

Oregon Slough Entrance Channel Sediment Quality Evaluation

ABSTRACT

This evaluation was conducted following procedures set forth in the Inland Testing Manual, developed jointly by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency to assess dredged material. Guidelines used are those developed to implement the Clean Water Act. These guidelines and associated screening levels are those adopted for use in the Dredge Material Evaluation Framework for the Lower Columbia River Management Area, November 1998.

A total of four (4) sediment samples were collected from the Oregon Slough entrance channel on June 19, 2001. All samples were submitted for physical analyses including total volatile solids and also were analyzed for metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons, organotin, and dioxin/furan.

The level for silver in sample OS-VC-04 was initially found to be above the SL; this result was suspected to be a lab error. To verify the results, the lab reanalyzed the sample, in duplicate, for silver; these results showed good correlation, were at the method detection limit for silver and therefore, did not verify the earlier hit. None of the other contaminants tested were found to be at or above their respective SLs in the samples. Therefore, all sediment is determined to be suitable for unconfined, in-water placement without further characterization.

INTRODUCTION

This report characterizes the sediment to be dredged at the Oregon Slough entrance channel for the purposes of dredging and disposal. The sampling and analysis objectives are stated in the Sampling and Analysis Plan (SAP June 2001), and are also listed below. This report will outline the procedures used to accomplish these objectives.

Sampling and Analysis Objectives

Characterize sediments in accordance with the regional dredge material testing manual, the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF).

- Physical and chemical analyses will be conducted on the 4 vibra-core samples representing the dredging prism. The sample portion representing the newly exposed surface (NES) after dredging will be archived for possible future analysis if dredging prism analyses exceed DEMF screening levels (SLs).

- Collect, handle and analyze representative sediment of the proposed dredging prism, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Characterize sediments to be dredged for evaluation of environmental impact.
- Conduct physical and chemical characterization only for this sediment evaluation.

PREVIOUS STUDIES

Physical and chemical evaluation sampling was performed at Oregon Slough in 1996 by the Corps and in 1988, 1993, 1995 by the Port of Portland. The evaluations done by the Port showed the pollutant levels in the sediments to be below levels of concern. During dredging in November 1995 by the Corps dredge Yaquina, oil droplets were seen rising to the surface and forming an oil sheen. Dredging was halted, and sampling and sediment quality testing was conducted by the Corps in March 1996.

In the March 1996 sampling event, four samples were collected using a gravity corer. All samples were submitted for physical and chemical analyses including volatile solids content, acid volatile sulfides, metals, organochlorine pesticides, organotin, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs). The pollutant content of the sediment in all cases was found to be below levels of concern. No indications were found of the presence of oily substances in the samples. Therefore, the sediments were found to be acceptable for unconfined, in-water disposal.

CURRENT SAMPLING EVENT/DISCUSSION

A total of four (4) sediment samples were collected from the Oregon Slough entrance channel on June 19, 2001 (see Figure 1 and Table 1).

Table 1. Sample Location Coordinates (NAD 83, Oregon State Plane North)

OR-VC-01	45° 36' 8.08"	OR-VC-03	45° 36' 9.25"
	122° 38' 46.71"		122° 38' 21.23"
OR-VC-02	45° 36' 7.481"	OR-VC-04	45° 36' 9.09"
	122° 38' 38.52"		122° 38' 16.31"

The samples were collected using a vibra-core sampling device. All samples were submitted for physical analyses including total volatile solids (TVS) and were analyzed for metals (9 inorganic), total organic carbon (TOC), pesticides and polychlorinated biphenyls

(PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs), organotin (TBT), and dioxin/furan.

RESULTS

Physical and Volatile Solids (ASTM methods). Four (4) samples and one (1) duplicate sample were submitted for physical and TVS analyses and data are presented in Table 1. None of the samples exceeded 20% fines and/or 5% volatile solids. Four samples were classified as “poorly graded sand,” and one sample was classified as “silty sand.” Mean grain size for all the samples is 0.37 mm, with 0.07% gravel, 95.07% sand and 4.85% fines. Volatile solids for all the samples ranged from 0.44% to 1.76%.

Metals (EPA method 6020/7471), Total Organic Carbon (EPA method 9060). Four (4) samples were submitted for testing and the data are presented in Table 2. The TOC ranged from 700 to 8,700 mg/kg in the samples.

Low levels of most metals were found but most did not approach the screening level (SL), except for silver in one sample (OS-VC-04), which exceeded the SL. The result for silver was suspected to be in error since the lab was having a problem with their silver analyses (the sediment evaluation reports that showed a lab problem with the silver analysis are listed on the reference page). To verify the results, the lab reanalyzed OS-VC-04 for silver, in duplicate, and the levels were found to be 0.084 mg/kg and <0.061 mg/kg (archive sample), which show good correlation and are below the SL.

Organotin [total (bulk) TBT]. Four (4) samples were tested and the data are presented in Table 3. The lab was not able to extract the amount of pore water necessary to run the pore water method analysis, so total (bulk) TBT was analyzed. Monobutyltin, which is a breakdown product of tributyltin (TBT), was detected in one sample (OS-VC-02) at 1.8 ug/kg (estimated value), which is below the screening level of 73 ug/kg TBT (PSDDA 1996). Organotin was not detected in the other samples at the method detection limit (MDL).

Pesticides/PCBs (EPA method 8081A/8082), Phenols, Phthalates and Miscellaneous Extractables (EPA method 8270). Four (4) samples were tested for pesticides/PCBs and the data are presented in Table 4. No PCBs were found at the MDL in any of the samples. No pesticides (including DDT) were found at the MDL in three of the samples; in one sample, total DDT was found at 2.5 ug/kg, which is 36% of the SL. Two phthalate compounds were detected in all samples, and the values were well below their respective SLs (<1%). No phenols or miscellaneous extractables were found at the MDL in any of the samples.

Polynuclear Aromatic Hydrocarbons (EPA method 8270C). Four (4) samples were tested and the data are presented in Tables 5 and 6. All the “low molecular weight” PAHs were not detected at the MDL in the samples. Low levels of most “high molecular weight” PAHs were found in all samples and all values ranged below 1% of their respective SLs.

Dioxins/Furans (Method SW846 8290). Four (4) sample was tested and the data are presented in Tables 7, 8, 9, and 10. Dioxin (2,3,7,8-TCDD) and furan (2,3,7,8-TCDF) were not found at the MDL for any of the samples. The total toxic equivalent concentration value for the samples was well below the guidance concentration value.

CONCLUSION

Collection and evaluation of the sediment data was completed using guidelines from the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF). The DMEF is a regional manual developed jointly with regional EPA, Corps, Oregon Department of Environmental Quality and Washington Departments of Ecology and Natural Resources. This document is a guideline for implementing the Clean Water Act (40 CFR 230), Section 404 (b)(1). The screening levels used are those adopted for use in the DMEF, final November 1998. The DMEF tiered testing approach requires that material in excess of 20% fines and greater than 5% volatile solids, as well as any material with prior history or is suspected (“reason to believe”) of being contaminated, be subjected to chemical as well as physical analyses.

A total of four (4) sediment samples were collected from the Oregon Slough entrance channel on June 19, 2001. All samples were submitted for physical and chemical analyses. The level for silver in sample OS-VC-04 was initially found to be above the SL; this result was suspected to be a lab error. To verify the results, the lab reanalyzed the sample, in duplicate, for silver; these results showed good correlation, were below the SL for silver and therefore, did not verify the earlier hit. None of the other contaminants tested were found to be at or above their respective SLs in the samples. Therefore, all sediment is determined to be suitable for unconfined, in-water placement without further characterization.

REFERENCES

1. U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. 1998 Final. Dredge Material Evaluation Framework for the Lower Columbia River Management Area.
2. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Testing Manual (referred to as the "Inland Testing Manual").
3. Clean Water Act, 40 CFR 230 (b)(1).
4. U.S. Army Corps of Engineers. June 2001. Sediment Sampling and Analysis Plan for Oregon Slough. Portland District.
5. U.S. Army Corps of Engineers. 1996. Columbia River, Multnomah Co., OR; Oregon Slough Sediment Quality Evaluation. Portland District.
6. PSDDA. 1996. Puget Sound Dredged Disposal Analysis, Technical Information Memorandum, Testing, Reporting and Evaluation of Tributyltin Data in PSDDA and SMS Programs.

The following reports, prepared by the U.S. Army Corps of Engineers, Portland District, December 2001, also showed a lab problem with the silver analysis:

Coquille River and Boat Basin, Sediment Quality Evaluation
Skipanon Entrance Channel and Boat Basin, Sediment Quality Evaluation
Chetco River and Boat Basin, Sediment Quality Evaluation
Columbia River Channel Deepening (CRCDD), Station #76 (CR-BC-76), Sediment
Quality Evaluation

Table 1. Oregon Slough Entrance Channel

Sampled June 19, 2001

Physical Analysis & Volatile Solids

Sample I.D.	Grain Size (mm)		Percent			
	Median	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
OS-VC-01A	0.24	0.34	0.37	99.22	0.41	0.52
OS-VC-01 DUP	0.21	0.27	0.00	97.25	2.75	0.44
OS-VC-02	0.19	0.26	0.00	98.66	1.34	0.63
OS-VC-03	0.18	0.13	0.00	97.87	2.13	1.72
OS-VC-04	0.19	0.83	0.00	82.37	17.63	1.76
Mean	0.20	0.37	0.07	95.07	4.85	1.01
Minimum	0.18	0.13	0.00	82.37	0.41	0.44
Maximum	0.24	0.83	0.37	99.22	17.63	1.76

Table 2. Oregon Slough Entrance Channel

Sampled June 19, 2001

Inorganic Metals and TOC

Sample I.D.	As	Sb	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)									
OS-VC-01A	0.93 J	0.53 J B1	0.3 J	5.8	2.8	<0.032	7.4	<0.056	36	700
OS-VC-02	1.6	0.27 J B1	0.37 J	7.5	3.7	0.03 J	6.7	0.065 J	47	1000
OS-VC-03	0.96 J	0.3 J B1	0.44 J	15	4.5	<0.026	8.4	0.087 J	53	1400
OS-VC-04	1.9	0.3 J B1	0.66 J	15	9.8	<0.037	12	18*	150	8700
Screening level (SL)	57	150	5.1	390	450	0.41	140	6.1	410	
<p>* Silver (Ag) for OS-VC-04 was reanalyzed on 7/19/01; the result = 0.084 J mg/kg (archive sample = <0.061 mg/kg).</p> <p>J = Estimated value (reported values are above the MDL, but below the PQL).</p> <p>B1 = Low-level contamination was present in the method blank (reported level was < 10 times blank concentration).</p> <p>Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).</p>										

Table 3. Oregon Slough Entrance Channel

Sampled June 19, 2001

Organotin
Total (Bulk) TBT

Sample I.D.	Tetrabutyltin	Tributyltin	Dibutyltin	Monobutyltin	Total TBT
	ug/kg				
OS-VC-01A	<0.51	<1.1	<0.67	<1.5	ND
OS-VC-02	<0.52	<1.1	<0.68	1.8 J	1.8
OS-VC-03	<0.55	<1.1	<0.71	<1.6	ND
OS-VC-04	<0.68	<1.4	<0.87	<1.9	ND
Screening level (SL)					73*
<p>*SL reference: Puget Sound Dredged Disposal Analysis (PSDDA), Technical Information Memorandum, Testing, Reporting and Evaluation of Tributyltin Data in PSDDA and SMS Programs, 1996. J = Estimated value (reported values are above the MDL, but below the PQL). Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).</p>					

Table 4. Oregon Slough Entrance Channel

Sampled June 19, 2001

Pesticides, PCBs*, Phenols, Phthalates and Extractables****

Sample I.D.	Pesticides				Phthalates	
	ug/kg (ppb)					
	4,4'- DDD	4,4'- DDE	4,4'- DDT	Total DDT	bis(2-Ethylhexyl) phthalate	Butylbenzyl- phthalate
OS-VC-01A	<0.2	<0.24	<0.27	ND	7.4 J B1	3.5 J
OS-VC-02	<0.22	<0.26	<0.29	ND	12 J B1	4.3 J
OS-VC-03	<0.24	<0.28	<0.31	ND	11 J B1	5.4 J
OS-VC-04	1.2 J C1	1.3 J C1	<0.36	2.5	9.1 J B1	8.4 J
Screen level (SL)	DDD + DDE + DDT = 6.9				8300	970
<p>*No PCBs were found in any sample at the MDL (SL = 130 ppb).</p> <p>**No Phenols or Extractables were found in any sample at their respective MDLs.</p> <p>J = Estimated value (reported values are above the MDL, but below the PQL).</p> <p>B1 = Low-level contamination was present in the method blank (reported level was < 10 times blank concentration).</p> <p>Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).</p>						

Table 5. Oregon Slough Entrance Channel

Sampled June 19, 2001

Polynuclear Aromatic Hydrocarbons (PAHs)
Low Molecular Weight Analytes
ug/kg (ppb)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phenanthrene	Total Low PAHs
OS-VC-01A	<0.78	<0.69	<0.4	<0.74	<0.25	<0.74	<0.34	ND
OS-VC-02	<0.79	<0.69	<0.4	<0.74	<0.25	<0.74	<0.34	ND
OS-VC-03	<0.83	<0.73	<0.42	<0.78	<0.26	<0.78	<0.36	ND
OS-VC-04	<0.87	<0.76	<0.44	<0.82	<0.27	<0.82	<0.37	ND
Screen level (SL)	500	560	960	540	670	2100	1500	5200
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)								

Table 6. Oregon Slough Entrance Channel

Sampled June 19, 2001

Polynuclear Aromatic Hydrocarbons (PAHs)
High Molecular Weight Analytes
ug/kg (ppb)

Sample I.D.	Benzo(b)- fluro- anthene	Benzo(k)- fluro- anthene	Benzo- (g,h,i)- perylene	Chrysene	Pyrene	Benzo(a)- pyrene	Indeno- (1,2,3-cd)- pyrene	Fluor- anthene	Total High PAHs
OS-VC-01A	<0.34	<0.69	<0.26	<0.93	<0.52	<0.93	<0.37	<0.74	ND
OS-VC-02	2.2	<0.69	1.7	<0.93	1.7	<0.93	<0.37	2.2	7.8
OS-VC-03	4.2	<0.73	1.8	2 J	2.3	2	1.8	2.7	16.8
OS-VC-04	5.4	<0.76	<0.29	4.2	3.9	3.3	<0.41	3.5	20.3
Screen level (SL)	b + k = 3200		670	1400	2600	1600	600	1700	12000
J = Estimated value (reported values are above the MDL, but below the PQL). Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).									

Table 7. Oregon Slough Entrance Channel

Sampled June 19, 2001

Dioxins/Furans (ng/kg, ppt)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
OS-VC-01A - Dioxin	2,3,7,8-TCDD	<1.1	0.55	1.0	0.55	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	Total TCDD	<1.1	0.55	0	0	
	1,2,3,7,8-PeCDD	<2.1	1.05	0.5	0.525	
	Total PeCDD	<2.1	1.05	0	0	
	1,2,3,4,7,8-HxCDD	<2.2	1.1	0.1	0.11	
	1,2,3,6,7,8-HxCDD	<2.3	1.15	0.1	0.115	
	1,2,3,7,8,9-HxCDD	<2.1	1.05	0.1	0.105	
	Total HxCDD	<2.3	1.15	0	0	
	1,2,3,4,6,7,8-HpCDD	<1.2	0.6	0.01	0.006	
	Total HpCDD	<1.2	0.6	0	0	
	OCDD	<3.3	1.65	0.001	0.0016	
OS-VC-01A - Furan	2,3,7,8-TCDF	<0.58	0.29	0.1	0.029	
	Total TCDF	<0.58	0.29	0	0	
	1,2,3,7,8-PeCDF	<1.1	0.55	0.05	0.028	
	2,3,4,7,8-PeCDF	<1.1	0.55	0.05	0.028	
	Total PeCDF	<1.5	0.75	0	0	
	1,2,3,4,7,8-HxCDF	<1.6	0.8	0.1	0.08	
	1,2,3,6,7,8-HxCDF	<1.5	0.75	0.1	0.075	
	2,3,4,6,7,8-HxCDF	<1.7	0.85	0.1	0.085	
	1,2,3,7,8,9-HxCDF	<1.9	0.95	0.1	0.095	
	Total HxCDF	<1.9	0.95	0	0	
	1,2,3,4,6,7,8-HpCDF	<0.67	0.34	0.01	0.0034	
1,2,3,4,7,8,9-HpCDF	<0.80	0.4	0.01	0.004		
Total HpCDF	<0.80	0.4	0	0		
OCDF	<2.6	1.3	0.001	0.0013		
Total Dioxins/Furans TEQ					1.841	<15 ng/kg

MDL = Method Detection Limit

TEQ = Toxicity Equivalency Quotient

TEF = Toxicity Equivalency Factors

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Table 8. Oregon Slough Entrance Channel

Sampled June 19, 2001

Dioxins/Furans (ng/kg, ppt)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
OS-VC-02 - Dioxin	2,3,7,8-TCDD	<0.96	0.48	1.0	0.48	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	Total TCDD	<0.96	0.48	0	0	
	1,2,3,7,8-PeCDD	<2.6	1.3	0.5	0.65	
	Total PeCDD	<2.6	1.3	0	0	
	1,2,3,4,7,8-HxCDD	<2.3	1.15	0.1	0.115	
	1,2,3,6,7,8-HxCDD	<2.4	1.2	0.1	0.12	
	1,2,3,7,8,9-HxCDD	<2.2	1.1	0.1	0.11	
	Total HxCDD	<2.4	1.2	0	0	
	1,2,3,4,6,7,8-HpCDD	<2.4	1.2	0.01	0.012	
	Total HpCDD	<3.0	1.5	0	0	
	OCDD	16		0.001	0.016	
OS-VC-02 - Furan	2,3,7,8-TCDF	<0.67	0.34	0.1	0.034	
	Total TCDF	<0.67	0.34	0	0	
	1,2,3,7,8-PeCDF	<1.3	0.65	0.05	0.033	
	2,3,4,7,8-PeCDF	<1.3	0.65	0.05	0.033	
	Total PeCDF	<1.7	0.85	0	0	
	1,2,3,4,7,8-HxCDF	<1.4	0.7	0.1	0.07	
	1,2,3,6,7,8-HxCDF	<1.4	0.7	0.1	0.07	
	2,3,4,6,7,8-HxCDF	<1.5	0.75	0.1	0.075	
	1,2,3,7,8,9-HxCDF	<1.7	0.85	0.1	0.085	
	Total HxCDF	<1.7	0.85	0	0	
	1,2,3,4,6,7,8-HpCDF	<0.64	0.32	0.01	0.003	
	1,2,3,4,7,8,9-HpCDF	<0.76	0.38	0.01	0.004	
	Total HpCDF	<0.76	0.38	0	0	
OCDF	<2.8	1.4	0.001	0.001		
Total Dioxins/Furans TEQ					1.911	<15 ng/kg

MDL = Method Detection Limit

TEQ = Toxicity Equivalency Quotient

TEF = Toxicity Equivalency Factors

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Table 9. Oregon Slough Entrance Channel

Sampled June 19, 2001

Dioxins/Furans (ng/kg, ppt)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
OS-VC-03 - Dioxin	2,3,7,8-TCDD	<0.75	0.375	1.0	0.375	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.	
	Total TCDD	<0.75	0.375	0	0		
	1,2,3,7,8-PeCDD	<3.6	1.8	0.5	0.9		
	Total PeCDD	<3.6	1.8	0	0		
	1,2,3,4,7,8-HxCDD	<2.7	1.35	0.1	0.135		
	1,2,3,6,7,8-HxCDD	<2.8	1.4	0.1	0.14		
	1,2,3,7,8,9-HxCDD	<2.6	1.3	0.1	0.13		
	Total HxCDD	<2.8	1.4	0	0		
	1,2,3,4,6,7,8-HpCDD	3.7 J			0.01		0.37
	Total HpCDD	7.2			0		0
	OCDD	22			0.001		0.022
OS-VC-03 - Furan	2,3,7,8-TCDF	<0.89	0.445	0.1	0.045		
	Total TCDF	<0.89	0.445	0	0		
	1,2,3,7,8-PeCDF	<1.6	0.8	0.05	0.04		
	2,3,4,7,8-PeCDF	<1.5	0.75	0.05	0.038		
	Total PeCDF	<2.0	1.0	0	0		
	1,2,3,4,7,8-HxCDF	<2.5	1.25	0.1	0.125		
	1,2,3,6,7,8-HxCDF	<2.3	1.15	0.1	0.115		
	2,3,4,6,7,8-HxCDF	<2.6	1.3	0.1	0.13		
	1,2,3,7,8,9-HxCDF	<2.9	1.45	0.1	0.145		
	Total HxCDF	<2.9	1.45	0	0		
	1,2,3,4,6,7,8-HpCDF	<1.1	0.55	0.01	0.006		
	1,2,3,4,7,8,9-HpCDF	<1.3	0.65	0.01	0.007		
	Total HpCDF	<1.3	0.65	0	0		
OCDF	<3.7	1.85	0.001	0.002			
Total Dioxins/Furans TEQ					2.725	<15 ng/kg	
J = Estimated result. Result is < reporting limit. MDL = Method Detection Limit TEQ = Toxicity Equivalency Quotient TEF = Toxicity Equivalency Factors *Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)							

Table 10. Oregon Slough Entrance Channel

Sampled June 19, 2001

Dioxins/Furans (ng/kg, ppt)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
OS-VC-04 - Dioxin	2,3,7,8-TCDD	<1.4	0.7	1.0	0.7	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	Total TCDD	<1.4	0.7	0	0	
	1,2,3,7,8-PeCDD	<3.3	1.65	0.5	0.825	
	Total PeCDD	<3.3	1.65	0	0	
	1,2,3,4,7,8-HxCDD	<2.8	1.4	0.1	0.14	
	1,2,3,6,7,8-HxCDD	<2.9	1.45	0.1	0.145	
	1,2,3,7,8,9-HxCDD	<2.7	1.35	0.1	0.135	
	Total HxCDD	<2.9	1.45	0	0	
	1,2,3,4,6,7,8-HpCDD	8.2		0.01	0.082	
	Total HpCDD	16		0	0	
	OCDD	58		0.001	0.058	
OS-VC-04 - Furan	2,3,7,8-TCDF	<0.85	0.425	0.1	0.043	
	Total TCDF	<0.85	0.425	0	0	
	1,2,3,7,8-PeCDF	<1.6	0.8	0.05	0.04	
	2,3,4,7,8-PeCDF	<1.6	0.8	0.05	0.04	
	Total PeCDF	<2.1	1.05	0	0	
	1,2,3,4,7,8-HxCDF	<2.2	1.1	0.1	0.11	
	1,2,3,6,7,8-HxCDF	<2.1	1.05	0.1	0.105	
	2,3,4,6,7,8-HxCDF	<2.4	1.2	0.1	0.12	
	1,2,3,7,8,9-HxCDF	<2.6	1.3	0.1	0.13	
	Total HxCDF	<2.6	1.3	0	0	
	1,2,3,4,6,7,8-HpCDF	<1.0	0.5	0.01	0.005	
	1,2,3,4,7,8,9-HpCDF	<1.1	0.55	0.01	0.006	
	Total HpCDF	<2.2	1.1	0	0	
OCDF	<4.2	2.1	0.001	0.002		
Total Dioxins/Furans TEQ					2.686	<15 ng/kg

MDL = Method Detection Limit

TEQ = Toxicity Equivalency Quotient

TEF = Toxicity Equivalency Factors

*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Figure 1. Oregon Slough Entrance Channel Sampling Locations

