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COQUILLE RIVER SEDIMENT QUALITY EVALUATION REPORT

April 2007

Prepared by:
Tim Sherman

Technical Review:
Mark Siipola

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CENWP-EC-HR

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EPA	Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
ODEQ	Oregon Department of Environmental Quality
DMEF	Dredge Material Evaluation Framework
SEF	Sediment Evaluation Framework
NES	Newly Exposed Surface
QA/QC	Quality Assurance/Quality Control
TOC	Total Organic Carbon
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
MDL	Method Detection Limit
PQL	Practical Quantitation Limit
MRL	Method Reporting Limit
TVS	Total Volatile Solids
ND	non-detect
CoC	Contaminates of concern
ppm	parts per million – mg/kg
ppb	parts per billion – ug/kg & ug/L
pptr	parts per trillion – ng/kg
SL	Screening level
As	Arsenic
Cd	Cadmium
Ni	Nickel
Cu	Copper
Sb	Thallium
Cr	Chromium
Pb	Lead
Hg	Mercury
Ni	Nickel
Ag	Silver
Zn	Zinc
ID	Identification Number
P	Ponar (sediment surface grab sampler)
HC	Hand Core (hand push tube sediment sampler)
RSET	Regional Sediment Evaluation Team
NWP	US Army Corps of Engineers, North Western (Division) Portland District

Note: This Coquille River Sediment Quality Evaluation Report was reviewed by the Regional Sediment Evaluation Team (RSET) in accordance with the SEF (2006). All comments received have been incorporated into the report and will be considered final at the end of the review period, May 2007.

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ABSTRACT

The Coquille River enters the Pacific Ocean north of the town of Bandon, Oregon, 226 miles south of the mouth of the Columbia River. The estuary is mainly fed by the Coquille River, which drains 1,058 square miles and is 99.1 miles from its mouth to headwaters.

The Federal project starts in deep water and proceeds to RM 1.3. It is maintained to a suitable width and a 13-foot depth. From the main river channel at RM 1.0 an entrance to the boat basin is provided at 12 feet deep and 100 feet wide for a distance of 250 feet to an inner access channel 12 feet deep and 50 feet wide for 500 feet. Snagging operations to clear the channel are authorized from RM 1.3 to RM 24.

Typically, two (2) shoals form in the Federal project; one (1) between the jetty ends at the outlet and the other extends across the channel between RM 0.2 and 0.5. In recent years, the average annual dredge volume from the main channel and the boat basin channel has been approximately 20,000 cubic yards of material is placed in the Ocean Dredge Material Disposal Site (ODMDS).

On September 8, 2006 a total of six (6) surface grab samples were collected, four (4) from the Coquille River from the entrance to River Mile (RM) 1.3 and two (2) from the boat basin inner channel . All six (6) samples were submitted for physical testing, with data presented in Table 3. Material in the channel consists of 97.2% poorly graded sand with shell hash; volatile solids content ranging from 1.29% to 3.15%. The mean value for the material within the boat basin was 90.2% silt and clay, with volatile solids content ranging from 9.07% to 8.54%. Two (2) fine-grained samples collected within the boat basin were submitted for chemical analyzes to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT) (total) analysis. Data results indicated no contaminants of concern were present at levels that approached the screening level guidelines.

Sediment represented by samples collected during this sampling event are consistent with historical sampling results and meet the Tier II guidelines established in the DMEF/SEF for unconfined in-water placement without further characterization.

INTRODUCTION

The sampling and analysis objectives are stated in the Sampling and Analysis Plan (SAP August 2006), and are, also, listed below. This report will characterize the sediment to be dredged and outline the procedures used to accomplish these objectives.

Sampling and Analysis Objectives

- To characterize sediments in accordance with the regional dredge material testing manual protocols, the Dredge Material Evaluation Framework (DMEF), 1998 and Sediment Evaluation Framework (SEF), 2006 as well as, the Evaluation of Dredged

Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing manual (Upland Testing Manual).

- Collect, handle and analyze representative sediment from Coquille Federal Project in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.

- Analyze for full suite of physical and chemical parameters as outlined in the DMEF/SEF Tier II a & b on select samples (containing >20% fine-grained material). DMEF/SEF – Tables contains the list of analytes and methods of analysis (see pgs. 16-22).

HISTORICAL SEDIMENT SAMPLING

Portland District routinely evaluates sediment from its projects on a 5-year rotation. Sediment evaluation sampling was performed at the Coquille River starting in 1979 and continued in 1981 1982, 1990, 1996 and 2001. Physical analyses were conducted on all samples, with chemical analyses conducted on the fine-grained sediment as part of the 2001 sampling event. Additional samples were collected in the boat basin as part of an EPA funded study in 1996. The results of all studies reveal the sediment, especially in Federal channel areas, to be predominately medium-grained sands with a low organic content. Sediments in the boat basin are primarily silt, with fine-grained sand and clay. All sediments from the previous studies have been determined to be suitable for in-water disposal.

CURRENT PROJECT CONDITIONS AND SAMPLING EVENT DISCUSSION

The August 2006 hydrographic condition survey maps (see figures 2-3) were used to determine the depth of the dredging prism within the project area at the time of this sampling event and select sampling stations. The maps indicate currently only minor shoaling in the main Federal Navigation Channel at river mile (RM) 0.57 and in the federally maintained entrance to the boat basin. The main channel dredging prism consists of primarily sand and coarser material; shoals vary in depth from >1ft. to 3 ft. The boat basin dredge prism is homogenous fine-grained material that has in filled since the last dredging and also varies in depth from >1ft. to 3 ft. A Ponar box coring sampler was selected for used in both the primarily sand main channel and the homogenous fine-grained material in the boat basin. An authorized advanced maintenance, with a potential precision overdepth allowance may also be dredged.

Table 1 lists the Project Team their duties and responsibilities for the sediment-sampling project at the Coquille River and marina at Bandon Oregon.

Table 1, Project Team

Task/Responsibility	CENWP Tim Sherman	CENWP Donna Ebner and Wendy Briner	Columbia Analytical Services	CENWP Mark Siipola	A/E Boat Operator Brian Baronian
Overall Project Management	X				
Sampling Plan Development	X				
Agency Coordination	X				
Positioning/Log Record	X	X			X
Sediment Sampling	X	X			
Physical Analysis			X		
Chemical Analysis			X		
Final Report	X				
Technical Review				X	
Boat & Operator					X

Table 2 lists the sampling coordinates within Coquille Federal Project. Coordinates are based on the Lambert Projection for Oregon; South Zone (NAD 83, U.S. Survey Feet) Datum is Mean Lower Low Water, (MLLW is 3.57 feet below National Geodetic Vertical Datum at the Coast Guard Dock, 1947 adjustment).

Table 2, Sampling Station Coordinates (NAD 83, Oregon State Plane South)

Sample ID	**Latitude**	**Longitude**
090806COQM-P-01	43˚07’23.4”	124˚25’40.5”
090806COQM-P-02	43˚07’20.3”	124˚25’16.3”
090806COQM-P-03	43˚07’16.4”	124˚24’51.1”
090806COQM-P-04	43˚07’21.6”	124˚24’36.3”
090806COQM-P-05	43˚07’15.6”	124˚24’42.4”
090806COQM-P-06	43˚07’12.8”	124˚24’43.7”

RESULTS

Physical and Volatile Solids (ASTM methods), Total Organic Carbon (EPA method 9060)

Six (6) samples were submitted for testing, with data presented in Table 3. All samples were submitted for physical analyses, material within the channel consisted of 97.2% poorly graded sand with shell hash (range 98.6% to 93.9% sand); with volatile solids content ranging from 1.29% to 3.15% (mean 1.92 %). Material within the boat basin was 90.2% silt and clay (range 92.3% to 88.1% [fines, <230 sieve]), with volatile solids content ranging from 9.07% to 8.54% (mean 8.8 %).
The TOC ranged from 0.07 to 2.2% in the samples. The TOC mean value in the Coquille River federal channel was 0.11% and 2.18% in the boat basin.

Metals (EPA method 6010/7471)

Two (2) fine-grained samples collected from within the boat basin were submitted for testing, with data presented in Table 4. Ag, As, Cd, Cr, Cu, Ni, Pb, Sb, Hg and Zn metals were detected in both fine-grained samples, but no levels approach their respective DMEF/SEF SL and are consistent with historically reported values.

Pesticides/PCBs (EPA method 8080), Phenols, Phthalates and Miscellaneous Extractables (EPA method 8270)

Two (2) fine-grained samples collected from within the boat basin were submitted for testing, with data presented in Tables 5-8. No pesticides (including DDT), PCBs, phenols, phthalates or were found at the MDL in any of the samples. One (1) miscellaneous extractable, Dibenzofuran, was detected in the 06 sample at the MDL, the level was below the MRL and is considered an estimate.

Polynuclear Aromatic Hydrocarbons (EPA method 8270C)

Two (2) fine-grained samples collected from within the boat basin were submitted for testing, with data presented in Tables 9-10. Both samples contained low levels of 3 “low molecular weight” PAHs and 7 “High molecular weight” PAHs; none approached their respective DMEF/SEF screening levels. All detection levels were low enough to adequately characterize sediment.

Tributyltin (Krone method for Total /Bulk organotin)

Two (2) fine-grained samples collected from within the boat basin were submitted for testing, with data presented in Table 11. Some organotin components were detected slightly above detection reporting levels in both samples, but levels were not considered levels of concern. Lack of pore-water in the samples submitted did not allow pore-water analyses to be run.

CONCLUSION

Collection and evaluation of the sediment data was completed using guidelines from the DMEF/SEF. The DMEF/SEF is a regional manual developed jointly with regional EPA, NMFS, USFW, Corps, Oregon Department of Environmental Quality and Washington Departments of Ecology and Natural Resources. This document is guidance for implementing the Marine Protection, Research, and Sanctuaries Act and 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 and the Intern Final SEF, 2006 (updated DMEF).

On September 8, 2006 six (6) surface grab samples were collected (4) in the Coquille River from the entrance to River Mile (RM) 1.3 and (2) from the boat basin inner channel. All six (6) samples were submitted for physical testing, with data presented in Table 3. Material in the channel consists of 97.2% poorly graded sand with shell hash (range 98.6% to 93.9%); volatile solids content ranging from 1.29% to 3.15% (mean 1.92 %). The mean value for the material within the boat basin was 90.2% silt and clay (range 92.3% to 88.1%), with volatile solids content ranging from 9.07% to 8.54% (mean 8.8 %). Two (2) fine-grained samples collected within the boat basin were submitted for chemical analyzes to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT) (total) analysis. Data results indicated no contaminants of concern were present at levels that approached the screening level guidelines set forth in the DMEF/SEF.

Sediment represented by samples collected during this sampling event are consistent with historical sampling results and meet the Tier II guidelines established in the DMEF/SEF 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. 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, NOAA fisheries and US Fish and Wild Life. 2006 Interim Final. Sediment Evaluation Framework.

3. 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").

4. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency. February 1991. Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual (referred to as the OTM or the "Green Book").

5. U.S. Army Corps of Engineers. January 2003. Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities - Testing Manual (referred to as the "Upland Testing Manual").

6. Clean Water Act, 40 CFR 230 (b)(1).

7. PSDDA. 1996. Puget Sound Dredged Disposal Analysis, Technical Information Memorandum, Testing, Reporting and Evaluation of Dioxin/furan Data in PSDDA Programs.

8. Sherman, T. Army Corps of Engineers, Portland District. August 2001. Coquille River Channel and Boat Basin Entrance, Sediment Quality Evaluation.

9. U.S. Army Corps of Engineers, Portland District. 1996. Coquille River Sediment Quality Evaluation.

Table 3: Physical Analysis and Volatile Solids

Sample I.D.	Grain Size Percent (%)				
	Gravel (shell hash)	**Sand**	**Silt/Clay**	**Volatile Solids**	**TOC**
090806COQM-P-01	0.2	98.1	1.7	1.29	0.07
090806COQM-P-02	0.1	98.0	1.9	1.26	0.08
090806COQM-P-03	31.9	66.7	1.4	1.99	0.13
090806COQM-P-04	3.5	90.4	6.4	3.15	0.15
Federal Channel Ave	8.9	88.3	2.85	1.92	0.11
090806COQM-P-05	0.0	11.9	88.1	9.07	2.22
090806COQM-P-06	0.0	7.7	92.3	8.54	2.13
Boat Basin Average	0.0	9.8	90.2	8.8	2.18
Minimum	0.0	7.7	1.4	1.29	0.07
Maximum	31.9	98.1	92.3	9.07	2.22
COQM = Coquille Main (Federal) Channel P = Ponar (surface grab sampler)					

Table 4: Inorganic Metals and TOC EPA method 6000/7000

Sample I.D.	As	Cd	Cr	Sb	Cu	Pb	Ni	Ag	Zn	Hg
	mg/kg (ppm)									
090806COQM-P-05	4.33	0.19	87.0	0.08	20.3	6.84	110	0.08	43.9	0.071
090806COQM-P-06	5.23	0.20	91.8	0.08	22.9	8.00	115	0.08	50.8	0.066
DMEF/SEF (SL)	57	5.1	--/260	150	390	450	140/--	6.1	410	0.41

Symbol (--) = Screening Level not established.

Table 5: Pesticides - EPA Method 8081 (ug/kg)

Sample I.D.	Aldrin	Chlordane	Dieldrin	Heptachlor	Gamma-BHC (Lindane)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Sum ∑ DDT
090806COQM-P-05	<1.6	<22*	<3.1	<0.84	<5.4	<1.3	<1.1	<0.68	ND
090806COQM-P-06	<5.4	<15*	<3.1	<0.84	<5.4	<1.3	<1.1	<0.67	ND
DMEF/SEF SL	10/9.5	10/2.8	10/1.9	10/1.5	10/--			Total	6.9/--

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
*Matrix interference elevated the detection limits above the screening level, however, historically chlordane has never been detected at Coquille and there is no known source in the area to support re-testing sediment.

Table 6: Polychlorinated Biphenyl - EPA Method 8082 (ug/kg)

Sample I.D.	PCB Aroclors ug/kg (ppb)							
	1016	1221	1232	1242	1248	1254	1260	Sum ∑
090806COQM-P-05	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6
090806COQM-P-06	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6
DMEF/SEF SL							Total	130

Dredge Material Evaluation Framework (1998) Sediment Evaluation Framework (2006 Interim Freshwater S1)
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Table 7: Chlorinated Hydrocarbons - EPA Method 8270 (ug/kg)

Sample I.D.	1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,2-Dichlorobenzene	1,2,4-Trichlorobenzene	Hexachlorobenzene
090806COQM-P-05	<3.3	<3.9	<2.6	<3.0	<4.1
090806COQM-P-06	<3.2	<3.7	<1.8	<2.1	<2.9
DMEF/SEF SL	170/35	110/110	35/35	31/31	22/22

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

Table 8: Miscellaneous Extractables - EPA Method 8270C (ug/kg)

Sample I.D.	Benzyl alcohol	Benzoic Acid	Dibenzofuran	Hexachloroethane	Hexachloro-butadiene	N-Nitroso diphenylamine
090806COQM-P-05	<7.6	<200	<2.7	<4.5	<2.9	<4.5
090806COQM-P-06	<7.2	<190	2.7 J	<4.3	<2.8	<4.3
DMEF/SEF SL	57/57	650/650	540540	1400/--	29/11	28/28

J = Estimated value (reported values are above the MDL, but below the MRL).
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Table 9: Polynuclear Aromatic Hydrocarbons (PAHs) Low Molecular Weight - EPA Method 8270C (ug/kg)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen-anthrene	Total Low PAHs
090806COQM-P-05	<2.1	<2.9	<2.9	<3.5	4.9 J	4.2 J	9.0 J	18.1 J
090806COQM-P-06	2.1 J	<2.8	3.6 J	<3.4	4.8 J	3.8 J	20	28.6 J
DMEF/SEF SL	500/500	560/560	960/960	540540	670/670	2100/2100	1500/1500	5200/5200

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 10: Polynuclear Aromatic Hydrocarbons (PAHs) High Molecular Weight - EPA Method 8270C (ug/kg)

Sample I.D.	Benzo(a)-anthracene	Benzo-fluro-anthenes	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Dibenzo(a,h) anthracene	Fluor-anthene	Total High PAHs
090806COQM-P-05	7.0 J	9.9 J	<4.7	8.7 J	18	6.0 J	<3.9	<4.5	22	71.6 J
090806COQM-P-06	11	21.8 J	6.3 J	17	32	9.8	6.9 J	<4.3	45	149.8 J
DMEF/SEF SL	1300/ 1300	3200/ 3200	670/ 670	1400/ 1400	2600/ 2600	1600/ 1600	600/ 600	230/ 230	1700/ 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 11: Organotin - Krone Method (ug/kg)

Organotin				
	Total (Bulk) ug/kg			
Sample I.D.	Monobutyltin	Dibutyltin	Tributyltin	Tetrabutyltin
090806COQM-P-05	0.46	0.43	0.76	<0.15
090806COQM-P-06	0.49	0.50	<0.12	<0.15
DMEF/SEF SL *	--/75*			

Due to lack of porewater in the samples only total TBT was analyzed *75 ug/Kg is the freshwater SL, a marine SL for total TBT has not been established in the SEF.
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Figure 1, Coquille Federal Channel Vicinity Map

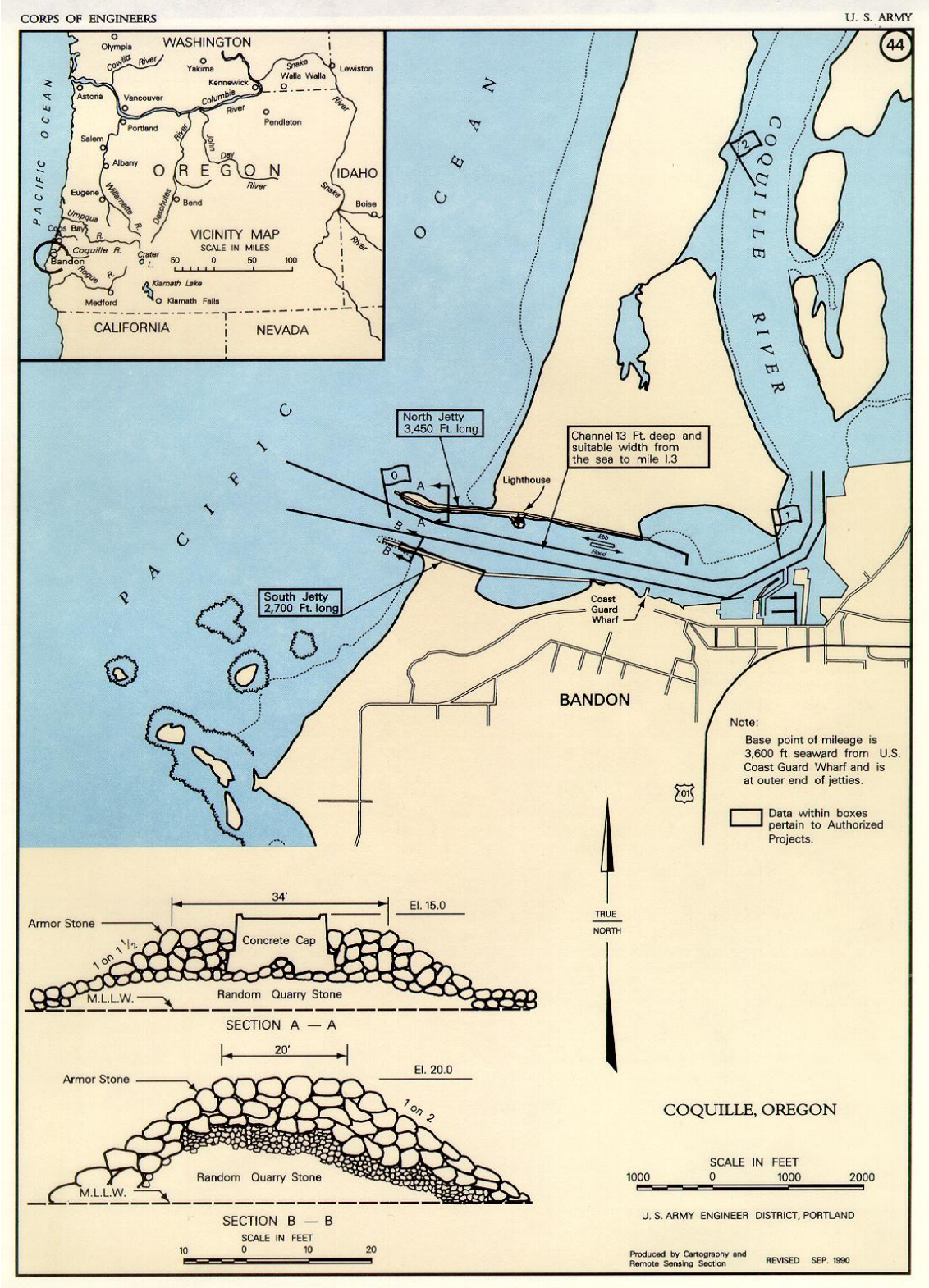


Figure 2: Coquille Federal Channel, Sediment Sampling Station Locations

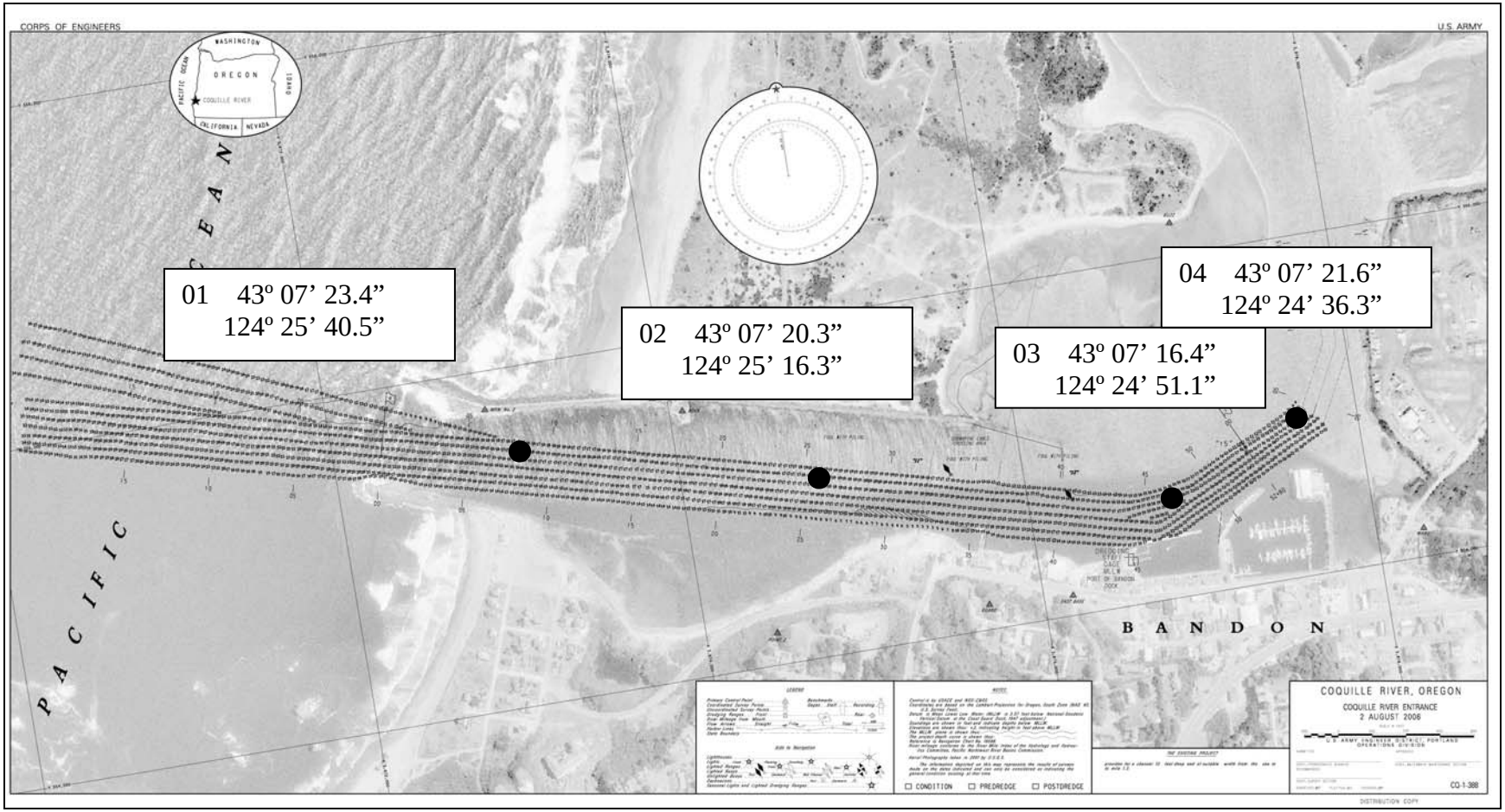


Figure 3: Coquille Boat Basin, Sediment Station Locations

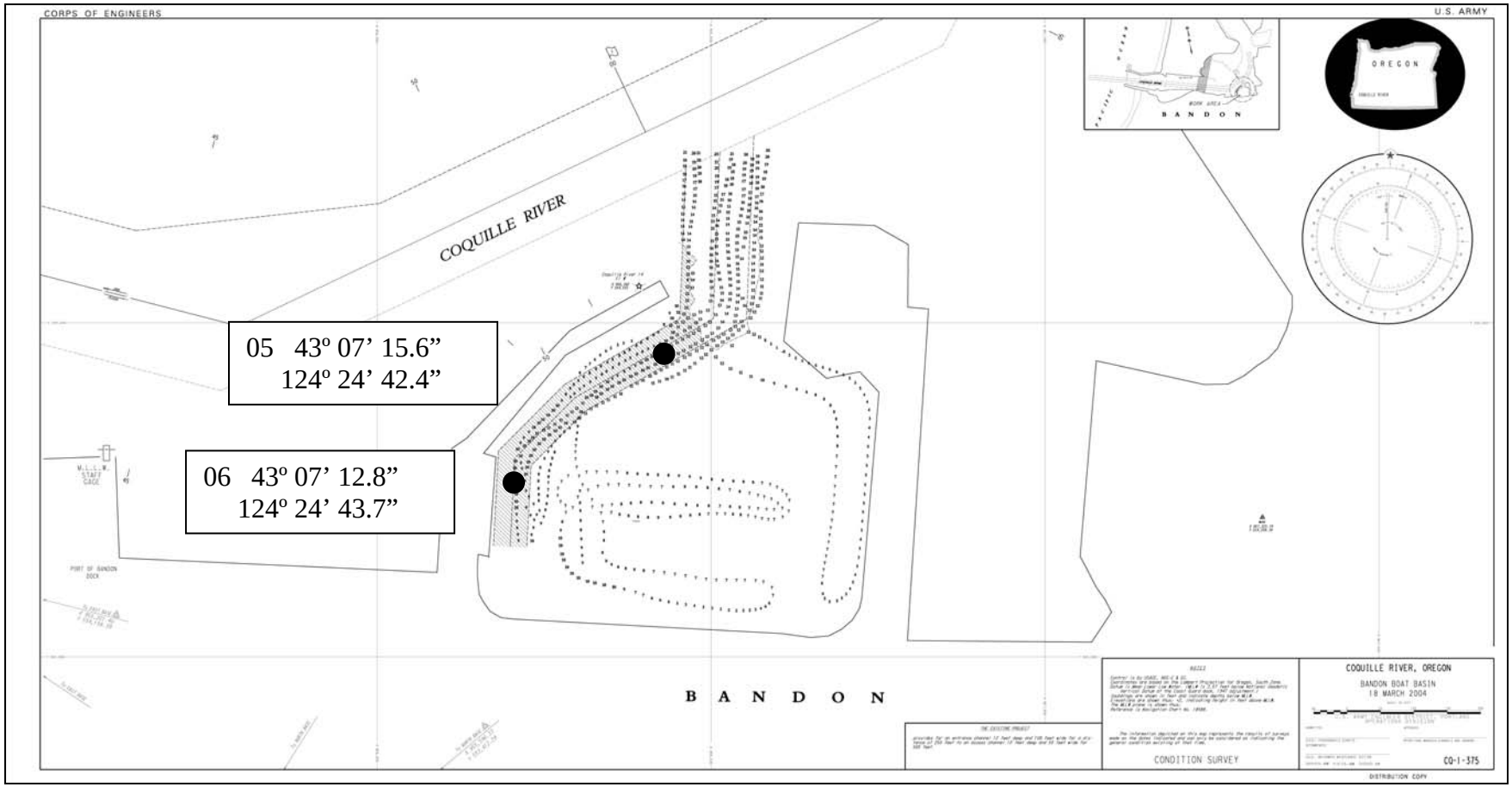
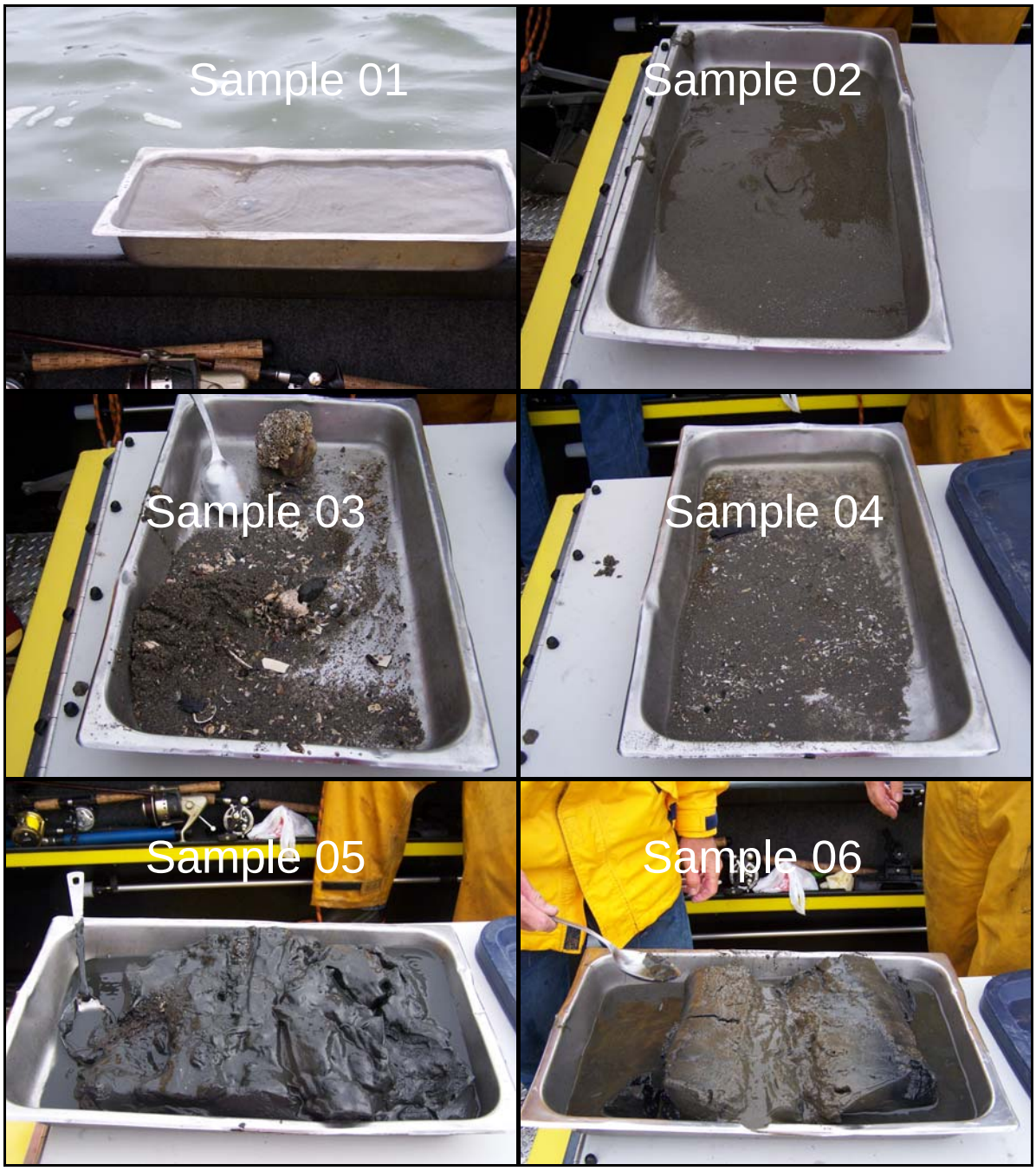


Figure 4: Sediment Samples, Coquille River and Boat Basin



DMEF REFERENCE TABLE

Testing Parameter, Preparation Method, Analytical Method, Sediment Method Detection Limit (MDL)

PARAMETER	PREP METHOD (recommended)	ANALYSIS METHOD (recommended)	SEDIMENT MDL (1)
CONVENTIONALS:			
Total Solids (%)	---	Pg.17 (2)	0.1
Total Volatile Solids (%)	---	Pg.20 (2)	0.1
Total Organic Carbon (%)	---	Pg.23 (2, 3)	0.1
Total Sulfides (mg/kg)	---	Pg.32 (2)	1
Ammonia (mg/kg)	---	Plumb 1981 (4)	1
Grain Size	---	Modified ASTM with Hydrometer	---
METALS mg/kg (ppm):			
Antimony	APNDX D (5)	GFAA (6)	2.5
Arsenic	APNDX D (5)	GFAA (6)	2.5
Cadmium	APNDX D (5)	GFAA (6)	0.3
Chromium	APNDX D (5)	GFAA (6)	0.3
Copper	APNDX D (5)	ICP (7)	15.0
Lead	APNDX D (5)	ICP (7)	0.5
Mercury	MER (8)	7471 (8)	0.02
Nickel	APNDX D (5)	ICP (7)	2.5
Silver	APNDX D (5)	GFAA (6)	0.2
Zinc	APNDX D (5)	ICP (7)	15.0
ORGANOMETALLIC COMPOUNDS (ug/L):			
Tributyltin (interstitial water)	NMFS	Krone	0.01

DMEF REFERENCE TABLE (CONTINUED)

ORGANICS ug/kg (ppb):			
LPAH			
Naphthalene	3550 (9)	8270 (10)	20
Acenaphthylene	3550 (9)	8270 (10)	20
Acenaphthene	3550 (9)	8270 (10)	20
Fluorene	3550 (9)	8270 (10)	20
Phenanthrene	3550 (9)	8270 (10)	20
Anthracene	3550 (9)	8270 (10)	20
2-Methylnaphthalene	3550 (9)	8270 (10)	20
Total LPAH			
HPAH			
Fluoranthene	3550 (9)	8270 (10)	20
Pyrene	3550 (9)	8270 (10)	20
Benzo(a)anthracene	3550 (9)	8270 (10)	20
Chrysene	3550 (9)	8270 (10)	20
Benzofluoranthenes	3550 (9)	8270 (10)	20
Benzo(a)pyrene	3550 (9)	8270 (10)	20
Indeno(1,2,3-c,d)pyrene	3550 (9)	8270 (10)	20
Dibenzo(a,h)anthracene	3550 (9)	8270 (10)	20
Benzo(g,h,i)perylene	3550 (9)	8270 (10)	20
Total HPAH			
CHLORINATED HYDROCARBONS			
1,3-Dichlorobenzene	P&T (12)	8260 (11)	3.2
1,4-Dichlorobenzene	P&T (12)	8260 (11)	3.2
1,2-Dichlorobenzene	P&T (12)	8260 (11)	3.2
1,2,4-Trichlorobenzene	3550 (9)	8270 (10)	6
Hexachlorobenzene (HCB)	3550 (9)	8270 (10)	12

DMEF REFERENCE TABLE (CONTINUED)

PHTHALATES		ug/kg	
Dimethyl phthalate	3550 (9)	8270 (10)	20
Diethyl phthalate	3550 (9)	8270 (10)	20
Di-n-butyl phthalate	3550 (9)	8270 (10)	20
Butyl benzyl phthalate	3550 (9)	8270 (10)	20
Bis(2-ethylhexyl)phthalate	3550 (9)	8270 (10)	20
Di-n-octyl phthalate	3550 (9)	8270 (10)	20
PHENOLS			
Phenol	3550 (9)	8270 (10)	20
2 Methylphenol	3550 (9)	8270 (10)	6
4 Methylphenol	3550 (9)	8270 (10)	20
2,4-Dimethylphenol	3550 (9)	8270 (10)	6
Pentachlorophenol	3550 (9)	8270 (10)	61
MISCELLANEOUS EXTRACTABLES			
Benzyl alcohol	3550 (9)	8270 (10)	6
Benzoic acid	3550 (9)	8270 (10)	100
Dibenzofuran	3550 (9)	8270 (10)	20
Hexachloroethane	3550 (9)	8270 (10)	20
Hexachlorobutadiene	3550 (9)	8270 (10)	20
N-Nitrosodiphenylamine	3550 (9)	8270 (10)	12
PESTICIDES			
Total DDT	---	---	---
p,p'-DDE	3540 (13)	8081 (13)	2.3
p,p'-DDD	3540 (13)	8081 (13)	3.3
p,p'-DDT	3540 (13)	8081 (13)	6.7
Aldrin	3540 (13)	8081 (13)	1.7
Chlordane	3540 (13)	8081 (13)	1.7
Dieldrin	3540 (13)	8081 (13)	2.3
Heptachlor	3540 (13)	8081 (13)	1.7
Lindane	3540 (13)	8081 (13)	1.7
Total PCBs	3540 (13)	8082 (13)	67

1. Dry Weight Basis.
2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, 1997.
3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May 1993.

4. Procedures For Handling and Chemical Analysis of Sediment and Water Samples, Russell H. Plumb, Jr., EPA/Corps of Engineers, May 1981.
5. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment and Tissue Samples, Puget Sound Estuary Program, 1997.
6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
8. Mercury Digestion and Cold Vapor Atomic Absorption (CVAA) Spectrometry - Method 747I, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.
10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
11. GCMS Analysis - Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
12. Purge and Trap Extraction and GCMS Analysis - Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
13. Soxlet Extraction and Method 8080, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1997.

SEF REFERENCE TABLE:

Recommended Analytical Methods and Quantitation Limits for Sediment

Parameter	Prep Method	Analysis Method	Sample Quantitation Limit (SQL) [1/]
Conventionals:			
Total Solids (%)		EPA 2450-G	0.1
Total Organic Carbon (%)		EPA 5310B mod	0.1
Total Sulfides (mg/kg)		PSEP 1997	1.0
Ammonia (mg/kg)		Plumb 1981	0.1
Grain Size (%)		ASTM D-422 mod	1.0
Metals (mg/kg):			
Antimony	EPA 6010/6020 [2/]	EPA 6010/6020	0.5
Arsenic	EPA 6010/6020	EPA 6010/6020	5
Cadmium	EPA 6010/6020	EPA 6010/6020	0.5
Chromium	EPA 6010/6020	EPA 6010/6020	5
Copper	EPA 6010/6020	EPA 6010/6020	5
Lead	EPA 6010/6020	EPA 6010/6020	5
Mercury	EPA 7471	EPA 7471	0.05
Nickel	EPA 6010/6020	EPA 6010/6020	5
Silver	EPA 6010/6020	EPA 6010/6020	0.5
Zinc	EPA 6010/6020	EPA 6010/6020	5
Polynuclear Aromatic Hydrocarbons (µg/kg):			
LPAH			
Naphthalene	EPA 3550-mod	EPA 8270	20
Acenaphthylene	EPA 3550-mod	EPA 8270	20
Acenaphthene	EPA 3550-mod	EPA 8270	20
Fluorene	EPA 3550-mod	EPA 8270	20
Phenanthrene	EPA 3550-mod	EPA 8270	20
Anthracene	EPA 3550-mod	EPA 8270	20
2-Methylnaphthalene	EPA 3550-mod	EPA 8270	20
HPAH			
Fluoranthene	EPA 3550-mod	EPA 8270	20
Pyrene	EPA 3550-mod	EPA 8270	20
Benzo(a)anthracene	EPA 3550-mod	EPA 8270	20
Chrysene	EPA 3550-mod	EPA 8270	20
Benzofluoranthenes	EPA 3550-mod	EPA 8270	20
Benzo(a)pyrene	EPA 3550-mod	EPA 8270	20
Indeno(1,2,3-c,d)pyrene	EPA 3550-mod	EPA 8270	20
Dibenzo(a,h)anthracene	EPA 3550-mod	EPA 8270	20
Benzo(g,h,i)perylene	EPA 3550-mod	EPA 8270	20

SEF REFERENCE TABLE (CONTINUED)

Chlorinated Hydrocarbons (µg/kg):			
1,4-Dichlorobenzene	EPA 3550-mod	EPA 8270	20
1,2-Dichlorobenzene	EPA 3550-mod	EPA 8270	20
1,2,4-Trichlorobenzene	EPA 3550-mod	EPA 8270	20
Hexachlorobenzene (HCB)	EPA 3550/3540	EPA 8270/8081	10
Phthalates (µg/kg):			
Dimethyl phthalate	EPA 3550-mod	EPA 8270	20
Diethyl phthalate	EPA 3550-mod	EPA 8270	20
Di-n-butyl phthalate	EPA 3550-mod	EPA 8270	20
Butyl benzyl phthalate	EPA 3550-mod	EPA 8270	20
Bis(2-ethylhexyl)phthalate	EPA 3550-mod	EPA 8270	100
Di-n-octyl phthalate	EPA 3550-mod	EPA 8270	20
Phenols (µg/kg):			
Phenol	EPA 3550-mod	EPA 8270	20
2 Methylphenol	EPA 3550-mod	EPA 8270	20
4 Methylphenol	EPA 3550-mod	EPA 8270	20
2,4-Dimethylphenol	EPA 3550-mod	EPA 8270	20
Pentachlorophenol	EPA 3550-mod	EPA 8270	100
Miscellaneous Extractables (µg/kg):			
Benzyl alcohol	EPA 3550-mod	EPA 8270	50
Benzoic acid	EPA 3550-mod	EPA 8270	100
Dibenzofuran	EPA 3550-mod	EPA 8270	20
Hexachloroethane	EPA 3550-mod	EPA 8270	20
Hexachlorobutadiene	EPA 3550/3540	EPA 8270/8081	10
N-Nitrosodiphenylamine	EPA 3550-mod	EPA 8270	20
Pesticides/PCBs (µg/kg):			
DDE (p,p'-, o,p'-)	EPA 3540	EPA 8081	2
DDD (p,p'-, o,p'-)	EPA 3540	EPA 8081	2
DDT (p,p'-, o,p'-)	EPA 3540	EPA 8081	2
Aldrin	EPA 3540	EPA 8081	2
Chlordane	EPA 3540	EPA 8081	2
Dieldrin	EPA 3540	EPA 8081	2
Heptachlor	EPA 3540	EPA 8081	2
Lindane	EPA 3540	EPA 8081	2
Total PCBs	EPA 3540	EPA 8082	10

SEF REFERENCE TABLE (CONTINUED)

Tributyltin (µg/L) [3/]:			
TBT in pore water (µg/L Ion)	NMFS/Hoffman	Krone 1989	0.03
TBT in sediment (µg/kg)	NMFS	Krone 1989	5

Notes:
1/ SQLs are based on dry sample weight assuming no interferences; site-specific method modifications may be required to achieve these SQLs in some cases.
2/ Includes hydrochloric acid digestion per EPA 3050-B.
3/ Tributyltin is a chemical of special concern; analysis of this constituent in pore-water or bulk sediment will be determined on a project-specific basis. EPA Method 3550 is modified to add matrix spikes before the dehydration step, not after. mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram; µg/L = micrograms per liter; % = percent; ASTM = American Society for Testing and Materials