAH	370	780	22	26.9	104.9	1.2	0.9	1.0	0.9	2.1	19.8	0.9	1.0 U
Fluoranthene	160	1,200	160	23	62	2.8	2.3	2.5	2.0	2.8	7.1	1.7	1.6
Pyrene	1,000	1,400	520	23	52	4.4	3.6	3.6	3.4	5.4	9.3	2.8	2.2
Benzo(a)anthracene	110	270	110	8.8	17	1.4	1.7	1.0	0.9	1.2	1.3	0.9 U	1.0 U
Chrysene	110	460	110	11	18	2.1	2.7	1.6	1.6	2.0	2.1	1.1	1.0 U
Benzofluoranthenes	230	450	230	12.3	18.9	3.8	4.3	3.1	3.1	4.3	2.6	2.7	1.0 U
Benzo(a)pyrene	99	210	99	5.2	7.9	1.6	1.8	1.2	1.3	1.7	1.1	1.0	1.0 U
Indeno(1,2,3-cd)pyrene	34	88	34	2.0	2.7	0.9	1.0	0.8 U	0.8	1.0	0.7 U	0.9 U	1.0 U
Dibenz(a,h)anthracene	12	33	12	0.8	1.5	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Benzo(g,h,i)perylene	31	78	31	1.9	2.7	1.0	1.1	0.8 U	0.9	1.1	0.7 U	1.0	1.0 U
Total HPAH	960	5,300	150	88	182.7	18	18.5	13	14.0	19.5	23.5	10.3	3.8
1,2-Dichlorobenzene	2.3	2.3	0.65	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
1,4-Dichlorobenzene	3.1	9	3.1	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
1,2,4-Trichlorobenzene	0.81	1.8	0.81	0.7 U	**1.2 U**	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	**0.9 U**	**1.0 U**
Hexachlorobenzene	0.38	2.3	0.38	**0.7 U**	**1.2 U**	**0.7 U**	**0.7 U**	**0.8 U**	**0.8 U**	**0.7 U**	**0.7 U**	**0.9 U**	**1.0 U**
Dimethylphthalate	53	53	2.4	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Diethylphthalate	61	110	61	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Di-n-butylphthalate	220	1,700	0.88	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Butylbenzylphthalate	4.9	64.0	4.9	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Bis(2-ethylhexyl)phthalate	47	78	47	2.8	3.3	1.7	1.2	1.3	1.4	2.4	1.0	1.1	1.0 U
Di-n-octyl phthalate	58	4,500	3.1	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Dibenzofuran	15	58	15	1.0	3.6	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Hexachlorobutadiene	3.9	6.2	3.9	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
N-Nitrosodiphenylamine	11	11	11	0.7 U	1.2 U	0.7 U	0.7 U	0.8 U	0.8 U	0.7 U	0.7 U	0.9 U	1.0 U
Total PCBs	12	65	12	1.3	3.1	0.93	1.0	1.0	0.98	1.4 U	1.0	0.78	0.83 J
ORGANICS (ug/kg dry weight)													
Phenol	420	1,200	180	20 U	20 U	19 U	20 U	20	20 U	19 U	20 U	38	19 U
2-Methylphenol	63	63	23	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U
4-Methylphenol	670	670	110	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U
2,4-Dimethylphenol	29	29	18	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U
Pentachlorophenol	360	690	180	98 U	98 U	97 U	100 U	98 U	100 U	97 U	98 U	97 U	94 U
Benzyl Alcohol	57	73	57	20 U	20 U	19 U	20 U	20 U	20 U	19 U	20 U	19 U	19 U
Benzoic Acid	650	650	65	200 U	200 U	190 U	200 U	200 U	200 U	190 U	200 U	220	190 U

U=Chemical is undetected and is reported at the detection limit.
J = Indicates an estimated value.

= Exceeds 1995 SQS
= Exceeds 1995 MCUL.

Table 5. Olympia Harbor Sediment Characterization Data Summary Compared to Marine Sediment Quality Standards (WAC 173-204).

PARAMETER	SEDIMENT QUALITY CRITERIA									
	1995 SQS	1995 MCUL	Draft 1998 SQS	MCW1	MCW2	OC1	OC2	OC3	TBW1	TBW2
CONVENTIONALS										
Total Solids (%)	---	---	---	57.7	72.0	40.6	39.8	53.3	43	71.7
Total Volatile Solids (mg/kg)	---	---	---	42,000	23,000	79,000	77,000	49,000	100,000	27,000
N-Ammonia (mg/L)	---	---	---	43	50	92	56	40	94	50
Sulfides (mg/L)	---	---	---	430	1.3U	950	1100	46	130	26
Total Organic Carbon (%)	---	---	---	1.4	0.74	2.4	2.3	1.7	3.2	1.0
Grain Size										
% gravel	---	---	---	4	6.5	2.9	5	3.8	2.8	4.5
% sand	---	---	---	52.1	65.8	28.5	22.3	49.6	18.3	71.3
% silt	---	---	---	27.9	18.8	39.7	42.5	28.2	49.8	16.8
% clay	---	---	---	16.1	9	29	29.9	18.4	29.2	7.5
METALS (mg/kg dry weight)										
Arsenic	57	93	57	9	7 U	8	8	7	9	5
Cadmium	5.1	6.7	2.7	0.9	0.7	1.8	1.7	1.2	2	0.6
Chromium	260	270	62	28.9	24.6	42	43.5	31.1	40.9	22.3
Copper	390	390	270	27.6	16.6	63.2	50.7	32.2	63.9	17.3
Lead	450	530	360	5	3 U	20	3	8	20	3
Mercury	0.41	0.59	0.41	0.08 U	0.06U	0.24	0.13	0.09	0.21	0.02
Silver	6.1	6.1	3.3	0.5 U	0.4 U	1.2	0.7	0.4	1.1	0.3
Zinc	410	960	410	45.7	31.6	92	80.1	52.5	92	34.9
ORGANICS (mg/kg OC)										
Naphthalene	99	170	39	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	1.2	1.8 U
Acenaphthylene	66	66	5.4	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Acenaphthene	16	57	16	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Fluorene	23	79	23	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Phenanthrene	100	480	100	1.4 U	2.7 U	0.9	1.5	1.2 U	1.5	1.8 U
Anthracene	220	1,200	93	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.7	1.8 U
2-Methylnaphthalene	38	64	13	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Total LPAH	370	780	22	1.4 U	2.7 U	0.9	1.5	1.2 U	3.4	1.8 U
Fluoranthene	160	1,200	160	1.4 U	2.7 U	1.8	1.5	1.3	2.6	2.1
Pyrene	1,000	1,400	520	2.4	2.7 U	3.2	2.5	2.0	4.6	2.7
Benzo(a)anthracene	110	270	110	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	1.0	1.8 U
Chrysene	110	460	110	1.4 U	2.7 U	1.0	0.9	1.2 U	1.5	1.8 U
Benzofluoranthenes	230	450	230	1.4 U	2.7 U	3.0	2.4	1.2 U	2.9	1.8 U
Benzo(a)pyrene	99	210	99	1.4 U	2.7 U	1.0	0.9	1.2 U	1.2	1.8 U
Indeno(1,2,3-cd)pyrene	34	88	34	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.7	1.8 U
Dibenz(a,h)anthracene	12	33	12	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Benzo(g,h,i)perylene	31	78	31	1.4 U	2.7 U	0.9	0.8 U	1.2 U	0.9	1.8 U
Total HPAH	960	5,300	150	2.4	2.7 U	10.9	8.2	3.3	15.4	4.8
1,2-Dichlorobenzene	2.3	2.3	0.65	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
1,4-Dichlorobenzene	3.1	9	3.1	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
1,2,4-Trichlorobenzene	0.81	1.8	0.81	**1.4 U**	2.7 U	0.8 U	0.8 U	**1.2 U**	0.6 U	**1.8 U**
Hexachlorobenzene	0.38	2.3	0.38	**1.4 U**	2.7 U	**0.8 U**	**0.8 U**	**1.2 U**	0.6 U	**1.8 U**
Dimethylphthalate	53	53	2.4	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Diethylphthalate	61	110	61	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Di-n-butylphthalate	220	1,700	0.88	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Butylbenzylphthalate	4.9	64.0	4.9	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Bis(2-ethylhexyl)phthalate	47	78	47	2.2	2.7 U	1.2	1.2	1.2 U	1.2	1.8 U
Di-n-octyl phthalate	58	4,500	3.1	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Dibenzofuran	15	58	15	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Hexachlorobutadiene	3.9	6.2	3.9	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
N-Nitrosodiphenylamine	11	11	11	1.4 U	2.7 U	0.8 U	0.8 U	1.2 U	0.6 U	1.8 U
Total PCBs	12	65	12	2.7 U	5.4 U	0.82	0.77 J	1.0 J	0.76	2.3
ORGANICS (ug/kg dry weight)										
Phenol	420	1,200	180	24	22	20 U	20 U	20 U	20 U	19 U
2-Methylphenol	63	63	23	19 U	20 U	20 U	20 U	20 U	20 U	19 U
4-Methylphenol	670	670	110	19 U	20 U	20 U	20 U	20 U	20 U	19 U
2,4-Dimethylphenol	29	29	18	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Pentachlorophenol	360	690	180	95 U	98 U	99 U	99 U	99 U	98 U	96 U
Benzyl Alcohol	57	73	57	19 U	20 U	20 U	20 U	20 U	20 U	19 U
Benzoic Acid	650	650	65	190 U	200 U	200 U	200 U	200 U	200 U	190 U

U=Chemical is undetected and is reported at the detection limit.
J = Indicates an estimated value.

= Exceeds 1995 SQS
= Exceeds 1995 MCUL

Table 6. Relative Depths (feet) of proposed Dredged Material within Olympia Harbor Project Area

DMMU Subarea	Station ID	Relative Depth of Dredged Material (feet)
Ports Berthing Area	1	**9**
Port's Berthing Area	2	10
Ports Berthing Area	3	10
Ports Berthing Area	4	13
Turning Basin	5	4
Turning Basin	6	3
Turning Basin	7	2
Main Channel	8	2
Turning Basin	9	2
Turning Basin	10	2
Turning Basin Widening	11	8
Turning Basin Widening	12	17
Main Channel	13	4
Main Channel Widening	14	9
Channel Bend	15	3
Channel Bend Widening	16	19
Outer Channel	17	3
Outer Channel	18	3
Outer Channel	19	3
Source area for habitat mitigation	20	2-4
BU Placement Area	21	BU Placement Area

Table 7. DMMP Sampling Strategy for the Olympia Harbor Federal/Port of Olympia Project for Dioxin/Furans and PAHs[1] (Shaded = Analyzed).

DMMU Subarea	Station ID[1]	Depth	Analysis ID	Analytes	Disposition
Port's Berthing Area	1a	0-4 ft	S1 (P1)	Dioxin	Analyze
Port's Berthing Area	1b	4-9 ft	S27 (A)[2]	Dioxin	Archived
Port's Berthing Area	1c	9-10 ft	Z-sample (A)	Dioxin	Archived
Port's Berthing Area	2a	0-4 ft	S2 (P1)	Dioxin	Analyze
Port's Berthing Area	2b	4-10 ft	S26 (P2)	Dioxin	Analyze
Port's Berthing Area	2c	10-11 ft	Z-sample (A)	Dioxin	Archived
Port's Berthing Area	3a	0-4 ft	S3 (P1)	Dioxin	Analyze
Port's Berthing Area	3b	4-10 ft	S25 (P2)	Dioxin	Analyze
Port's Berthing Area	3c	10-11 ft	Z-sample (A)	Dioxin	Archived
Port's Berthing Area	4a	0-4 ft	S4 (P1)	Dioxin, PAHs	Analyze
Port's Berthing Area	4b	4-13 ft	S24 (P2)	Dioxin, PAHs	Analyze
Port's Berthing Area	4c	13-14 ft	Z-sample (A)	Dioxin	Archived
Turning Basin	5a	0-4 ft	C1 (P1) S23 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin	5b	4-5 ft	Z-Sample: SZ5 (P2)	Dioxin	Analyze
Turning Basin	6a	0-4 ft	C1 (P1) S22 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin	6b	4-5 ft	Z-Sample: SZ6 (P2)	Dioxin	Analyze
Turning Basin	7a	0-2 ft	C2 (P1) S21 (P2)	Dioxin	Analyze Analyze
Turning Basin	7b	2-3 ft	Z-Sample: SZ7 (P2)	Dioxin	Analyze
Turning Basin	8a	0-2 ft	C2 (P1) S20 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin	8b	2-3 ft	Z-Sample: SZ8 (P2)	Dioxin	Analyze
Main Channel	9a	0-2 ft	C3 (P1) S19 (P2)	Dioxin, PAHs Dioxin	Analyze Analyze
Main Channel	9b	2-3 ft	Z-Sample: SZ9 (P2)	Dioxin, PAH's	Analyze
Main Channel	10a	0-2 ft	C3 (P1) S18 (P2)	Dioxin, PAHs Dioxin	Analyze Analyze
Main Channel	10b	2-3 ft	Z-Sample: SZ10 (P2)	Dioxin	Analyze
Turning Basin Widening	11a	0-4 ft	C4 (P1) S29 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin Widening	11b	4-8 ft	S16 (P2)	Dioxin	Analyze
Turning Basin Widening	11c	8-9 ft	Z-sample: SZ11 (P2)	Dioxin	Analyze
Turning Basin Widening	12a	0-4 ft	C4 (P1) S28 (P2)	Dioxin Dioxin	Analyze Analyze
Turning Basin Widening	12b	4-17 ft	S17 (P2)	Dioxin	Analyze
Turning Basin Widening	12c	17-18 ft	Z-sample: SZ12 (P2)	Dioxin	Analyze
Main Channel	13a	0-4 ft	S5 (P1)	Dioxin	Analyze
Main Channel	13b	4-5 ft	Z-Sample: SZ13 (P2)	Dioxin	Analyze
Main Channel Widening	14a	0-4 ft	S6 (P1)	Dioxin	Analyze
Main Channel Widening	14b	4-9 ft	S14 (P1)	Dioxin	Analyze
Main Channel Widening	14c	9-10 ft	Z-sample (A)	Dioxin	Archived
Main Channel	15a	0-3 ft	S7 (P1)	Dioxin	Analyze
Main Channel	15b	3-4 ft	Z-sample (A)	Dioxin	Archived
Channel Bend Widening	16a	0-4 ft	S8 (P1)	Dioxin	Analyze
Channel Bend Widening	16b	4-19 ft	S15 (P1)	Dioxin	Analyze
Channel Bend Widening	16c	19-20 ft	Z-sample (A)	Dioxin	Archived
Outer Channel	17a	0-3 ft	S9 (P1)	Dioxin	Analyze
Outer Channel	17b	3-4 ft	Z-sample (A)	Dioxin	Archived
Outer Channel	18a	0-3 ft	S10 (P1)	Dioxin	Analyze
Outer Channel	18b	3-4 ft	Z-Sample: SZ18 (P2)	Dioxin	Analyze
Outer Channel	19	0-4 ft	S11 (P1)	Dioxin	Analyze
Outer Channel	19	4-5 ft	Z-sample (A)	Dioxin	Archived
BU Placement Area.	20	0-10 cm	S12 (P1)	Dioxin	Analyze
BU Placement Area	21	0-10 cm	S13 (P1)	Dioxin	Analyze

Legend: S = uncomposited samples; C = composited for initial analysis during P1 (analyzed as uncomposited samples in P2); P1 = Initial Phase of analyses; P2 = Second Phase of analyses; A = Archived sample

[1] Z-samples were collected and archived at each Core location

[2] The surface sample (S1) overlying S27 met the Tier 1 guideline (see Table 6 of SDM), and the DMMP agencies using BPJ determined that analysis of this sample was not required.

CENWS-OD-TS 17 May 2000
Dredged Material Management Office

MEMORANDUM FOR RECORD

SUBJECT: DETERMINATION OF THE SUITABILITY OF DREDGED MATERIAL TESTED UNDER DMMP EVALUATION PROCEDURES FOR THE OLYMPIA HARBOR NAVIGATION PROJECT FOR DISPOSAL AT THE ANDERSON/KETRON OPEN WATER DISPOSAL SITE.

1. The Corps of Engineers proposes to dredge the navigation channel at Olympia, Washington. In addition, the Port of Olympia proposes to widen the entrance channel and to deepen the port's berthing area. The total proposed dredged volume is approximately 635,000 cubic yards. The following summary reflects the DMMP agencies (Corps of Engineers, Department of Ecology, Department of Natural Resources and the Environmental Protection Agency) consensus decision on the acceptability of the sampling plan and all relevant test data to make a determination of suitability for the disposal of the material at a PSDDA open-water disposal site.

2. The ranking for this area is "low" based on the DMMP agency review of sediment chemistry data from the 1988 sampling and testing of the Olympia Harbor Navigation Improvement Project, and the lack of any ongoing sources of chemical contamination.

3. A sampling and analysis plan was completed for this project and approved by the PSDDA agencies on 14 February 1999. Sampling for this project was performed from 26 April to 7 May 1999. Additional sampling and testing data for bioaccumulation are discussed in paragraph 7.

SAP approval date	14 February 1999
Sampling dates	26 April to 7 May 1999
Data Report submittal date	June 1999
Recency determination dates	May 2004 to May 2006

4. Core samples were taken from a total of 64 locations and composited for ~~thirteen~~ seventeen analyses. The sampling and compositing scheme is listed in Table 1. Sample depths could not be achieved at stations 6, 7 (composite TBW-2), and Station 47 (composite MCW-2). Core refusal occurred before reaching the planned sampling depths. In each case the maximum bore length was collected and all bores reached native material. The resulting under-representation of deeper native sediments (assumed to be uncontaminated) in the DMMU composite results in potentially

Attachment 1

higher chemical concentrations. This result is more conservative and is therefore usable in making a suitability determination for these samples.

5. There were no exceedances of 1999 DMMP screening levels for the standard list of chemicals of concern. All detection limits were below screening level.

6. A tiered approach was used in the analysis for Tributyltin (TBT). Composites in the berthing are (B1 and B2) were analyzed for TBT. If there were no TBT exceedances in these samples, TBT testing would not be required for the rest of the samples. Composite B1 had a porewater TBT level of 0.28 ug/L, above the screening level of 0.15 ug/L. This exceedance triggered the requirement to test all remaining DMMUs for TBT. One of these DMMU also exceeded the screening level for TBT (TBW-1). DMMU exceeding the screening level for TBT are required to undergo bioaccumulation testing in order to determine suitability for open-water disposal.

7. A separate sampling and analysis effort was undertaken for the bioaccumulation testing of samples B1 and TBW-1. A sampling plan addendum was approved by the agencies in July 1999. Sampling for TBT bioaccumulation analysis was completed in August 1999.

8. Bioaccumulation testing was performed with bivalve *Macoma nasuta* and the polychaete *Nephtys caecoides*. The two species were tested together in the same 18-liter glass aquarium. At the time of project initiation, the standard DMMP bioaccumulation protocol called for 28-day test duration. The project proponents agreed to extend the test to 45 days, based on the recommendation of the DMMP agencies. The extended test provides a better approximation of steady-state tissue concentrations for TBT.

9. Six replicate aquaria (five test replicates and one replicate for steady state monitoring) were run for the two test sediments, the two reference sediments and the negative control.

10. Tissue concentrations from the 45-day exposure were compared to the reference sediments. Initial sediment chemistry was used to adjust the observed tissue concentrations. The sediment chemistry results between the first and second rounds of TBT testing differed, and so a ratio of the two was used to adjust the bioaccumulation tissue concentrations to reflect a "worst case" analytical result. These TBT chemistry results are listed in Table 3.

11. The DMMP agencies agreed to use the target tissue level developed for the East Waterway project, 3 ppm dry weight of TBT in tissue, as the value appropriate for the Olympia Harbor Navigation Project. Given the limited residue-effects data for the Olympia area, it was determined that the number calculated for Elliott Bay would be the closest approximation available for making a determination of suitability. The method of calculation and the data supporting this value is documented in the

suitability determination for the East Waterway project suitability determination (1999), paragraph 18, and in the "Review of Tissue Residue Effects Data for Tributyltin, Mercury and Polychlorinated Biphenyls", prepared by EVS solutions for the Port of Seattle.

12. TBT concentrations in tissues from *Macoma* and *Nephtys* exposed to test sediments were significantly less than the target tissue level of 3 ppm dry weight TBT in tissue. TBT tissue concentrations were also compared to reference and significant differences were observed for both DMMU. These results are listed in Table 4. The DMMP agencies agreed that comparing statistical difference from reference is a necessary but not a sufficient condition to determine a DMMU unsuitable for open-water disposal. Sediments from these two DMMU are suitable because all TBT tissue concentrations are significantly less than the target tissue level, TBT is undetected in most test replicates and differs from reference only when conservative assumptions are applied to non-detected values, and TBT concentrations in the retested samples were all lower than the screening level.

13. In summary, the DMMP-approved sampling and analysis plan was followed, and quality assurance, quality control guidelines specified by the DMMP were followed. The data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program. Based on the results of the chemical testing, the consensus determination of the DMMP agencies is that all 635,000 cubic yards from the Olympia Navigation Channel and the Port of Olympia's berthing area are suitable for open-water disposal.

14. This memorandum documents the suitability of proposed dredged sediments for disposal at a PSDDA open water disposal site or for beneficial use. It does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. A final decision will be made after full consideration of agency and public input, and after an alternatives analysis is done under section 404 (b) 1 of the Clean Water Act.

OLYMPIA HARBOR NAVIGATION PROJECT

Concur:

7/20/00
Date

Stephanie Stirling
Seattle District Corps of Engineers

1 August 2000
Date

Justine Barton
Environmental Protection Agency, Region 10

1 Aug 00
Date

Rick Vining
Washington Department of Ecology

25 JUL 00
Date

Ted Benson
WA Department of Natural Resources

Copies Furnished:
EPA/Justine Barton
DNR/Ted Benson
DOE/Rick Vining
CENWS/Hiram Arden

Table 1. Sampling/Compositing Scheme

	DMMU	Samples Composited by Core Section	DMMU Volume Represented (cy)
SURFACE SEDIMENTS			
Berthing Area Maintenance			
	B1	1A, 2A, 3A, 4A	30,335
Turning Basin Widening			
	TBW1	5A, 6A, 7A	23,471
Main Channel O & M Dredging			
	MC1	8A, 9A, 10A, 11A, 12A	35,494
	MC2	13A, 14A, 15A, 16A, 17A, 18A	44,114
	MC3	19A, 20A, 21A, 22A, 23A	38,595
	MC4	24A, 25A, 26A, 27A, 28A	36,646
	MC5	29A, 30A, 31A, 32A, 33A	36,053
	MC6	34A, 35A, 36A, 37A, 38A	34,841
	MC7	39A, 40A, 41A, 42A, 43A, 44A	40,779
Main Channel Widening			
	MCW1	45A, 46A, 47A, 48A, 49A	39,463
Outer Channel O & M Dredging			
	OC1	50A, 51A, 52A, 53A, 54A	43,977
	OC2	55A, 56A, 57A, 58A, 59A	36,325
	OC3	60A, 61A, 62A, 63A, 64A	39,052
SUBSURFACE SEDIMENTS			
Berthing Area Maintenance			
	B2	1B, 2B, 3B	15,010
Turning Basin Widening			
	TBW2	5B, 5C, 6B, 6C, 6D, 6E, 7B, 7C, 7D, 7E	52,499
Main Channel O & M Dredging			
	MC8	9B, 11B, 12B, 15B, 18B	23,419
Main Channel Widening			
	MCW2	45B, 45C, 46B, 46C, 47B, 47C, 48B, 49B, 49C, 49D	54,198
			624,271

Table 2. Sediment Conventional Parameters

Parameter	B1	B2	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8
Total Solids (%)	49.9	72.2	40.4	40.8	45.7	42	38.6	38.2	44.1	61.6
Total Organic Carbon (%)	2.7	1.6	2.9	2.8	2.3	2.5	2.7	2.7	2.3	1.9
Bulk Ammonia (mg/kg)	7.8	58	4.8	4.9	87	9.2	78	68	77	69
Total Sulfides (mg/kg)	360	0.62U	460	90	19	430	900	170	960	48
Grain-size										
gravel	22.5	32.7	7.5	0.9	1.4	2.2	0.6	1.5	1.8	14.1
sand	39	50.3	26.9	25	27.1	20.1	19.2	28.5	30.8	52.8
silt	20.6	10.7	36.9	42.1	43.4	45.7	46.4	38.6	38.9	21.6
clay	18	6.3	28.6	31.8	28	31.9	33.9	31.5	28.5	11.6

Table 2. Sediment Conventional Parameters (Continued)

Parameter	MCW1	MCW2	OC1	OC2	OC3	TBW1	TBW2
Total Solids (%)	57.7	72	40.6	39.8	53.3	43	71.7
Total Organic Carbon (%)	1.4	0.74	2.4	2.3	1.7	3.2	1.0
Bulk Ammonia (mg/kg)	43	50	92	56	40	94	50
Total Sulfides (mg/kg)	430	1.3U	950	1100	46	130	26
Grain-size							
gravel	4	6.5	2.9	5	3.8	2.8	4.5
sand	52.1	65.8	28.5	22.3	49.6	18.3	71.3
silt	27.9	18.8	39.7	42.5	28.2	49.8	16.8
clay	16.1	9	29	29.9	18.4	29.2	7.5

Table 3. TBT Sediment Chemistry Data

Parameter	DMMU B1			DMMU TBW1		
	Initial (4/99)	Retest (8/99)	Ratio I/R	Initial (4/99)	Retest (8/99)	Ratio I/R
TBT Porewater (ug/L)	0.28	0.14	2.0	0.16	0.02	8.0

Table 4. Bioaccumulation Test Results

		Nephtys		*Macoma*	
Sample	Replicate	Lipids (% dry wt)	TBT (ug/kg dry wt)	Lipids (% dry wt)	TBT (ug/kg dry wt)
Control	A	2.3	10 U	1.3	10 U
	B	2.8	10 U	1.6	10 U
	D	2.2	10 U	1.8	10 U
	E	2.7	10 U	1.8	10 U
	F	3.1	10 U	1.3	10 U
CR02	A	1.7	10 U	1.7	2
	B	2.6	10 U	1.1	10 U
	D	3.0	10 U	1.6	10 U
	E	2.8	10 U	1.9	10 U
	F	2.0	10 U	2.0	10 U
CR23	A	2.3	20 U,G	2.2	10
	B	1.9	20 U,G	1.8	10 U
	D	2.8	10 U	1.4	10 U
	E	2.2	10 U	1.8	10 U
	F	1.8	10 U	2.2	10 U
TBW1	A	2.8	20 U,G	1.9	2
	B	2.0	10 U	1.5	17
	D	1.0	30 U,G	1.5	10 U
	E	1.6	20 U,G	1.5	10 U
	F	1.5	10 U	1.6	10 U
B1	A	1.9	4 U,G	1.4	51
	B	1.9	2 U	2.0	71
	D	1.6	10 U	1.7	72
	E	1.7	20 U,G	1.6	49
	F	2.2	10 U	1.7	54

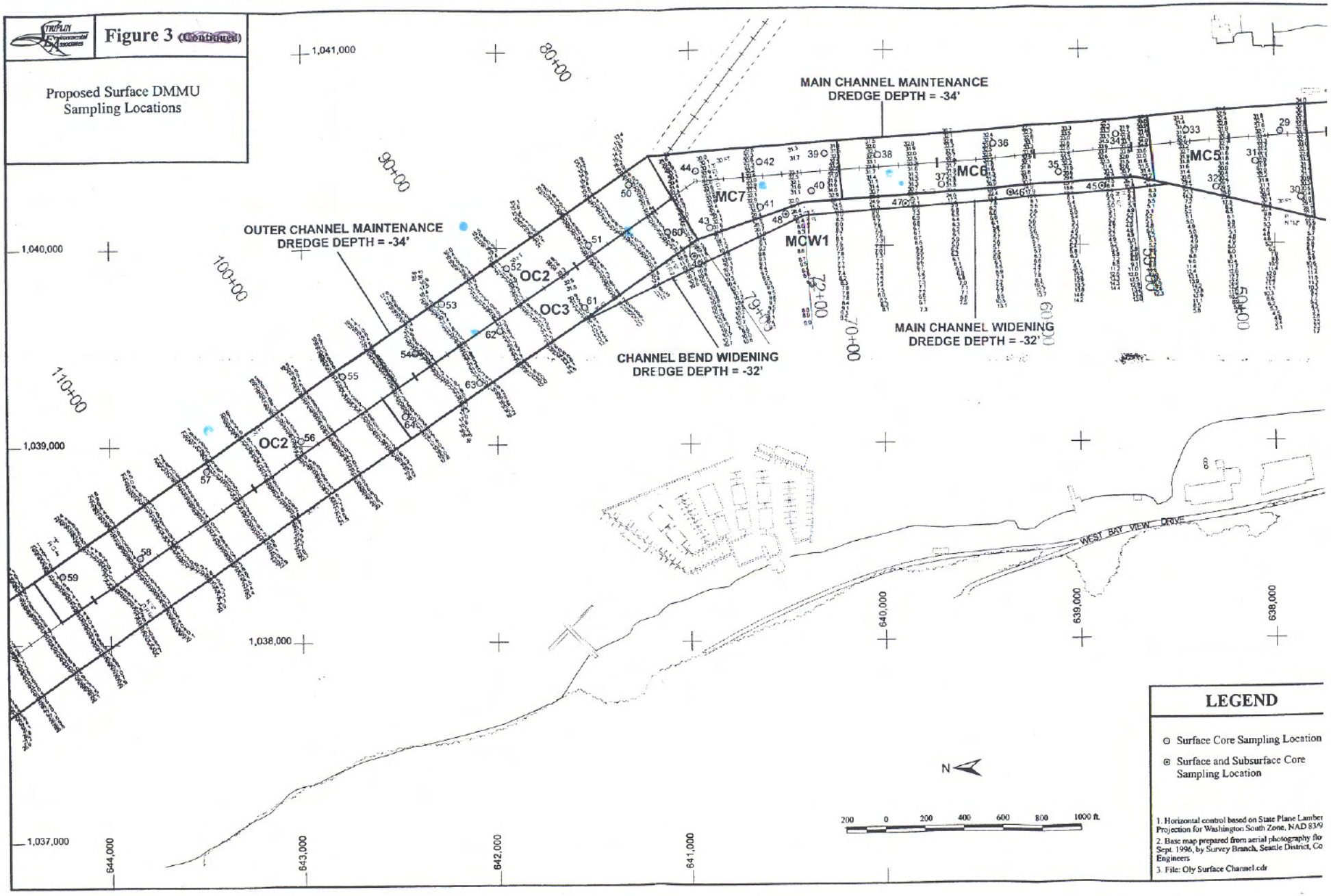


Figure 3 (Continued)
Proposed Surface DMMU Sampling Locations
MAIN CHANNEL MAINTENANCE DREDGE DEPTH = -34'
OUTER CHANNEL MAINTENANCE DREDGE DEPTH = -34'
CHANNEL BEND WIDENING DREDGE DEPTH = -32'
MAIN CHANNEL WIDENING DREDGE DEPTH = -32'
MC5
MC6
MC7
MCW1
OC2
OC3
80+00
90+00
100+00
110+00
70+00
60+00
1,041,000
1,040,000
1,039,000
1,038,000
1,037,000
644,000
643,000
642,000
641,000
640,000
639,000
638,000
WEST BAY VIEW DRIVE
N
200 0 200 400 600 800 1000 ft.
LEGEND
Surface Core Sampling Location
Surface and Subsurface Core Sampling Location
1. Horizontal control based on State Plane Lamber Projection for Washington South Zone, NAD 83/9
2. Base map prepared from aerial photography flo Sept. 1996, by Survey Branch, Seattle District, Co Engineers
3. File: Oly Surface Channel.cdr

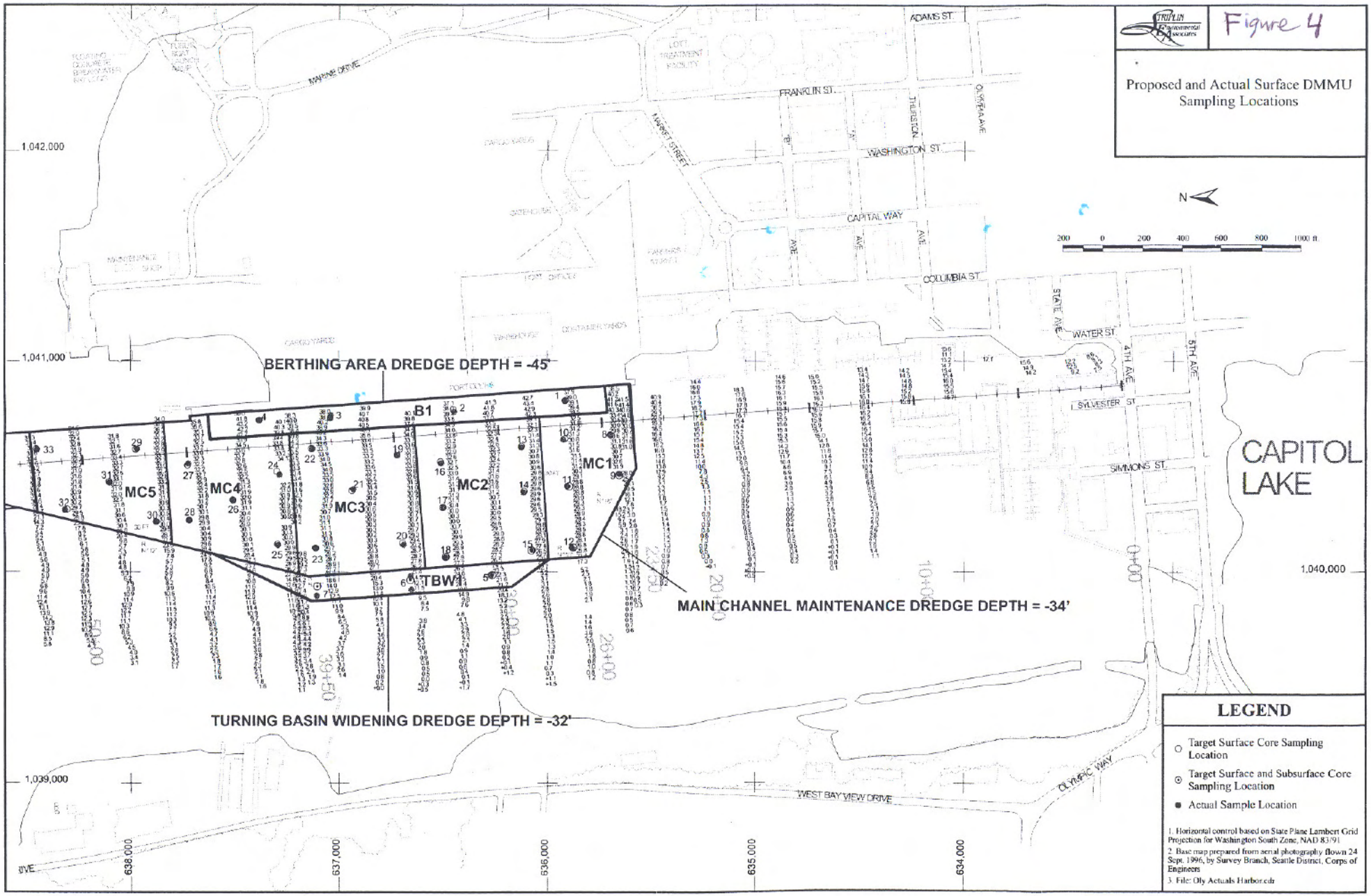


Figure 4
Proposed and Actual Surface DMMU Sampling Locations
BERTHING AREA DREDGE DEPTH = -45'
MAIN CHANNEL MAINTENANCE DREDGE DEPTH = -34'
TURNING BASIN WIDENING DREDGE DEPTH = -32'
B1
MC1
MC2
MC3
MC4
MC5
TBW1
CAPITOL LAKE
ADAMS ST.
FRANKLIN ST.
WASHINGTON ST.
CAPITAL WAY
COLUMBIA ST.
WATER ST.
SYLVESTER ST.
SIMMONS ST.
MARINE DRIVE
WEST BAY VIEW DRIVE
OLYMPIC WAY
1,042,000
1,041,000
1,040,000
1,039,000
638,000
637,000
636,000
635,000
634,000
N
200 0 200 400 600 800 1000 ft.
LEGEND
Target Surface Core Sampling Location
Target Surface and Subsurface Core Sampling Location
Actual Sample Location
1. Horizontal control based on State Plane Lambert Grid Projection for Washington South Zone, NAD 83/91
2. Base map prepared from aerial photography flown 24 Sept. 1996, by Survey Branch, Seattle District, Corps of Engineers
3. File: Oly Actuals Harbor.cdr

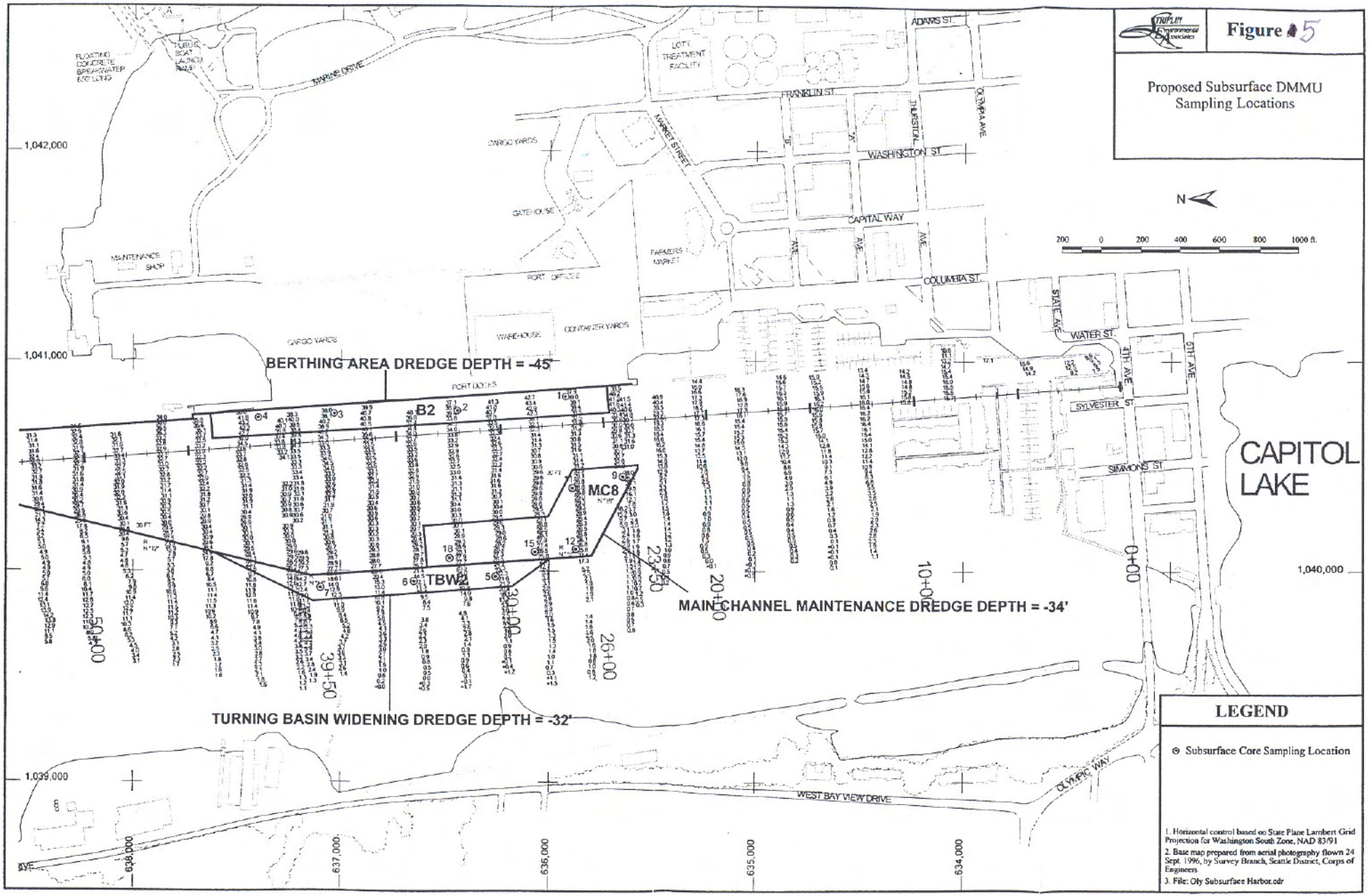
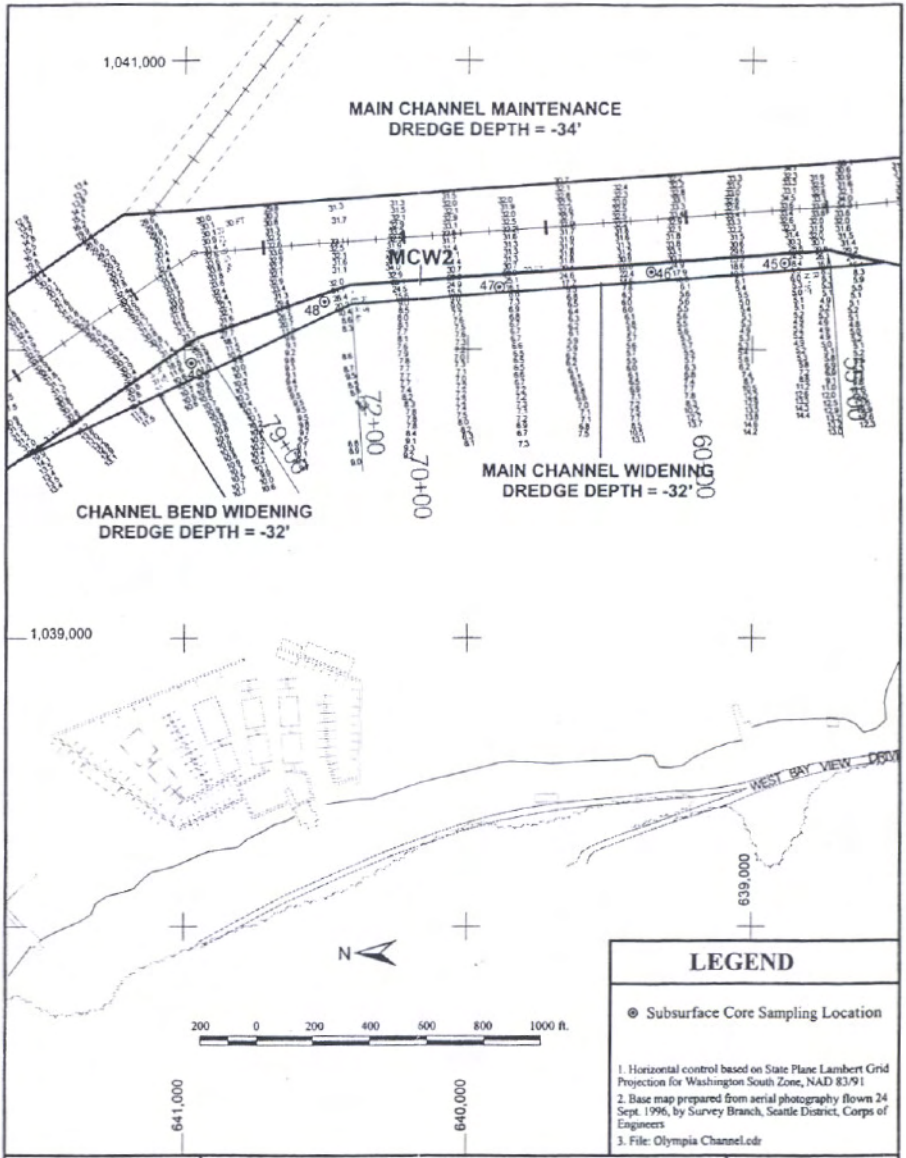


Figure 5
Proposed Subsurface DMMU Sampling Locations
N
200 0 200 400 600 800 1000 ft.
BERTHING AREA DREDGE DEPTH = -45'
MAIN CHANNEL MAINTENANCE DREDGE DEPTH = -34'
TURNING BASIN WIDENING DREDGE DEPTH = -32'
B2
MC8
TBW2
CAPITOL LAKE
1,042,000
1,041,000
1,040,000
1,039,000
638,000
637,000
636,000
635,000
634,000
50+00
39+50
30+00
26+00
23+50
20+00
10+00
0+00
MARINE DRIVE
FLOATING CONCRETE BREAKWATER
PUBLIC BOAT LAUNCH RAMP
LOTT TREATMENT FACILITY
ADAMS ST.
FRANKLIN ST.
THURSTON
OLYMPIA AVE
WASHINGTON ST.
CAPITAL WAY
COLUMBIA ST.
MARKET STREET
CARGO YARDS
GATEHOUSE
MAINTENANCE SHOP
PORT OFFICE
FARMERS MARKET
WAREHOUSE
CONTAINER YARDS
PORT DOCKS
STATE AVE
WATER ST.
4TH AVE
5TH AVE
SYLVESTER ST.
SIMMONS ST.
WEST BAY VIEW DRIVE
OLYMPIC WAY
LEGEND
Subsurface Core Sampling Location
1. Horizontal control based on State Plane Lambert Grid Projection for Washington South Zone, NAD 83/91
2. Base map prepared from aerial photography flown 24 Sept. 1996, by Survey Branch, Seattle District, Corps of Engineers
3. File: Oly Subsurface Harbor.cdr



TRIPLIN Environmental Associates

Figure 6 (Continued)

Proposed Subsurface DMMU Sampling Locations

Olympia Harbor
3/23/99
Oly Subsurface Channel.cdr

CENWS-OD-TS-DMMO

MEMORADUM FOR RECORD 24 May 2005

SUBJECT: SUITABILITY DETERMINATION RECENCY EXTENSION FOR PROPOSED MAINTENANCE DREDGE MATERIAL AT OLYMPIA HARBOR, LOWER BUDD INLET, OLYMPIA, WASHINGTON (Public Notice #23) EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR OPEN-WATER DISPOSAL AT AN APPROVED PSDDA (ANDERSON ISLAND) SITE.

1. Background. The proposed dredge material at Olympia Harbor underwent DMMP characterization through April, May, and August 1999. The results of that characterization are documented in a May 17, 2000 suitability determination memorandum (SDM), in which 624,000 cubic yards (cy) were found to be suitable for disposal at a PSDDA open water disposal site or for beneficial use. The consensus determination of the DMMP agencies was that all 624,000 cy from the federal, Olympia Harbor Navigation Channel and the Port of Olympia's berthing area are suitable for open-water disposal. Note: The May 17, 2000 suitability determination included characterization of two feet of potential advance maintenance dredging and areas of minor widening at the bend, entrance and turning basin for the free movement of vessels.

The Corps of Engineers proposes to dredge the deep-draft, navigation channel at Olympia, Washington. In addition, the Port of Olympia proposes to maintenance dredge their existing berthing area. However, the total proposed dredged volume is approximately 478,000 cubic yards which is less that the 624,000 characterization volume because the advance maintenance dredging could not be justified; however, the characterization does confirm that materials below the maintenance dredge cut (Z material) are clean for the resulting sediment / water interface. The following summary reflects the DMMP agencies (Corps of Engineers, Department of Ecology, Department of Natural Resources and the Environmental Protection Agency) consensus decision on the acceptability of all relevant test data to make a determination of suitability for the disposal of the material at a PSDDA open-water disposal site.

The proposed dredging area is ranked "low" based on sediment chemistry data and the lack of any ongoing sources of chemical contamination. There has been no change in adjacent land use or other potential sources of contaminants and no significant (>5 gallons) spills of petroleum or hazardous materials in the immediate vicinity of the proposed dredged area. The amount of sediment accumulation since the original characterization was evaluated by comparing data from bathymetry surveys conducted by the U.S. Army Corps of Engineers in May 1998 and in April 2004. There has been no or minimal sediment accumulation (±0.5 feet) between 1999 and 2004 in much of the proposed dredged area. In some areas, there has been up to 1 foot of sediment accumulation, with a maximum accumulation of up to 1.24 feet in small, isolated spots.

ATTACHMENT 2

Permitting for this project is expected to be complete in time to dredge during the 2006-2007 dredging season. To meet this schedule, the applicant (Corps Navigation & Port, local sponsor) requests that the DMMP suitability for unconfined open-water disposal be extended through May 2008.

2. Analysis. In a 2002 Clarification Paper, the DMMP outlined an approach for considering recency extensions for projects that could not be dredged during the standard recency window due to permitting requirements. That approach considers 1) previous characterization data; 2) any new data from the dredge site or vicinity; and 3) site use and character.

The additional areas of Corps minor widening at the bend, entrance channel and turning basin, were included in the 1999 sediment characterization. There were no exceedances of 1999 DMMP screening levels for the standard list of chemicals of concern. All detection limits were below the screening levels. A tiered approach was used in the analysis for Tributyltin (TBT). Composites for the berthing area exceeded the screening level for TBT. Two DMMUs exceeded BT for TBT but passed bioaccumulation testing. A separate sampling and analysis effort was undertaken for the bioaccumulation testing. Sampling for TBT bioaccumulation analysis was completed in August 1999. Sediments from the two DMMUs are suitable because all TBT tissue concentrations are significantly less than the target tissue level.

Based on the above review, the DMMP determined that there is little risk in granting the requested recency extension.

3. Suitability. This summary reflects a consensus determination of the agencies that comprise the regional Dredged Material Management Program (DMMP) for the State of Washington. The agencies include the Corps of Engineers, the Environmental Protection Agency, and the Washington Departments of Ecology and Natural Resources. The DMMP agencies concurred that an extension of the recency date of the suitable DMMUs through May 2008 is acceptable. Thus approximately 478,000 cubic yards remain suitable for open water disposal. This recency extension is contingent upon no significant perturbations or unanticipated impacts occurring that would affect the quality of the sediments between the dated of this memorandum and the dredging dates.

This memorandum documents the suitability of sediment to be dredged from the Olympia Harbor Navigation project for disposal at a PSDDA open-water disposal site. However, this suitability determination does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under Section 404(b)(1) of the Clean Water Act.

Reference:

Warner, L.C. 2002. DMMP Clarification Paper: Recency Guidelines – Program Considerations. Prepared by Lauran Cole Warner (US Army Corps of Engineers) for the DMMP agencies, SMARM 2002.

Concur:

6/2/2005
Date

Gwyn Puckett, Seattle District Corps of Engineers

6/2/2005
Date

Jonathan Freedman, Environmental Protection Agency

6/2/05
Date

Cinde Donoghue, Washington Department of Ecology

June 2, 2005
Date

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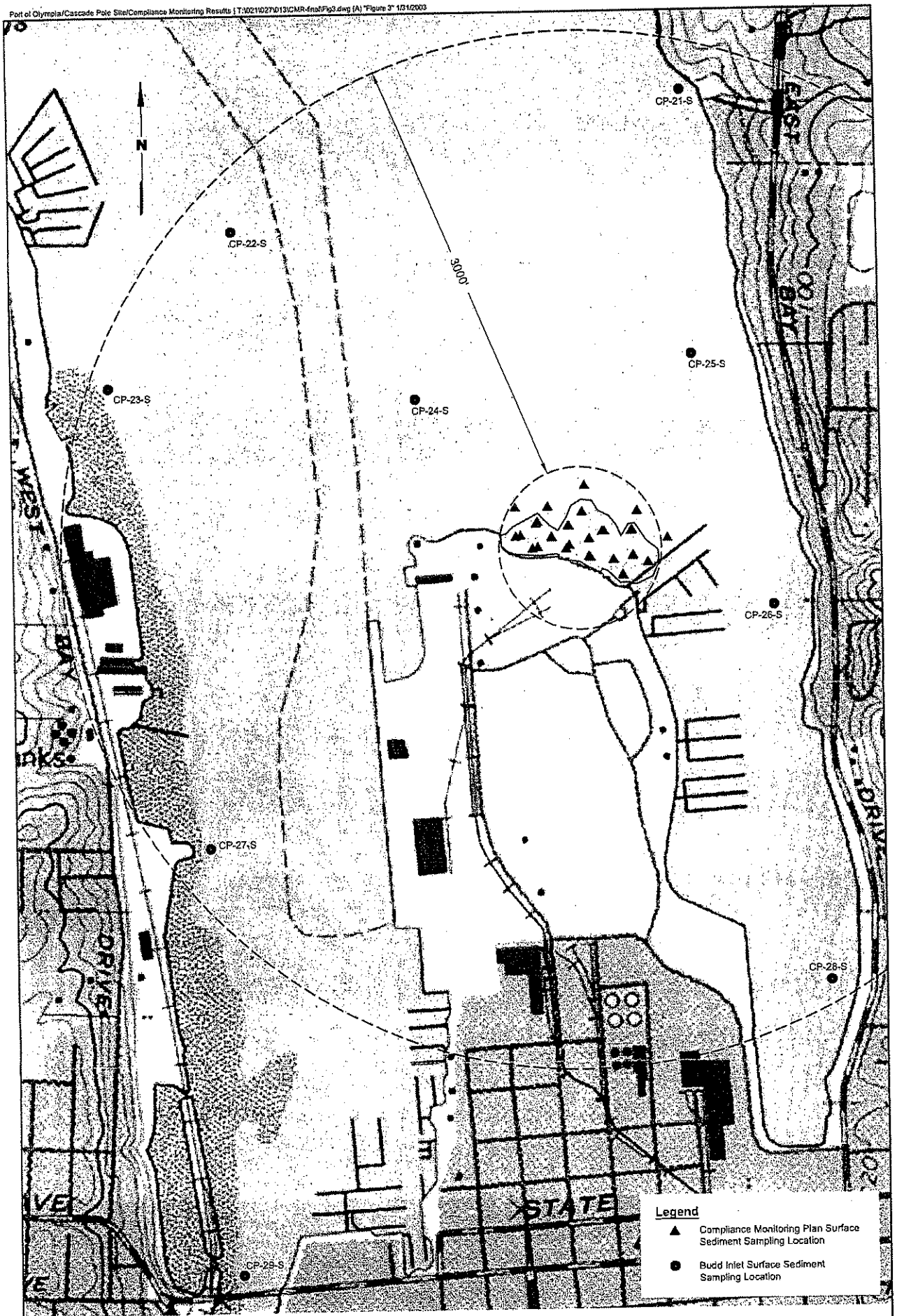
DMMO File

Port of Olympia/Cascade Pole Site/Compliance Monitoring Results | T:\021\027\013\CMR-final\Fig3.dwg (A) "Figure 3" 1/31/2003



Adapted from: Maptech Terrain Navigator, 1998

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0 600 1200
Scale in Feet

Cascade Pole Site
Olympia, Washington

Surface Sediment Sampling Locations

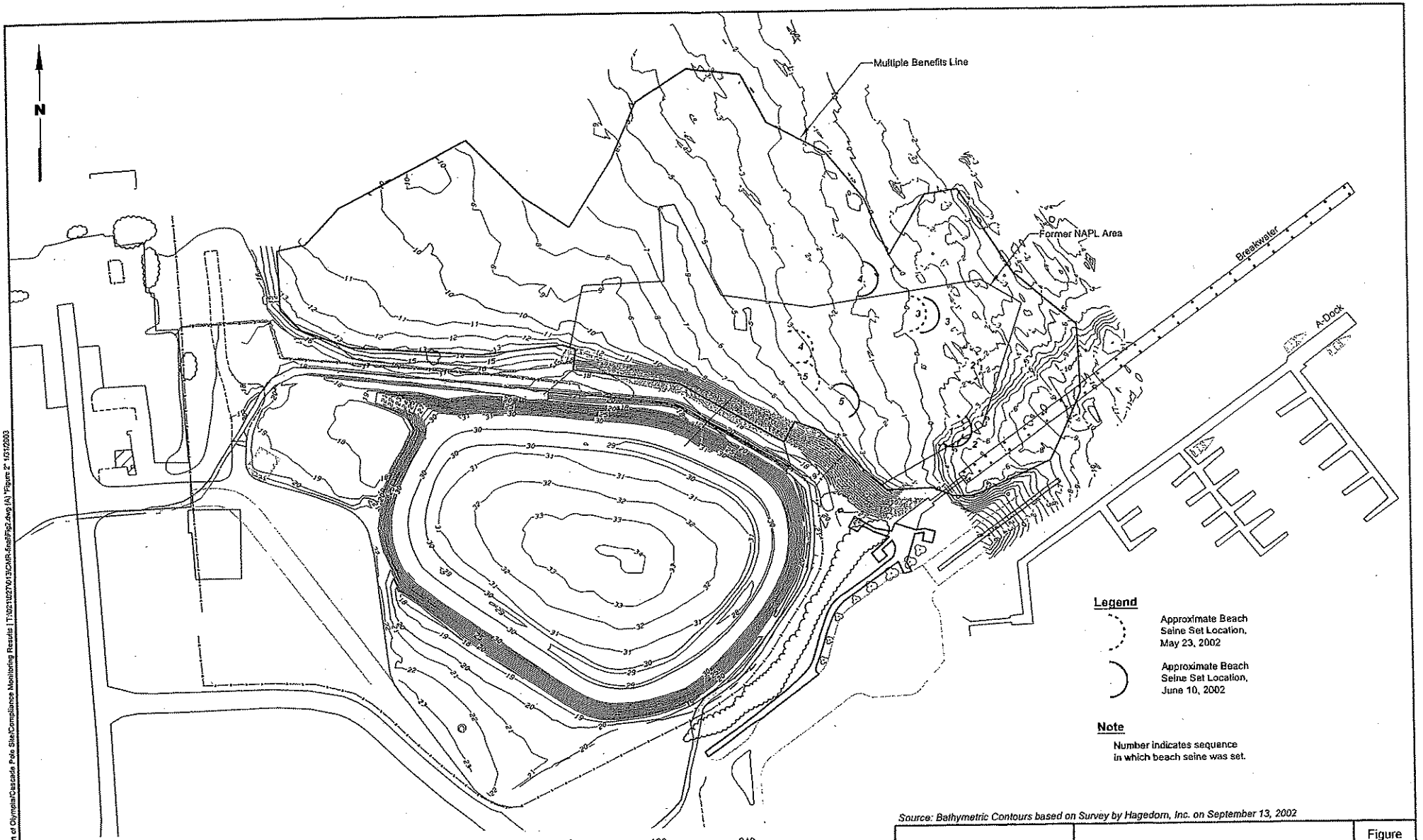
Figure 3

ATTACHMENT 3

TABLE 7
SEDIMENT SAMPLE ANALYTICAL RESULTS

Sample ID:	CP-21-S	CP-22-S	CP-23-S	CP-24-S	CP-25-S	CP-26-S	CP-27-S	CP-28-S	CP-29-S
Lab ID:	2202374-017	K2202330-026	K2202330-027	K2202330-025	K2202330-024	K2202330-023	K2202330-029	K2202374-018	K2202330-030
Sample Date:	4/12/2002	4/11/2002	4/11/2002	4/11/2002	4/11/2002	4/11/2002	4/11/2002	4/12/2002	4/11/2002
Dioxins and Furans (ng/kg)									
2,3,7,8-TCDD	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,3,7,8-PeCDD	2.5 U	2.5 U	2.5 U	2.5 U	3.316	2.5 U	2.5 UJ	2.5 U	2.5 U
1,2,3,4,7,8-HxCDD	2.5 U	2.5 U	2.55	2.5 U	4.775	2.933	2.5 U	2.5 U	2.5 U
1,2,3,6,7,8-HxCDD	2.5 U	7.093	18.982	3.534	28.292	12.057	6.991	5.486	2.5 U
1,2,3,7,8,9-HxCDD	2.5 U	3.619	6.65	2.5 U	14.991	7.418	4.188	4.014	2.5 U
1,2,3,4,6,7,8-HpCDD	21.233	135.371	254.216	79.252	527.609	222.552	135.823	112.301	31.532
OCDD	144.677	810.248	1314.234 J	518.845	4290.636	1300.39 J	813.099	666.653	253.099
2,3,7,8-TCDF	1.101	1 U	1.09	1 U	2.893	1.891	1 U	1 U	1 U
1,2,3,7,8-PeCDF	2.5 U	2.5 U	2.5 U	2.5 U	2.865 J	2.5 U	2.5 U	2.5 U	2.5 U
2,3,4,7,8-PeCDF	2.5 U	2.5 U	2.5 U	2.5 U	3.876 J	2.5 U	2.5 U	2.5 U	2.5 U
1,2,3,4,7,8-HxCDF	2.5 U	2.853	4.345	2.5 U	12.999	4.244 J	2.774	2.797	2.5 U
1,2,3,6,7,8-HxCDF	2.5 U	2.5 U	2.833	2.5 U	5.006	2.5 U	2.5 U	2.5 U	2.5 U
1,2,3,7,8,9-HxCDF	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
2,3,4,6,7,8-HxCDF	2.5 U	2.5 U	6.253	2.5 U	4.859	3.248	2.5 U	2.5 U	2.5 U
1,2,3,4,6,7,8-HpCDF	4.249	49.307	120.007	24.379	158.166	38.854	42.678	26.683	7.149
1,2,3,4,7,8,9-HpCDF	2.5 U	2.5 U	3.684	2.5 U	8.445	2.5 U	2.5 U	2.5 U	2.5 U
OCDF	5 U	66.776	126.464	29.803	238.564	52.899 J	55.923	41.249	15.208
Total TCDD	5 U	9.509	4.827	4.355	177.151	104.522	6.354	10.558	0.324
Total PeCDD	0.507	7.489	13.142	3.282	79.412	104.336	12.609	15.499	5 U
Total HxCDD	10.052	65.453	108.676	29.132	262.72	155.945	60.935	51.876	9.125
Total HpCDD	47.686	336.508	562.801	184.837	1460.398	471.96	323.638	264.633	98.879
Total TCDF	2.095	16.443	9.357	7.115	52.602	41.881	11.991	18.114	5 U
Total PeCDF	2.164	17.648	44.317	10.386	89.719	44.88	20.352	23.74	2.586
Total HxCDF	7.574	58.095	188.843	26.084	211.03	74.073	58.43	39.823	8.422
Total HpCDF	10.618	143.771	359.129	61.529	475.354	119.513	100.953	65.075	20.511
TEQ	0.510	4.01	9.36	1.91	22.4	7.09	3.99	3.29	0.640
Conventionals (percent)									
TOC	0.17	3.53	4.26	1.79	3.5	1.53	5.6	2.33	3
Total solids	91.8	31.7	48	55.2	34	66.4	36.1	45.2	80.3

U = Compound not detected at the given detection limit.
J = Estimated value.
TEQ = Toxicity equivalency quotient.



Source: Bathymetric Contours based on Survey by Hagedorn, Inc. on September 13, 2002

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Cascade Pole Site Olympia, Washington	**Beach Seining Locations**	Figure 2

Port of Olympia/Cascade Pole Site/Compliance Monitoring Results | T:\0021\027\013\CMR-final\Fig2.dwg [A] "Figure 2" 12/12/2003

TABLE 6
FISH TISSUE ANALYTICAL RESULTS

Sample ID:	CPC-02-T1	CPC-02-T2	CPC-02-T3
Lab ID:	L4688-1	L4840-1 L	L4840-2 L
Sample Date:	5/23/2002	6/10/2002	6/10/2002
Sample Locations:	CPC	Hatchery	CPC
Dioxins and Furans (ng/kg)			
2,3,7,8-TCDD	0.050 U	0.085 U	0.050 U
1,2,3,7,8-PeCDD	0.471	0.050 U	0.241
1,2,3,4,7,8-HxCDD	0.199	0.050 U	0.050 U
1,2,3,6,7,8-HxCDD	1.18	0.050 U	0.520
1,2,3,7,8,9-HxCDD	0.345	0.050 U	0.050 U
1,2,3,4,6,7,8-HpCDD	7.11	0.050 U	1.59
OCDD	33.5	0.066 U	7.45
2,3,7,8-TCDF	0.245	0.279	0.309
1,2,3,7,8-PeCDF	0.133	0.050 U	0.108
2,3,4,7,8-PeCDF	0.230	0.050 U	0.050 U
1,2,3,4,7,8-HxCDF	0.125	0.050 U	0.084
1,2,3,6,7,8-HxCDF	0.078	0.050 U	0.050 U
1,2,3,7,8,9-HxCDF	0.050 U	0.050 U	0.050 U
2,3,4,6,7,8-HxCDF	0.050 U	0.050 U	0.050 U
1,2,3,4,6,7,8-HpCDF	0.050 U	0.090 U	0.278
1,2,3,4,7,8,9-HpCDF	0.050 U	0.117 U	0.050 U
OCDF	0.050 U	0.050 U	0.050 U
Total TCDD	0.0500 U	0.211	0.0500 U
Total PeCDD	0.701 U	0.481	0.324
Total HxCDD	3.75	0.669	0.428
Total HpCDD	15.5	0.985	4.12
Total TCDF	0.319	0.442	0.781
Total PeCDF	1.10	0.400	0.577
Total HxCDF	0.607	0.366	0.341
Total HpCDF	0.468	0.117 U	0.278
TEQ	0.679	0.028	0.244
Lipids (percent)	2.4	5.7	4.2

U = Compound not detected at the given detection limit.
TEQ = Toxicity equivalency quotient.