CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD July 14, 2011

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM THE PORT OF TACOMA'S HUSKY TERMINAL (BLAIR WATERWAY, BERTHS 3 & 4), FOR UNCONFINED OPEN-WATER DISPOSAL AT THE COMMENCEMENT BAY SITE.

1. Introduction. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) regarding the suitability of 42,100 cubic yards (cy) of dredged material from the Port of Tacoma's Husky Terminal for disposal at the Commencement Bay open-water site.

2. Background. Husky Terminal is located at Berths 3 & 4 within the Blair Waterway in Tacoma (see Figure 1). Berths 3 and 4 were constructed in stages, ending in 2005. Prior to that time, the area was the location of Piers 1, 2, and 3, located adjacent to Slips 1, 2, and 3. Slip 3 was filled between 1965 and 1970, and Slip 2 was filled in the 1980s with dredged material from the Blair Waterway. Between 2002 and 2005, Occidental Chemical Corporation and the Port constructed a confined disposal facility (CDF) in Slip 1 and disposed of approximately 265,000 cubic yards (cy) of sediment from the mouth of the Hylebos Waterway. This material was characterized in accordance with the DMMP and was determined to be chemically unsuitable for open-water disposal. The substances that exceeded DMMP screening levels included hexachlorobutadiene, total polychlorinated biphenyls, high-molecular-weight polynuclear aromatic hydrocarbons, zinc, and tributyltin (TBT). Materials were filled and isolated with 9 feet of clean material before being paved and converted to a terminal facility (Anchor, 2011a).

   The Port of Tacoma proposes to perform maintenance dredging within the berthing area at Husky Terminal. This area was last dredged in 2000, with disposal at the Commencement Bay site. Dioxin testing was not conducted at that time. For the current round of maintenance dredging at Husky Terminal, dioxin testing was required.

3. Project Summary. Table 1 includes project summary and tracking information.

Table 1. Project Summary

Project ranking	Moderate
Dredging volume	42,100 cubic yards
Proposed dredging depth	-51 feet MLLW plus 2 feet of overdepth
1st draft sampling and analysis plan (SAP) received	December 1, 2010
DMMP comments provided on 1st draft	December 15, 2010
2nd draft SAP received	January 18, 2011
DMMP comments provided on 2nd draft	January 19, 2011

Final revisions to SAP received	February 2, 2011
SAP revisions approved	February 3, 2011
Sampling dates	February 9-10, 2011
Draft data report received	May 11, 2011
DMMP comments provided on draft report	May 18, 2011
Final data report received	July 13, 2011
DAIS Tracking number	HUSKY-1-A-F-306
USACE Permit Application Number	NWS-2010-1118-WRD
Recency Determination (moderate rank = 5-7 years)	February 2016 – February 2018

4. Project Ranking and Sampling Requirements. The Husky Terminal project was ranked "moderate" because it is a ship berthing facility without any recent sediment characterization data to support a lower rank.

   In a moderate-ranked area the number of samples and analyses are calculated using the following guidelines (DMMP, 2008a):
   - Maximum volume of sediment represented by each field sample (typically a 4-foot core) = 4,000 cubic yards
   - Maximum volume of sediment represented by each analysis in the upper 4-feet of the dredging prism (surface sediment) = 16,000 cubic yards
   - Maximum volume of sediment represented by each analysis beyond the upper 4-feet of the dredging prism (subsurface sediment) = 24,000 cubic yards

   Figure 2 displays the bathymetry at Berths 3 & 4, with areas above elevation -51 feet MLLW highlighted. Some small areas are present off the pier face, but the majority of the material to be dredged is the result of shoaling at the toe of the under-pier slope at the pier face. The volume of material to be removed within the dredge footprint is 9,400 cy; however, some under-pier material is expected to move into the dredge area during dredging. A conservative approach was taken to estimate the maximum amount of under-pier sediment that could be removed as part of the dredging. The total maximum under-pier volume along Berths 3 and 4 is 32,700 cy. The total maximum removal volume in the project area, including under-pier volume, is 42,100 cy. Actual volume from under-pier areas is expected to be less than estimated, but this approach provided a maximum volume for characterization purposes (Anchor, 2011a).

   Because the dredge prism was generally only a few feet thick except at the pier face, the entire dredge prism was characterized as surface material. Based on the guidelines, the proposed dredging volume of 42,100 cy required a minimum of three analyses, or dredged material management units (DMMUs). However, in order to address concerns expressed by EPA Superfund regarding sediment adjacent to the Slip-1 CDF, an extra DMMU was added. The approved SAP therefore included four DMMUs, each represented by a composite of sediment from two sampling locations. It was anticipated that each of the eight sampling locations would yield two 4-foot core sections (A and B intervals), for a total of 16 field samples, thereby meeting the minimum requirement of 11 field samples for this project volume.

5. Sampling. Field sampling took place February 9-10, 2011 using a vibracore sampler. Table 6 includes the coordinates of the sampling stations and Table 7 includes compositing information. Figure 2 shows the actual and target sampling coordinates. Dredged material samples were taken from mudline to -53 feet MLLW (design depth of -51 feet plus 2-foot overdepth). Z-samples were collected from -53 to -55 feet MLLW.

   Some of the core samples were collected away from the target station due to penetration refusal or the presence of gravel or riprap. If refusal was encountered, attempts were first shifted laterally along the pierface, but if refusal continued to prevent achieving the target depth, cores were shifted away from the pierface. In order to achieve the target depth of -55 feet MLLW, several cores were collected from locations with deeper mudline elevations than anticipated. This resulted in a smaller volume of material collected from A and B intervals, but adequate volume was acquired for all testing and archiving for each core (Anchor, 2011b). Eight A-interval samples and three B-interval samples were collected for a total of 11 field samples, thereby meeting the minimum requirement. All other work took place in compliance with the approved sampling plan.

   Samples were processed at the Analytical Resources, Inc. laboratory on February 10 and 11. Laboratory IDs assigned to the DMMUs were as follows:

   DMMU 1 = HT-01 DMMU 2 = HT-02 DMMU 3 = HT-03 DMMU 4 = HT-04

6. Chemical Analysis. The approved SAP was followed and quality control guidelines specified by DMMP were generally met. The sediment conventional and chemistry results can be found in Table 8. The grain-size data and core logs show that the proposed dredged material is predominantly silt and sand, with a fines fraction ranging from 27 to 42% for the four DMMUs. The total organic carbon content ranged from 0.57 to 0.80%. The chemistry results indicated that there were no detected exceedances of screening levels for the standard DMMP chemicals of concern or TBT.

   There were only minor quality assurance issues with the chemistry data. Benzyl alcohol was undetected, but the reporting limit exceeded the SL of 57 ug/kg for each sample, ranging from 97 to 100 µg/kg. However, the laboratory reviewed the data and observed the ion response well below the method detection limit (MDL), which was below the SL. Table 8, therefore, presents the qualified MDL for benzyl alcohol. The benzoic acid result for the composite sample from DMMU 2 was rejected due to zero recovery in the matrix spike/matrix spike duplicate sample. This analyte was not detected in the other samples and is not expected to be a chemical of concern in this area (Anchor, 2011b).

   Dioxins in the dredging-prism material were analyzed in two rounds. In the first round of dioxin testing, composited samples representing DMMUs 1 through 4 were tested, resulting in concentrations ranging from 2.78 to 10.99 parts per trillion (pptr) toxicity equivalents (TEQ, with undetects = ½ estimated detection limit). The Port of Tacoma independently initiated a second round of testing to determine the dioxin concentrations in the individual cores making up DMMUs 1, 2 and 3. The range of concentrations for these cores was 1.21 to 8.02 pptr. Detailed results for the two rounds of testing can be found in Tables 9 and 10. Table 2 provides a summary of the data. The dioxin data underwent Stage 4 validation by Laboratory Data Consultants of Carlsbad, CA.

Table 2. Dioxin results for Rounds 1 and 2

DMMU	Volume (cy)	Round 1 Dioxin/Furan TEQ (ng/kg)	Individual Cores	Volume (cy)	Round 2 Dioxin/Furan TEQ (ng/kg)
1	12,100	10.99	HT-01-01	6,050	5.93
			HT-01-02	6,050	5.83
2	14,200	4.12	HT-02-01	7,100	1.21
			HT-02-02	7,100	4.76
3	14,100	6.13	HT-03-01	7,050	8.02
			HT-03-02	7,050	4.51
4	1,700	2.78	HT-04-01	850	---
			HT-04-02	850	---

7. Sediment Exposed by Dredging. Sediment exposed by dredging must either meet the State of Washington Sediment Quality Standards (SQS) (Ecology, 1995) or the State's antidegradation standard (DMMP, 2008b). For this project, dioxin was the main concern since all other chemicals were below the DMMP SLs. The analysis of z-samples associated with cores that exceeded 4 pptr was required by the DMMP agencies. The results for the z-samples can be found in Table 3.

Table 3. Antidegradation Results

DMMU	Round 1 Composite Results	Individual Cores	Round 2 Individual Core Results	Z-Layer Results	Meets AD Standard?
1	10.99	HT-01-01	5.83	0.05	Yes
		HT-01-02	5.93	3.26	Yes
2	4.12	HT-02-01	1.21	NR	Yes
		HT-02-02	4.76	0.21	Yes
3	6.13	HT-03-01	4.51	0.22	Yes
		HT-03-02	8.02	0.10	Yes
4	2.78	HT-04-01	---	NR	Yes
		HT-04-02	---	NR	Yes

Concentrations in pptr TEQ (u = ½ DL)
NR = Not Required

The z-layer dioxin concentrations were all less than the concentrations in overlying material. Based on this analysis, the DMMP agencies concluded that DMMUs 1, 2, 3 and 4 can be dredged to a depth of -53 feet without violating the DMMP antidegradation guidelines.

8. Suitability Determination. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from the Port of Tacoma Husky Terminal for open-water disposal. The approved sampling and analysis plan was followed (with the exception noted previously) and the data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

There were no SL exceedances for standard DMMP chemicals of concern or TBT. Therefore, with respect to these chemicals, the dredged material is suitable for open-water disposal.

With regard to dioxin, the DMMP agencies established new interim disposal guidelines in December 2010 (DMMP, 2010). The new interim guidelines are as follows for non-dispersive sites:

> *DMMUs with dioxin concentrations below 10 pptr TEQ will be allowed for open-water disposal as long as the volume-weighted average concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 pptr TEQ.*

The guidelines also provide flexibility for non-dispersive disposal on a project-specific basis:

> *Case-by-case decisions to allow disposal of material not meeting the screening levels may be made by the DMMP Agencies based on the overall goal of meeting the Non-dispersive Disposal Site Management Objective. Case-by-case considerations will include the following: (a) material placement sequencing; (b) consideration of the possible cumulative effects of other bioaccumulative compounds within the project sediments; and (c) the frequency of disposal site use.*

In the case of Husky Terminal, there were no other bioaccumulative compounds detected above DMMP screening levels and Commencement Bay is a frequently-used disposal site, thereby providing more latitude in making a case-by-case determination. The DMMP agencies evaluated the data from both rounds of testing and provided the Port of Tacoma options for moving forward with the project, including the sequenced dredging and disposal of the entire 42,100 cubic yards of material at the Commencement Bay site, followed by post-disposal monitoring to determine whether the site management objective of 4 pptr had been met (see Attachment A for a complete account of the case-by-case determination). The Port opted not to conduct post-disposal monitoring, but to pursue a mixed-disposal option instead, in which some of the material would be taken to the Commencement Bay site, with the rest of the material disposed upland.

The Port of Tacoma indicated that "Parcel 14", near the head of the Blair Waterway (see Figure 3), would be used for the upland disposal component of the project. The DMMP agencies communicated their preference to the Port that the VWA of material taken to the Commencement Bay site be reduced to 4.0 pptr or less if Parcel 14 had adequate capacity for unsuitable material and the upland disposal cost was reasonably low. The Port of Tacoma agreed to this proposal and accepted the following sequence of dredging and disposal at the Commencement Bay site (calculation of the VWA can be found in Table 11):

Table 4. Accepted sequence of dredging for open-water disposal

Dredging Order	Dredging Unit	Dioxin/furan TEQ (ng/kg)	Volume (cy)
1	HT-03-01	8.02	*3,200*
2	HT-02-02	4.76	7,100
3	HT-03-02	4.51	7,050
4	DMMU 4	2.78	1,700
5	HT-02-01	1.21	7,100
	VWA:	4.00	26,150

In order to meet the 4.0 pptr target, only a portion of the material from HT-03-01 can be disposed in open water. The maximum volume that can be dredged from HT-03-01 and taken to the Commencement Bay site is 3,200 cubic yards, which is approximately 45% of the total material in that unit. The rest of the material will be disposed at Parcel 14:

Table 5. Material for upland disposal

Dredging Unit	Dioxin/furan TEQ (ng/kg)	Volume (cy)
DMMU 1	10.99	12,100
HT-03-01	8.02	*3,850*
VWA:	10.27	15,950

As discussed previously, much of the maximum estimated dredge volume for this project is located under-pier, not all of which is likely to slough during dredging along the pier face. Assuming that the fraction of sloughing will be the same for each DMMU, the percent of HT-03-01 *by area* is the same as the percent by volume. Therefore, only 45% of the area represented by HT-03-01 waterward of the pier face may be dredged and taken to the Commencement Bay site. In summary, based on the results of the previously described testing and discussions with the Port of Tacoma, up to 26,150 cubic yards of material from Husky Terminal (see Table 4) will be disposed at the Commencement Bay non-dispersive site (with the stipulation that no more than 45% of the area represented by HT-03-01 may be included). The remaining 15,950 cubic yards will be disposed upland. The local health district should be contacted for guidance on upland disposal requirements.

This suitability determination does ***not*** constitute final agency approval of the project. During the public comment period that follows a public notice, the resource agencies will provide input on the overall project. 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.

A pre-dredge meeting with DNR, Ecology and the Corps of Engineers is required at least 7 days prior to dredging. A dredging quality control plan must be developed and submitted to the Regulatory Branch of the Seattle District Corps of Engineers at least 7 days prior to the pre-dredge meeting. The dredging quality control plan must clearly show the divisions between the dredging units that will be taken to the open-water disposal site and those that will be taken to Parcel 14. The

sequencing of dredging must also be addressed. A DNR site-use authorization must be acquired. Disposal at the Commencement Bay site must be by bottom-dump barge.

9. References.

Anchor, 2011a. *Sediment Sampling and Analysis Plan – Berths 3 and 4 Sediment Characterization, Blair Waterway, Tacoma, Washington.* Prepared by Anchor QEA for the Port of Tacoma, January 2011.

Anchor, 2011b. *Sediment Characterization Report – Berths 3 and 4, Blair Waterway, Tacoma, Washington.* Prepared by Anchor QEA for the Port of Tacoma, May 2011.

DMMP, 2008a. *Dredged Material Evaluation and Disposal Procedures (Users Manual)*. Prepared by the Seattle District Dredged Material Management Office for the Dredged Material Management Program, July 2008.

DMMP, 2008b. *Quality of Post-Dredge Sediment Surfaces (Updated).* A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

DMMP, 2010. *Dredged Material Management Program – New Interim Guidelines for Dioxin.* DMMP agencies, December 2010.

Ecology, 1995. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, December 1995.

10. Agency Signatures.

Concur:

7/14/11 David Fox
Date David Fox - Seattle District Corps of Engineers

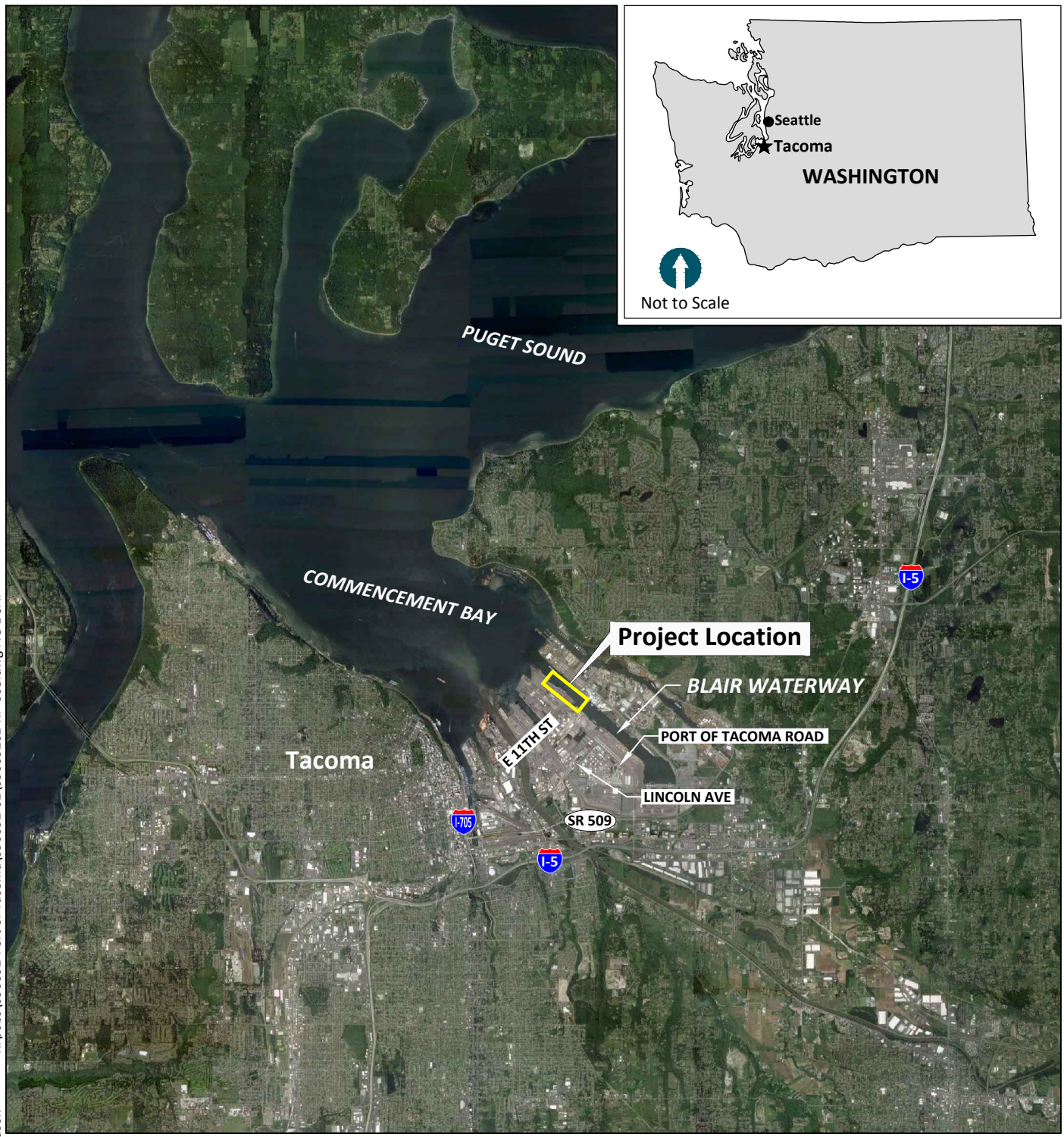
7/15/11
Date Erika Hoffman - Environmental Protection Agency

July 18, 2011 Laura Inouye
Date Laura Inouye, Ph.D. - Washington Department of Ecology

7/28/11
Date Lionel Klikoff - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Olivia Romano – Seattle District Regulatory
Dan Berlin – Anchor QEA
Robert Brenner – Port of Tacoma



SOURCE: Google Earth Pro, 2010.

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Scale in Miles

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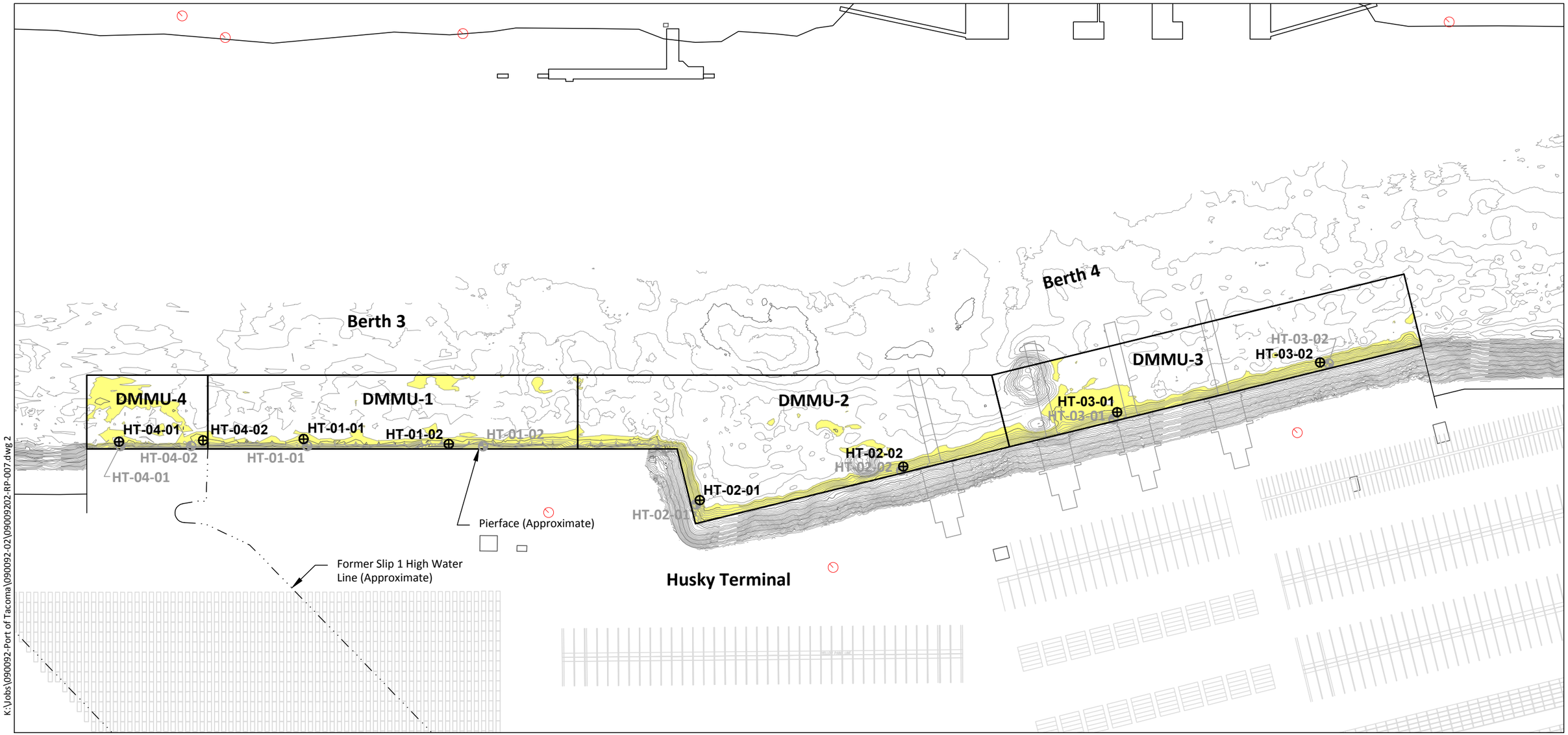
Figure 1
Vicinity Map
Berths 3 and 4
Port of Tacoma



SOURCE: Berth 3 survey from drawing by Bush, Roed & Hitchings, Inc. dated October, 2010.
Berth 4 survey by Gahagan & Bryant Associates, Inc. dated June 3, 2010.
HORIZONTAL DATUM: Washington State Plane South, NAD83, US Survey Feet.
VERTICAL DATUM:
Berth 3: Port of Tacoma MLLW.
Berth 4: Bathymetric soundings are based on Mean Lower Low Water (MLLW) Vertical Datum (1960-1978 Tidal Epoch); Elev. 0.00' NAVD88 = +2.67' MLLW; per Port of Tacoma drawing E7001-SV01-CONTROL.

LEGEND:

- Approximate Outfall Location
- DMMU-1 — Dredged Material Management Unit
- Shallower than Elevation -51 MLLW
- HT-01-01 — Proposed DMMU Sample Location
- HT-01-01 — Actual DMMU Sample Location

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Figure 2
DMMU Sampling Locations
Berths 3 and 4
Port of Tacoma

Figure 3 - Location of the upland disposal site, Parcel 14

NWS-2005-467-WRD

Table 6
Coordinates and Mudline Elevations for Sample Locations (from Anchor, 2011b)

Core Station ID	Latitude [a] (°N)	Longitude [a] (°W)	Northing [a] (feet)	Easting [a] (feet)	Mudline Elevation (feet MLLW)	Depth Achieved [b] (feet MLLW)
HT-01-01	47 16.57316	122 24.74788	714285	1165722	-50.4	-55
HT-01-02	47 16.53899	122 24.69717	714072	1165927	-51.2	-55
HT-02-01	47 16.46827	122 24.62526	713635	1166214	-47.9	-55
HT-02-02	47 16.43037	122 24.54061	713396	1166559	-47.7	-55
HT-03-01	47 16.39520	122 24.44530	713173	1166948	-48.0	-55
HT-03-02	47 16.36140	122 24.35550	712959	1167314	-49.1	-55
HT-04-01	47 16.61435	122 24.81544	714542	1165449	-50.6	-55
HT-04-02	47 16.59563	122 24.78462	714425	1165574	-51.3	-55

Notes:

a – Washington South Zone, NAD 83 geographic and state plane coordinates – U.S. survey feet

b – The target depth for sediment cores comprises the project depth of -51 feet mean lower low water (MLLW), 2 feet of overdredge, and 2 feet of Z-layer material.

Table 7
Sediment Core and Composite Sample IDs and Compositing Scheme
(from Anchor, 2011b)

DMMU	Core Station ID	Core Intervals	DMMU Composite Sample ID	Estimated Volume (cy)
HT-01	HT-01-01	A: 0-2.6 ft Z: 2.6-4.6 ft	HT-01-CS	12,100
	HT-01-02	A: 0-1.8 ft Z: 1.8-3.8 ft		
HT-02	HT-02-01	A: 0-4.0 ft B: 4.0-5.1 ft Z: 5.1-7.1 ft	HT-02-CS	14,200
	HT-02-02	A: 0-4.0 ft B: 4.0-5.3 ft Z: 5.3-7.1 ft		
HT-03	HT-03-01	A: 0-4.0 ft B: 4.0-5.0 ft Z: 5.0-7.0 ft	HT-03-CS	14,100
	HT-03-02	A: 0-3.9 ft Z: 3.9-5.9 ft		
HT-04	HT-04-01	A: 0-2.4 ft Z: 2.4-4.4 ft	HT-04-CS	1,700
	HT-04-02	A: 0-1.7 ft Z: 1.7-3.7 ft		
Totals:	**8**	**--**	**4**	**42,100**

Note: Estimated volume includes 2-foot overdredge.

Table 8
Summary of Sediment Chemical Results Compared to DMMP Evaluation Criteria (from Anchor, 2011b)

	Dredged Material Management Program Criteria						
	Screening Level	Bioaccumulation Trigger	Maximum Level	HT-01 Composite	HT-02 Composite	HT-03 Composite	HT-04 Composite
Conventional Parameters (mg/kg)							
Ammonia	--	--	--	**2.96**	**2.42**	**2.77**	**4.24**
Sulfide	--	--	--	**953**	**347**	**556**	**1290**
Conventional Parameters (pct)							
Total organic carbon	--	--	--	**0.778**	**0.706**	**0.804**	**0.574**
Total solids	--	--	--	**71.4**	**75.1**	**75.3**	**83.2**
Total solids (preserved)	--	--	--	**62.7**	**70.9**	**67.9**	**71**
Total volatile solids	--	--	--	**2.12**	**1.87**	**1.79**	**1.51**
Grain Size (pct)							
Total Gravel	--	--	--	**1.4**	**3.7**	**1.6**	**26.3**
Total Sand	--	--	--	**56.3**	**62.5**	**65.3**	**47.1**
Total Silt	--	--	--	**29.3**	**25.3**	**24.4**	**19.7**
Total Clay	--	--	--	**13**	**8.4**	**8.7**	**7.1**
Total Fines (silt + clay)	--	--	--	**42.3**	**33.7**	**33.1**	**26.8**
Metals (mg/kg)							
Antimony	150	--	200	7 UJ	6 UJ	6 UJ	6 UJ
Arsenic	57	507.1	700	7 U	6 U	6 U	6 U
Cadmium	5.1	11.3	14	0.3 U	0.3 U	0.3 U	0.2 U
Chromium	--	267	--	**18.4**	**16.1**	**15.8**	**17.1**
Copper	390	1027	1300	**29.8**	**24.4**	**24.9**	**22.3**
Lead	450	975	1200	**6**	**6**	**5**	**5**
Mercury	0.41	1.5	2.3	**0.03**	**0.03**	**0.03**	**0.04**
Nickel	140	370	370	**14**	**14**	**12**	**17**
Selenium	--	3	--	0.7 U	0.6 U	0.6 U	0.6 U
Silver	6.1	6.1	8.4	0.4 U	0.4 U	0.4 U	0.3 U
Zinc	410	2783	3800	**38**	**34**	**36**	**34**
Organometallic Compounds (µg/L)							
Butyltin (ion)	--	--	--	**0.012**	**0.012**	**0.015**	**0.009**
Dibutyltin (ion)	--	--	--	**0.013**	**0.01**	0.015 U	**0.008**
Tributyltin (ion)	0.15	0.15	--	**0.057**	**0.005**	**0.022**	0.005 U
Volatile Organics (µg/kg)							
1,2-Dichlorobenzene	35	--	110	1.1 U	1 U	1 U	0.9 U
1,2,4-Trichlorobenzene	31	--	64	5.4 U	5.1 U	4.9 U	4.5 U
1,3-Dichlorobenzene	170	--		1.1 U	1 U	1 U	0.9 U
1,4-Dichlorobenzene	110	--	120	1.1 U	1 U	1 U	0.9 U
Ethylbenzene	10	--	50	1.1 U	1 U	1 U	0.9 U
Hexachlorobutadiene	29	--	270	0.98 U	1 U	0.98 U	0.99 U
m,p-Xylene	--	--	--	1.1 U	1 U	1 U	0.9 U
o-Xylene	--	--	--	1.1 U	1 U	1 U	0.9 U
Tetrachloroethene (PCE)	57	--	210	1.1 U	1 U	1 U	0.9 U
Trichloroethene (TCE)	160	--	1600	1.1 U	1 U	1 U	0.9 U
Total Xylene (U = 0)	40	--	160	1.1 U	1 U	1 U	0.9 U
Polycyclic Aromatic Hydrocarbons (µg/kg)							
Benzo(b,j,k)fluoranthenes	--	--	--	19 U	20 U	20 U	20 U
1-Methylnaphthalene	--	--	--	19 U	20 U	20 U	20 U
2-Methylnaphthalene	670	--	1900	19 U	20 U	20 U	20 U
Acenaphthene	500	--	2000	19 U	20 U	20 U	20 U
Acenaphthylene	560	--	1300	19 U	20 U	20 U	20 U
Anthracene	960	--	13000	19 U	20 U	20 U	20 U
Benzo(a)anthracene	1300	--	5100	19 UJ	20 UJ	20 UJ	20 UJ
Benzo(a)pyrene	1600	--	3600	19 UJ	20 UJ	20 UJ	20 UJ
Benzo(g,h,i)perylene	670	--	3200	19 UJ	20 UJ	20 UJ	20 UJ
Chrysene	1400	--	21000	19 U	20 U	20 U	20 U
Dibenzo(a,h)anthracene	230	--	1900	19 U	20 U	20 U	20 U
Fluoranthene	1700	4600	30000	19 U	20 U	20 U	20 U
Fluorene	540	--	3600	19 UJ	20 UJ	20 UJ	20 UJ
Indeno(1,2,3-c,d)pyrene	600	--	4400	19 UJ	20 UJ	20 UJ	20 UJ
Naphthalene	2100	--	2400	19 U	20 U	20 U	20 U
Phenanthrene	1500	--	21000	19 U	20 U	20 U	20 U
Pyrene	2600	11980	16000	19 UJ	**10 J**	20 UJ	20 UJ
Total DMMP LPAH (U = 0)	5200	--	29000	19 U	20 U	20 U	20 U
Total DMMP HPAH (U = 0)	12000	--	69000	19 U	**10**	20 U	20 U
Total DMMP PAH (U = 0)	--	--	--	19 U	**10**	20 U	20 U
Semivolatile Organics (µg/kg)							
2-Methylphenol (o-Cresol)	63	--	77	19 U	20 U	20 U	20 U
2,4-Dimethylphenol	29	--	210	19 U	20 U	20 U	20 U
4-Methylphenol (p-Cresol)	670	--	3600	19 U	20 U	20 U	20 U
Benzoic acid	650	--	760	190 U	R	200 U	200 U
Benzyl alcohol	57	--	870	46 UJ*	46 UJ*	46 UJ*	46 UJ*
Bis(2-ethylhexyl) phthalate	1300	--	8300	19 U	20 U	20 U	20 U

Table 8
Summary of Sediment Chemical Results Compared to DMMP Evaluation Criteria (from Anchor, 2011b)

	Dredged Material Management Program Criteria						
	Screening Level	Bioaccumulation Trigger	Maximum Level	HT-01 Composite	HT-02 Composite	HT-03 Composite	HT-04 Composite
Butylbenzyl phthalate	63	--	970	19 U	20 U	20 U	20 U
Dibenzofuran	540	--	1700	19 U	20 U	20 U	20 U
Diethyl phthalate	200	--	1200	19 U	20 U	20 U	20 U
Dimethyl phthalate	71	--	1400	19 U	20 U	20 U	20 U
Di-n-butyl phthalate	1400	--	5100	19 U	20 U	20 U	20 U
Di-n-octyl phthalate	6200	--	6200	19 U	20 U	20 U	20 U
Hexachlorobenzene	22	168	230	0.98 U	1 U	0.98 U	0.99 U
Hexachlorobutadiene	29	--	270	19 U	20 U	20 U	20 U
Hexachloroethane	1400	--	14000	19 U	20 U	20 U	20 U
N-Nitrosodiphenylamine	28	--	130	19 U	20 U	20 U	20 U
Pentachlorophenol	400	504	690	97 U	100 UJ	98 U	98 U
Phenol	420	--	1200	19 U	20 U	20 U	20 U
PCB Aroclors (µg/kg)							
Aroclor 1016	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Aroclor 1221	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Aroclor 1232	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Aroclor 1242	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Aroclor 1248	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Aroclor 1254	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Aroclor 1260	--	--	--	9.8 U	10 U	9.8 U	9.9 U
Total PCB Aroclors (U = 0)	130	--	3100	9.8 U	10 U	9.8 U	9.9 U
PCB Aroclors (mg/kg-OC)							
Total PCB Aroclors (U = 0)	--	38	--	1.2596 U	1.4164 U	1.2189 U	1.7247 U
Pesticides (µg/kg)							
4,4'-DDD (p,p'-DDD)	--	--	--	2 U	2 U	2 U	2 U
4,4'-DDE (p,p'-DDE)	--	--	--	2 U	2 U	2 U	2 U
4,4'-DDT (p,p'-DDT)	--	--	--	2 U	2 U	2 U	2 U
Aldrin	10	--	--	0.98 U	1 U	0.98 U	0.99 U
alpha-Chlordane (cis-Chlordane)	--	--	--	0.98 U	1 U	0.98 U	0.99 U
beta-Chlordane (trans-Chlordane)	--	--	--	0.98 U	1 U	0.98 U	0.99 U
cis-Nonachlor	--	--	--	2 U	2 U	2 U	2 U
Dieldrin	10	--	--	2 U	2 U	2 U	2 U
gamma-Hexachlorocyclohexane (BHC) (Lindane)	10	--	--	0.98 U	1 U	0.98 U	0.99 U
Heptachlor	10	--	--	0.98 U	1 U	0.98 U	0.99 U
Oxychlordane	--	--	--	2 U	2 U	2 U	2 U
trans-Nonachlor	--	--	--	2 U	2 U	2 U	2 U
Total DDx (U = 0)	6.9	50	69	2 U	2 U	2 U	2 U
Total DMMP Chlordane (U = 0)	10	37	--	2 U	2 U	2 U	2 U

Notes:

Bold = Detected result

J = Estimated value

U = Compound analyzed, but not detected above detection limit

* The reporting limit for benzyl alcohol ranged from 97 to 100 µg/kg, which is above the SL. ARI reviewed the results of benzyl alcohol and observed the ion response below the method detection limit (MDL). Therefore, the MDL for benzyl alcohol has been reported for each sample and qualified as UJ.

Table 9
Composite DMMU Sediment Dioxin/Furan Results (from Anchor, 2011b)

Sample	HT-01 Composite	HT-02 Composite	HT-03 Composite	HT-04 Composite
Dioxin Furans (ng/kg)				
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	0.128 U*	0.205 U*	0.185 U*	0.0979 U*
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	**0.663 J**	**0.944 J**	**1.1 J**	**0.473 J**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	**0.723 J**	**0.902 J**	**1.04 J**	**0.423 J**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	**3.31**	**5.84**	**7.4**	**2.21**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	**1.85 J**	**2.79 J**	**3.41 J**	**1.19 J**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	**64.8**	**79.3**	**146**	**38.3**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	**635**	**834**	**2550**	**349**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	**19.9**	**1.07**	**1.36**	**1.89**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	**15.9**	**0.868 J**	**1.23 J**	**1.85**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	**12.9**	**0.718 J**	**1.02**	**1.05**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	**13.9**	**2.45**	**3.72**	**3.97**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	**3.51**	**1.04 J**	**1.39 J**	**1.26 J**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	**3.38**	**0.636 J**	**1.06 J**	**0.77 J**
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	**2.38 J**	**1.23 J**	**1.59 J**	**0.856 J**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	**14.8**	**17.3**	**23.2**	**11.2**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	**2.2**	1.31 U*	**2.06**	**1.74 J**
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	**39.8 J**	**41.3 J**	**64.9 J**	**31.6 J**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	**8.08 J**	**10.4 J**	**15.8 J**	**6.98 J**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	**7.9 J**	**11.5 J**	**12.7 J**	**6.41 J**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	**32**	**44.9**	**53.6**	**19.7**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	**198**	**191**	**360**	**108**
Total Tetrachlorodibenzofuran (TCDF)	**61.3**	**8.96**	**11.8**	**10.1**
Total Pentachlorodibenzofuran (PeCDF)	**69.6 J**	**12.1 J**	**14.7 J**	**11.8 J**
Total Hexachlorodibenzofuran (HxCDF)	**44.4 J**	**30.3 J**	**45.3 J**	**20.4 J**
Total Heptachlorodibenzofuran (HpCDF)	**44.9 J**	**56 J**	**81.1 J**	**34.5 J**
Total Dioxin/Furan TEQ 2005 (U = 0)	**10.93**	**4.01**	**6.04**	**2.73**
Total Dioxin/Furan TEQ 2005 (U = 1/2)	**10.99**	**4.12**	**6.13**	**2.78**

Notes:

Bold = Detected result

J = Estimated value

U* = The value shown is the estimated maximum possible concentration (EMPC);
DMMP treats such compounds as non-detects at the EMPC reporting level

Table 10
Individual Core Sediment Dioxin/Furan Results (from Anchor, 2011b)

DMMU	HT-01		HT-02		HT-03	
Sample ID	HT-01-01	HT-01-02	HT-02-01	HT-02-02	HT-03-01	HT-03-02
Dioxin Furans (ng/kg)						
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	0.12 U*	0.152 U*	0.0591 U*	0.186 U*	0.303 U*	0.171 U*
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	**0.7 J**	**0.97 J**	**0.275 J**	**1.08 J**	**1.65 J**	**0.938 J**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	**0.733 J**	**1.14 J**	0.285 U	**0.912 J**	**1.59 J**	**1.01 J**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	**3.81**	**5.29**	**1.17 J**	**6.2**	**9.54**	**5.03**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	**2.07 J**	**2.58 J**	**0.582 J**	**2.95 J**	**4.76 J**	**2.67 J**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	**104**	**125**	**24.2**	**79.2**	**176**	**103**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	**1370**	**1280**	**463**	**926**	**3170**	**1120**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	**3.21**	**2.5**	**0.37 J**	**1.59**	**1.44**	**1.28**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	**5.93**	**2.73**	**0.392 J**	**1.89**	**1.4 J**	**1.32 J**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	**2.76**	**1.62**	0.292 U	**1.23**	**1.2**	**0.91 J**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	**8.64**	**7.15**	**0.837 J**	**3.46**	**4.54**	**3.3**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	**2.73**	**2.15**	**0.37 J**	**1.41 J**	**1.81 J**	**1.34 J**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	**1.36 J**	**1.32 J**	**0.257 J**	**0.769 J**	**1.37 J**	**0.699 J**
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	**1.66 J**	**1.04 J**	**0.379 J**	**1.45 J**	**2.28 J**	**0.631 J**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	**23.2**	**21.6**	**4.69**	**18.6**	**32.1**	**18.1**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	**2.83**	**2.88**	**0.495 J**	**1.57 J**	**2.84**	**1.63 J**
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	**94.2 J**	**59.9 J**	**14.4 J**	**44.7 J**	**89.6 J**	**54 J**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	**7.80 J**	**10.5 J**	**3.56 J**	**12.7 J**	**33.0 J**	**8.87 J**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	**8.79 J**	**11.5 J**	**3.34 J**	**13.8 J**	**21.5 J**	**10 J**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	**31**	**48.9**	**10.9**	**44.8**	**64.9**	**40.6**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	**227**	**380**	**84.6**	**181**	**392**	**281**
Total Tetrachlorodibenzofuran (TCDF)	**14.4**	**15.8**	**2.45**	**12.8**	**16.8**	**11.4**
Total Pentachlorodibenzofuran (PeCDF)	**25.5 J**	**21.1 J**	**3.59 J**	**15.8 J**	**20.9 J**	**14.3 J**
Total Hexachlorodibenzofuran (HxCDF)	**39.1 J**	**48.6 J**	**7.92 J**	**33.8 J**	**64.0 J**	**34.6 J**
Total Heptachlorodibenzofuran (HpCDF)	**74 J**	**74.3 J**	**15.8 J**	**58.4 J**	**121 J**	**61 J**
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)	**5.87**	**5.75**	**1.12**	**4.67**	**7.87**	**4.42**
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2)	**5.93**	**5.83**	**1.21**	**4.76**	**8.02**	**4.51**

Notes:

Bold = Detected result

J = Estimated value

U = Compound analyzed, but not detected above detection limit

U* = The value shown is the estimated maximum possible concentration (EMPC);
DMMP treats such compounds as non-detects at the EMPC reporting level

Table 11
Calculation of Volume-Weighted Average for
Accepted Dredging Sequence for Open-Water Disposal

Dredging Order	Dredging Unit	Dioxin/furan TEQ (ng/kg)		Volume (cy)		TEQ x Volume ng·cy/kg
1	HT-03-01	8.02	x	3,200	=	25,664
2	HT-02-02	4.76	x	7,100	=	33,796
3	HT-03-02	4.51	x	7,050	=	31,796
4	DMMU 4	2.78	x	1,700	=	4,726
5	HT-02-01	1.21	x	7,100	=	8,591
				26,150		104,573

Volume-weighted average = 104,573 ng·cy/kg ÷ 26,150 cy = 4.0 ng/kg

CENWS-OD-TS-DMMO

MEMORANDUM FOR: RECORD July 14, 2011

SUBJECT: CASE-BY-CASE DELIBERATIONS UNDER THE DMMP INTERIM DIOXIN GUIDELINES FOR THE PORT OF TACOMA'S HUSKY TERMINAL (BLAIR WATERWAY, BERTHS 3 & 4), WITH RESPECT TO UNCONFINED OPEN-WATER DISPOSAL AT THE COMMENCEMENT BAY SITE.

1. Introduction. This memorandum documents the case-by-case deliberations of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the Environmental Protection Agency) for the Port of Tacoma's Husky Terminal under the DMMP interim dioxin guidelines. This document is a supplement to the suitability determination for this project (DMMP, 2011).

2. Interim Guidelines for Dioxin. The DMMP agencies established new interim guidelines for dioxin in December 2010 (DMMP, 2010). The interim guidelines are as follows for non-dispersive sites:

   DMMUs with dioxin concentrations below 10 pptr TEQ will be allowed for open-water disposal as long as the volume-weighted average concentration of dioxins in material from the entire dredging project does not exceed the Disposal Site Management Objective of 4 pptr TEQ.

   The guidelines also provide flexibility for non-dispersive disposal on a project-specific basis:

   Case-by-case decisions to allow disposal of material not meeting the screening levels may be made by the DMMP Agencies based on the overall goal of meeting the Non-dispersive Disposal Site Management Objective. Case-by-case considerations will include the following: (a) material placement sequencing; (b) consideration of the possible cumulative effects of other bioaccumulative compounds within the project sediments; and (c) the frequency of disposal site use.

3. Dioxin Analysis. Dioxins in the dredged material were analyzed in two rounds. In the first round of dioxin testing, composited samples representing DMMUs 1 through 4 were tested, resulting in concentrations ranging from 2.78 to 10.99 parts per trillion (pptr) toxicity equivalents (TEQ, with undetects = ½ estimated detection limit). The Port of Tacoma independently initiated a second round of testing to determine the dioxin concentrations in the individual cores making up DMMUs 1, 2 and 3. The range of concentrations for these cores was 1.21 to 8.02 pptr. Detailed results for the two rounds of testing can be found in Tables 9 and 10 of the suitability determination. Table A-1 provides a summary of the data. The dioxin data underwent Stage 4 validation by Laboratory Data Consultants of Carlsbad, CA.

Table A-1 – Dioxin results for Rounds 1 and 2

DMMU	Volume (cy)	Round 1 Dioxin/Furan TEQ (ng/kg)	Individual Cores	Volume (cy)	Round 2 Dioxin/Furan TEQ (ng/kg)
1	12,100	10.99	HT-01-01	6,050	5.93
			HT-01-02	6,050	5.83
2	14,200	4.12	HT-02-01	7,100	1.21
			HT-02-02	7,100	4.76
3	14,100	6.13	HT-03-01	7,050	8.02
			HT-03-02	7,050	4.51
4	1,700	2.78	HT-04-01	850	---
			HT-04-02	850	---

4. Case-by-Case Deliberations. There were no other bioaccumulative compounds detected above DMMP screening levels for Husky Terminal, and Commencement Bay is a frequently-used disposal site, thereby providing more latitude in making a case-by-case determination. The DMMP agencies evaluated the data from both rounds of testing and provided the Port of Tacoma two options for moving forward with the project.

   a. The first option was the sequenced dredging and disposal of the entire 42,100 cubic yards of material at the Commencement Bay site, followed by post-disposal monitoring by the Port of Tacoma to determine whether the site management objective of 4 pptr had been met. The post-disposal monitoring would consist of sediment profile imaging at the disposal site, followed by targeted sediment sampling and dioxin testing. Because the cumulative disposal volume at the Commencement Bay site since it was last monitored in 2007 was not enough to trigger another full monitoring event, the proposed monitoring was strictly for the purpose of determining whether the sequencing of dredged material from Berths 3 and 4 was effective in meeting the site management objective within the impacted area. For that reason the costs of monitoring would be borne by the Port of Tacoma.

   b. The second option was the dredging and disposal of the Husky Terminal material at the Commencement Bay site, followed by the dredging and disposal of another dredging project - with clean material - that would bring the volume-weighted average of the entire disposed volume down below 4 pptr. The other dredging project would have to be conducted within the same dredging season. If the Port were to conduct the Husky Terminal dredging and disposal, but the other project was unable to be dredged within the same season, then the Port would need to conduct monitoring at the Commencement Bay site as delineated in the first option.

The Port opted not to pursue either of these options, but to pursue a mixed-disposal option instead, in which some of the material would be taken to the Commencement Bay site, with the rest of the material disposed upland. The DMMP agencies agreed to evaluate this option and determine what portion of the material could be taken to the Commencement Bay site without a requirement for post-disposal monitoring.

Determination of the volume-weighted average (VWA) dioxin concentration for the project was complicated by the high degree of variability exhibited for samples from DMMU 1. While the dioxin concentration of the individual cores comprising DMMUs 2 and 3 bracketed the concentration for their respective composites, the concentrations of the individual cores from DMMU 1 were both less than for the composite (see Table A-1). The DMMP agencies addressed this variability by calculating a range for the VWA. Table A-2 presents the subset of dredging units and sequence of dredging and open-water disposal that the agencies were willing to allow without post-disposal monitoring:

Table A-2. Allowable dredging sequence without monitoring

Dredging Order	Dredging Unit	Dioxin/furan TEQ (ng/kg)	Volume (cy)
1	HT-01-02	5.83 to 10.99	6,050
2	HT-02-02	4.76	7,100
3	HT-03-02	4.51	7,050
4	DMMU 4	2.78	1,700
5	HT-02-01	1.21	7,100
	VWA:	3.94 to 5.01	29,000

Subsequent to making this case-by-case determination, the Port of Tacoma indicated that "Parcel 14", near the head of the Blair Waterway, would be used for the upland disposal component of the project. The DMMP agencies communicated their preference to the Port that the VWA of material taken to the Commencement Bay site be reduced to 4.0 pptr or less if Parcel 14 had adequate capacity for unsuitable material and the upland disposal cost was reasonably low. The Port of Tacoma agreed to this proposal and accepted the subset of dredging units and sequence of dredging and disposal at the Commencement Bay site shown in Table A-3. This differs from what is presented in Table A-2 in that HT-01-02 (from DMMU 1, in which the individual cores showed the highest variability in dioxin relative to the composite results) is replaced with a portion of HT-03-01. Under this scenario, all of DMMU 1 is dredged and disposed of upland.

Table A-3. Accepted sequence of dredging for open-water disposal

Dredging Order	Dredging Unit	Dioxin/furan TEQ (ng/kg)	Volume (cy)
1	HT-03-01	8.02	*3,200*
2	HT-02-02	4.76	7,100
3	HT-03-02	4.51	7,050
4	DMMU 4	2.78	1,700
5	HT-02-01	1.21	7,100
	VWA:	4.00	26,150

5. References.

DMMP, 2010. *Dredged Material Management Program – New Interim Guidelines for Dioxin.* DMMP agencies, December 2010.

DMMP, 2011. *Determination Regarding the Suitability of Proposed Dredged Material from the Port of Tacoma's Husky Terminal (Blair Waterway, Berths 3 & 4), for Unconfined Open-Water Disposal at the Commencement Bay Site*, Memorandum for Record prepared by David Fox (USACE) for the Dredged Material Management Program, July 2011.