OSV BOLD SURVEY REPORT

Puget Sound Sediment PCB and Dioxin 2008 Survey

July 31 to August 6, 2008

Submitted by Matthew Liebman
U.S. Environmental Protection Agency New England
Oceans and Coastal Protection Unit
Boston, MA

Final Report
September 11, 2008

1. GENERAL

Project and Survey title	**Puget Sound Sediment PCB and Dioxin 2008 Survey**
Program Support	Oceans and Coastal Protection Unit
Survey vessel	OSV Bold
Vessel requested by	Michael Szerlog, U.S. EPA Region 10 (MS-083) Aquatic Resources Unit Manager, ETPA, 1200 Sixth Avenue, Suite 900, Seattle, WA 98101-3140
Partnering Organizations	U.S. EPA Region 10, Washington Department of Ecology, U.S. Army Corps of Engineers Seattle District, Washington Department of Natural Resources, Dredged Material Management Program (DMMP)
EPA Project Managers	Erika Hoffman (Biologist), Renee Dagseth (Logistics)
Organization	Aquatic Resources Unit, ETPA, R10
Telephones	(206) 553- 0279 [MS], (360) 753-9540 [EH], (206) 553-1889 [RD], FAX No.: (206) 553-1775
OSV BOLD Chief Scientist	Matthew Liebman
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External Funding	Washington Departments of Ecology and Natural Resources, Army Corps Seattle District

2. SCHEDULE OF OPERATIONS

Mobilization Date	July 30 and July 31, 2008
Location	Pier 90/91, Port of Seattle, WA
Departure Date	July 31, 2008
Survey Duration (Days)	6 days (scheduled)
Weather/Breakdown Days	2 days
Demobilization Date	August 5 to August 6, 2008
Location	Pier 90/91, Port of Seattle, WA

3. PURPOSE AND BACKGROUND INFORMATION

Background

The Dredged Material Management Program (DMMP) is an interagency organization implemented by the following agencies – US EPA Region 10, the Army Corps of Engineers Seattle District, the Washington State Department of Natural Resources and the Washington State Department of Ecology. The DMMP agencies are in the process of developing new guidance for evaluation of dredged material for the presence of persistent contaminants (specifically PCB congeners and dioxins) to protect human health and the environment, support the Puget Sound Initiative's goals for Puget Sound, maintain the viability of the open-water disposal program, and ensure consistency with regulatory requirements. A number of alternatives are under consideration by the DMMP agencies (the "Agencies") to determine the suitability of dredged material containing dioxin (and dioxin-like compounds such as PCBs) for unconfined, open-water disposal. While the Puget Sound Ambient Monitoring Program (PSAMP) has generated a geographically extensive, long-term sediment data set from sites throughout Puget Sound, they have not routinely analyzed for dioxins/furans and have limited their PCB congener analysis to a subset of the 209 possible congeners. There is little high resolution dioxin/furan or polychlorinated biphenyl (PCB) congener data available for Puget Sound outside of certain Superfund and Model Toxics Control Act (MTCA) cleanup sites.

Purpose of survey

The DMMP agencies determined that additional sampling of surface sediments at established reference sites and locations distant from known sources of contamination (non-urban) to assess background concentrations of PCB congeners and dioxins/furans in Puget Sound. These samples will also be evaluated for conventional sediment properties (total organic content, grain size and percent solids to determine whether contaminant levels vary with these properties. A full suite of DMMP contaminants of concern (COCs) including semi-volatiles, PAHs, Aroclor PCBs, pesticides and trace metals will also be measured to support the use of this data for the dredging program as well as other programs focused on sediment contamination in the Puget Sound region. In addition, the traditional methods for analysis of dioxins using GC/MS will be compared to three recently EPA approved biological based methods and an additional experimental molecular method. The Procept method is a cell based PCR method that rapidly detects the presence of a DNA-bound dioxin receptor in a micro well and is amplified using PCR. The CALUX and 101L methods are based on the ability of dioxin and other dioxin-like compounds to activate the Aryl hydrocarbon receptor (AhR), a chemical responsive DNA binding protein that is responsible for producing the toxic and chemical effects of these chemicals. The final method is an experimental method using molecular tools to determine the presence and activity of aerobic PCB-degrading microorganisms.

The sampling scheme was designed to answer the following questions:

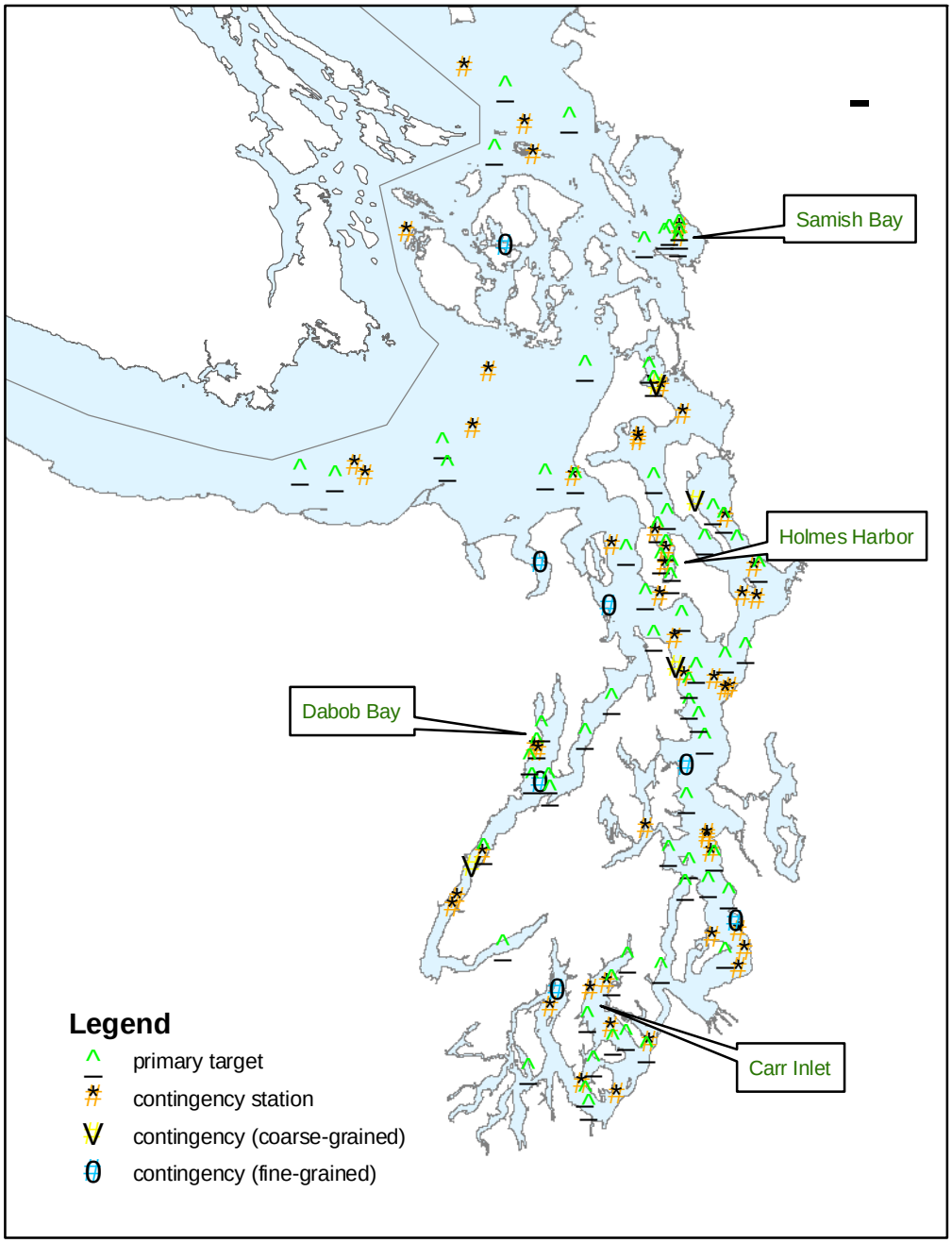
- Question 1. What are the concentrations of dioxins/furans and PCB congeners in the existing reference areas used by the DMMP?
- Question 2. What are the concentrations of dioxins/furans and PCB congeners generally in Puget Sound, outside of the areas that have already been sampled?
- Question 3. Are the concentrations of dioxins/furans and PCB congeners in the existing reference areas different from those in Puget Sound that are also away from known sources?
- Question 4. Are these concentration distributions affected by TOC or grain size?
- Question 5. Are there reliable and less expensive methods for testing dioxins/furan and coplanar PCB toxicity that could be used to reduce the cost of testing for both agencies and applicants
- Question 6. What are concentrations of the standard suite of COCs in these sediment samples?

Study design

Surface sediment samples were collected from 70 primary sampling locations throughout Puget Sound including the San Juan Islands and the Strait of Juan de Fuca (Figure 1). A subset of these sample locations (n = 20) are located within four of the existing reference areas (Carr Inlet, Samish Bay, Holmes Harbor, and Dabob Bay). In each reference area, five target (and two to three contingency) sediment sampling locations were located based on a stratified random sampling design. The remaining 50 sample locations are spread throughout Puget Sound and are intended to represent areas outside the influence of urban bays and known point sources. Contingency stations were also selected as alternate sampling locations in the event that a sample could not be obtained from a target location or to provide a broader range of grain sizes for each area. The decision to sample at contingency locations was made on a sample location-specific basis by the Chief Scientist, Principal Investigator and/or Watch Captain. Generally, a station was abandoned after two or three grabs. Both target and contingency stations were located using the same stratified random approach as was used for the reference sites

Locations for each target and contingency sampling station are displayed in Figure 1.

Figure 1. Study area and sediment target locations for Puget Sound sediment PCB and dioxin study. Four reference areas are identified. Map provided by David Fox, Army Corps of Engineers Seattle District.



4. SUMMARY OF SCIENTIFIC ACTIVITIES AND OBSERVATIONS

Methods and Equipment Used

Surface (0-10 cm) sediment samples were collected from the OSV Bold utilizing a stainless steel double Van Veen grab provided by NOAA and delivered to the ship by the EPA Region 10 Regional Laboratory. In addition to this grab, a backup double Van Veen grab from the Department of Ecology was also delivered to the ship. The Bold's 0.1-m2 Ted Young-modified van Veen grab was also available as a backup to the primary sampler. The NOAA grab worked very well. Four weights were utilized for coarse sediments and two weights for fine sediments. If two to three grabs at a location yielded refusal or coarse sediments that didn't stay in the grab, then alternative contingency stations were sampled. Our goal was to successfully sample 70 stations utilizing the contingency stations if necessary.

When the grab hit the bottom, a mark was made in the EPA Region 10-supplied laptop with Hypack navigation survey system deployed in the wet lab, and connected to the ship's GPS. The Hypack survey software automatically compensated for the difference between the locations of the grab off the A frame on the stern and the GPS receiver (about 47 meters). Although the goal of the survey was to sample within 15 meters of the targeted sample, this was not always possible. Typically, the grab was collected between 10 and 50 meters of the target. This was not a major issue because the stations were selected randomly.

The Chief Scientist had also provided coordinates to the OSV Bold crew in Nobeltec format, which was installed on both the Data Acquisition Center and the Bridge computers for the ship's navigation system. Nobeltec was used to steer the ship, and for the scientific crew to understand the ship's location and provide guidance to the ship's crew, but Hypack was used to record the station positions.

All samples were first examined for any signs of leakage from the sampler following the protocols outlined in the QAPP. If the grab was full and successful, the Watch captain signaled the deck technician and the bridge to continue to the next station. If not, the station was re-sampled one or two more times. Coarser sediments often yielded unsuccessful grabs due to incomplete penetration or rocks that prevented the jaws from fully closing. For each grab, a measure of the penetration depth was measured. Sediment to 10 cm was scooped using pre-cleaned decontaminated stainless steel spoons into a decontaminated stainless steel 2 gallon bowl. Care was taken to avoid taking any sample in contact with the grab. The sediment was photographed with an identifying label, homogenized and then aliquoted into 11 containers using decontaminated stainless steel spoons. At five stations, a duplicate sample (or field split) was collected for QA purposes. The samples from each location were homogenized and aliquotted into containers labeled with station number, date and time. They were placed in one of the five appropriate freezers or refrigerators in the dry lab (Table 1). In addition, about 50 ml of sediment was transferred to a beaker to measure approximate grain size using a standardized wet

sieving protocol[1]. The sediment was sieved through a 63 um sieve to estimate by volume the percent silt/clay (fine) grain size fraction, which was washed through the sieve, with only the coarser sediments (e.g., sand/gravel) retained on the sieve.

Table 1. Container size, temperature and refrigerator or freezer used for each sample type.

Analyte	Container Size	Temperature	Temperature; Freezer/Refrigerator
PCB congeners	4 ounce	-20°C	Frigidaire
Dioxin/Furans	4 ounce	-20°C	Frigidaire
SVOCs, PAHs, Aroclor PCBs, Pesticides	8 ounce	-20°C	Frigidaire
Metals/mercury	4 ounce	4°C	Absocold
TOC/ percent solids	4 ounce	4°C	Absocold
Procept	4 ounce	-20°C	Kelvinator
Calux	4 ounce	-20°C	Kelvinator
Archive	4 ounce (2x)	-20°C	Kelvinator
Molecular	15 ml centrifuge tube	-80°C	Nuaire Freezer
Grain size	32 ounce	4°C	Isotemp Fisher Scientific

A written sample log was kept with the following information recorded for each station:

- Date/Time of each sample (local)
- Latitude and Longitude of each sample (in decimal minutes, although Hypack recorded in decimal degrees)
- Sample ID
- Water Depth (based on ship's fathometer, corrected, in feet)
- Visual characterization of each sample (color, sediment type), presence of biota
- Penetration depth
- Calculation of percent fines based on wet sieving

Navigation files from the Hypack system were backed up two to three times per day and copied to a thumb drive and ultimately to an external hard drive provided by EPA Region 10.

[1] The wet sieving protocol in the QAPP SOP #6 was slightly modified from 100 ml sample volume to a 50ml sample volume, to facilitate processing of the fine-grained samples.

Sampling schedule and survey tracks

We mobilized as planned at the Port of Seattle on July 30 and 31, 2008.

July 30

Staff from EPA Region 10 (Tim Siewic) worked with OSV Bold techs on July 30 to connect the dedicated Hypack laptop to the GPS and entered the automatic layback – the distance between the stern of the ship (where the grab was deployed) to the GPS receiver on the house of the ship.

Sample bottles, coolers and other equipment were delivered to the ship.

July 31

Most of the scientific crew arrived on July 31.

In the morning, Tim Siewic of EPA Region 10 provided training to scientific crew on use of Hypack. In addition, the Principal Investigator, David Kendall of Army Corps of Engineers Seattle District provided an overview of the objectives of the survey to the scientific crew and the Bold techs.

In the afternoon, First Mate Bob Overman provided the safety talk. In addition, the scientific crew reviewed the sampling processing and decontamination protocols for each grab sample.

During the day, all the sampling labels were completed, an inventory of all equipment was conducted, and refrigerator/freezer space and the amount of deionized water were evaluated. It was determined that there was sufficient refrigerator and freezer space, and that sufficient deionized water had been prepared by the ship's crew.

Underway at 1545.

Successful grab at first station (CPS_3) at 1658. Sampling in Central and North Central Puget Sound.

August 1

Sampling in Admiralty Inlet, Straits of Juan de Fuca and Samish Bay. One of the stations (SJF12C_GS) was planned for Discovery Bay, near Port Townsend. Due to fog, however, we decided to sample this station on the way back from the San Juan Islands.

In addition, we decided to alter our planned route by sampling in Samish Bay during the night, and San Juan Islands during the day (August 2, 2008).

Spectacular scenery as we approached Samish Bay at around 2030, with a rainbow over

some islands – apparently this is fairly typical.

Samish Bay exhibited very fine sediments, and one set of weights was removed from the grab to reduce the penetration depth.

August 2

Sampling in San Juan Islands, crossed over Strait of Juan de Fuca, arrival at Discovery Bay at about 1300, continued to entrance to Hood Canal and Dabob Bay. Observed harbor seals, but no orcas.

At the entrance to Hood Canal, waited for up to 2 hours for the Hood Canal Bridge to be opened.

One station was near the Navy Base at Bangor. We called the Navy Port Operations unit to determine whether there were any conditions for sampling at Hood Canal and Dabob Bay. No constraints were placed on our operations by the Navy. For future reference, we should call:
Watch Commander
Navy Region NW
360-315-5123

August 3

Finished sampling Hood Canal, and continued sampling in Port Susan/Possession Sound, Saratoga Passage/Skagit Bay and Holmes Harbor.

During the day, we noticed that the edges of the Van Veen grab were flared out, which affected the seal of the grab, allowing some leakage. We asked Jesse (2^{nd} Engineer) to fix this, and he was successful in removing the flares with a hammer and pliers thereby giving the jaws of the grab a much better seal than previously.

August 4

Sampling in Central Puget Sound, South Central Puget Sound, Carr Inlet, and South Sound.

One scientific crewmember -- Jeff Rodin -- was injured while trying to dislodge a rock from the grab. His finger was pinched in the jaws, became swollen and turned black and blue. Icing his finger reduced the swelling, and he was able to work on his next shift. We warned all crew members that the jaws are dangerous and that they should be careful.

Beautiful views of both Mount Rainier and the Olympics this morning.

Because we had extra time, we decided to sample additional stations at the Anderson/Ketron Island disposal site near Tacoma in South Central Sound. These

samples required more precise navigation than the previous samples, because we were re-occupying specific stations that had been sampled in a 2005 DMMP monitoring survey. Only two bottles (for dioxin and archiving) were filled. These nine stations were occupied from 1930 to 2246.

August 5

The final station in South Central Puget Sound was collected at 0051.

Ship docked at Pier 90/91 at 0800.

Sea and weather conditions

The weather for the survey was excellent. Although it rained the first day, and there was some leakage into the wet lab, it was clear the rest of the survey, except for the heavy fog on August 1. There were light to moderate winds and seas of one to two feet at most. Tidal currents in some cases were strong, but not challenging to the ship operators. The tidal currents helped us cross from the San Juan Islands to the Hood Canal in record time. According to the captain, the ship was transiting at over 15 knots.

Sample processing

All bottles and chain-of-custody forms were prepared for shipping in coolers to various laboratories.

- The PCB and dioxin bottles were shipped via FedEx to SGS Laboratories in North Carolina.
- The PAH, PCB Aroclor and metals bottles were shipped via FedEx to a Superfund CLP laboratory.
- The grain size, TOC and solids bottles were transported to ARI labs in the afternoon in Tukwila, Washington.
- The archive samples were transported to EPA Region 10 Environmental Laboratory in Manchester Washington on August 6.
- The molecular samples were transported by the Army Corps of Engineers to a Laboratory at the University of Washington.
- The Procept assay containers were shipped via FedEx to the Army Corps of Engineers' Engineer Research and Development Center in Vicksburg, Mississippi.
- The CALUX assay containers were shipped via FedEx to Xenobiotic Detection Systems in Durham, North Carolina.

5. SUMMARY OF OBSERVATIONS AND RESULTS COMPLETED DURING THE SURVEY

Overall, although there were 47 grabs that resulted in unsuccessful samples, we were able to collect all 70 stations we targeted, many of which were contingency stations. In addition, we collected nine samples from the Anderson/Ketron Island disposal site for a total of 79 stations. These stations are listed in Table 2.

Figure 2 displays the locations of successful and unsuccessful sampling stations. Figure 3 displays the results of the wet sieving method for measuring percent fines at the sampling stations.

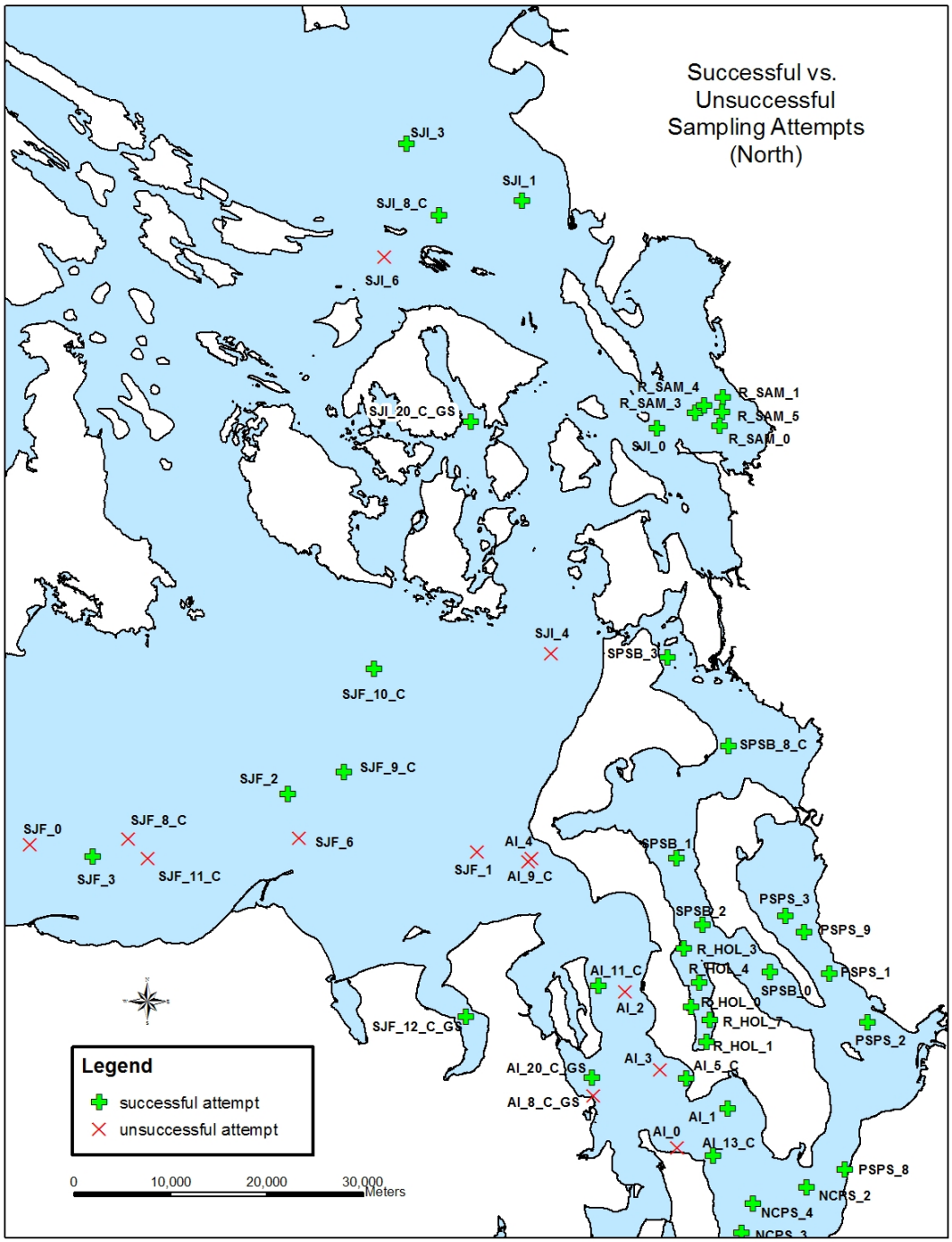
Table 2. Date, coordinates, and results of wet-sieving of successful grab samples, based on marks recorded in Hypack.

Station	Date	Time	Latitude	Longitude	Depth (feet)	Percent Fines (Wet Sieved)
CPS_3b	7/31/2008	16:58:00	47 38.725979	122 28.976183	403.8	55
CPS_5b	7/31/2008	18:20:07	47 44.887069	122 26.28357	280.1	28
NCPS_0a	7/31/2008	19:12:22	47 47.084149	122 27.207505	534.7	60
NCPS_1d	7/31/2008	19:58:50	47 48.447736	122 28.608002	47.2	2
NCPS_3a	7/31/2008	20:30:08	47 50.621518	122 28.453375	606.4	56
NCPS_4b	7/31/2008	21:23:09	47 52.257128	122 27.51329	373.9	36
AI_1a	7/31/2008	22:11:50	47 57.617282	122 29.534811	283.6	44
AI_20_C_GSa	8/1/2008	0:34:07	47 59.417252	122 40.932995	135.9	32
AI_5_Ca	8/1/2008	1:59:55	47 59.323833	122 32.997379	126.6	32
AI_11_Cb	8/1/2008	4:40:44	48 04.563402	122 40.355505	310.6	Missing data can be provided
SJF_2a	8/1/2008	8:58:53	48 15.3862	123 06.415407	518.4	46
SJF_3a	8/1/2008	10:14:33	48 11.841783	123 22.840515	419.2	32
SJF_9_Ca	8/1/2008	15:13:40	48 16.620416	123 01.725255	480.3	42
SJF_10_Ca	8/1/2008	16:43:06	48 22.440063	122 59.164956	483.7	32
SJI_0a	8/1/2008	21:11:16	48 35.951471	122 35.137905	95	72
R_SAM_3a	8/1/2008	21:41:04	48 36.785825	122 31.948991	67.3	80
R_SAM_4b	8/1/2008	22:26:28	48 37.216162	122 31.161171	55.3	80
R_SAM_1a	8/1/2008	22:56:52	48 37.645868	122 29.598858	43.1	60
R_SAM_5a	8/1/2008	23:19:18	48 36.803996	122 29.657737	49.7	76
R_SAM_0a	8/1/2008	23:38:10	48 36.060211	122 29.866238	46.6	84
SJI_1a	8/2/2008	1:49:10	48 48.745793	122 46.54468	180.2	54
SJI_3a	8/2/2008	2:47:08	48 51.961376	122 56.416747	514.7	58
SJI_8_Ca	8/2/2008	5:45:03	48 47.952987	122 53.601921	583.6	52
SJI_20_C_GSa	8/2/2008	9:17:18	48 36.319453	122 50.956816	80.8	84
SJF_12_C_GSa	8/2/2008	13:19:00	48 2.839148	122 51.472843	156.2	84
HC_1a	8/2/2008	18:15:44	47 49.099891	122 40.484361	186.8	48
HC_3a	8/2/2008	19:01:15	47 45.376835	122 44.36442	315	84
R_DAB_5a	8/2/2008	20:02:56	47 40.801396	122 50.047346	321.8	90
R_DAB_2a	8/2/2008	20:27:55	47 40.871814	122 52.455208	407.1	95
R_DAB_7_Ca	8/2/2008	21:08:04	47 43.477387	122 51.695999	319.3	80
R_DAB_0a	8/2/2008	21:28:05	47 44.406698	122 51.796867	111.7	32

R_DAB_1a	8/2/2008	22:07:58	47 46.118856	122 51.082759	379.3	72
HC_6a	8/2/2008	23:08:01	47 39.633169	122 49.828087	289.1	80
HC_0a	8/3/2008	0:20:28	47 33.591325	122 59.857943	517.4	98
HC_2a	8/3/2008	2:41:27	47 23.730783	122 57.085629	71.7	98
AI_13_Cb	8/3/2008	8:49:50	47 54.989042	122 30.809175	322.1	24
NCPS_2a	8/3/2008	9:57:39	47 53.146248	122 22.975183	415.4	54
PSPS_8a	8/3/2008	10:28:05	47 54.136196	122 19.770187	48.2	4
PSPS_2a	8/3/2008	11:45:11	48 02.400319	122 17.746414	290.9	90
PSPS_1a	8/3/2008	12:19:33	48 05.184765	122 20.912735	387.2	98
PSPS_9a	8/3/2008	12:46:40	48 07.537433	122 23.02858	392.1	96
PSPS_3a	8/3/2008	13:05:56	48 08.42628	122 24.568482	361.5	96
SPSB_0a	8/3/2008	14:27:12	48 05.278977	122 25.959802	385.2	80
SPSB_2a	8/3/2008	15:07:27	48 07.978434	122 31.595423	291.4	88
SPSB_1a	8/3/2008	15:41:27	48 11.719748	122 33.756575	261.8	88
SPSB_8_Ca	8/3/2008	16:38:20	48 18.049443	122 29.259485	78.2	46
SPSB_3a	8/3/2008	17:25:40	48 23.017806	122 34.390291	45.3	82
R_HOL_3a	8/3/2008	19:40:27	48 06.644156	122 33.140385	114.5	90
R_HOL_4a	8/3/2008	20:02:14	48 04.751722	122 31.898419	182.5	72
R_HOL_0a	8/3/2008	20:23:50	48 03.368081	122 32.532016	74.9	20
R_HOL_7a	8/3/2008	20:42:36	48 02.629577	122 31.037104	108.1	80
R_HOL_1a	8/3/2008	21:06:22	48 01.410998	122 31.298031	71.4	42
CPS_1a	8/4/2008	1:45:59	47 33.313158	122 31.821657	142.6	62
CPS_4b	8/4/2008	2:29:34	47 32.017158	122 28.665331	122.3	20
SCPS_2a	8/4/2008	3:11:35	47 29.870798	122 29.357895	336.6	24
CPS_0a	8/4/2008	4:00:19	47 32.825152	122 24.843276	557.4	86
SCPS_1a	8/4/2008	4:37:34	47 30.078348	122 25.888154	569.8	88
SCPS_5a	8/4/2008	5:05:26	47 28.949565	122 22.684026	597.3	84
SCPS_3a	8/4/2008	6:10:21	47 22.904987	122 23.251164	91.7	2
R_CAR_5a	8/4/2008	9:21:10	47 14.494022	122 38.400692	375.3	98
R_CAR_1a	8/4/2008	9:45:15	47 13.997499	122 40.298637	207	44
R_CAR_0a	8/4/2008	11:05:10	47 20.032704	122 40.537819	68.1	78
R_CAR_4a	8/4/2008	11:34:18	47 22.424564	122 38.182436	44.5	92
R_CAR_6_Ca	8/4/2008	12:16:06	47 18.876564	122 43.859896	58.8	28
SS_8_Ca	8/4/2008	14:35:10	47 08.134517	122 39.995183	379.6	44
SS_1a	8/4/2008	15:03:41	47 07.263068	122 44.090558	102.2	10
SS_2a	8/4/2008	15:22:10	47 08.651993	122 44.643159	232.1	38
SS_0a	8/4/2008	16:25:54	47 11.001143	122 53.162033	16.7	96
SS_9_Ca	8/4/2008	17:45:44	47 17.064303	122 49.842619	140.2	92
AKB03a	8/4/2008	19:34:21	47 08.351888	122 39.080872	330.4	
AKT01a	8/4/2008	19:51:26	47 08.783884	122 39.79327	419.8	
AKP01a	8/4/2008	20:11:19	47 08.962586	122 39.664813	423	
AKADLb	8/4/2008	20:41:00	47 08.961574	122 39.584195	415.7	
AKZ01a	8/4/2008	21:08:40	47 09.417435	122 39.472752	434.8	
AKP04a	8/4/2008	21:35:39	47 09.576114	122 40.055291	460.1	
AKP03a	8/4/2008	22:09:25	47 09.908495	122 39.259308	446.4	
AKP02a	8/4/2008	22:28:03	47 09.260516	122 38.869581	382.1	
AKB02a	8/4/2008	22:46:07	47 09.7947	122 38.575583	467.6	
SCPS_10_Ca	8/5/2008	0:51:08	47 20.965487	122 21.321062	343.7	40

Figures 2a and b. Successful and unsuccessful sampling stations for the Puget Sound sediment PCB and dioxin study from north stations (a) and south stations (b). Map provided by David Fox, Army Corps of Engineers Seattle District.

(a)



(b)

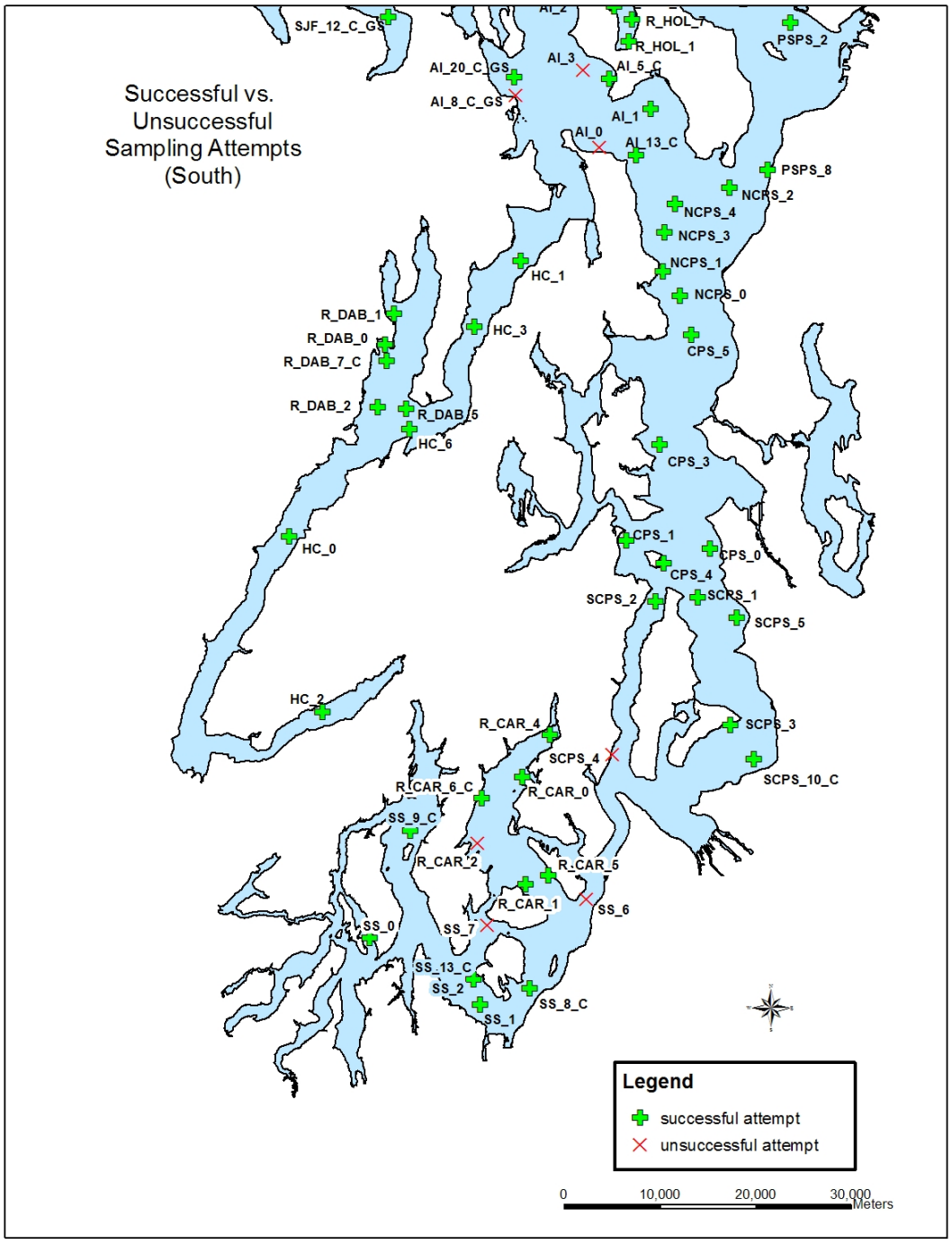
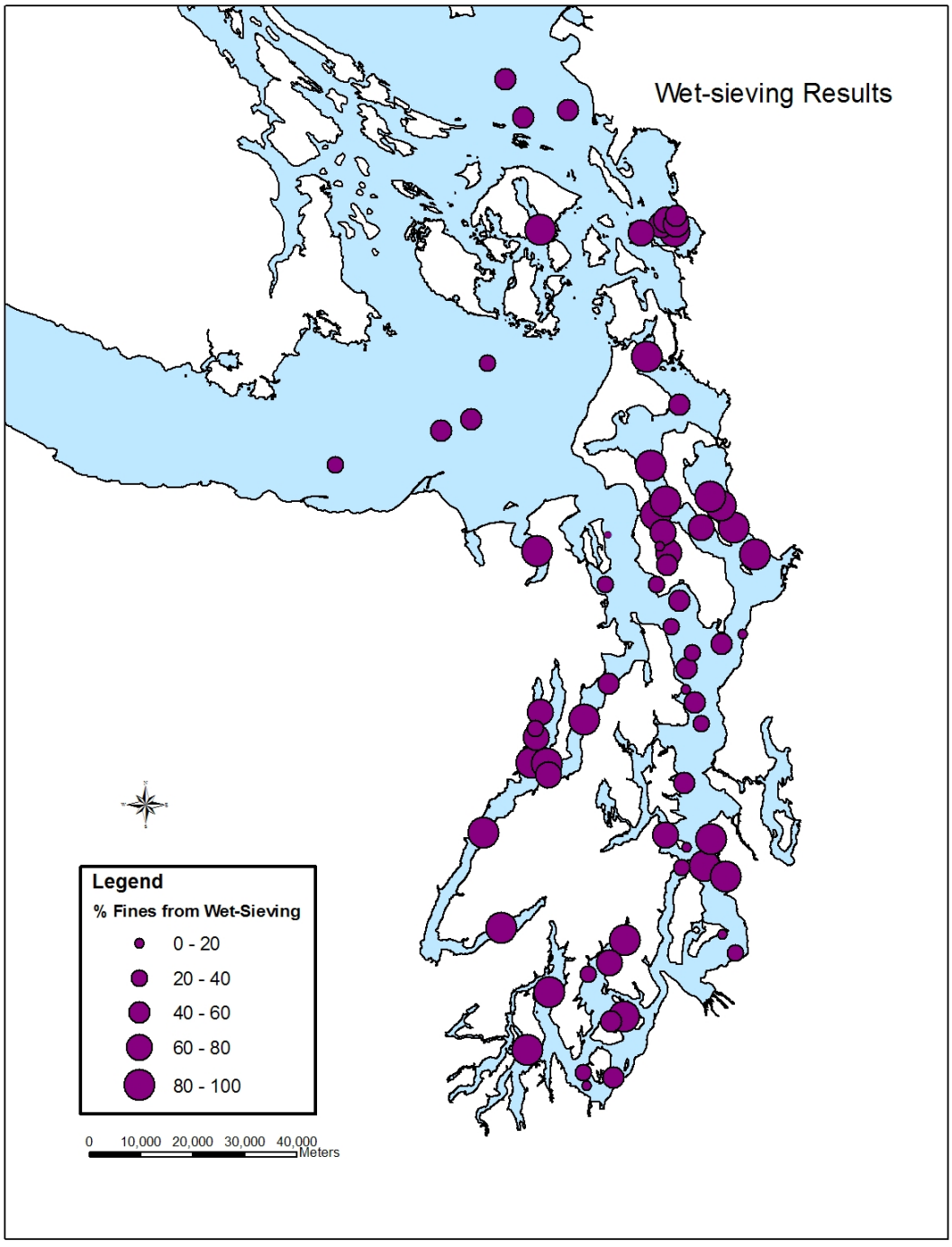

Successful vs.
Unsuccessful
Sampling Attempts
(South)
SJF_12_C_GS
AI_20_C_GS
AI_8_C_GS
AI_3
AI_5_C
AI_1
AI_0
AI_13_C
R_HOL_1
PSPS_2
PSPS_8
NCPS_2
NCPS_4
NCPS_3
NCPS_1
NCPS_0
HC_1
HC_3
R_DAB_1
R_DAB_0
R_DAB_7_C
R_DAB_2
R_DAB_5
HC_6
CPS_5
CPS_3
CPS_1
CPS_0
CPS_4
SCPS_2
SCPS_1
SCPS_5
HC_0
HC_2
R_CAR_4
SCPS_4
SCPS_3
SCPS_10_C
R_CAR_6_C
R_CAR_0
SS_9_C
R_CAR_2
R_CAR_5
R_CAR_1
SS_6
SS_0
SS_7
SS_13_C
SS_2
SS_8_C
SS_1
Legend
successful attempt
unsuccessful attempt
0
10,000
20,000
30,000
Meters

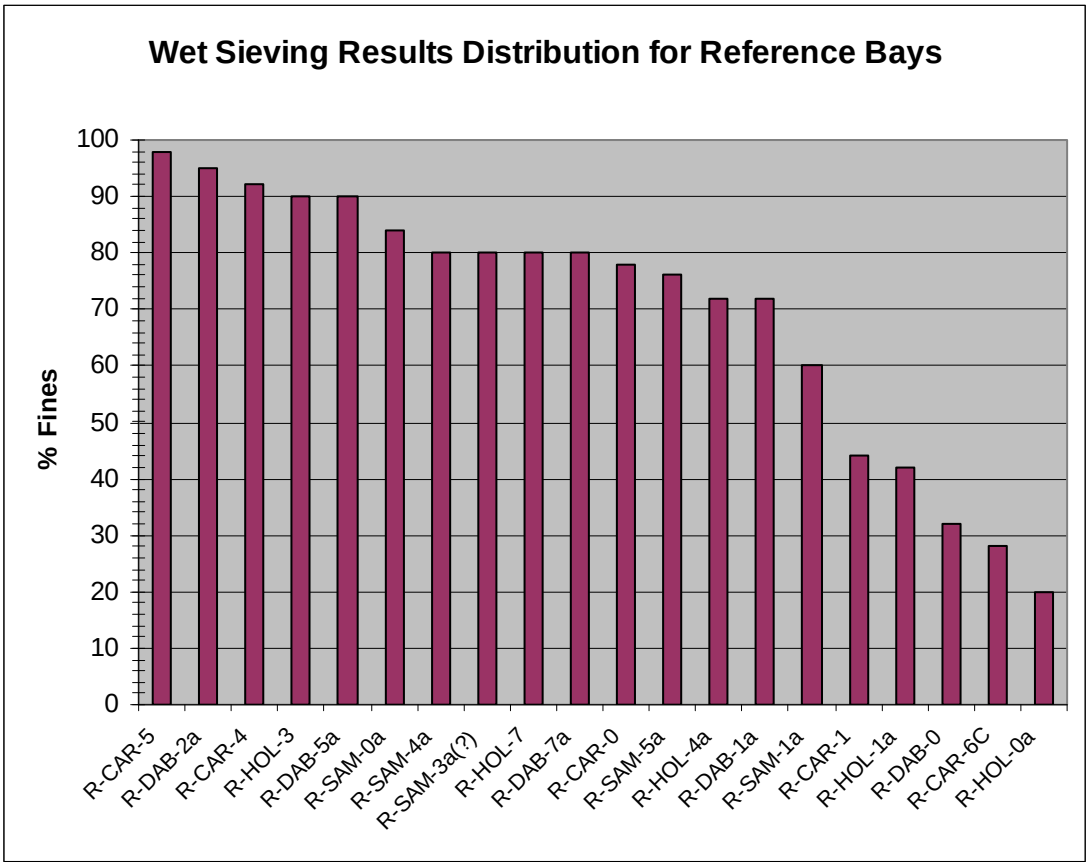
Figure 3. Results of wet sieving of sediments. Map provided by David Fox, Army Corps of Engineers Seattle District.



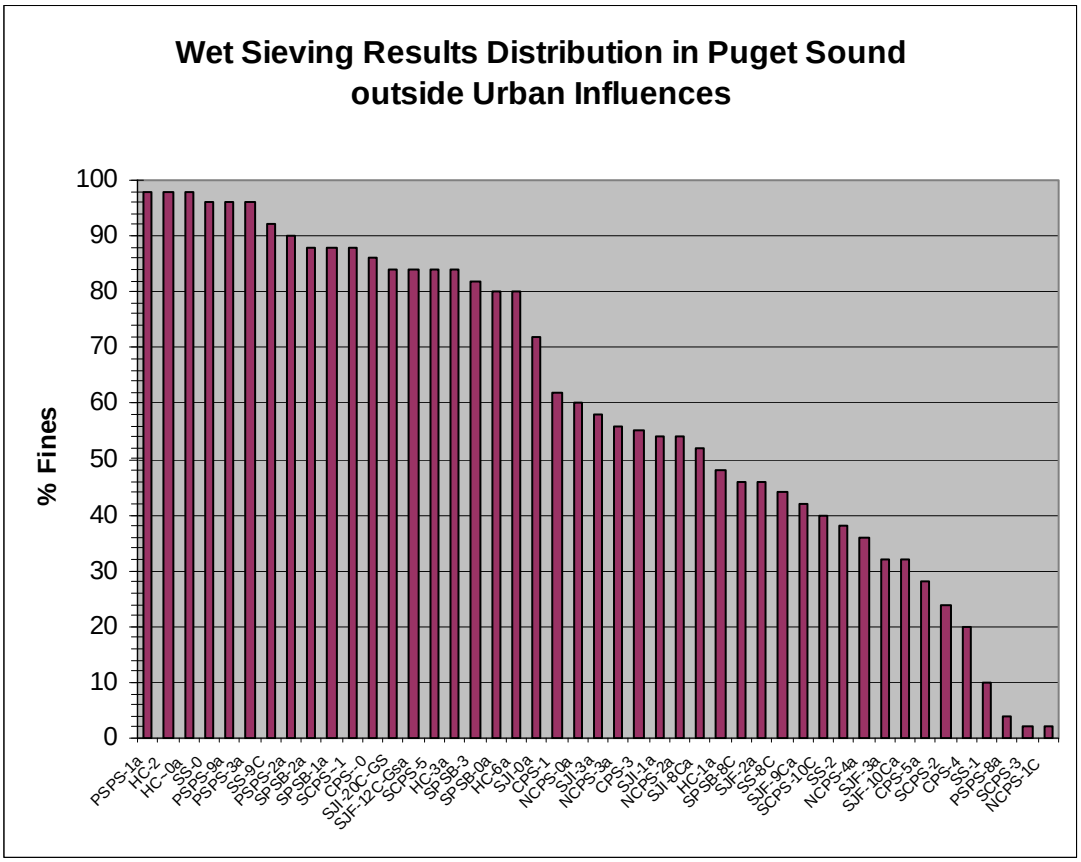
Sediments in areas where we thought would be difficult to sample were more fine-grained than expected and therefore we were able to sample them successfully. Figure 4 a and b display the distribution of grain sizes observed based on the wet sieving for the twenty reference areas stations and the 50 outside urban influence stations. On average, the reference areas were slightly more fine grained than the outside urban influence stations.

Figure 4. Distribution of wet sieving results for (a) reference bays and (b) stations outside urban influence. Graph provided by David Fox, Army Corps of Engineers Seattle District.

(a)



(b)



6. COMPLETION DATES, AND DISCUSSION OF PENDING ANALYSES

Results of the chemical analyses will be available in fall of 2008, so that the DMMP agencies can complete its evaluation of the data in 2009.

7. SUCCESSES and PROBLEMS ENCOUNTERED

Successes

The ship's crew was very helpful and first rate and had excellent attitudes. We occupied every station with little fanfare. Both the Nobeltec and Hypack software worked well, and provided comparable navigation information. The scientific crew was highly motivated and performed tasks very responsibly.

The NOAA Van Veen grab was solid. It worked remarkably and consistently well. We did not need to use the backup grabs. Transferring samples from the stern to the wet lab worked well.

There was ample refrigerator space to store grab samples.

Operation of the A-frame was not loud during the grab sampling.

Problems

The temperature of the refrigerators or freezers was not always consistent or met the target temperature.

8. ACHIEVEMENT OF SURVEY OBJECTIVES

The main survey objective was to collect samples at 70 stations in Puget Sound. We achieved this objective, and collected samples from nine additional sampling locations, in one day less than expected.

9. PRELIMINARY ENVIRONMENTAL MANAGEMENT DECISIONS FROM THE SURVEY

None.

10. RECOMMENDATIONS FOR OSV BOLD IMPROVEMENTS

Improve temperature consistency of refrigerators and freezers.

11. KEY SHIP PERSONNEL

Captain
Jere Chamberlain

Mates
Bob Overmon, Steve Roy and Doug Mohr

Techs
Patrick Trevathan, Emily Loose and Donny Rayhill

12. SCIENTIFIC PARTY

Name	Watch Number	Survey Responsibility	Organization
Matthew Liebman	N/A	Chief Scientist	EPA R1
Valerie Partridge	1	Watch Captain	WDOE
Ted Benson	1	Survey Support	WDOE
Laura Buelow	1	Survey Support	EPA R10 Hanford
Korina Lane-Jones	1	Survey Support	EPA R10 OMP
David Kendall	2	Principal Investigator/ Watch Captain	COE-Seattle
Erin Seyfried	2	Survey Support/Hypack	EPA R10 OWW
Elaine Somers	2	Survey Support	EPA R10
Alicia Boyd	2	Survey Support	EPA R10 Hanford
Laura Inouye	3	Watch Captain	WDOE
Mandy Michalsen	3	Survey Support/Chain of Custody	COE-Seattle
Jeff Rodin	3	Survey Support	EPA R10 ECL
Harry Craig	3	Survey Support	EPA R10 OOO
David Fox	4	Watch Captain	COE-Seattle
Lauran Warner	4	Survey Support	COE-Seattle
Jennifer Fitchorn	4	Survey Support/Chain of Custody	EPA R10 OCE
Sean Standing	4	Survey Support	Environment Canada

13. FINAL REPORTING PLANS

None contemplated.