

**Columbia River Mile 29-34
Brookfield Mound and Skamakawa Turn
Sediment Evaluation**

Abstract

The Clean Water Act (CWA) of 1977, as amended regulates dredging activities and requires sediment quality evaluation, including testing, prior to dredging. Guidelines to implement 40 CFR Part 230-Section 404(b)(1) regulations of the CWA, the national Inland Testing Manual (ITM) and the regional Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF) have adopted a tiered testing approach for the evaluation of dredge material. Tier IIa (physical testing) and Tier IIb (chemical testing) have been completed for this evaluation, using screening levels (SL) adopted in the DMEF.

Twenty (20) surface grab sediment samples were collected from the Brookfield Mound and Skamakawa Turn sites on August 9, 2000 (see Figure 1). All samples were sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical analysis. Five (5) of the 20 samples were selected for chemical analyses, to include: inorganic metals (9), total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs). Three (3) samples were submitted for P450 HRGS and Dioxin/Furan.

Five (5) vibra core samples were collected on September 7, 2000 (from the same stations submitted for chemical analysis above) and sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical and chemical analyses. The chemical analyses include inorganic metals (9), total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs), P450 HRGS and Dioxin/Furan.

This evaluation characterizes the Brookfield Mound (RM 29), using both surface and core samples, analyzed for physical and chemical parameters. The Skamakawa Turn (RM 31-34) was characterized for physical and chemical parameters using surface samples only.

Possible further characterization at Skamakawa Turn with deep cores is under consideration, sediment represented by surface (both RM 29 & 31-34) and core samples (RM 29) collected during this sampling event meet the Tier II guidelines established in the DMEF for open inwater, unconfined placement.

Introduction

The purpose of this report is to characterize the sediment of the Brookfield Mound (RM 29) and Skamakawa Turn (RM 31-34) sites based on the sampling event described. The sampling and analysis objectives from the Sampling and Analysis Plan are listed below. This report will outline the procedures used to accomplish these goals.

SAMPLING AND ANALYSIS OBJECTIVES

- To characterize sediments in accordance with the regional dredge material testing manual, the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF).
- Collect, handle and analyze representative sediment, of the purposed 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, unless DMEF screening levels are exceeded and further characterization (Tier III Biological Assays) is needed to determine the disposal method.

Previous Studies

In 1996 and 1997 twenty (20) surface sediment were collected as part of four (4) benthic sampling events between river mile (RM) 31-34. Grain size analyses were conducted as a part of these sampling events. The material tested was 99.9% sand and 0.1% fines, with a median grain size 0.35-mm. The mean grain size of the material ranged from 20 mm at the down stream extreme, to a mean of 0.45 mm at the upstream extreme of the study area.

The 1997 Columbia River Channel Deepening-sampling event collected two (2) samples in the study area at Skamakawa Turn RM 30 and 32. The material tested at RM 30 was 97.2% sand and 2.8% fines, with a mean grain size 0.18-mm. The material tested at RM 32 was 99.7% sand and 0.3% fines, with a mean grain size 0.33-mm.

Current Sampling Event

Two (2) sampling rounds were conducted as part of this current study.

Sixteen (16) surface grab samples were collected at the Brookfield Mound (RM 29) and four (4) surface samples at Skamakawa Turn (RM 31-34), on August 9, 2000. All samples were sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical analysis. Five (5) of the 20 samples were selected for chemical analyses (01-05), to include inorganic metals (9), total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs). Three (3) samples were submitted for P450 HRGS (EPA 4425) and Dioxin/Furan.

Five (5) vibra core samples collected on September 7, 2000 (from the same stations submitted for chemical analysis above) and were sent to Sound Analytical Services, Inc. laboratory of Tacoma, WA, for physical and chemical analyses. The chemical analyses include inorganic metals (9), total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs), P450 HRGS (EPA 4425) and Dioxin/Furan.

Core samples were collected in addition to surface samples in an attempt to characterize the strata of the mound at river mile 29. Due to the nature of the material, full-length cores could not be

retained (sandy material has a tendency to flow out of the tubes). Penetration of the vibra coring tubes was recorded at twenty (20) feet, but only 7-8 feet of material was retained for each core, except CRM-VC-01, which was the last core taken. Wind and current conditions, at station CRM-VC-01, made it difficult to stay on station, even with two (2) anchors out to hold position, the coring tube penetrated at an angle and was bent, retaining only 34" of material. The Sampling Plan strategy was to sample the contour of the mound with fourteen (14) to twenty (20) foot core penetration and recovery, thereby using the mound contour and the recovery depth to cover each strata down to elevation -42 feet MLLW. Of the approximately forty-two (42) foot depth of material in the mound, about thirty-two (32), feet were characterized, due to the reduced sample recovery rate.

Figure 1 (page 26) is a Sample Site Location map of, both the August 9th and the September 7th sampling events, at Brookfield Mound (RM 29). The Sampling Plan for the September sampling event called for vibra core samples to be collected at the same sites as the first five (5) surface grab samples collected in August. The surface sample coordinate locations were recorded using a hand held GPS device and the vibra core sample locations were recorded with the GPS system from the contractor's boat. The Figure 1 map was generated using our newly adopted sediment quality database (SEDQUAL), which provides a graphic display of the coordinates (as well as linking analyzed data to the points) entered for both sampling events. Sample location distribution and the closely aligned correlation of the duplicate sample collection points on the map indicates, both the accuracy of the hand held GPS of the original sites and the ability of this contractor (Marine Sampling Systems) to hold site coordinates, during sample collection.

Results/Discussion

Physical and Volatile Solids Method ASTM D2974: Data for these analyses are presented in Table 1 & 7. All samples submitted, for both sampling events, were classified as "poorly graded sand. Median grain size for all surface samples is 0.35mm (mean 0.28mm), with 99.14% sand, 0.86% fines and 0.67% volatile solids. Median grain size for all vibra core samples is 0.36mm (mean 0.24mm), with 0.05% gravel, 99.3% sand, 0.86% fines and 0.71% volatile solids.

Metals – Method 6020/7470, Total Organic Carbon (TOC) – Method 9060: Data for these analyses are presented in Table 2 & 8. Low levels of most metals of concern were found in all of the samples collected. All metals detected were well below DMEF screening levels for both sampling events. Zinc was the highest level detected at 64 mg/Kg (ppm), which is 15.6% of the 410 mg/Kg screening level. TOC was measured at 486 mg/Kg (ppm) and 469 mg/Kg (ppm), respectively.

Pesticide/PCBs – Method 8081, Phenols, Phthalates and Misc. Extractables – Method 8270: Data for these analyses are presented in Table 3 & 9. No PCBs, chlorinated pesticides (to include total DDT), phenols or extractables were found at the method detection limits in any of the samples. Phthalates were detected in the laboratory method blanks for both sampling events. The only sample that contained phthalates significantly higher than that contained in the method blanks was sample CRM-BC-05 (170 ug/Kg, ppb), which is 14% of the 1200 ug/Kg screening level.

Polynuclear Aromatic Hydrocarbons (PAHs) – Method 8270: Data for these analyses are presented in Tables 4-5 & 10-11. No individual "low molecular weight" PAHs were found in any of the samples at levels above the method detection limit. One (1) "high molecular weight" PAHs was found in one (1)

sample (CRM-VC-03A) at a level above the method detection limit (MDL), but below the practical quantitation limit (PQL) and is considered an estimate by the lab.

Dioxin/furan – Method 8290: Data for these analyses are presented in Tables 6 & 12. This method provides procedures for the detection and quantitative measurement of polychlorinated dibenzo-p-dioxins (tetra- through octachlorinated homologues; PCDDs), and polychlorinated dibenzofurans (tetra- through octachlorinated homologues; PCDFs) in a variety of environmental matrices and at part-per-trillion (ppt) concentrations. The PCDDs include 75 individual compounds, and the PCDFs include 135 individual compounds. These individual compounds are technically referred to as congeners. Only 7 of the 75 congeners of PCDDs are thought to have “dioxin-like” toxicity; these are ones with chlorine substitutions in, at least, the 2,3,7,8 positions. Only 10 of the 135 possible congeners of PCDFs are thought to have “dioxin-like” toxicity: these also are ones with substitutions in the 2,3,7,8 positions. For risk assessment purposes, a toxicity equivalency procedure was developed to describe the cumulative toxicity of these mixtures. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the PCDD and PCDF congeners. These TEF values have been adopted by international convention (U.S. EPA, 1989; Ahlborg, et al., 1994). TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1.0. All other congeners have lower TEF values ranging from 0.5 to 0.001 for dioxin/furans. Calculating the toxic equivalency (TEQ) of a mixture involves multiplying the concentration of individual congeners by their respective TEF. For undetected congeners, detection limits will be divided by two and used in calculations. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture.

Very low levels of some of the total congeners were detected in two (2) samples (CRM-VC-02 and CRM-VC-03). The *guidance states that 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 (ppt), will trigger the requirement to perform bioaccumulation testing. The total toxic equivalent (TEQ) concentration for sample CRM-VC-02 was 0.7227 ng/Kg and for sample CRM-VC-03 was 0.81205 ng/kg.

*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).

P450 Human Reporter Gene System (HRGS) – Method 4425: Data for these analyses are presented in Tables 13. This assay uses a transgenic cell line to screen samples from a site to determine the distribution of significant levels of carcinogens and toxic contaminants, including polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzo-p-furans (PCDFs) and coplanar polychlorinated biphenyl (PCB) congeners, (PAHs were removed in a silica gel cleanup procedure).

None of the samples tested contained dioxins, furans or coplanar PCBs at or above our reporting limit. They were all between the method detection limit (10 ppt) and reporting limits (18-22 ppt).

Method P450 HRGS (EPA Method 4425) is a method designed to be used as an inexpensive way to screen for 2,3,7,8-substituted chlorinated dioxins, furans, coplanar PCBs, and certain PAHs in all environmental samples. Due to method detection and reporting limit constraints, Method 4425 is limited in its usefulness as a screening tool in areas where extremely low levels of these contaminants are present (<15 ppt). The Columbia River Mainstem Navigational Channel is one such area. EPA Method 8290, although almost five (5) times the cost, has the ability of

quantifying dioxin/furans to a level less than one (1) ppt, which is necessary to calculate meaningful TEQs.

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 Dept. of Environmental Quality and Washington Depts. of Ecology and Natural Resources. This document is a guideline for implementing the Clean Water Act, 40 CFR 230 sec 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.

The DMEF guidelines present the minimum testing requirements to characterize a potential dredging prism and newly exposed surface during the dredging and disposal process. Columbia River sediment in the Federal Navigational Channel is ranked “exclusionary” in the DMEF (Table 5-3). As “exclusionary” material all available data was reviewed and indicates coarse-grained sediment with at least 80% sand retained in a No. 230 sieve and a Total Volatile Solids content of less than 5.0% and is sufficiently removed from potential sources of sediment contamination. While no testing was required under DMEF guidance, surface and vibra core samples were collected as part of this sampling event. Physical and chemical analyses, to include dioxin/furan, were conducted to fully characterize these sediments.

The median grain size for all surface samples is 0.35mm (mean 0.28mm), with 99.14% sand, 0.86% fines and 0.67 volatile solids. Median grain size for all vibra core samples is 0.36mm (mean 0.24mm), with 0.05% gravel, 99.3% sand, 0.86% fines and 0.71 volatile solids. Few chemicals of concern were detected above the method detection levels, with all levels well below the DMEF Tier IIb screening levels. The physical and chemical analyses of this sampling event uphold the exclusionary ranking.

This evaluation characterizes the Brookfield Mound (RM 29), using both surface and core samples, analyzed for physical and chemical parameters. The Skamakawa Turn (RM 31-34) was characterized for physical and chemical parameters using surface samples only.

Possible further characterization at Skamakawa Turn with deep cores is under consideration, sediment represented by surface (both RM 29 & 31-34) and core samples (RM 29) collected during this sampling event meet the Tier II guidelines established in the DMEF for open inwater, unconfined placement.

References

1. U.S. Army Corps of Engineers, Portland District, 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, dated (referred to as the “Inland Testing Manual”).
3. The Clean Water Act, 40 CFR 230 (b) (1).
4. Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA, 1989; Ahlborg, et al., 1994).
5. McCabe G.T., Jr., S.A. Hinton. 1998. National Marine Fisheries Service. Benthic Invertebrates and Sediment Characteristics in and Adjacent to a Proposed Channel Widening Area (River Mile 31-34), Columbia River Estuary. Seattle Washington.
6. U.S. Army Corps of Engineers, Portland District. 1999. Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement: Columbia and lower Willamette River Federal Navigational Channel. Appendix H, Volume 1: Ocean Dredged material Disposal Sites main Report and Technical Exhibits.
7. Anderson, J.W., (et al). 2000. EPA method 4425, the P450 Human Reporter Gene System assay SOP, Columbia Analytical Services, Inc.
8. EPA. 1994. Test Methods for Evaluating Solid Waste Physical/Chemical methods (SW 846) 3rd edition.

Physical Analysis

Sample I.D.	Grain Size (mm)				%			
	Median		Mean		Gravel	Sand	Silt/Clay	Volatile solids
CRM-BC-01	0.32		0.27		0.00	99.08	0.92	0.62
CRM-BC-02	0.29		0.23		0.00	98.04	1.96	0.59
CRM-BC-03	0.20		0.32		0.00	99.52	0.48	0.67
CRM-BC-04	0.28		0.21		0.00	98.73	1.27	0.66
CRM-BC-05	0.39		0.32		0.00	99.96	0.04	0.58
Mean to compare with Cores	0.30		0.27		0.00	99.07	0.93	0.62
CRM-BC-06	0.30		0.24		0.00	97.96	2.04	0.60
CRM-BC-07	0.30		0.25		0.00	100	0	0.61
CRM-BC-08	0.60		0.35		0.00	100	0	0.59
CRM-BC-09	0.30		0.23		0.00	98.70	1.29	0.62
CRM-BC-10	0.43		0.33		0.00	99.09	0.91	0.64
CRM-BC-11	0.42		0.32		0.00	99.91	0.09	0.63
CRM-BC-12	0.31		0.25		0.00	97.64	2.36	0.68
CRM-BC-13	0.38		0.30		0.00	99.50	0.50	0.79
CRM-BC-14	0.30		0.26		0.00	99.33	0.67	0.63
CRM-BC-15	0.70		0.44		0.00	100	0	0.98
CRM-BC-16	0.35		0.30		0.00	99.47	0.53	0.65
Mean at Brookfield Mound	0.37		0.29		0.00	99.18	0.82	0.66
CRM-BC-17	0.25		0.19		0.00	99.46	0.54	0.70
CRM-BC-18	0.30		0.25		0.00	98.68	1.32	0.67
CRM-BC-19	0.30		0.23		0.00	99.14	0.86	0.74
CRM-BC-20	0.31		0.24		0.00	98.61	1.39	0.82
Mean at Skamakawa Turn	0.29		0.23		0.00	98.97	1.02	0.73
Mean of Mound & Turn	0.35		0.28		0.00	99.14	0.86	0.67

Inorganic Metals and TOC

Sample I.D.	As	Sb	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)									
CRM-BC-01	2.1	<.2	0.47*J	10	2.8	<0.029	11	0.081*J	51*B2	570
CRM-BC-02	2.0	3.9*B2	0.43*J	9.7	3.2	<0.030	12	0.330*J	52*B2	510
CRM-BC-03	1.8	1.7*J,B1	0.48*J	12	3.0	<0.029	14	0.099*J	64*B2	500
CRM-BC-04	1.6	1.1*J,B1	0.41*J	11	3.3	<0.028	14	0.079*J	56*B2	400
CRM-BC-05	1.9	0.68*J,B1	0.41*J	11	3.3	<0.028	14	0.079*J	56*B2	450
Screening level (SL)	57	150	5.1	390	450	0.41	140	6.1	410	
Mean	1.9	1.5	0.44	10.7	3.1	ND	13	0.13	56	486
Maximum	2.1	3.9	0.48	12	3.3	ND	14	0.33	64	570

*J = Estimated value (reported values are above the MDL, but below the PQL).

*B1 = Low level contamination was present in the method blank, analytical result is < 10 times blank concentration.

*B2 = Low level contamination was present in the method blank, analytical result is > 10 times blank concentration.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

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	Di-n-butyl phthalate	Diethyl phthalate	bis(2-Ethyl) hexzyl phthalate	Butyl Benzyl phthalate	
CRM-BC-01	<0.22	<0.45	<1.6	ND	25 *B1 (23)	3.4 *J,B1(3.5)	14 *B1 (10)	1.8 *J,B1 (1.5)	
CRM-BC-02	<0.21	<0.45	<1.5	ND	24 *B1 (23)	3.2 *J,B1(3.5)	13 *B1 (10)	<1.7	
CRM-BC-03	<0.22	<0.47	<1.6	ND	28 *B1 (23)	3.1 *J,B1(3.5)	17 *B1 (10)	1.9 *J,B1 (1.5)	
CRM-BC-04	<0.20	<0.42	<1.4	ND	22 *J,B1 (23)	3.7 *J,B1(3.5)	12 *B1 (10)	<1.7	
CRM-BC-05	<0.19	<0.41	<1.4	ND	22 *B1 (23)	170 B2 (3.5)	13 *B1 (10)	1.7 *J,B1 (1.5)	
Screen level (SL)	DDD + DDE + DDT = 6.9				5100	1200	8300	970	
Mean	ND	ND	ND	ND	24.2*	36.7*	13.8*	1.1*	
Maximum	ND	ND	ND	ND	28*	170*	17*	1.9*	

PCBs = Non-detect (ND) <15.0 ppb (SL = 130 ppb).

*J = Estimated value (reported values are above the MDL, but below the PQL).

*B1 = Low level contamination was present in the method blank, indicated in parenthesis, analytical result is < 10 times blank concentration.

*B2 = Low level contamination was present in the method blank, indicated in parenthesis, analytical result is > 10 times blank concentration.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

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
CRM-BC-01	<0.83	<0.92	<1.1	<0.92	<1.6	<2.2	<0.75	ND
CRM-BC-02	<0.94	<0.94	<1.1	<0.94	<1.7	<2.3	<0.76	ND
CRM-BC-03	<0.83	<0.96	<1.1	<0.96	<1.7	<2.3	<0.78	ND
CRM-BC-04	<0.82	<0.94	<1.1	<0.94	<1.7	<2.3	<0.76	ND
CRM-BC-05	<0.76	<0.88	<1.0	<0.88	<1.5	<2.1	<0.71	ND
Screen level (SL)	500	560	960	540	670	2100	1500	5200
Mean	ND	ND	ND	ND	ND	ND	ND	
Maximum	ND	ND	ND	ND	ND	ND	ND	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

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

Sample I.D.	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(g,h,i) perylene	Chrysene	Pyrene	Benzo(a) pyrene	Dibenz(a,h) anthracene	Indeno (1,2,3-cd) pyrene	Fluoranthene	Total High PAHs
CRM-BC-01	<0.72	<0.75	<0.75	<0.34	<0.94	<0.64	<0.94	<0.53	<0.85	<0.72	ND
CRM-BC-02	<0.74	<0.96	<0.96	<0.35	<0.97	<0.66	<0.96	<0.54	<0.87	<0.74	ND
CRM-BC-03	<0.75	<0.78	<0.78	<0.35	<0.98	<0.67	<0.98	<0.55	<0.88	<0.75	ND
CRM-BC-04	<0.74	<0.77	<0.77	<0.35	<0.97	<0.66	<0.96	<0.54	<0.87	<0.74	ND
CRM-BC-05	<0.69	<0.90	<0.90	<0.33	<0.90	<0.61	<0.90	<0.50	<0.81	<0.69	ND
Screen level (SL)	1300	3200	3200	670	1400	2600	1600	230	600	1700	12000
Mean	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Maximum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Dioxins/Furans (pg/g, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
CRM-BC-01 Dioxin	2,3,7,8 - TCDD	<0.13	0.065	1.0	0.065	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	<0.13	0.065	0	0	
	1,2,3,7,8 – PeCDD	<0.20	0.10	0.5	0.05	
	Total PeCDD	<0.55	0.275	0	0	
	1,2,3,4,7,8 – HxCDD	<0.17	0.085	0.1	0.0085	
	1,2,3,6,7,8 – HxCDD	<0.16	0.08	0.1	0.008	
	1,2,3,6,7,9 – HxCDD	<0.15	0.075	0.1	0.0075	
	Total (other)HxCDD	<0.17	0.085	0	0	
	1,2,3,4,6,7,8-HpCDD	<0.39	0.195	0.01	0.00195	
	Total (other) HpCDD	<0.42	0.21	0	0	
	OCDD	<2.8	1.4	0.001	0.0014	
CRM-BC-01 Furan	2,3,7,8-TCDF	<0.11	0.055	0.1	0.0055	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 TCDF	<0.11	0.055	0	0	
	1,2,3,7,8 – PeCDF	<0.11	0.055	0.05	0.00275	
	1,3,4,7,8 – PeCDF	<0.11	0.055	0.05	0.00275	
	Total (other) PeCDF	<0.11	0.055	0	0	
	1,2,3,4,7,8 – HxCDF	<0.12	0.06	0.1	0.006	
	1,2,3,6,7,8 – HxCDF	<0.10	0.05	0.1	0.005	
	2,3,4,6,7,8 – HxCDF	<0.13	0.065	0.1	0.0065	
	2,3,6,7,8,9 – HxCDF	<0.13	0.065	0.1	0.0065	
	Total (other) HxCDF	<0.13	0.065	0	0	
	1,2,3,4,6,7,8 – HpCDF	<0.15	0.075	0.01	0.00075	
	1,2,3,4,7,8,9 – HpCDF	<0.11	0.055	0.01	0.00055	
	Total (other) HpCDF	<0.15	0.075	0	0	
OCDF	<0.22	0.11	0.001	0.00011		
Total Dioxins/Furans TEQ ng/kg					0.17876	<15 ng/kg

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection 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)

Surface Samples

Dioxins/Furans (pg/g, pptr)

Sample I.D.	Dioxin/Furan	Result (MDL)	½ MDL	TEF	TEQ	Guidance*
CRM-BC-03 Dioxin	2,3,7,8 - TCDD	<0.14	0.07	1.0	0.07	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	<0.14	0.07	0	0	
	1,2,3,7,8 – PeCDD	<0.22	0.11	0.5	0.055	
	Total PeCDD	<0.44	0.22	0	0	
	1,2,3,4,7,8 – HxCDD	<0.16	0.08	0.1	0.008	
	1,2,3,6,7,8 – HxCDD	<0.15	0.075	0.1	0.0075	
	1,2,3,6,7,9 – HxCDD	<0.14	0.07	0.1	0.007	
	Total (other)HxCDD	<0.26	0.13	0	0	
	1,2,3,4,6,7,8-HpCDD	<0.60	0.30	0.01	0.003	
	Total (other) HpCDD	<0.60	0.30	0	0	
CRM-BC-03 Furan	OCDD	<3.4	1.7	0.001	0.0017	
	2,3,7,8-TCDF	<0.10	0.05	0.1	0.005	
	Total TCDF	<0.10	0.05	0	0	
	1,2,3,7,8 – PeCDF	<0.14	0.07	0.05	0.0035	
	1,3,4,7,8 – PeCDF	<0.13	0.065	0.05	0.00325	
	Total (other) PeCDF	<0.14	0.07	0	0	
	1,2,3,4,7,8 – HxCDF	<0.11	0.055	0.1	0.0055	
	1,2,3,6,7,8 – HxCDF	<0.096	0.048	0.1	0.0048	
	2,3,4,6,7,8 – HxCDF	<0.12	0.06	0.1	0.006	
	2,3,6,7,8,9 – HxCDF	<0.12	0.06	0.1	0.006	
	Total (other) HxCDF	<0.12	0.06	0	0	
	1,2,3,4,6,7,8 – HpCDF	<0.17	0.085	0.01	0.00085	
	1,2,3,4,7,8,9 – HpCDF	<0.12	0.06	0.01	0.0006	
	Total (other) HpCDF	<0.17	0.085	0	0	
OCDF	<0.26	0.13	0.001	0.00013		
Total Dioxins/Furans TEQ ng/kg					0.18783	<15 ng/kg

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection 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)

Dioxins/Furans (pg/g, ppt)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
CRM-BC-05 Dioxin	2,3,7,8 - TCDD	<0.12	0.06	1.0	0.06	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	<0.12	0.06	0	0		
	1,2,3,7,8 – PeCDD	<0.23	0.115	0.5	0.0575		
	Total PeCDD	<0.40	0.20	0	0		
	1,2,3,4,7,8 – HxCDD	<0.14	0.07	0.1	0.007		
	1,2,3,6,7,8 – HxCDD	<0.13	0.065	0.1	0.0065		
	1,2,3,7,8,9 – HxCDD	<0.12	0.06	0.1	0.006		
	Total (other)HxCDD	<0.14	0.07	0	0		
	1,2,3,4,6,7,8-HpCDD	<0.76	0.38	0.01	0.0038		
	Total (other) HpCDD	<0.76	0.38	0	0		
	OCDD	<3.6	1.8	0.001	0.0018		
	CRM-BC-05 Furan	2,3,7,8-TCDF	<0.10	0.05	0.1		0.005
		Total TCDF	<0.10	0.05	0		0
1,2,3,7,8 – PeCDF		<0.11	0.055	0.05	0.0055		
1,3,4,7,8 – PeCDF		<0.11	0.055	0.05	0.0055		
Total (other) PeCDF		<0.11	0.055	0	0		
1,2,3,4,7,8 – HxCDF		<0.12	0.06	0.1	0.006		
1,2,3,6,7,8 – HxCDF		<0.083	0.0415	0.1	0.00415		
2,3,4,6,7,8 – HxCDF		<0.10	0.05	0.1	0.005		
2,3,6,7,8,9 – HxCDF		<0.10	0.05	0.1	0.005		
Total (other) HxCDF		<0.12	0.06	0	0		
1,2,3,4,6,7,8 – HpCDF		<0.20	0.10	0.01	0.001		
1,2,3,4,7,8,9 – HpCDF		<0.15	0.075	0.01	0.00075		
Total (other) HpCDF		<0.20	0.10	0	0		
OCDF	<0.27	0.135	0.001	0.000135			
Total Dioxins/Furans TEQ ng/kg					0.180635	<15 ng/kg	

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection 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 7, Columbia River Mile 29 Mound

Brookfield Mound
Vibra Core Samples
Physical Analysis

Sampled September 7, 2000

Sample I.D.	Grain Size (mm)			%					
	Median		Mean	Gravel	Sand	Silt/Clay	Volatile solids		
CRM-VC-01	0.69		0.40	0.44	99.18	0.38		0.69	
CRM-VC-02A	0.32		0.24	0.00	99.76	0.24		0.72	
CRM-VC-02B	0.30		0.18	0.00	98.95	1.05		0.67	
CRM-VC-03A	0.31		0.23	0.00	99.62	0.38		0.84	
CRM-VC-03B	0.28		0.16	0.00	99.12	0.88		0.60	
CRM-VC-04A	0.35		0.25	0.00	98.91	1.09		0.68	
CRM-VC-04B	0.35		0.24	0.00	98.67	1.33		0.80	
CRM-VC-05A	0.35		0.27	0.00	100	0		0.74	
CRM-VC-05B	0.30		0.22	0.00	99.52	0.48		0.68	
Mean	0.36		0.24	0.05	99.30	0.70		0.71	

Table 8, Columbia River Mile 29-34

Brookfield Mound
Vibra Core Samples

Sampled September 7, 2000

Inorganic Metals and TOC

Sample I.D.	As	Sb	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)									
CRM-VC-01	2.2	<0.15	0.38*J	9.1*B2	2.5*B2	<0.027	8.8	0.063*J	39	440
CRM-VC-02A	1.6	<0.22	0.52*J	12*B2	2.9*B2	<0.035	14	0.074*J	56	370
CRM-VC-02B	2.1	<0.19	0.58*J	12*B2	2.8*B2	<0.031	15	0.077*J	52	300
CRM-VC-03A	2.1	<0.17	0.52*J	11*B2	2.6*B2	<0.029	12	0.080*J	49	600
CRM-VC-03B	1.3	<0.16	0.49*J	11*B2	2.7*B2	<0.028	14	0.076*J	47	300
CRM-VC-04A	1.6	<0.17	0.49*J	11*B2	2.6*B2	<0.029	12	0.067*J	51	400
CRM-VC-04B	1.8	<0.18	0.54*J	12*B2	2.7*B2	<0.029	11	0.070*J	47	870
CRM-VC-05A	1.9	<0.17	0.50*J	11*B2	2.6*B2	<0.026	12	0.067*J	44	340
CRM-VC-05B	1.4	<0.15	0.52	12*B2	2.6*B2	<0.028	14	0.065*J	48	600
Screening level (SL)	57	150	5.1	390	450	0.41	140	6.1	410	
Mean	1.8	ND	0.50*J	11.2	2.7*B2	ND	12.5	0.071*J	48	469
Maximum	2.2	ND	0.52	12*B2	2.9*B2	ND	15	0.080*J	56	870

*J = Estimated value (reported values are above the MDL, but below the PQL).

*B2 = Low level contamination was present in the method blank, analytical result is < 10 times blank concentration.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

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		Diethyl phthalate	bis(2-Ethyl) hexzyl phthalate
CRM-VC-01	<0.12	<0.15	<0.18	ND		<3.0	17 *B1 (12)
CRM-VC-02A	<0.13	<0.16	<0.19	ND		5.3*J	24 *B1 (12)
CRM-VC-02B	<0.12	<0.15	<0.18	ND		<3.5	22 *B1 (12)
CRM-VC-03A	<0.13	<0.16	<0.19	ND		<3.5	23 *B1 (12)
CRM-VC-03B	<0.13	<0.15	<0.19	ND		<3.3	18 *B1 (12)
CRM-VC-04A	<0.11	<0.13	<0.16	ND		<3.2	22 *B1 (12)
CRM-VC-04B	<0.11	<0.14	<0.17	ND		<3.3	19 *B1 (12)
CRM-VC-05A	<0.11	<0.13	<0.16	ND		<3.3	22 *B1 (12)
CRM-VC-05B	<0.12	<0.14	<0.17	ND		<3.2	<4.6
Screen level (SL)	DDD + DDE + DDT = 6.9					1200	8300
Mean	ND	ND	ND	ND		<3.6	19 *B1 (12)
Maximum	ND	ND	ND	ND		5.3*J	24 *B1 (12)

PCBs = Non-detect (ND) <11.0 ppb (SL = 130 ppb).

*J = Estimated value (reported values are above the MDL, but below the PQL).

*B1 = Low level contamination was present in the method blank, indicated in parenthesis, analytical result is < 10 times blank concentration.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit). All analytes by 8270 method not reported are ND.

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
CRM-VC-01	<1.0	<1.2	<1.4	<1.2	<2.0	<2.8	<0.94	ND
CRM-VC-02A	<1.3	<1.5	<1.8	<1.5	<2.7	<3.7	<1.2	ND
CRM-VC-02B	<1.2	<1.3	<1.6	<1.3	<2.3	<3.2	<1.1	ND
CRM-VC-03A	<1.2	<1.3	<1.6	<1.3	<2.4	<3.3	<1.1	ND
CRM-VC-03B	<1.1	<1.3	<1.5	<1.3	<2.2	<3.1	<1.0	ND
CRM-VC-04A	<1.0	<1.2	<1.4	<1.2	<2.1	<2.9	<0.98	ND
CRM-VC-04B	<1.1	<1.3	<1.5	<1.3	<2.2	<3.1	<1.0	ND
CRM-VC-05A	<1.1	<1.3	<1.5	<1.3	<2.2	<3.1	<1.0	ND
CRM-VC-05B	<1.1	<1.2	<1.5	<1.2	<2.2	<3.0	<1.0	ND
Screen level (SL)	500	560	960	540	670	2100	1500	5200
Mean	ND	ND	ND	ND	ND	ND	ND	
Maximum	ND	ND	ND	ND	ND	ND	ND	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

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

Sample I.D.	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(g,h,i) perylene	Chrysene	Pyrene	Benzo(a) pyrene	Dibenz(a,h) anthracene	Indeno (1,2,3-cd) pyrene	Fluoranthene	Total High PAHs
CRM-VC-01	<0.91	<0.95		<0.43	<1.2	<0.81	<1.2	<0.66	<1.1	<0.91	ND
CRM-VC-02A	<1.2	<1.6		<0.57	<1.6	<1.1	<1.6	<0.88	<1.4	<1.2	ND
CRM-VC-02B	<1.0	<1.1		<0.49	<1.4	<0.93	<1.4	<0.76	<1.2	<1.0	ND
CRM-VC-03A	<1.1	2.6 J		<0.50	<1.4	<0.94	<1.4	<0.77	<1.2	<1.1	2.6 J
CRM-VC-03B	<1.0	<1.3		<0.47	<1.3	<0.89	<1.3	<0.73	<1.2	<1.0	ND
CRM-VC-04A	<0.95	<0.99		<0.45	<1.2	<0.84	<1.2	<0.69	<1.1	<0.95	ND
CRM-VC-04B	<1.0	<1.0		<0.47	<1.3	<0.89	<1.3	<0.73	<1.2	<1.0	ND
CRM-VC-05A	<1.0	<1.0		<0.47	<1.3	<0.89	<1.3	<0.73	<1.2	<1.0	ND
CRM-VC-05B	<0.97	<1.0		<0.46	<1.3	<0.87	<1.3	<0.71	<1.1	<0.97	ND
Screen level (SL)	1300	3200		670	1400	2600	1600	230	600	1700	12000
Mean	ND	<1.3		ND	ND	ND	ND	ND	ND	ND	
Maximum	ND	2.6 J		ND	ND	ND	ND	ND	ND	ND	

J = Estimated result. Result is < reporting limit.

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Dioxins/Furans (pg/g, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
CRM-VC-01 Dioxin	2,3,7,8 - TCDD	<0.56	0.28	1.0	0.28	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	<0.56	0.28	0	0	
	1,2,3,7,8 – PeCDD	<0.92	0.46	0.5	0.023	
	Total PeCDD	<2.0	1.0	0	0	
	1,2,3,4,7,8 – HxCDD	<0.57	0.285	0.1	0.0285	
	1,2,3,6,7,8 – HxCDD	<0.63	0.315	0.1	0.0315	
	1,2,3,7,8,9 – HxCDD	<0.54	0.27	0.1	0.027	
	Total (other)HxCDD	<0.63	0.315	0	0	
	1,2,3,4,6,7,8-HpCDD	<2.0	1.0	0.01	0.01	
	Total (other) HpCDD	<2.0	1.0	0	0	
	OCDD	J	J	0.001	0.001 J	
CRM-VC-01 Furan	2,3,7,8-TCDF	<0.36	0.18	0.1	0.018	
	Total TCDF	<0.36	0.18	0	0	
	1,2,3,7,8 – PeCDF	<0.50	0.25	0.05	0.0125	
	1,3,4,7,8 – PeCDF	<0.47	0.235	0.05	0.01175	
	Total (other) PeCDF	<0.71	0.355	0	0	
	1,2,3,4,7,8 – HxCDF	<0.46	0.23	0.1	0.023	
	1,2,3,6,7,8 – HxCDF	<0.43	0.215	0.1	0.0215	
	2,3,4,6,7,8 – HxCDF	<0.47	0.235	0.1	0.0235	
	2,3,6,7,8,9 – HxCDF	<0.49	0.245	0.1	0.0245	
	Total (other) HxCDF	<0.49	0.245	0	0	
	1,2,3,4,6,7,8 – HpCDF	<0.57	0.285	0.01	0.00285	
	1,2,3,4,7,8,9 – HpCDF	<0.50	0.25	0.01	0.0025	
	Total (other) HpCDF	<0.92	0.46	0	0	
	OCDF	<0.85	0.425	0.001	0.000425	
Total Dioxins/Furans TEQ ng/kg					0.5415 J	<15 ng/kg

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection 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)

Dioxins/Furans (pg/g, ppt)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
CRM-VC-02 Dioxin	2,3,7,8 - TCDD	<0.58	0.29	1	0.29	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	<0.58	0.29	0	0	
	1,2,3,7,8 – PeCDD	<0.89	0.445	0.5	0.2225	
	Total PeCDD	<1.2	0.6	0	0	
	1,2,3,4,7,8 – HxCDD	<0.55	0.275	0.1	0.0275	
	1,2,3,6,7,8 – HxCDD	<0.60	0.3	0.1	0.03	
	1,2,3,7,8,9 – HxCDD	<0.53	0.265	0.1	0.0265	
	Total (other)HxCDD	<0.86	0.43	0	0	
	1,2,3,4,6,7,8-HpCDD	<0.99	0.495	0.01	0.00495	
	Total (other) HpCDD	<1.0	0.5	0	0	
	OCDD	5.3	2.65	0.001	0.00265	
	CRM-VC-02 Furan	2,3,7,8-TCDF	<0.33	0.165	0.1	
Total TCDF		<0.33	0.165	0	0	
1,2,3,7,8 – PeCDF		<0.48	0.24	0.05	0.012	
1,3,4,7,8 – PeCDF		<0.46	0.23	0.05	0.0115	
Total (other) PeCDF		<0.61	0.305	0	0	
1,2,3,4,7,8 – HxCDF		<0.37	0.185	0.1	0.0185	
1,2,3,6,7,8 – HxCDF		<0.34	0.17	0.1	0.017	
2,3,4,6,7,8 – HxCDF		<0.38	0.19	0.1	0.019	
2,3,6,7,8,9 – HxCDF		<0.39	0.195	0.1	0.0195	
Total (other) HxCDF		<0.39	0.195	0	0	
1,2,3,4,6,7,8 – HpCDF		<0.39	0.195	0.01	0.00195	
1,2,3,4,7,8,9 – HpCDF		<0.46	0.23	0.01	0.0023	
Total (other) HpCDF		<0.46	0.23	0	0	
OCDF	<0.65	0.325	0.001	0.000325		
Total Dioxins/Furans TEQ ng/kg					0.7227	<15 ng/kg

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection 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)

Dioxins/Furans (pg/g, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
CRM-VC-03 Dioxin	2,3,7,8 - TCDD	<0.49	0.245	1.0	0.245	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	<0.49	0.245	0	0		
	1,2,3,7,8 – PeCDD	<0.66	0.33	0.5	0.165		
	Total PeCDD	<1.3	0.65	0	0		
	1,2,3,4,7,8 – HxCDD	<0.61	0.305	0.1	0.0305		
	1,2,3,6,7,8 – HxCDD	<1.0	0.50	0.1	0.05		
	1,2,3,7,8,9 – HxCDD	<0.68	0.34	0.1	0.034		
	Total (other)HxCDD	<2.1	1.05	0	0		
	1,2,3,4,6,7,8-HpCDD	ND J	ns	0.01	ND J		
	Total (other) HpCDD	3.1	1.55	0	0		
	OCDD	ND	ns	0.001	ND		
	CRM-VC-03 Furan	2,3,7,8-TCDF	<0.35 CON	0.175	0.1		0.0175
		Total TCDF	9.3	4.65	0		0
1,2,3,7,8 – PeCDF		<2.9	1.45	0.05	0.075		
1,3,4,7,8 – PeCDF		<2.7	1.35	0.05	0.0675		
Total (other) PeCDF		29	14.5	0	0		
1,2,3,4,7,8 – HxCDF		ND J	ns	0.1	ND J		
1,2,3,6,7,8 – HxCDF		ND	ns	0.1	ND		
2,3,4,6,7,8 – HxCDF		<1.0	0.5	0.1	0.05		
2,3,6,7,8,9 – HxCDF		<1.5	0.75	0.1	0.075		
Total (other) HxCDF		42	0.21	0	0		
1,2,3,4,6,7,8 – HpCDF		ND J	ns	0.01	ND J		
1,2,3,4,7,8,9 – HpCDF		ND	ns	0.01	ND		
Total (other) HpCDF		21	11	0	0		
OCDF	<5.1	2.55	0.001	0.00255			
Total Dioxins/Furans TEQ ng/kg					0.81205	<15 ng/kg	

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

ns = not supplied by lab

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)

Dioxins/Furans (pg/g, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
CRM-VC-04 Dioxin	2,3,7,8 - TCDD	<0.52	0.26	1.0	0.26	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	<0.52	0.26	0	0		
	1,2,3,7,8 – PeCDD	<1.0	0.5	0.5	0.25		
	Total PeCDD	<1.3	0.65	0	0		
	1,2,3,4,7,8 – HxCDD	<0.54	0.27	0.1	0.027		
	1,2,3,6,7,8 – HxCDD	<0.59	0.295	0.1	0.0295		
	1,2,3,7,8,9 – HxCDD	<0.52	0.26	0.1	0.026		
	Total (other)HxCDD	<1.1	0.55	0	0		
	1,2,3,4,6,7,8-HpCDD	<2.0	1.0	0.01	0.01		
	Total (other) HpCDD	<2.6	1.3	0	0		
	OCDD	ND	ns	0.001	ND		
	CRM-VC-04 Furan	2,3,7,8-TCDF	<0.36	0.18	0.1		0.018
		Total TCDF	<0.36	0.18	0		0
1,2,3,7,8 – PeCDF		<0.52	0.26	0.05	0.013		
1,3,4,7,8 – PeCDF		<0.50	0.25	0.05	0.0125		
Total (other) PeCDF		<0.66	0.33	0	0		
1,2,3,4,7,8 – HxCDF		<0.50	0.25	0.1	0.025		
1,2,3,6,7,8 – HxCDF		<0.45	0.225	0.1	0.0225		
2,3,4,6,7,8 – HxCDF		<0.51	0.255	0.1	0.0255		
2,3,6,7,8,9 – HxCDF		<0.52	0.26	0.1	0.026		
Total (other) HxCDF		<0.52	0.26	0	0		
1,2,3,4,6,7,8 – HpCDF		<0.54	0.27	0.01	0.0027		
1,2,3,4,7,8,9 – HpCDF		<0.45	0.225	0.01	0.00225		
Total (other) HpCDF		<0.86	0.43	0	0		
OCDF	<0.89	0.445	0.001	0.000445			
Total Dioxins/Furans TEQ ng/kg					0.7504	<15 ng/kg	

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

ns = not supplied by lab

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)

Dioxins/Furans (pg/g, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*	
CRM-VC-05 Dioxin	2,3,7,8 - TCDD	<0.40	0.20	1.0	0.10	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	<0.40	0.20	0	0		
	1,2,3,7,8 – PeCDD	<1.1	0.55	0.5	0.275		
	Total PeCDD	<1.1	0.55	0	0		
	1,2,3,4,7,8 – HxCDD	<0.63	0.315	0.1	0.0315		
	1,2,3,6,7,8 – HxCDD	<0.70	0.35	0.1	0.035		
	1,2,3,7,8,9 – HxCDD	<0.61	0.305	0.1	0.0305		
	Total (other)HxCDD	<0.70	0.35	0	0		
	1,2,3,4,6,7,8-HpCDD	<1.7	0.85	0.01	0.085		
	Total (other) HpCDD	<1.7	0.85	0	0		
	OCDD	ND	ns	0.001	ND		
	CRM-VC-05 Furan	2,3,7,8-TCDF	<0.45	0.225	0.1		0.0225
		Total TCDF	<0.45	0.225	0		0
1,2,3,7,8 – PeCDF		<0.69	0.345	0.05	0.01725		
1,3,4,7,8 – PeCDF		<0.65	0.325	0.05	0.01625		
Total (other) PeCDF		<0.78	0.39	0	0		
1,2,3,4,7,8 – HxCDF		<0.53	0.265	0.1	0.0265		
1,2,3,6,7,8 – HxCDF		<0.49	0.245	0.1	0.0245		
2,3,4,6,7,8 – HxCDF		<0.55	0.275	0.1	0.0275		
2,3,6,7,8,9 – HxCDF		<0.56	0.28	0.1	0.028		
Total (other) HxCDF		<0.56	0.28	0	0		
1,2,3,4,6,7,8 – HpCDF		<0.47	0.235	0.01	0.00235		
1,2,3,4,7,8,9 – HpCDF		<0.56	0.23	0.01	0.0023		
Total (other) HpCDF		<0.65	0.325	0	0		
OCDF	<0.72	0.36	0.001	0.00036			
Total Dioxins/Furans TEQ ng/kg					0.7245	<15 ng/kg	

Total Dioxin/Furan TEQ is calculated using one-half (1/2) of the MDL value if congener is non-detect (ND)

Symbol (<) = Non-detect (ND) at the value listed (Method Detection 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 13, Columbia River Mile 29

Brookfield Mound
Surface Samples & Vibra Core Samples
P450 HRGS (ng/g, ppb)

Sampled September 1-3, 2000

Sample ID	Fold Induction	TEQ pg/ml	Well Vol. (ml)	Injection Vol.	Dilution Factor	Extract Vol. (mL)	Grams Extracted	Calculated ng/g TEQ	Reporting Limit ng/g TEQ	Reporting Limit ng/g TEQ	Report ng/g TEQ	Report Notes
CRM-BC-01	1.7	1.8	2	0.020	1	0.5	7.77	0.011	0.021	0.010	0.011	J
CRM-BC-03	2.6	2.2	2	0.020	1	0.5	7.38	0.015	0.022	0.010	0.015	J
CRM-BC-05	1.7	1.8	2	0.020	1	0.5	7.49	0.012	0.022	0.010	0.012	J
CRM-VC-01	1.6	1.8	2	0.020	1	0.5	9.24	0.010	0.018	0.010	0.010	J
CRM-VC-02	1.6	1.7	2	0.020	1	0.5	8.21	0.011	0.020	0.010	0.011	J
CRM-VC-03	1.6	1.7	2	0.020	1	0.5	8.00	0.011	0.021	0.010	0.011	J
CRM-VC-04	1.6	1.7	2	0.020	1	0.5	8.33	0.010	0.020	0.010	0.010	J
CRM-VC-05	1.6	1.7	2	0.020	1	0.5	8.68	0.010	0.019	0.010	0.010	J
CRM-VC-05 Dup	1.6	1.7	2	0.020	1	0.5	8.68	0.010	0.019	0.010	0.010	J

Assume 5 Fold Induction for Reporting Limit

$$\text{Reporting Limit} = \{((5\text{fold} * 0.4645) + (\text{Well Vol. mL})(\text{Dilution Factor})(\text{Extract Vol. mL})) / \{\text{Inj Vol. mL})(\text{Grams})(1000\text{pg/ng})\}$$

$$\text{Pg/mL TEQ} = (0.4645)(\text{Fold Induction}) + 1.00 \quad r \text{ squared} = 0.9956$$

Figure 1

SAMPLE SITE LOCATIONS

Columbia River Mile 29 (Brookfield Mound)
Sampled August 9 (Surface Samples) & September 7, 2000 (Core Samples)

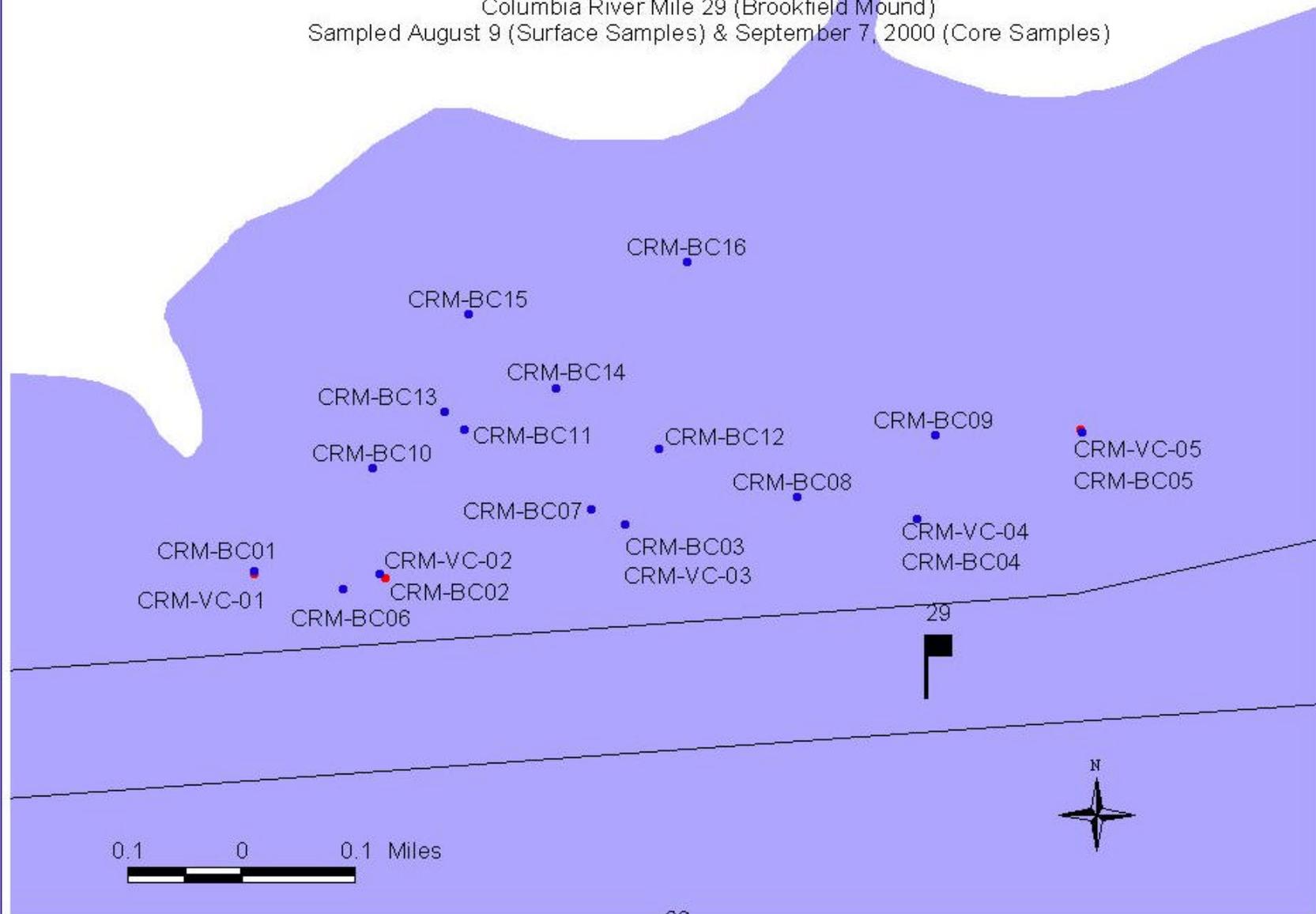


Figure 2

Sample Site Locations

Columbia River Mile 26-34 (Brookfield Mound and Skamakawa Turn)
Sampled August 9 (Surface samples) & September 7, 2000 (Core samples)

