PNNL-13730

Pacific Northwest National Laboratory

Operated by Battelle for the U.S. Department of Energy

Field Investigation to Determine the Extent of Sediment Recontamination at the United Heckathorn Superfund Site, Richmond, California

N. P. Kohn
T. J Gilmore

November 2001

Prepared for the
U.S. Environmental Protection Agency
Region IX
under a Related Services Agreement
with the U.S. Department of Energy
under Contract DE-AC06-76RL01830

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service,
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161
ph: (800) 553-6847
fax: (703) 605-6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

This document was printed on recycled paper.

(8/00)

PNNL-13730

FIELD INVESTIGATION TO DETERMINE THE EXTENT OF SEDIMENT RECONTAMINATION AT THE UNITED HECKATHORN SUPERFUND SITE, RICHMOND, CALIFORNIA

N. P. Kohn
T. J Gilmore

November 2001

Prepared for the
U.S. Environmental Protection Agency
Region IX
under a Related Services Agreement
with the U.S. Department of Energy
under Contract DE-AC06-76RL01830

Prepared by
Battelle Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington

SUMMARY

The purpose of this study was to investigate the present condition of sediment in Lauritzen Channel, approximately 2 years after completion of sediment remedial actions at the United Heckathorn Superfund site. Post-remedial monitoring data demonstrated that the pesticide DDT was less bioavailable to marine biota 2 years after remediation than it was in the first 6-10 months after remediation. However, DDT was detected in the tens of parts per million range in sediment samples collected from Lauritzen Channel in October and November 1998. This study, the 1999 Sediment Investigation, was undertaken to supplement the post-remediation monitoring program by determining the extent and identifying potential sources of observed pesticide contamination.

Core samples were collected from Lauritzen Channel and Parr Canal in July 1999. Sediment samples were prepared from vertical sections of core based on the sediment type, such as younger bay mud (YBM) or older bay mud (OBM). Samples were screened for presence of DDT compounds using an immunoassay technique. A subset of samples was analyzed using established quantitative methods, with sample selection based on the screening results as well as the representativeness of the sample as far as sediment type and importance for determining extent of contamination.

Only minor changes have occurred in Parr Canal since remedial actions were taken in 1996-1997. The sand layer appears to be intact and effective in isolating any remaining contaminated YBM. There has been very little deposition of recent YBM on top of the sand layer.

DDT concentrations exceed the remedial goal of 590 µg/kg dry weight in nearly all the YBM sediment in Lauritzen Channel. Sediment DDT concentrations greater than 590 µg/kg were first measured in October 1998 and reported in Anderson et al. (2000). DDT in sediment was confirmed by additional measurements in November 1998 (Antrim and Kohn, 2000b), and was additionally verified in the present study. The source of contaminated sediment could not be confirmed by this study; there was no clear correlation between high DDT concentrations and sediment remaining between the pilings, as was originally suspected. There also was no correlation between high DDT concentrations in sediment and the locations of outfalls, although some of the contamination retained by the creosote-treated wood appeared to be highest close to the known outfalls.

CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION

1.1 BACKGROUND

The United Heckathorn site in Richmond, California (Figure 1), was used from 1945 to 1966 by several operators to produce agricultural chemicals, including DDT, dieldrin, and other pesticides. The setting and use history of the Heckathorn Site is described in documents such as the Remedial Investigation/Feasibility Study report (White et al. 1994). In March 1982, the California Department of Health Services (DHS) designated the area a state Superfund site because of residual contamination present from past activities. In March 1990, the U. S. Environmental Protection Agency (EPA) listed the United Heckathorn site on its National Priorities List (NPL) of federal Superfund sites. A remedial investigation and feasibility study of marine sediments at the site was completed in 1994 (White et al. 1994). The resulting Record of Decision (ROD), prepared by EPA, identified dredging with offsite disposal as a preferred cleanup action. The EPA Regional Administrator approved the ROD in October 1994.

Sediment remediation by dredging, dewatering, and offsite disposal took place between July 1996 and March 1997. Extensive coring was conducted to verify that the younger bay (contaminated) mud (YBM) was removed and that only older bay (less contaminated) mud (OBM) remained. EPA collected and analyzed post-remedial samples of the remaining OBM for DDT, and found the average concentration to be 263 µg/kg dry weight, below the remedial goal of 590 µg/kg DDT dry weight. In April 1997, 9100 cubic yards of clean sand was placed in Lauritzen Channel, equivalent to an average depth of 1 ft over the dredged area. The purpose of this sand layer was to provide a substrate that would be more suitable for colonization by benthic organisms than the OBM surface. The sand was placed more thickly near the head of the channel where the pilings may have prevented complete removal of YBM; the intended thickness was 0.5 ft in the rest of the channel. The actual thickness of the sand layer was probably variable because of the uneven, sloping channel bottom.

Post-remedial biomonitoring was conducted 6 months after remediation and showed that pesticide concentrations in the tissues of resident mussels exposed at the site (Figure 2) were similar to or higher than those observed before remediation, with the tissue concentrations highest in Lauritzen Channel. The Year 1 monitoring results summarized in Antrim and Kohn (2000a) show that DDT is still present and bioavailable in Lauritzen Channel, especially near its head, relative to other waterways. In October 1998, the Institute of Marine Sciences at the University of California, Santa Cruz (UCSC) reported finding 20 mg/kg (20,000 µg/kg) total DDT (dry weight) in a Lauritzen Channel sediment sample (Anderson et al.

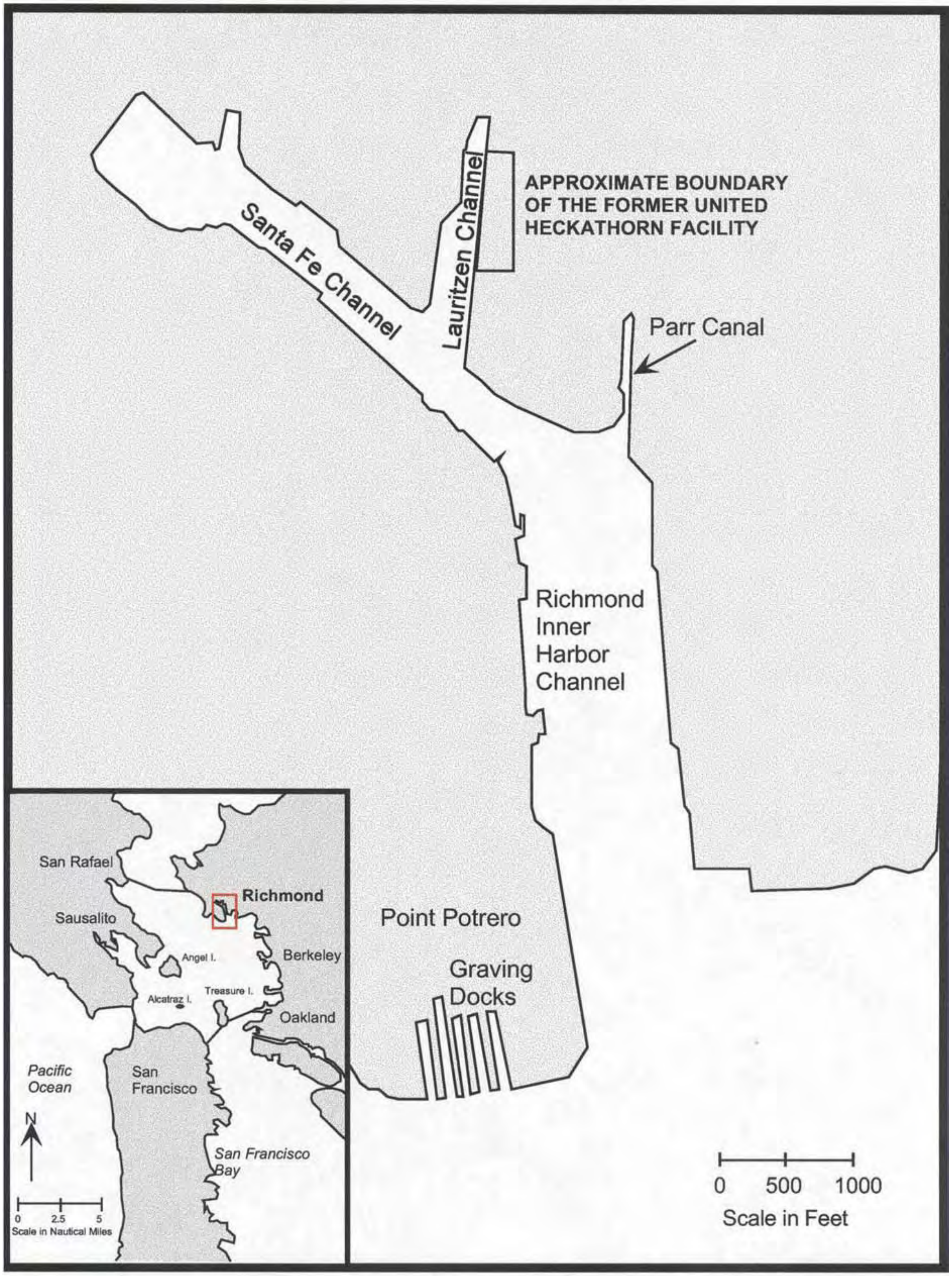

Figure 1. Location of the United Heckathorn Superfund Site, Richmond, California

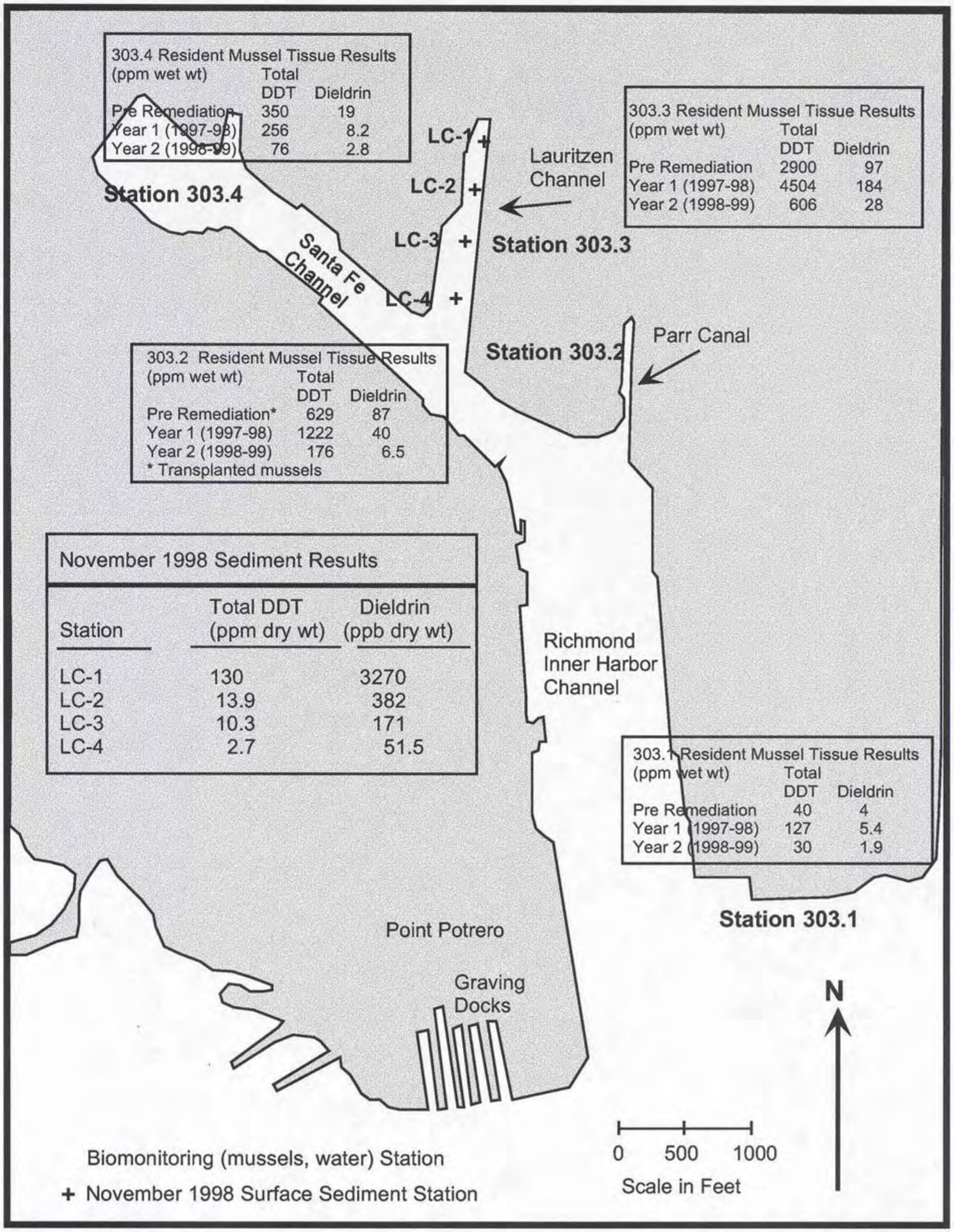

Figure 2. Sample Locations and Results of Post-Remedial Monitoring Near the Heckathorn Site

2000). Based on this observation, EPA collected four additional sediment samples in early November 1998, to check the UCSC finding. The location of the November 1998 sediment sampling stations and concentrations of DDT are presented in Figure 2. These samples showed parts per million levels of DDT, in excess of the remedial goal. Elevated concentrations of other pesticides and polynuclear aromatic hydrocarbons (PAH) were also measured (Table 1).

Year 2 (1998-1999) post-remedial biomonitoring results showed a reduction in tissue concentrations of DDT and dieldrin in resident mussels and transplanted mussels deployed in Lauritzen and Santa Fe Channels (Antrim and Kohn, 2000b). Year 2 total DDT concentrations (wet weight basis) averaged 80% lower, and dieldrin concentrations averaged 75% lower than concentrations in Year 1. This demonstrates that pesticides from sediment were less available to marine biota 2 years after remediation than they were in the first 6-10 months after remediation. However, concurrent surface sediment analyses were not available for the Year 1 monitoring period to compare with the November 1998 sample results, and the November 1998 samples indicated a potential recontamination problem in Lauritzen Channel. This study, referred to as the 1999 Sediment Investigation, was undertaken to supplement the post-remediation monitoring program by determining the extent and identifying potential sources of observed pesticide contamination. The rationale, approach, and methods for this study are described in detail in the project-specific sampling and analysis plan, *Field Investigation to Determine the Extent and Sources of Sediment Recontamination at the United Heckathorn Superfund Site, Richmond, California*. This report briefly summarizes the approach and methods, and presents the results of the 1999 Sediment Investigation.

1.2 STUDY PURPOSE AND OBJECTIVES

The purpose of the 1999 Sediment Investigation was to look into the present condition of sediment in Lauritzen Channel, approximately 2 years after completion of sediment remedial actions. Although sediment samples collected immediately following remediation showed that DDT concentrations were below the cleanup level in the remaining sediment, there was more recent evidence that the channel sediments were either still contaminated, or were recontaminated, with DDT. The specific objectives were to:

- determine the existing condition of sediment in Parr Canal
- determine the present horizontal and vertical extent of sediment DDT contamination in Lauritzen Channel, and
- investigate potential sources of recontamination to Lauritzen Channel sediment.

Table 1. Results of Sediment Chemical Analyses, Surface Sediment Collected in November 1998 from Lauritzen Channel, Richmond, California

Station ID	**LC-4 Lauritzen Channel South**	**LC-3 Lauritzen Channel South/Center**	**LC-2 Lauritzen Channel North/Center**	**LC-1 Lauritzen Channel North**
Conventionals (Percent dry weight)				
Gravel	0.00	0.00	0.68	0.10
Sand	14.04	9.03	67.14	31.67
Silt	23.93	25.26	10.61	43.05
Clay	62.03	65.71	21.57	25.19
TOC	1.53	1.67	0.89	3.11
Total Solids	36.79	36.37	64.04	19.39
Chlorinated Pesticides (µg/kg dry weight)				
A-BHC	25.8 U	55.9 U	60.6 U	204 U
B-BHC	25.8 U	55.9 U	60.7 U	204 U
G-BHC	15.5 U	33.7 U	36.5 U	122 U
D-BHC	25.8 U	55.9 U	60.7 U	204 U
Heptachlor	9.73 U	21.1 U	40.0	77.0 U
Aldrin	15.8 U	43.1	60.5	790
Heptachlor Epoxide	31.6 U	68.4 U	74.2 U	250 U
g-Chlordane	25.8 U	55.9 U	60.7 U	1660
Endosulfan I	25.8 U	55.9 U	60.7 U	3240
a-Chlordane	8.18 U	17.7 U	59.5	1000
Dieldrin	**51.5**	**171**	**382**	**3270**
4,4'-DDE	**93.8**	**323**	**383**	**84400**
Endrin	25.8 U	55.9 U	507	671
Endosulfan II	25.8 U	55.9 U	60.7 U	204 U
4,4'-DDD	**1190**	**4080**	**3150**	**15700**
Endrin Aldehyde	25.8 U	55.9 U	60.7 U	204 U
Endosulfan Sulfate	25.8 U	55.9 U	60.7 U	204 U
4,4'-DDT	**1450**	**5850**	**10400**	**30100**
Toxaphene	ND	ND	ND	ND
Total DDT (ppm)	**2.7**	**10.3**	**13.9**	**130.2**
% DDT	53%	57%	75%	23%
% DDE	3%	3%	3%	65%
% DDD	44%	40%	23%	12%
PCB Aroclors (µg/kg dry weight)				
1242	8.11 U	9.06 U	4.79 U	16.1 U
1248	8.11 U	9.06 U	4.79 U	16.1 U
1254	89.9	150	245	981
1260	8.11 U	9.06 U	4.79 U	16.1 U

Table 1. (cont'd)

Station ID	LC-4 Lauritzen Channel South	LC-3 Lauritzen Channel South/Center	LC-2 Lauritzen Channel North/Center	LC-1 Lauritzen Channel North
PAHs (µg/kg dry weight)				
naphthalene	134	178	112	1960
Acenaphthylene	473	704	212	102
Acenaphthene	125	303	73.3	1830
Fluorene	199	394	162	3490
phenanthrene	728	1250	676	9120
anthracene	1070	2810	696	1760
Total LPAH	**2729**	**5639**	**1931**	**18262**
fluoranthene	4510	5700	2140	5100
pyrene	2700	3170	1340	3870
benzo[a] anthracene	1970	3080	1150	1170
chrysene	2580	4580	1560	1710
benzo[b] fluoranthene	2220	3720	1740	1230
benzo[k] fluoranthene	822	1420	626	425
benzo[a] pyrene	1360	2320	1080	655
indeno [1,2,3-c,d] pyrene	463	789	396	278
dibenzo [a,h] anthracene	142	234	124	93.9
benzo [g,h,i] perylene	407	633	338	288
Total HPAH	**17174**	**25646**	**10494**	**14820**
TOTAL PAH (ppm)	**19.9**	**31.3**	**12.4**	**33.1**

U Undetected above given concentration.
ND Not detected.

1.3 CONTAMINANTS OF CONCERN

Contaminants of concern identified in early site investigations and subsequent monitoring and characterization included the pesticide DDT, its degradation products 4,4'-DDD, 4,4'-DDE, and dieldrin. PAHs and polychlorinated biphenyls (PCBs) also have been measured in Lauritzen Channel and adjacent areas, but were not a subject of this investigation. For the purpose of this study, we determined the range and extent of DDT recontamination of the Lauritzen Channel through collection and analysis of sediment core samples.

2.0 METHODS

2.1 BATHYMETRIC SURVEY

Prior to core sampling, a bathymetric survey of Lauritzen Channel was conducted by TEG Oceanographic Services to obtain the current sediment surface elevation and topography. TEG's 24-ft survey vessel, *Relentless,* was used to collect the bathymetric data for this project. The vessel is equipped with a Trimble Differential global positioning system (DGPS) integrated with Hypack survey software and a Ross survey fathometer. A rigorous "bar check" (fathometer calibration) was performed before and after each day of survey operations. Hypack was used to plan the survey with tracklines at 50-ft intervals along an east-west grid and three tracklines (east, center, and west side) at 50-ft intervals along the length of the Lauritzen Canal. The Ross fathometer transducer was mounted in an over-the-side configuration at a measured draft, situated directly beneath the GPS antenna for maximum horizontal accuracy of the hydrographic data. All soundings were collected at an acoustic frequency of 200 kHz. The depth sounder was interfaced to the integrated navigation computer using Hypack Survey Software for automatic and continuous data logging. The bathymetric survey was plotted in the California State Plane NAD83 coordinate system. Corrections based on recorded water level (tide) were applied to the data to remove the effects of changes in water level that occurred during the survey. Vertical elevations were referenced to the mean lower low water (MLLW) datum based at the Port of Richmond Terminal 2 (13.89 MLLW).

2.2 SEDIMENT SAMPLE COLLECTION AND HANDLING

2.2.1 Sediment Core Samples

Sediment core samples were collected by TEG Ocean Services under the supervision of a Battelle scientist, using a vibracorer deployed from a 12-ft by 24-ft motorized pontoon barge. TEG also used DGPS to provide accurate horizontal and vertical positioning at each planned sampling station. Once on station, a buoy was put in the water to mark the location, and the barge was anchored at the station or tied to an immobile object (pier, barge, piling). The water depth at the station was measured using a lead line, then corrected for the tide at the time to obtain a water depth (mudline elevation) in feet relative to MLLW.

The vibracorer used to collect the cores was a small (6 hp) unit to which up to 10 ft of aluminum core barrel tubing could be attached. The 12-ft by 24-ft pontoon barge has a 4-ft square "moon pool" or opening in the deck through which the vibracorer was lowered and lifted from a 12-ft gantry. The core barrel was lined with 4-in.-diameter butyrate liner. An integrated core cutter/catcher assembly was inserted into the core liner and riveted in place. Once the station location and corrected depth were confirmed, the core barrel assembly was lowered to the sediment surface, powered on, and driven in to the point of refusal. The goal was to collect 0.5 ft into the OBM.

When each core was brought on deck, the cutter/catcher assembly was removed and the core liner pulled out so the sample could be measured and visually inspected. Cores that were obviously disturbed, entirely YBM, or otherwise unacceptable were washed out of the liner, and sampling was repeated. The core was deemed acceptable if the surface was clearly visible (not unusually disturbed) and if there was a plug of OBM in the bottom of the core or in the core catcher. Notes were made as to the type of material encountered, depth of core, and the presence or absence of OBM. When an acceptable core was collected, it was cut to length, capped, labeled, and transferred to a refrigerated van for transport to the Battelle Marine Sciences Laboratory (MSL). In some cases, OBM or other material in the core catcher was saved in a labeled, precleaned glass jar rather than pushed back into the core liner. All sediment samples were kept cool in a cooler with ice (on board the vessel) or the refrigerated van until shipped to the MSL.

2.2.2 Sediment Grab Samples

Surface sediment from Santa Fe Channel was collected using a van Veen grab sampler deployed from the same 12-ft by 24-ft pontoon barge used for core sampling. Sediment was placed into labeled 1-gal HDPE containers, capped, and stored in the refrigerated truck for shipping to the MSL.

2.2.3 Creosote-Treated Wood Samples

Treated wood samples from the surface of selected pilings were collected by scraping the wood fiber from a known area to a depth of approximately 3 mm. Treated wood samples were placed in precleaned glass jars with Teflon-lined lids, and stored on ice in a cooler until they could be placed in the refrigerated truck.

2.3 CORE DESCRIPTIONS AND SAMPLE PREPARATION

Sediment sample processing was conducted at the Battelle MSL in Sequim, Washington. Core samples were opened, described by a geologist, and subsampled. Sediment samples were homogenized, labeled, and transferred to analytical laboratories.

2.3.1 Geologic Descriptions of Sediment Cores

Each core was removed from the cold room and its label checked to make sure the entire core was processed together. Each section was scored longitudinally with a circular saw, cut with a clean linoleum knife, and the core halves separated using a clean, solvent-rinsed stainless steel spatula. The lithology of each core sample was described by a geologist, following ASTM Method D2488-84 (ASTM 1984). The geologist described sediment type, color, consistency, cementation, structure, hydrochloric acid reaction, odor, and any unusual characteristics (e.g., oily sediment, shell fragments, wood chips).

2.3.2 Sediment Sample Preparation

Sediment for physical and chemical analyses was removed from the center of each core with a clean, solvent-rinsed stainless steel spatula or spoon. Sediment in direct contact with the core liner or core cap was avoided. Each discrete vertical segment of core, as delineated by the geologist based on sediment type (YBM, OBM), was removed separately and homogenized in a clean, labeled, stainless steel bowl until a homogeneous color and texture was observed. YBM was not composited, but OBM from sediment cores within a subarea was mixed into an OBM composite. Subsamples for the various physical and chemical parameters were placed in labeled containers of appropriate size and material. If there was sufficient sample, a 250-mL or 500-mL subsample was frozen and archived for possible future analyses. Sediment samples for chemical analysis were transferred to the appropriate analytical laboratories as soon as possible after sample preparation. If samples were not shipped immediately, they were stored at 4°±2°C.

2.4 ANALYTICAL CHEMISTRY METHODS

The chemical and physical analyses conducted on Heckathorn sediment samples were selected to identify the nature and extent of, and to identify probable sources of, pesticide recontamination. Most important was the analysis for the pesticide DDT, its breakdown products DDD and DDE, and dieldrin. We also analyzed for physical parameters that control the distribution and bioavailability of DDT: grain size and total organic carbon (TOC).

2.4.1 Grain Size and Total Organic Carbon

The conventional parameters grain size, TOC, and total solids were determined on all sediment samples. Total solids and grain size class determinations (percent gravel, sand, silt, clay) were determined using ASTM D-422 and D-2217 (wet preparation method). TOC was determined by EPA

Method 9060. Quality control samples consisted of a duplicate sample analysis with every batch of up to 20 sediment samples.

2.4.2 DDT Immunoassay Screening Analysis

All surface sediment, sand layer, OBM composite, and creosote piling samples were screened for DDT by EPA Method 4042 (EPA 1996) using EnviroGard commercial test kits for extraction and analysis of DDT in soil, obtained from Strategic Diagnostics, Inc. This method determines whether total DDT (DDT+ breakdown products) is present above concentrations of 0.2, 1.0, or 10 mg/kg. The sediment samples were air-dried overnight in a hood at approximately 20ºC, then a 5-g subsample was extracted by shaking with 5 mL methanol. An aliquot of the extract and an enzyme-DDT conjugate reagent were added to DDT antibody that is immobilized on the side of a test tube. The enzyme-DDT conjugate "competes" with DDT in the sample for binding sites on the DDT antibody. The colorless substrate catalyzes to a colored product when the enzyme-DDT conjugate binds with the antibody. Therefore, more color after the reaction indicates *less* DDT in the sample. If the substrate remained colorless or had less color than the calibration standard after the reaction, then the antibody binding sites were occupied by DDT in the sample. This method can yield semiquantitative results if the absorbance of each tube is measured in a spectrophotometer at 450-nm wavelength and compared to the absorbance of the 0.2, 1.0, and 10.0 mg/kg DDT calibrator standards. Applicable quality control measures were analysis of a negative control sample and one duplicate sample per batch of up to 20 samples.

2.4.3 Confirmatory Pesticide Analysis

Confirmatory pesticide analysis was by modified EPA Method 8081 (EPA 1998). Samples were solvent extracted and purified using a high-performance liquid chromatography (HPLC) size-exclusion technique. Analysis was by capillary gas chromatography with electron capture detection (GC/ECD). Quality control samples included a method blank, matrix spike, matrix spike duplicate, sample duplicate, and standard reference material (SRM) 1941A.

3.0 RESULTS

The results of sediment sampling in Lauritzen Channel and Parr Canal are presented below. Bathymetric survey plots were submitted to EPA under separate cover and are not presented in this report. However, the survey did show that surface sediment elevations in July 1999 were slightly less (shallower) than surface elevations measured immediately after remediation in April 1997 (all water depths were referenced to MLLW). Bathymetric surveys are very difficult to compare between dates, especially when conducted by different surveyors. Surveys conducted by different surveyors cannot be used for precise comparison because of differences in equipment and calibration. In this 1999 Sediment Investigation, the depth measured at each station at the time of core sampling was used for the purpose of estimating the thickness and volume of the various sediment types.

3.1 FIELD SAMPLING

All field samples for the 1999 Sediment Investigation were collected July 28-30, 1999. Samples in Levin Berths B and C and southwest Lauritzen Channel were collected first as these were expected to be less contaminated than those from upper Lauritzen Channel. This also minimized the potential for the sampling vessel to interfere with Levin's ship berthing schedule. Creosote-treated wood samples were collected at the morning low tide on July 30, so that samples could be collected as close as possible to the 0 ft MLLW elevation on the pilings. Parr Canal core samples were collected on the afternoon of July 30 when the flood tide allowed safe access and sufficient draft for the vessel.

Sediment core samples were collected at 25 locations in Lauritzen Channel and three locations in Parr Canal; surface sediment grab samples were collected at two locations in Santa Fe Channel (Figures 3 and 4). Sampling information such as station locations, mudline elevations, and length of core collected is provided in Table 2. The vibracore sampler was driven to the point of refusal, with the intent of reaching at least to the depth of OBM so that the thickness of recently deposited soft mud and the sand layer could be determined. The OBM layer was reached or penetrated in 19 of the 25 cores collected in Lauritzen Channel.

In addition to the planned 24 core locations in Lauritzen Channel, a core was collected at a station labeled PL-01A. Station PL-01A was located approximately 15 ft southwest of PL-01, just far enough away that the bottom was not as steeply sloping as at PL-01. The core from PL-01 was retained even though the OBM layer had not been penetrated. Much of the YBM from upper Lauritzen cores (UL-09, PL-01 through PL-04) appeared to have an oily sheen; PL-03 in particular was noted as having a strong petroleum odor and appeared oily even in the green clay at the bottom of the core.

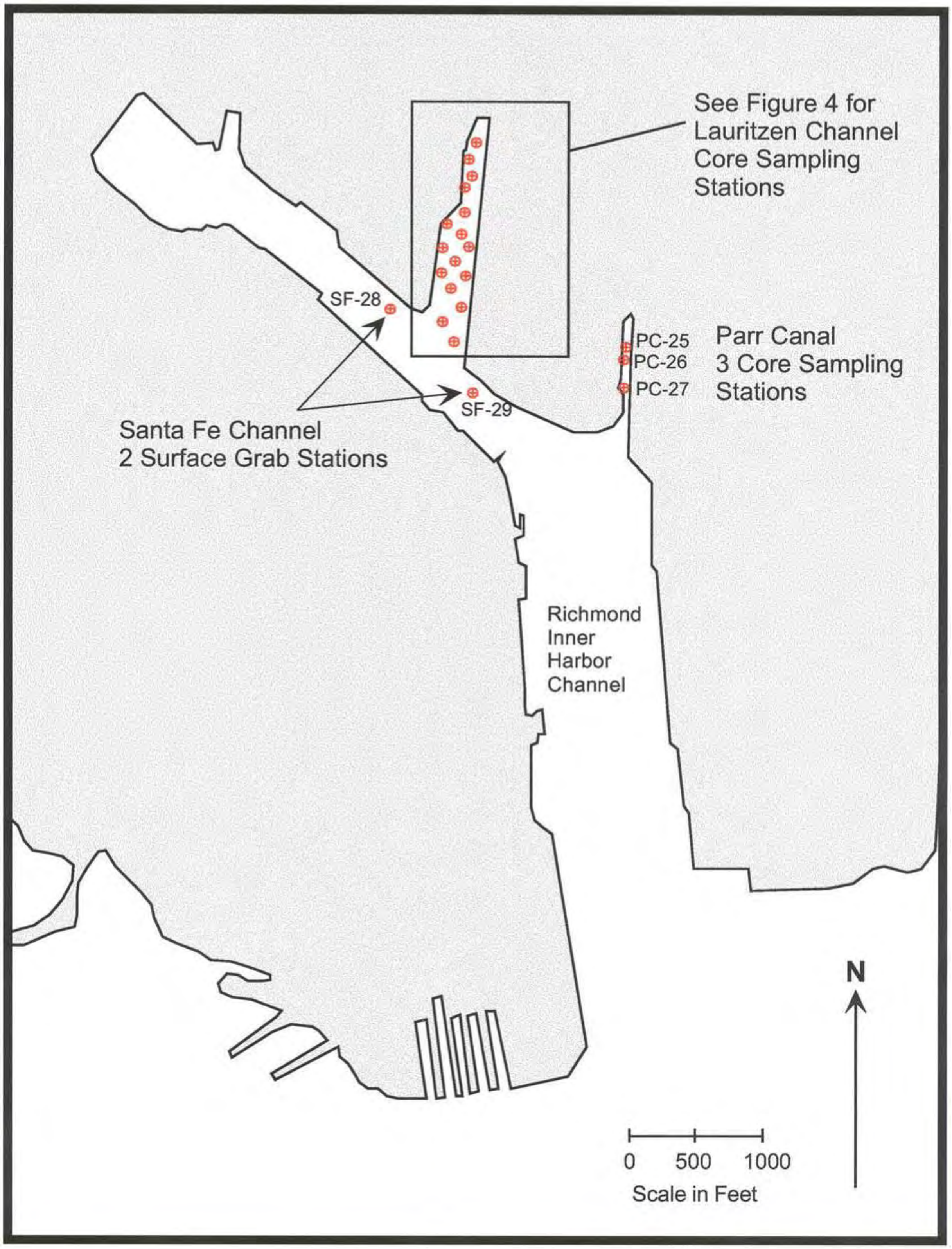

Figure 3. Sampling Locations for the Heckathorn 1999 Sediment Investigation

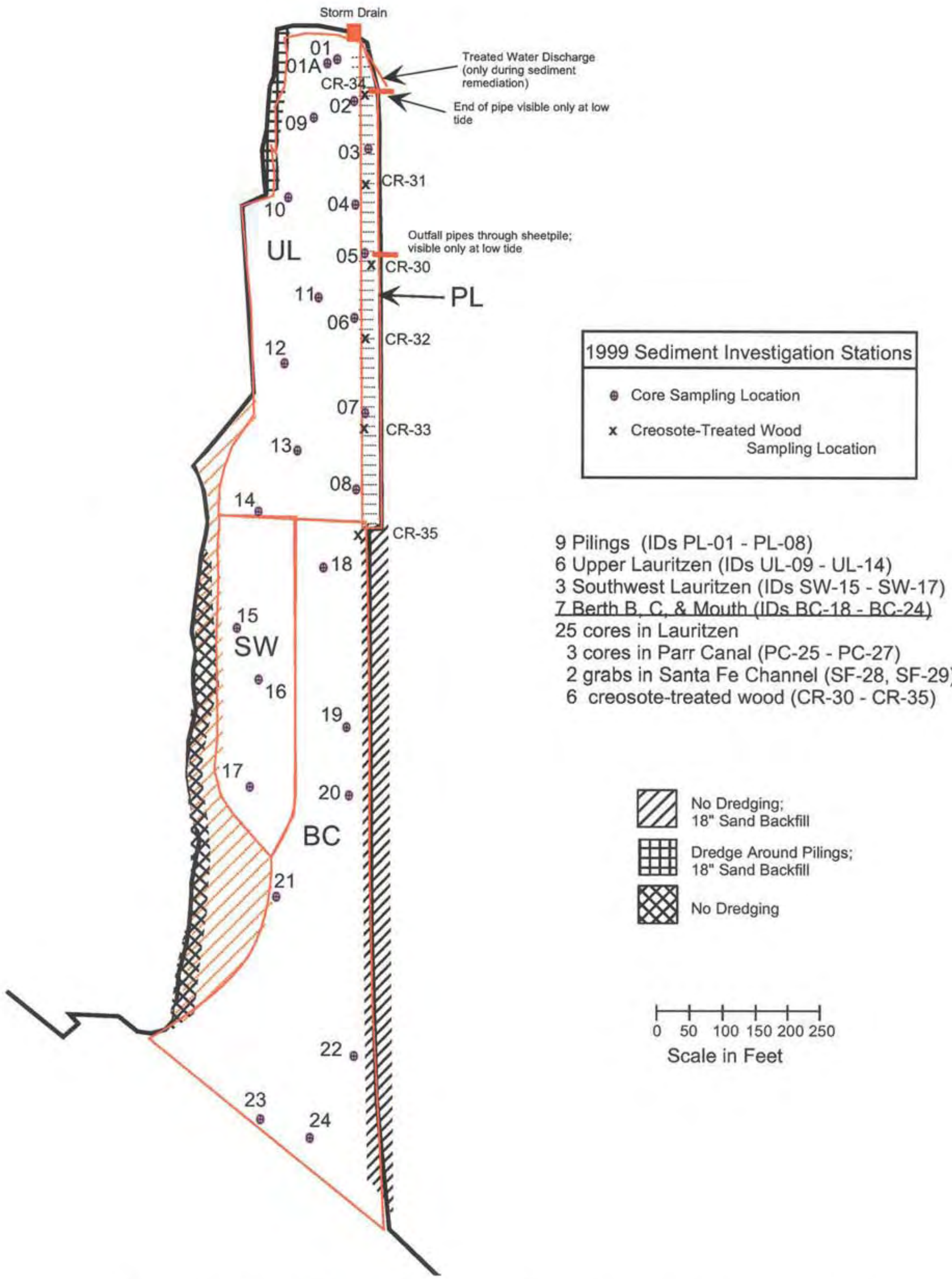

Figure 4. Sampling Stations in Lauritzen Channel, 1999 Sediment Investigation

Table 2. Sampling Information for the Heckathorn 1999 Sediment Investigation

SubArea	Station ID	Location UTM NAD 83 Latitude (N)	Longitude (W)	California State Plane Coordinates (Zone 3, NAD 83) Northing	Easting	Mudline (-ft MLLW)	Ft Core Collected	OBM Plug in Core?
Pilings	PL-01	37° 55.473’	122° 21.991’	2164481	6023325	7.9	2.0	No
Pilings	PL-01A	37° 55.466’	122° 21.992’	2164468	6023319	9.9	2.5	No
Pilings	PL-02	37° 55.462’	122° 21.993’	2164414	6023314	12.9	0.5	No (rocks)
Pilings	PL-03	37° 55.450’	122° 21.988’	2164341	6023337	12.7	2.2	Yes
Pilings	PL-04	37° 55.436’	122° 21.993’	2164258	6023311	12.6	0.9	Yes
Pilings	PL-05	37° 55.424’	122° 21.992’	2164184	6023314	11.9	0.8	Yes
Pilings	PL-06	37° 55.407’	122° 21.999’	2164081	6023279	15.9	0.4	Yes
Pilings	PL-07	37° 55.383’	122° 21.996’	2163938	6023288	12.0	1.1	Yes
Pilings	PL-08	37° 55.364’	122° 22.005’	2163821	6023245	21.8	0.6	no data
Upper LC	UL-09	37° 55.458’	122° 22.003’	2164391	6023266	21.1	2.2	Yes
Upper LC	UL-10	37° 55.439’	122° 22.015’	2164277	6023206	19.3	1.1	Yes
Upper LC	UL-11	37° 55.412’	122° 22.007’	2164112	6023241	22.4	0.5	Yes
Upper LC	UL-12	37° 55.397’	122° 22.019’	2164022	6023181	15.3	1.2	Yes
Upper LC	UL-13	37° 55.376’	122° 22.018’	2163895	6023184	22.9	1.1	Yes
Upper LC	UL-14	37° 55.360’	122° 22.033’	2163799	6023110	22.8	2.0	no data
Southwest LC	SW-15	37° 55.340’	122° 22.046’	2163679	6023045	17.0	1.2	no data
Southwest LC	SW-16	37° 55.322’	122° 22.042’	2163569	6023062	23.8	1.2	Yes
Southwest LC	SW-17	37° 55.287’	122° 22.045’	2163357	6023043	21.8	1.0	Yes
Levin Berth B,C	BC-18	37° 55.345’	122° 22.013’	2163706	6023204	38.4	1.6	Yes
Levin Berth B,C	BC-19	37° 55.322’	122° 22.012’	2163465	6023204	35.4	2.2	Yes (lost)
Levin Berth B,C	BC-20	37° 55.289’	122° 22.011’	2163366	6023207	37.4	1.6	no data
Levin Berth B,C	BC-21	37° 55.264’	122° 22.042’	2163217	6023055	39.4	1.7	Yes
Levin Berth B,C	BC-22	37° 55.233’	122° 22.017’	2162954	6023170	39.4	1.4	Yes
Levin Berth B,C	BC-23	37° 55.221’	122° 22.017’	2162836	6023018	40.3	1.7	Yes
Levin Berth B,C	BC-24	37° 55.201’	122° 22.025’	2162834	6023129	41.2	2.8	Yes
Santa Fe Channel	SF-28	37° 55.242’	122° 22.189’	2163098	6022345	43.3	grab	NA
Santa Fe Channel	SF-29	37° 55.131’	122° 22.012’	2162408	6023183	38.5	grab	NA
Parr Canal	PC-25	37° 55.202’	122° 21.764’	2162815	6024383	2.2	2.5	NA
Parr Canal	PC-26	37° 55.178’	122° 21.762’	2162669	6024390	2.1	2.7	NA
Parr Canal	PC-27	37° 55.150’	122° 21.764’	2162499	6024378	4.4	1.6	NA

3.2 CORE DESCRIPTIONS AND SAMPLE PREPARATION

All cores were split longitudinally, and sediment stratigraphy was described by a geologist. Each core was labeled and photographed prior to removing sediment for chemical analysis. The geologic descriptions and photographs are reproduced in Appendix A. The surface elevation and thickness of the sediment types found in each core are provided in Table 3 for Lauritzen Channel and Table 4 for Parr Canal. In most cores, a layer of YBM was distinct from underlying rocks or firm OBM. The YBM was distinguished by its softer consistency, very fine grain size, and dark gray to black color. The OBM varied in appearance from very firm green clay to firm brown clay or sandy clay. The YBM/OBM interface sometimes appeared disturbed; these observations are described in the geologic logs as discoloration of OBM, streaks of fine YBM in the OBM, or chunks of OBM material in the overlying YBM. The sand layer that was placed in Parr Canal was found to be intact up to 1 ft thick at the three coring stations, separating buried consolidated YBM from a very thin layer of newly deposited YBM. The sand layer that was placed in Lauritzen Channel was recovered at only two coring stations, UL-09 and SW-15.

Individual samples for analysis were prepared as described in Section 2.3.2. A total of 49 sediment samples and six creosote-treated wood samples were prepared and split for various analyses. Table 5 indicates the samples prepared from each vertical segment of core, the approximate volume of available sample for each possible analysis, and comments noted during sample preparation. Samples were stored at 4ºC until shipping to analytical laboratories; archived samples were frozen. Samples for grain size, TOC, and total solids analysis were shipped shortly after all samples were prepared. Samples for DDT screening analysis were hand-carried to the MSL's analytical chemistry laboratory facility. Samples prepared for confirmatory pesticide/PCB analysis were stored at 4ºC until the completion of screening analyses and selection of the subset that would be analyzed for pesticides and PCBs. Selection of samples for confirmatory pesticide/PCB analysis is discussed further in Section 3.3.

YBM from the north end of Lauritzen Channel contained more debris (wood, plastic, shells) than YBM from other parts of the channel. YBM from the north end of Lauritzen Channel was notably black and oily, with strong petroleum hydrocarbon odors noted in PL-01, PL-02, and PL-03. The presence of debris and hydrocarbons is expected from the proximity of the stations to the large municipal stormwater outfall. Undisturbed OBM from stations in the Pilings and Upper Lauritzen subareas was combined into composite samples (Table 5). In the other subareas, OBM samples from individual stations were maintained separately because few cores contained a sufficient quantity of undisturbed OBM.

Table 3. Sediment Types and Thickness in Lauritzen Channel Core Samples, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	YBM Ft Core Collected	YBM Elevation (-ft MLLW)	Sand Thickness (ft)	Sand Elevation (-ft MLLW)	OBM Thickness (ft)	Elevation (-ft MLLW)	Comments
PL- 01	7.9	2.0	7.9	>2.0	NA	0.0	>9.9	
PL- 01A	9.9	2.5	9.9	2.3	NA	0.0	12.2	
PL- 02	12.9	0.5	12.9	0.5	NA	0.0	>13.4	Rocks at -13.4 ft MLLW (below YBM)
PL- 03	12.7	2.2	12.7	2.2	NA	0.0	19.9	
PL- 04	12.6	0.9	12.6	0.6	NA	0.0	13.2	
PL- 05	11.9	0.8	11.9	0.6	NA	0.0	12.5	
PL- 06	15.9	0.4	15.9	0.2	NA	0.0	16.1	
PL- 07	12.0	1.1	12.0	1.0	NA	0.0	13.0	Rocks at surface (-12 ft MLLW)
PL- 08	21.8	0.6	21.8	0.6	NA	0.0	>22.4	
UL- 09	21.1	2.2	21.1	0.9	22.0	0.5	22.5	
UL- 10	19.3	1.1	19.3	1.0	NA	0.0	20.3	
UL- 11	22.4	0.5	NA	0.0	NA	0.0	22.4	
UL- 12	15.3	1.2	NA	0.0	NA	0.0	15.3	
UL- 13	22.9	1.1	22.9	1.1	NA	0.0	>24.0	
UL- 14	22.8	2.0	22.8	0.8	NA	0.0	23.6	0.3-0.8 ft in core is disturbed YBM/OBM interface, counted as YBM for plotting thickness & estimating volume
SW-15	17.0	1.2	NA	0.0	17.0	0.5	17.5	Black streaky stains in OBM, 0.5-1.2 ft in core
SW-16	23.8	1.2	23.8	0.5	NA	0.0	24.3	
SW-17	21.8	1.0	21.8	0.8	NA	0.0	22.6	
BC- 18	38.4	1.6	38.4	1.3	39.1	0.1	39.7	
BC- 19	35.4	2.2	35.4	2.2	36.6	0.15	37.6	
BC- 20	37.4	1.6	37.4	1.6	NA	0.0	~39.0	
BC- 21	39.4	1.7	39.4	1.5	NA	0.0	40.9	
BC- 22	39.4	1.4	39.4	1.4	NA	0.0	~40.8	
BC- 23	40.3	1.7	40.3	1.6	NA	0.0	41.9	
BC- 24	41.2	2.8	41.2	2.7	NA	0.0	43.9	

Table 4. Sediment Types and Thickness in Parr Canal Core Samples, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	Ft Core Collected	YBM Elevation (-ft MLLW)	YBM Thickness (ft)	Sand Elevation (-ft MLLW)	Sand Thickness (ft)	Deep YBM Elevation (-ft MLLW)	Deep YBM Thickness (ft)	OBM Elevation (-ft MLLW)
PC- 25	2.2	2.5	2.2	0.2	2.4	0.9	3.3	>1.4	>4.7
PC- 26	2.1	2.7	none	0.0	2.1	1.0	3.1	>1.7	>4.8
PC- 27	4.4	1.6	4.4	0.2	4.6	0.5	5.1	0.8	5.9

Table 5. Sample Preparation Record, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	Vertical Segment	Approximate Amount per Jar: DDT Screen	DDT 8081	Grain Size, TOC	Archive	Comments	Type
PL- 01	7.9	0-2.0	1	1	1	1	Strong HC odor, wood, shells, plastic	YBM
PL- 01A	9.9	0-2.3	1	1	1	1	Black YBM w/debris	YBM
PL- 01A	9.9	2.3-2.5	0.5	0.5	0	0	Soft OBM w/black silt	OBM-dist
PL- 02	12.9	0-0.5	1	1	1	1	YBM; strong HC odor; used sed in contact with liner	YBM
PL- 03	12.7	0-1.3	1	1	1	1	Gray YBM	YBM
PL- 03	12.7	1.3-1.7	1	0.6	0.5	0.5	Wood fiber soaked in black silt	YBM
PL- 03	12.7	1.7-2.2	1	1	0.5	0.6	Disturbed YBM, oily 0.5" green clay at bottom.	YBM
PL- 04	12.6	0-0.6	0	0	0	0	YBM Sample NOT COLLECTED	YBM
PL- 04	12.6	0.6-0.9	NA	NA	NA	NA	Contributed to OBM Comp	OBM
PL- 05	11.9	0-0.6	1	0.6	0.5	0	YBM	YBM
PL- 05	11.9	0.6-0.7	NA	NA	NA	NA	Contributed to OBM Comp	OBM
PL- 06	15.9	0-0.2	0	1	0	0	OBM	OBM
PL- 06	15.9	0.2-0.4	NA	NA	NA	NA	Contributed to OBM Comp	OBM
PL- 07	12.0	0-0.3	0	0	0	0	Rocks at surface	NA
PL- 07	12.0	0.3-1.0	1	1	1	0.3	Consolidated YBM	YBM
PL- 07	12.0	1.0-1.1	NA	NA	NA	NA	Contributed to OBM Comp	OBM
PL- 7, 6, 5, 4 OBM	various	various	1	0.6	0.3	0.3	OBM, brown & gray clay	OBM Comp
PL- 08	21.8	0-0.2	0	0.5	0	0	Soft YBM	YBM
PL- 08	21.8	0.2-0.6	1	1	0.5	0	Disturbed YBM/OBM interface	OBM-Dist
UL- 09	21.1	0-0.9	1	1	1	0.6	YBM, used mud in contact w/liner	YBM
UL- 09	21.1	0.9-1.4	1	1	1	0	Sand Cap mixed w/black YBM	Sand
UL- 09	21.1	1.4-2.0	NA	NA	NA	NA	Contributed to OBM Comp	OBM
UL- 9,10 OBM	various	various	1	1	1	0		OBM Comp
UL- 10	19.3	0-1.0	1	1	1	1	YBM, twigs	YBM
UL- 10	19.3	1.0-1.1	NA	NA	NA	NA	very stiff gray clay, some discoloration; contributed to OBM comp	OBM
UL- 11	22.4	approx 0-0.5	NA	NA	NA	NA	very small contribution to OBM comp, all from jar	OBM
UL- 12	15.3	0-1.0	NA	NA	NA	NA	Contributed to OBM Comp	OBM
UL- 13	22.9	0-1.1	1	1	1	1	2-3-in. rocks! YBM	YBM
UL- 14	22.8	0-0.3	1	0.6	0.5	0		YBM
UL- 14	22.8	0.3-0.8	1	1	1	0	Disturbed YBM/OBM interface	OBM-Dist
UL- 14,11,12 OBM	various	various	1	1	1	1	Brown sandy clay	OBM comp

Table 5. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment	Approximate Amount per Jar: DDT Screen	DDT 8081	Grain Size, TOC	Archive	Comments	Type
SW- 15	17.0	0-0.5	1	1	1	1	Sand layer	Sand
SW- 15	17.0	0.5-1.2	1	1	1	1	Stiff dark gray clay w/ black stains	OBM-Dist
SW- 16	23.8	0-0.5	1	1	0.5	0	YBM	YBM
SW- 16	23.8	0.5-1.0	1	1	1	0.6	OBM	OBM
SW- 17	21.8	0-0.8	1	1	1	1	YBM	YBM
SW- 17	21.8	0.8-1.0	1	0.5	0.3	0	Firm gray sandy clay	OBM
BC- 18	38.4	0-0.7	1	1	1	0.6	Upper YBM	YBM
BC- 18	38.4	0.7-0.8	0	0	0	0	Thin sand layer, not sampled	Sand
BC- 18	38.4	0.8-1.3	1	1	0.5	0.5	deeper YBM	YBM
BC- 18	38.4	1.3-1.6	0.5	0.5	0	0	Green gray clay, some black silt	OBM
BC- 19	35.4	0-1.2	1	1	1	1	Soft YBM	YBM
BC- 19	35.4	1.2-1.4	0	0	0	0	Sand layer	Sand
BC- 19	35.4	1.4-2.2	1	1	1	1	Deeper YBM	YBM
BC- 20	37.4	0-1.6	1	1	1	1	YBM	YBM
BC- 21	39.4	0-1.5	1	1	1	1	YBM, some sand	YBM
BC- 21	39.4	1.5-1.7	1	1	1	1	OBM	OBM
BC- 22	39.4	0-1.4	1	1	1	1	black silt, clay balls, shells	YBM
BC- 23	40.3	0-1.6	1	1	1	1	YBM	YBM
BC- 23	40.3	1.6-1.7	NA	NA	NA	NA	OBM	OBM
BC- 24	41.2	0-2.7	1	1	1	1	black silt; thin sand lens above OBM	YBM
BC- 24	41.2	27.-2.8	NA	NA	NA	NA	OBM, some black streaks	OBM
SF- 28	43.3	approx 0-0.4	1	1	1	1	thin light brown silt	YBM
SF- 29	38.5	approx 0-0.5	1	1	1	1	thin light brown silt	YBM
PC- 25	2.2	0.2-1.1	1	1	0.5	0.5	Sand layer	Sand
PC- 25	2.2	0-0.2	0.3	0.3	0.3	0	Fine silt	YBM
PC- 25	2.2	1.1-2.5	1	1	1	1	Fairly stiff black silt, debris	YBM
PC- 26	2.1	0-1.0	1	1	1	1	Sand cap	Sand
PC- 26	2.1	1.0-2.7	1	1	1	1	Stiff black silt; moderate HC odor	YBM
PC- 27	4.4	0.2-0.7	1	1	0.5	0.5	Sand cap w/some black silt	Sand
PC- 27	4.4	0.7-1.5	1	1	1	1	Stiff black YBM	YBM
PC- 27	4.4	0-0.2	0	0.5	0	0	Surface silt	YBM
PC- 27	4.4	1.5-1.6	0.5	0.5	0	0	stiff gray silty clay	OBM

Table 5. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment	DDT Screen	DDT 8081	Grain Size, TOC	Archive	Comments	Type
			Approximate Amount per Jar					
CR- 30	NA	NA	1	1	0	0	creosote-treated wood	wood
CR- 31	NA	NA	1	1	0	0	creosote-treated wood	wood
CR- 32	NA	NA	1	1	0	0	creosote-treated wood	wood
CR- 33	NA	NA	1	1	0	0	creosote-treated wood	wood
CR- 34	NA	NA	1	1	0	0	creosote-treated wood	wood
CR- 35	NA	NA	1	1	0	0	creosote-treated wood	wood

3.3 SEDIMENT SAMPLE ANALYSIS

The final number of samples for each analysis is summarized in Table 6. Grain size, TOC, and total solids analyses were performed by Applied Marine Sciences, Inc., of League City, Texas. DDT immunoassay screening and confirmatory pesticide/PCB analyses were conducted by Battelle MSL, Sequim, Washington. Sample analysis results are summarized in this section; complete sediment chemistry and quality control data can be found in Appendix B.

3.3.1 Grain Size, TOC, Total Solids

Total solids, grain size, and TOC results are presented in Table 7. OBM sediment was of variable grain size and generally had higher total solids and lower TOC than other sediments. The sand layer samples were clearly identified as the only samples with over 85% sand. TOC in the sand samples was also very low (<0.5% dry weight). YBM sediment was generally composed mostly of silt and clay, but some samples were notable for their high percentage of gravel, shells, and/or rocks (e.g., UL-13, PL-01, PL-02, PL-03, and BC-22). Most YBM sediment had 1-2% TOC; the northernmost pilings samples were notable exceptions with 6-7% TOC, and were probably influenced by the petroleum hydrocarbons in stormwater runoff.

Table 6. Number and Types of Samples for Analysis, Heckathorn 1999 Sediment Investigation

Subarea	Subarea Code	YBM	Sand Layer	OBM	Creosote-Treated Wood	Total
Samples Prepared						
Lauritzen Channel						
Between Pilings	PL	10	0	3	0	13
Upper Lauritzen	UL	4	1	3	0	8
Southwest Lauritzen	SW	2	1	3	0	6
Levin Berths B & C	BC	9	0	2	0	11
Santa Fe Channel	SF	2	0	0	0	2
Parr Canal	PC	5	3	1	0	9
Creosote Pilings	CR	0	0	0	6	6
Total Samples Prepared		**32**	**5**	**12**	**6**	**55**
Samples Analyzed						
Number for Grain Size, TOC		30	5	8	0	43
Number for DDT Screening		30	5	11	6	52
Number of diluted samples for additional DDT Screening						44
Number for Confirmatory Pesticide Analysis		22	1	6	5	34
Number Archived		25	5	4	0	34

Table 7. Sediment Grain Size and Total Organic Carbon Results, Heckathorn 1999 Sediment Investigation

	Mudline	Vertical Segment	Sediment	Total Solids	Grain Size and TOC (% dry weight)				
Station ID	(-ft MLLW)	(ft below mudline)	Type	(% dry weight)	Gravel	Sand	Silt	Clay	TOC
Between Pilings, northeastern Lauritzen Channel									
PL- 01	7.9	0-2.0	YBM	47.3	23.8	31.6	23.1	21.5	7.4
PL- 01A	9.9	0-2.3	YBM	54.5	19.8	29.4	23.0	27.9	6.5
PL- 01A	9.9	2.3-2.5	OBM-dist	75.6	9.7	39.4	20.3	30.6	0.5
PL- 02	12.9	0-0.5	YBM	46.3	20.5	16.1	20.9	42.5	7.1
PL- 03	12.7	0-1.3	YBM	48.1	3.2	10.2	35.0	51.6	3.0
PL- 03	12.7	1.3-1.7	YBM	41.7	4.1	5.5	40.3	50.2	6.8
PL- 03	12.7	1.7-2.2	OBM-dist	67.8	21.9	26.6	19.6	32.0	1.0
PL- 05	11.9	0-0.6	YBM	54.7	1.4	9.1	38.7	50.9	1.1
PL- 06	15.9	0-0.2	YBM	77.7	17.4	33.9	21.3	27.4	0.3
PL- 07	12.0	0.3-1.0	YBM	70.2	3.9	16.7	31.9	47.5	1.7
PL- 7, 6, 5, 4	various	various	OBM comp	74.4	12.3	19.1	31.1	37.4	0.2
PL- 08	21.8	0-0.2	YBM	NA[(a)]	NA	NA	NA	NA	NA
PL- 08	21.8	0.2-0.6	OBM-dist	86.4	55.1	16.8	17.6	10.5	0.2
Upper Lauritzen Channel									
UL- 09	21.1	0-0.9	YBM	51.7	1.2	49.2	19.5	30.2	1.5
UL- 09	21.1	0.9-1.4	Sand	75.9	0.5	85.4	4.5	9.6	0.3
UL- 10	19.3	0-1.0	YBM	57.1	1.5	14.8	38.9	44.8	1.2
UL- 9, 10	various	various	OBM comp	74.0	2.1	28.5	33.2	36.2	0.4
UL- 13	22.9	0-1.1	YBM rocks	86.6	73.3	17.2	3.1	6.4	0.2
UL- 14	22.8	0-0.3	YBM	57.1	2.1	26.5	30.3	41.1	1.1
UL- 14	22.8	0.3-0.8	OBM-Dist	74.8	1.9	34.2	36.1	27.9	0.1
UL- 14,11,12	various	various	OBM comp	77.6	4.8	33.9	43.9	17.4	ND

Table 7. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Total Solids (% dry weight)	Grain Size and TOC (% dry weight) Gravel	Sand	Silt	Clay	TOC
Southwest Lauritzen Channel									
SW- 15	17.0	0-0.5	Sand	80.8	3.8	85.2	4.6	6.4	0.2
SW- 15	17.0	0.5-1.2	OBM-Dist	69.5	4.5	33.0	36.5	26.0	0.7
SW- 16	23.8	0-0.5	YBM sandy	69.7	1.0	66.5	13.4	19.2	0.7
SW- 16	23.8	0.5-1.0	OBM	77.0	0.9	68.6	17.3	13.3	0.2
SW- 17	21.8	0-0.8	YBM	59.1	2.6	37.6	27.3	32.5	0.9
SW- 17	21.8	0.8-1.0	OBM	77.1	3.0	53.6	27.9	15.5	0.2
Levin Berths B & C									
BC- 18	38.4	0-0.7	YBM	46.2	1.0	22.5	24.5	52.0	1.5
BC- 18	38.4	0.8-1.3	YBM	53.0	4.6	21.6	31.3	42.5	1.2
BC- 18	38.4	1.3-1.6	OBM	74.1	0.2	22.7	39.7	37.5	0.2
BC- 19	35.4	0-1.2	YBM	50.3	4.7	29.3	18.3	47.8	2.0
BC- 19	35.4	1.4-2.2	YBM	71.0	13.6	31.1	27.4	27.9	1.1
BC- 20	37.4	0-1.6	YBM	52.0	11.3	21.6	22.0	45.0	1.6
BC- 21	39.4	0-1.5	YBM	54.5	5.0	37.5	17.5	40.0	0.8
BC- 21,23,24	various	various	OBM comp	73.6	3.1	15.1	40.7	41.1	0.2
BC- 22	39.4	0-1.4	YBM	56.6	20.9	27.6	16.3	35.2	2.4
BC- 23	40.3	0-1.6	YBM	42.3	0.0	10.2	22.7	67.2	1.4
BC- 24	41.2	0-2.7	YBM	45.9	0.9	18.7	26.0	54.3	1.6

Table 7. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Total Solids (% dry weight)	Grain Size and TOC (% dry weight) Gravel	Sand	Silt	Clay	TOC
<u>Santa Fe Channel</u>									
SF- 28	43.3	approx 0-0.4	YBM	34.6	0.2	4.1	20.8	74.9	1.6
SF- 29	38.5	approx 0-0.5	YBM	37.2	2.2	6.8	22.5	68.5	1.4
<u>Parr Canal</u>									
PC- 25	2.2	0-0.2	YBM	82.3	0.2	58.7	19.3	21.8	6.1
PC- 25	2.2	0.2-1.1	Sand	64.3	0.4	96.3	0.9	2.5	0.5
PC- 25	2.2	1.1-2.5	YBM	81.8	0.2	24.1	39.2	36.5	6.9
PC- 26	2.1	0-1.0	Sand	56.2	1.3	97.0	0.3	1.5	0.1
PC- 26	2.1	1.0-2.7	YBM	54.9	0.1	13.7	44.8	41.5	4.2
PC- 27	4.4	0.2-0.7	Sand	79.7	0.8	94.9	1.1	3.2	0.2
PC- 27	4.4	0.7-1.5	YBM	54.4	17.5	30.0	10.0	42.5	1.2
Creosote-Treated Pilings									
CR- 30	NA	NA	wood	NA	NA	NA	NA	NA	NA
CR- 31	NA	NA	wood	NA	NA	NA	NA	NA	NA
CR- 32	NA	NA	wood	NA	NA	NA	NA	NA	NA
CR- 33	NA	NA	wood	NA	NA	NA	NA	NA	NA
CR- 34	NA	NA	wood	NA	NA	NA	NA	NA	NA
CR- 35	NA	NA	wood	NA	NA	NA	NA	NA	NA

(a) NA Not applicable (sample not analyzed).

3.3.2 DDT Immunoassay Screen

Samples for confirmatory pesticide analysis by traditional quantitative methods were selected on the basis of the DDT immunoassay screening results. Table 8 lists all the vertical segments of core and the screening results for segments with enough sample to screen. Although the semiquantitative spectrophotometric analysis was used to estimate total DDT in the sample extracts (described in Section 2.4.2), many samples needed to be diluted and reanalyzed to obtain concentrations within the calibration range. Even after multiple dilutions, some samples were never within the calibration range, and are expressed as less than or greater than the calibration limit in Table 8**.** Because of the qualitative nature of the DDT immunoassay screening analysis and the lack of refinements of the technique for saturated marine sediments, the reported screening concentrations should not be construed as a quantitative measurement of DDT. Table 8 also contains the justification for whether or not the sample was selected for confirmatory pesticide/PCB analysis. The screening results were just one factor considered when selecting samples for confirmatory analysis; other factors for consideration were as follows:

- sample was needed for delineation of horizontal or vertical extent of contamination,
- sample was most representative of its area with regard to sediment type and DDT screen result,
- sample was representative of a unique sediment type or layer, or
- sample was needed for potential source identification.

3.3.3 Confirmatory Pesticide and PCB Results

Confirmatory quantitative analysis of chlorinated pesticides and PCB aroclors was accomplished using modified EPA Method 8081 (EPA 1998) as described in Section 2.4.3. Complete analytical results and quality control data are contained in Appendix B. Data quality objectives were met for the pesticide/PCB analyses with few exceptions. Samples were analyzed in two batches; all analytes were undetected in the blanks associated with both batches. More than half of the samples required dilution in order to quantify the DDT compounds within the instrument calibration range; sample dilution resulted in elevated detection limits for other analytes. Matrix spike (MS) and matrix spike duplicate (MSD) recoveries were within acceptable range with the exception of 4,4'-DDT, which had slightly high recovery (132% and 135% in the MS and MSD, respectively). Accuracy was confirmed by acceptable SRM results, with all certified analytes recovered within 30% of the certified values. Precision was also acceptable, with RPDs <30% between all MS and MSD recoveries. In sample duplicate analysis, RPDs were <30% except for 4,4'-DDT in the Batch 2 duplicates, which had an RPD of 35%. This is not unexpected because the DDT concentrations in Lauritzen Channel samples are highly variable and samples can be inhomogeneous.

Table 8. Selection of Samples for Confirmatory Pesticide and PCB Analysis, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	Vertical Segment	Screening Results (ug/g dry)	Type	Confirmatory Pest/PCB Final List	Justification
Pilings						
PL- 01	7.9	0-2.0	>200	YBM	Yes	Source ID
PL- 01A	9.9	0-2.3	>200	YBM	No	Represented by PL-01 YBM
PL- 01A	9.9	2.3-2.5	>200	OBM-dist	No	Very thin layer; assume part of YBM
PL- 02	12.9	0-0.5	>200	YBM	Yes	Source ID
PL- 03	12.7	0-1.3	>200	YBM	Yes	Source ID; represents all PL-03 YBM
PL- 03	12.7	1.3-1.7	>200	YBM	No	Represented by PL-03 0-1.3 (screened at similar conc).
PL- 03	12.7	1.7-2.2	177	OBM-dist	Yes	possible for cutting; worst case is to assume same as upper PL-03 even though screen is 30-50% of upper conc.
PL- 04	12.6	0-0.6	no data	YBM	NA	No sample
PL- 04	12.6	0.6-0.9	no data	OBM	NA	Contributed to OBM composite
PL- 05	11.9	0-0.6	36	YBM	Yes	Source ID
PL- 05	11.9	0.6-0.7	no data	OBM	NA	Contributed to OBM composite
PL- 06	15.9	0-0.2	no data	YBM	Yes	Surface YBM, very thin but needed for source ID
PL- 06	15.9	0.2-0.4	no data	OBM	NA	Contributed to OBM composite
PL- 07	12.0	0-0.3	NA	NA	NA	No sample
PL- 07	12.0	0.3-1.0	<4	YBM	Yes	Surface YBM, very thin but needed for source ID
PL- 7, 6, 5, 4 OBM	various	various	13.7	OBM	Yes	Screened >4 ppm
PL- 08	21.8	0-0.2	no data	YBM	Yes	Surface YBM, very thin but needed for source ID
PL- 08	21.8	0.2-0.6	>200	OBM-dist	Yes	possible for cutting; worst case is to assume same as upper PL-08
Upper Lauritzen Channel						
UL- 09	21.1	0-0.9	>200	YBM	Yes	Surface YBM, source ID
UL- 09	21.1	0.9-1.4	>200	Sand	No	Can be represented by surface YBM
UL- 09	21.1	1.4-2.0	no data	OBM	NA	Contributed to OBM composite
UL- 10	19.3	0-1.0	2.8	YBM	Yes	! Screened very low!
UL- 9,10	various	various	4.1	OBM	Yes	Possible for cutting; UL-09 YBM screened very low, and UL-10 contributed very little OBM to this comp
UL- 11	22.4	0-0.5 approx	no data	OBM	NA	Contributed to OBM composite
UL- 12	15.3	0-1.0	no data	OBM	NA	Contributed to OBM composite

Table 8. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment	Screening Results (ug/g dry)	Type	Confirmatory Pest/PCB Final List	Justification
Upper Lauritzen Channel (cont'd)						
UL- 13	22.9	0-1.1	<4	YBM rocks	Yes	Thick YBM layer, center channel, moderate screen
UL- 14	22.8	0-0.3	>200	YBM	Yes	Thin layer but screened substantially higher than neighbors.
UL- 14	22.8	0.3-0.8	>200	OBM-Dist	No	Disturbed OBM screened low, <4 (2). At worst case could estimate volume with UL-14 YBM
UL- 14,11,12 OBM	various	various	<0.4	OBM	No	OBM Comp screened <0.4
Southwest Lauritzen Channel						
SW- 15	17.0	0-0.5	38	Sand	Yes	
SW- 15	17.0	0.5-1.2	14.9	OBM-Dist	Yes	possible for cutting; disturbed OBM. Worst case would be to use surface YBM conc to represent this layer.
SW- 16	23.8	0-0.5	>200	YBM	Yes	
SW- 16	23.8	0.5-1.0	1	OBM	No	
SW- 17	21.8	0-0.8	>200	YBM	Yes	
SW- 17	21.8	0.8-1.0	<4	OBM	No	
Levin Berths B, C, and mouth of Lauritzen						
BC- 18	38.4	0-0.7	131	YBM	Yes	Possible for cutting; thinner layer could be represented by BC-19 YBM and also deeper BC-18 YBM
BC- 18	38.4	0.7-0.8	no data	Sand	NA	
BC- 18	38.4	0.8-1.3	>200	YBM	Yes	Consolidated buried YBM--could estimate same as upper YBM, but this screened much higher. YBM layers were separated by thin sand layer. This could represent lower from BC-19
BC- 18	38.4	1.3-1.6	137	OBM	No	OBM screened high; thin layer so assume same as overlying YBM

Table 8. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment	Screening Results (ug/g dry)	Type	Confirmatory Pest/PCB Final List	Justification
Levin Berths B, C, and mouth of Lauritzen (cont'd)						
BC- 19	35.4	0-1.2	>200	YBM	Yes	Use this to represent upper YBM from 18 and 20 (all screened 130-225)
BC- 19	35.4	1.2-1.4	no data	Sand	NA	
BC- 19	35.4	1.4-2.2	>200	YBM	No	Represented by BC-18 deep YBM at worst case. Could also compare to other YBMs that screened at similar level
BC- 20	37.4	0-1.6	>200	YBM	No	Represented by BC-19 surface YBM. Could also compare to other YBMs that screened at similar level
BC- 21	39.4	0-1.5	85	YBM	Yes	mid range YBM. Need for extent gradient
BC- 21,23,24 OBM	various	various	9.9	OBM	Yes	Very thin layers. Screened at 9.9 ppm; need for both vertical and horizontal extent
BC- 22	39.4	0-1.4	24.4	YBM	No	Can be represented by 24 YBM
BC- 23	40.3	0-1.6	16.5	YBM	Yes	Possible for cutting; screened low; could be represented by 24 YBM, but what if 24 is >1 ppm??
BC- 23	40.3	1.6-1.7	no data	OBM	NA	Contributed to OBM composite
BC- 24	41.2	0-2.7	25.6	YBM	Yes	
BC- 24	41.2	2.7-2.8	no data	OBM	NA	Contributed to OBM composite
Santa Fe Channel						
SF- 28	43.3	approx 0-0.4	2.8	YBM	Yes	Upstream of LC; represents incoming sed from channel
SF- 29	38.5	approx 0-0.5	1.0	YBM	No	screened low; downstream of Lauritzen mouth

Table 8. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment	Screening Results (ug/g dry)	Type	Confirmatory Pest/PCB Final List	Justification
Parr Canal						
PC- 25	2.2	0-0.2	11.7	YBM	Yes	Representative of newly deposited surface YBM, north end
PC- 25	2.2	0.2-1.1	<0.4	Sand	No	Screened low; sand cap
PC- 25	2.2	1.1-2.5	28.3	YBM	No	Deep YBM isolated by sand cap
PC- 26	2.1	0-1.0	<0.2	Sand	No	Screened low; sand cap
PC- 26	2.1	1.0-2.7	>200	YBM	No	Deep YBM isolated by sand cap
PC- 27	4.4	0.2-0.7	3.4	Sand	No	Screened low; sand cap
PC- 27	4.4	0.7-1.5	>200	YBM	No	Deep YBM isolated by sand cap
PC- 27	4.4	0-0.2	no data	YBM	Yes	Representative of newly deposited surface YBM , south part of canal
PC- 27	4.4	1.5-1.6	102	OBM	No	possible for later analysis
Creosote-Treated Wood from Pilings						
CR- 30	NA	NA	>200	wood	Yes	
CR- 31	NA	NA	>200	wood	Yes	
CR- 32	NA	NA	>200	wood	Yes	
CR- 33	NA	NA	94	wood	Yes	
CR- 34	NA	NA	>200	wood	Yes	
CR- 35	NA	NA	82	wood	No	Similar to CR-33

Because the DDT compounds and dieldrin are the primary contaminants of concern at the Heckathorn site, these are the pesticides that are reported in Table 9. Total DDT ranged from 100 µg/kg dry weight to 180,840 µg/kg dry weight in Lauritzen Channel sediments. As expected, DDT concentrations were highest in YBM samples. However, the highest concentrations did not occur at the head of Lauritzen Channel as expected, but in the thin layer of surface YBM from Station UL-14 and in deeper YBM sediments from Station BC-18 at the north end of Levin Berths B&C.

Aroclor 1254 was the only PCB aroclor detected, and it was detected only in the Berth B&C surface sediments and in the OBM composite from Stations BC-21, BC-23, and BC-24 (Table 9). Other chlorinated pesticides, notably aldrin and endosulfan-I, were detected in half the sediment samples and all of the creosote-treated wood samples (Table 10). The presence of other pesticides was generally correlated with the higher concentrations of DDT compounds.

Table 9. DDT Compounds, Dieldrin, and Aroclor 1254 in Sediment, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Concentrations in µg/kg dry weight					
				Total DDT	Dieldrin	DDE	DDD	DDT	Aroclor 1254
Between Pilings, northeastern Lauritzen Channel									
PL- 01	7.9	0-2.0	YBM	85040	3200	2940	51500	30600	316 U
PL- 01A	9.9	0-2.3	YBM	NA	NA	NA	NA	NA	NA
PL- 01A	9.9	2.3-2.5	OBM-dist	NA	NA	NA	NA	NA	NA
PL- 02	12.9	0-0.5	YBM	37860	1220	1160	18100	18600	316 U
PL- 03	12.7	0-1.3	YBM	24199	68.0	449	21100	2650	316 U
PL- 03	12.7	1.3-1.7	YBM	NA	NA	NA	NA	NA	NA
PL- 03	12.7	1.7-2.2	OBM-dist	3519	17.4 U	58.7	3260	200	316 U
PL- 05	11.9	0-0.6	YBM	2108	107	202	1720	186	316 U
PL- 06	15.9	0-0.2	YBM	3258	272	220	708	2330	316 U
PL- 07	12.0	0.3-1.0	YBM	26.3	18.1 U	12.6 U	26.3	64.6 U	316 U
PL- 7, 6, 5, 4	various	various	OBM comp	69.1	17.6 U	12.2 U	69.1	62.5 U	316 U
PL- 08	21.8	0-0.2	YBM	30060	2590	1420	8340	20300	316 U
PL- 08	21.8	0.2-0.6	OBM-dist	21840	1650	1110	6230	14500	316 U
Upper Lauritzen Channel									
UL- 09	21.1	0-0.9	YBM	45220	1910	2410	36300	6510	3020
UL- 09	21.1	0.9-1.4	Sand	NA	NA	NA	NA	NA	NA
UL- 10	19.3	0-1.0	YBM	239	22.2 U	15.4 U	239	78.9 U	316 U
UL- 9, 10	various	various	OBM comp	47.3	17.4 U	12.1 U	47.3	62.0 U	316 U
UL- 13	22.9	0-1.1	YBM rocks	8764	317	254	5600	2910	316 U
UL- 14	22.8	0-0.3	YBM	104340	3000	1940	40100	62300	316 U
UL- 14	22.8	0.3-0.8	OBM-Dist	NA	NA	NA	NA	NA	NA
UL- 14,11,12	various	various	OBM comp	NA	NA	NA	NA	NA	NA

Table 9. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Concentrations in µg/kg dry weight					
				Total DDT	Dieldrin	DDE	DDD	DDT	Aroclor 1254
Southwest Lauritzen Channel									
SW- 15	17.0	0-0.5	Sand	5665	217	205	3000	2460	10700
SW- 15	17.0	0.5-1.2	OBM-Dist	1036	45.6	31.1	495	510	316 U
SW- 16	23.8	0-0.5	YBM sandy	43353	887	953	16200	26200	316 U
SW- 16	23.8	0.5-1.0	OBM	NA	NA	NA	NA	NA	NA
SW- 17	21.8	0-0.8	YBM	20551	701	681	12600	7270	316 U
SW- 17	21.8	0.8-1.0	OBM	NA	NA	NA	NA	NA	NA
Levin Berths B & C									
BC- 18	38.4	0-0.7	YBM	54130	881	1150	7080	45900	23800
BC- 18	38.4	0.8-1.3	YBM	180840	3400	3240	85200	92400	316 U
BC- 18	38.4	1.3-1.6	OBM	NA	NA	NA	NA	NA	NA
BC- 19	35.4	0-1.2	YBM	42350	531	1030	7820	33500	14000
BC- 19	35.4	1.4-2.2	YBM	NA	NA	NA	NA	NA	NA
BC- 20	37.4	0-1.6	YBM	NA	NA	NA	NA	NA	NA
BC- 21	39.4	0-1.5	YBM	6770	193	220	3400	3150	11400
BC- 21,23,24	various	various	OBM comp	551.8	16.7 U	14.8	343	194	1220
BC- 22	39.4	0-1.4	YBM	NA	NA	NA	NA	NA	NA
BC- 23	40.3	0-1.6	YBM	2255.3	90.9	95.3	1160	1000	316 U
BC- 24	41.2	0-2.7	YBM	3451	132	141	2040	1270	6330

Table 9. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Concentrations in µg/kg dry weight Total DDT	Dieldrin	DDE	DDD	DDT	Aroclor 1254
Santa Fe Channel									
SF- 28	43.3	approx 0-0.4	YBM	582	36.0 U	28.3	257	297	316 U
SF- 29	38.5	approx 0-0.5	YBM	NA	NA	NA	NA	NA	NA
Parr Canal									
PC- 25	2.2	0-0.2	YBM	1172	85.1	122	435	615	316 U
PC- 25	2.2	0.2-1.1	Sand	NA	NA	NA	NA	NA	NA
PC- 25	2.2	1.1-2.5	YBM	NA	NA	NA	NA	NA	NA
PC- 26	2.1	0-1.0	Sand	NA	NA	NA	NA	NA	NA
PC- 26	2.1	1.0-2.7	YBM	NA	NA	NA	NA	NA	NA
PC- 27	4.4	0.2-0.7	Sand	NA	NA	NA	NA	NA	NA
PC- 27	4.4	0.7-1.5	YBM	825	20.3 U	71.7	279	474	316 U
Creosote-Treated Piliings									
CR- 30	NA	NA	wood	200530	24100	14100	185000	1430	316 U
CR- 31	NA	NA	wood	63200	26700	4710	55900	2590	316 U
CR- 32	NA	NA	wood	50340	10200	3270	45700	1370	316 U
CR- 33	NA	NA	wood	1720	22.6 U	15.8 U	1720	80.7 U	316 U
CR- 34	NA	NA	wood	155350	6850	8880	145000	1470	316 U
CR- 35	NA	NA	wood	NA	NA	NA	NA	NA	NA

NA Not applicable; sample not analyzed for pesticides and PCBs (see Table 8 for sample selection rationale).

Table 10. Other Detected Chlorinated Pesticides, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Concentrations in µg/kg dry weight							
				a-BHC	b-BHC	d-BHC	Heptachlor	Aldrin	Endosulfan I	g-Chlordane	a-Chlordane
PL- 01	7.9	0-2.0	YBM	ND[(a)]	ND	60.7	ND	301	139	277	173
PL- 02[(b)]	12.9	0-0.5	YBM	42.6	42.6	42.6	8.85	46.1	82.9	95.3	68.4
PL- 06	15.9	0-0.2	OBM	ND	ND	ND	50.3	68.7	34.0	ND	71.4
PL- 08	21.8	0-0.2	YBM	32.8	32.1	ND	32.6	487	82.8	385	389
PL- 08	21.8	0.2-0.6	YBM	ND	ND	ND	10.1	190	68.1	194	212
UL- 09	21.1	0-0.9	YBM	ND	ND	ND	ND	93.2	139	197	110
UL- 13	22.9	0-1.1	YBM	ND	ND	ND	ND	94.1	ND	ND	ND
UL- 14	22.8	0-0.3	YBM	89.6	43.2	64.3	ND	305	99.3	82.4	ND
SW- 16	23.8	0-0.5	YBM	37.0	ND	28.0	ND	101	55.0	ND	ND
SW- 17	21.8	0-0.8	YBM	ND	ND	ND	ND	97.0	44.2	38.1	ND
BC- 18	38.4	0-0.7	YBM	ND	ND	ND	ND	81.8	57.4	ND	ND
BC- 18	38.4	0.8-1.3	YBM	74.4	ND	70.9	ND	3210	190	158	142
BC- 19	35.4	0-1.2	YBM	ND	ND	ND	ND	56.0	51.3	ND	ND
BC- 21	39.4	0-1.5	YBM	ND	ND	ND	ND	27.0	ND	ND	ND
CR- 30	NA	NA	wood	132	482	ND	ND	ND	1330	2400	1370
CR- 31	NA	NA	wood	191	459	221	ND	2070	533	1270	861
CR- 32	NA	NA	wood	ND	611	ND	ND	ND	431	ND	282
CR- 33	NA	NA	wood	ND	ND	ND	20.9	ND	ND	ND	101
CR- 34	NA	NA	wood	812	ND	1360	ND	ND	1000	1260	818

(a) ND not detected.
(b) PL-02 YBM also has 29.4 µg/kg g-BHC and 41.7 µg/kg heptachlor epoxide.

4.0 DISCUSSION AND CONCLUSIONS

4.1 CURRENT CONDITION OF PARR CANAL

Sediment cores were collected at three stations in Parr Canal, in approximately the same locations as pre-remedial and post-remedial samples. In Parr Canal, the sand layer was still in place, clearly identifiable at all three stations. Parr Canal cores contained different sediment types in up to four vertical segments: newly deposited surface YBM on top of sand layer on top of deep YBM on top of OBM (Table 3). The DDT concentration in the surface YBM was 1.2 mg/kg dry weight, which slightly exceeds the remedial goal for the Heckathorn site. It is not known whether the Parr Canal surface sediment exceeds the ambient concentration in Richmond Harbor Channel, since no sample was collected outside the mouth of Parr Canal. In any case, the layer of recently deposited YBM in Parr Canal was discontinuous and only a few inches thick, and therefore is probably a very small volume of material. The sand layer appears to effectively isolate the deeper layer of YBM in Parr Canal.

4.2 HORIZONTAL AND VERTICAL EXTENT OF SEDIMENT CONTAMINATION IN LAURITZEN CHANNEL

The Heckathorn 1999 Sediment Investigation geologic core descriptions, sediment physical characteristics, and sediment chemistry data were used to assess the extent of sediment contamination and to estimate the volume of contaminated sediment in Lauritzen Channel. The geologic core descriptions showed less YBM present than expected in Lauritzen Channel. YBM deposition of 1-2 ft was expected throughout Lauritzen Channel because of high-precipitation, high-runoff winters in 1998 and 1999. The actual thickness of YBM was less than 1 ft in much of Lauritzen Channel, with a deeper pocket of YBM off the outfall pipe at the north end. The observed accumulation of 1.5 ft to 2.5 ft YBM in Berth B-C was expected for the environmental conditions (winter runoff, resuspension, ship activity).

The 1999 Sediment Investigation shows that nearly all YBM, sand, and disturbed OBM contained DDT above the remedial goal of 590 ug/kg dry weight. Table 11 summarizes the sediment type, thickness, and associated total DDT concentration used to create plots of contaminated sediment thickness (Figure 5) and DDT distribution (Figure 6). The thickness of contaminated sediment plotted in Figure 5 includes sand and disturbed OBM in addition to YBM. Both plots were generated in Surfer surface mapping software, using the inverse distance contouring method with default values (power 2, no anisotropy, no smoothing). Grid spacing was 40X100, twice as dense as the default spacing. In the data input file, contaminated sediment thickness was set at 0 ft where there was riprap or sheetpile along the shoreline. The zeros are appropriate because of the riprap and thinning of sediment at the margins of the channel.

Table 11. Summary of Surface Sediment Thickness and DDT Concentration Data Used to Estimate Contaminated Volume

Station	Thickness (ft)	Total DDT (µg/kg dry wt)	Source of Surface Sediment Thickness Data	Source of DDT Data
PL- 01	2.0	85,040	YBM	Measured YBM concentration
PL- 01A	2.3	85,040	YBM	PL-01 YBM concentration
PL- 02	0.5	37,860	YBM	Measured YBM concentration
PL- 03	2.2	24,199	YBM + disturbed OBM	Measured YBM concentration
PL- 04	0.6	24,199	YBM	PL-03 YBM concentration
PL- 05	0.6	2,108	YBM	Measured YBM concentration
PL- 06	0.2	3,258	YBM	Measured YBM concentration
PL- 07	1.0	26	YBM	Measured YBM concentration
PL- 08	0.6	30,060	YBM + disturbed OBM	Measured YBM concentration
UL- 09	1.4	45,220	YBM + Sand	Measured YBM concentration
UL- 10	1.0	239	YBM	Measured YBM concentration
UL- 11	0.0	47	YBM	Measured OBM composite concentration
UL- 12	0.0	47	YBM	Measured OBM composite concentration
UL- 13	1.1	8,764	YBM	Measured YBM concentration
UL- 14	0.8	104,340	YBM + disturbed OBM	Measured YBM concentration
SW- 15	1.2	5,665	YBM + disturbed OBM	Measured YBM concentration
SW- 16	0.5	43,353	YBM	Measured YBM concentration
SW- 17	0.8	20,551	YBM	Measured YBM concentration
BC- 18	1.3	117,485	YBM	Average YBM concentration of 0-0.7 ft and 0.8-1.3 ft segments
BC- 19	2.2	42,350	YBM	Measured YBM concentration in 0-1.2 ft segment
BC- 20	1.6	42,350	YBM	BC-19 YBM concentration
BC- 21	1.5	6,770	YBM	Measured YBM concentration
BC- 22	1.4	3,451	YBM	BC-24 YBM concentration
BC- 23	1.6	2,255	YBM	Measured YBM concentration
BC- 24	2.7	3,451	YBM	Measured YBM concentration

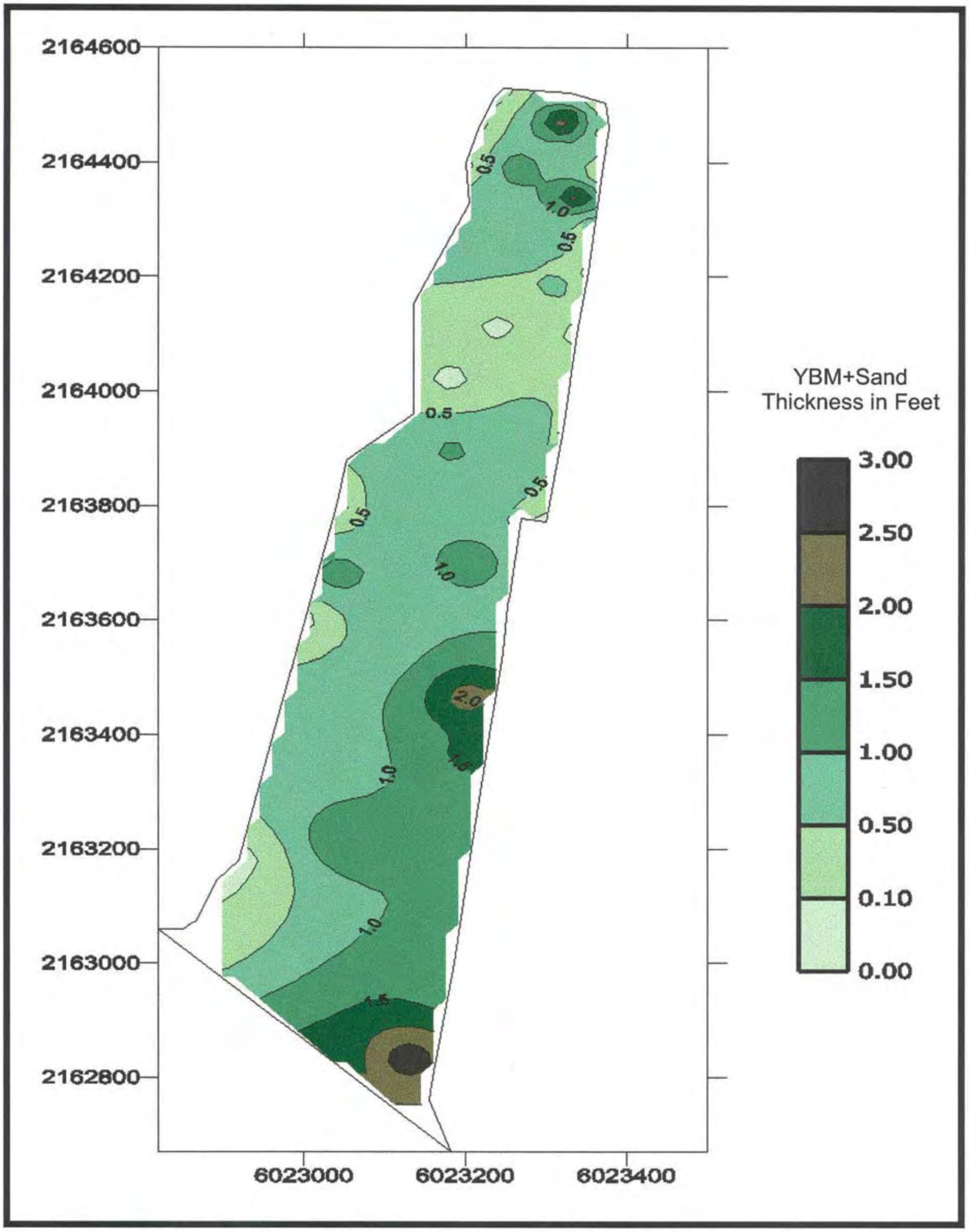

Figure 5. Surface Sediment Thickness in Lauritzen Channel, 1999 Sediment Investigation

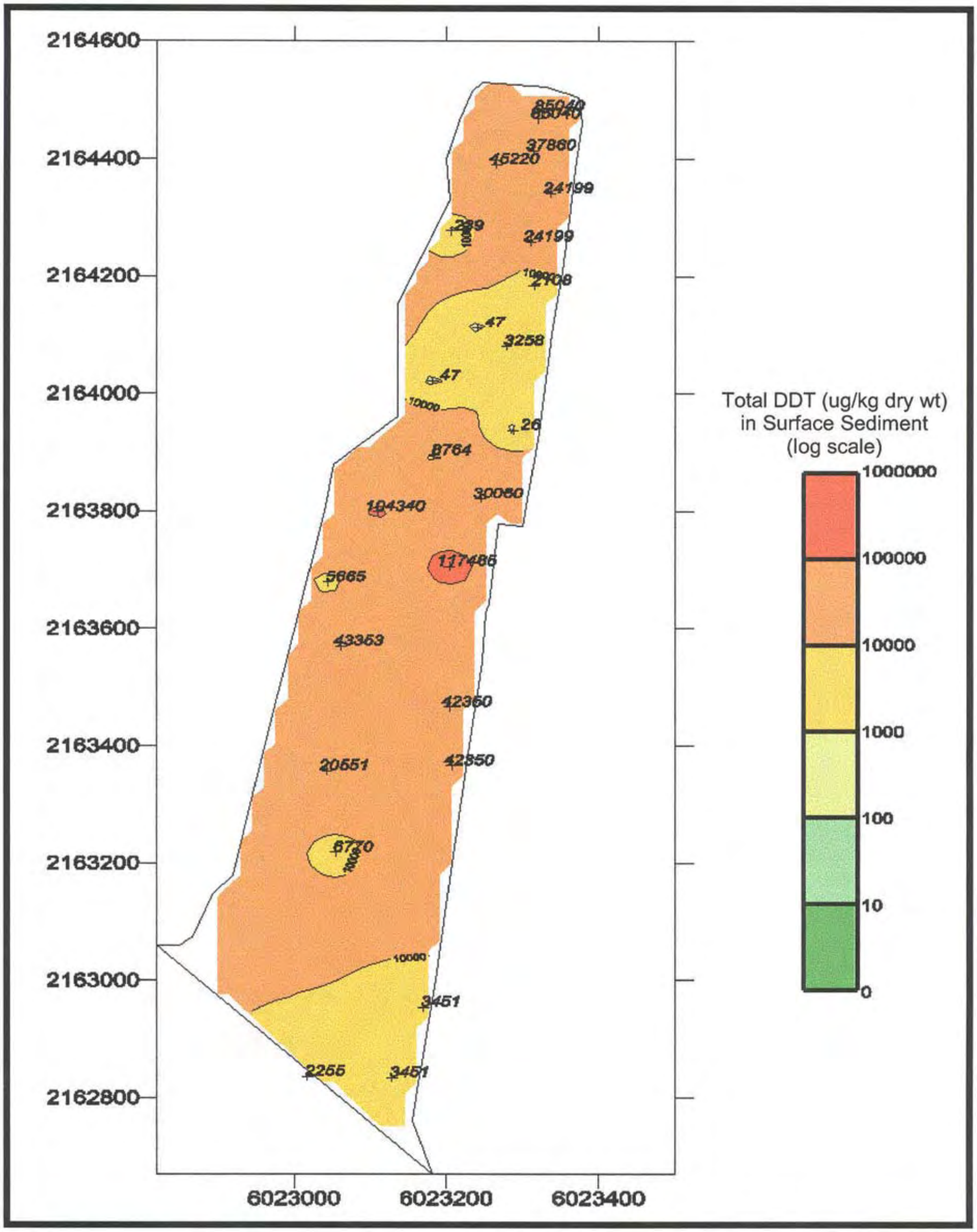

Figure 6. Total DDT in Lauritzen Channel Surface Sediment, 1999 Sediment Investigation

Sediment thickness was not set to 0 ft where there was a pier along the shoreline (e.g., between BC-18 and BC-24, and between UL-10 and UL-14), because the YBM thickness could be continuous under the pier.

The 1999 Sediment Investigation confirms the Year 2 Monitoring Study finding that YBM in Lauritzen Channel contains DDT ranging from about 2000 µg/kg (2 ppm) to nearly 200,000 µg/kg (200 ppm) dry weight (Figure 6). The four stations analyzed in the Year 2 Monitoring Study showed a gradient from a very high concentration (130 ppm) at the closed north end of Lauritzen Channel to low concentrations (2.8 ppm) at the mouth of the channel (Figure 2). The samples analyzed in the 1999 Sediment Investigation showed a very wide range of concentrations, but no clear gradient from north to south (Figure 6). The current extent of high DDT contamination in Lauritzen Channel appears to be in two "patches" separated by a relatively uncontaminated area that comprises the west side of upper Lauritzen Channel (Stations UL-10, UL-11, and UL-12) and trends southeast to include the east bank (PL-05, PL-06, and PL-07, Figure 6). One "patch" of high concentrations remains near the outfall at north end (PL-01, PL-02, PL-03, and UL-09). Contaminated sediment was 2 ft to 2.5 ft thick just off the outfall (PL-01, PL-01A), and 0.5-1 ft thick at PL-02, PL-03, and UL-09 (Figure 6). The other "patch" of contaminated YBM was larger and the sediment concentrations somewhat higher, although the highest concentrations were generally associated with a few inches to a foot of YBM. Very high concentrations at BC-18 (average of 181 mg/kg DDT in deep YBM and 54 mg/kg in surface YBM is plotted in Figure 6) and UL-14 (104 ppm DDT in surface YBM) in the middle portion of Lauritzen Channel grade to 20-45 mg/kg in adjacent stations, with what appears to be transport to the south. BC-18 is near what was the offloading zone during remediation; contaminated sediment could also be sloughing from beneath the dock.

The 1999 Sediment Investigation also confirmed that the OBM was uncontaminated except where a few inches of the upper OBM surface appeared disturbed. In cases where the sand layer or disturbed OBM was found to have a DDT concentration above the remediation goal of 590 µg/kg, the thickness of sand or disturbed OBM was included in the contaminated sediment thickness plot in Figure 5 and therefore included in the contaminated sediment volume estimate. The same data used to plot thickness and DDT concentration (Table 11) were used to estimate the contaminated sediment volume. The volume of contaminated sediment was estimated at 12,770 cubic yards (cy) using the volume utility in the Surfer program, which used the thickness data as plotted in Figure 5 to represent the volume between the sediment surface (mudline) and the uncontaminated OBM surface. This estimate is similar to the rough estimate of about 12,000 cy (range 9,000 to 15,000 cy) obtained by averaging the YBM thickness over the surface area of the PL-north, PL-south, UL-, SW-, and BC- subareas of Lauritzen Channel.

4.3 EVALUATION OF CONTAMINANT SOURCES

When the 1999 Sediment Investigation was conceived, sloughing of sediment from between the pilings was believed to be the most probable source of recontamination, because of the difficulty in completely dredging sediment from the pilings during remediation. However, the conclusion from the study data is quite different: the low DDT concentrations in some of the associated samples (PL-05, PL-06, PL-07) do not support of sloughing from the pilings area as a source to other areas of Lauritzen Channel. Although it is possible that contaminated sediment was transported from the pilings area to the locations of current high DDT concentrations, this is unlikely because of the patchiness of the observed high concentrations and the very low concentrations in the supposed source area.

The unusually high DDE concentration relative to total DDT that was found at the north end of Lauritzen in the Year 2 Monitoring study (sampled Nov 1998; Antrim and Kohn 1999) was not repeated in the 1999 Sediment Investigation. The 1999 samples all show the expected low contributions of DDE (<10%) to total DDT (Table 12). The relative contribution of the different isomers shows the degree of degradation, but does not provide additional information for source identification in this case.

Very high concentrations of DDT and other pesticides were associated with creosote-treated pilings near the head of Lauritzen Channel (17+50) and near outfall pipes (15+00). The pilings are unlikely to be a significant source of DDT to the water column or the sediment: the DDT compounds have very high octanol-water partition coefficients (Kow) and very high sediment-water partition coefficients (Koc), meaning the chemical is much more likely to bind with an organic solvent (i.e., the oil in creosote) or organic carbon (organic matter in sediment, wood, or petroleum). Log Kow and log Koc for DDT are 6.19 and 5.39, respectively, indicating that at equilibrium, the concentration associated with organic material should be about a million times greater than the concentration in water. The pilings could contribute to sediment contamination by mechanical weathering or chipping in which broken piling pieces or particles end up in the sediment.

Table 12. Total DDT, Organic-Carbon-Normalized DDT, and Proportion of DDE, DDD, and DDT in Sediment, Heckathorn 1999 Sediment Investigation

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Total DDT (µg/kg dry wt)	DDT (mg/kg OC)	%DDE	%DDD	%DDT	
Between Pilings, northeastern Lauritzen Channel									
PL- 01	7.9	0-2.0	YBM	85040	1149	3.5%	60.6%	36.0%	source ID
PL- 01A	9.9	0-2.3	YBM	NA	NA	NA	NA	NA	
PL- 01A	9.9	2.3-2.5	OBM-dist	NA	NA	NA	NA	NA	
PL- 02	12.9	0-0.5	YBM	37860	533	3.1%	47.8%	49.1%	source ID
PL- 03	12.7	0-1.3	YBM	24199	807	1.9%	87.2%	11.0%	source ID
PL- 03	12.7	1.3-1.7	YBM	NA	NA	NA	NA	NA	
PL- 03	12.7	1.7-2.2	OBM-dist	3519	352	1.7%	92.6%	5.7%	
PL- 05	11.9	0-0.6	YBM	2108	192	9.6%	81.6%	8.8%	source ID
PL- 06	15.9	0-0.2	YBM	3258	1086	6.8%	21.7%	71.5%	
PL- 07	12.0	0.3-1.0	YBM	26.3	1.55	ND	100%	ND	
PL- 7, 6, 5, 4	various	various	OBM comp	69.1	34.6	ND	100%	ND	
PL- 08	21.8	0-0.2	YBM	30060	NA	4.7%	27.7%	67.5%	
PL- 08	21.8	0.2-0.6	OBM-dist	21840	10920	5.1%	28.5%	66.4%	
Upper Lauritzen Channel									
UL- 09	21.1	0-0.9	YBM	45220	3015	5.3%	80.3%	14.4%	
UL- 09	21.1	0.9-1.4	Sand	NA	NA	NA	NA	NA	
UL- 10	19.3	0-1.0	YBM	239	19.9	ND	100%	ND	
UL- 9, 10	various	various	OBM comp	47.3	11.8	ND	100%	ND	
UL- 13	22.9	0-1.1	YBM rocks	8764	4382	2.9%	63.9%	33.2%	
UL- 14	22.8	0-0.3	YBM	104340	9485	1.9%	38.4%	59.7%	
UL- 14	22.8	0.3-0.8	OBM-Dist	NA	NA	NA	NA	NA	
UL- 14,11,12	various	various	OBM comp	NA	NA	NA	NA	NA	

Table 12. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Total DDT (µg/kg dry wt)	DDT (mg/kg OC)	%DDE	%DDD	%DDT
Southwest Lauritzen Channel								
SW- 15	17.0	0-0.5	Sand	5665	2833	3.6%	53.0%	43.4%
SW- 15	17.0	0.5-1.2	OBM-Dist	1036	148	3.0%	47.8%	49.2%
SW- 16	23.8	0-0.5	YBM sandy	43353	6193	2.2%	37.4%	60.4%
SW- 16	23.8	0.5-1.0	OBM	NA	NA	NA	NA	NA
SW- 17	21.8	0-0.8	YBM	20551	2283	3.3%	61.3%	35.4%
SW- 17	21.8	0.8-1.0	OBM	NA	NA	NA	NA	NA
Levin Berths B & C								
BC- 18	38.4	0-0.7	YBM	54130	3609	2.1%	13.1%	84.8%
BC- 18	38.4	0.8-1.3	YBM	180840	15070	1.8%	47.1%	51.1%
BC- 18	38.4	1.3-1.6	OBM	NA	NA	NA	NA	NA
BC- 19	35.4	0-1.2	YBM	42350	2118	2.4%	18.5%	79.1%
BC- 19	35.4	1.4-2.2	YBM	NA	NA	NA	NA	NA
BC- 20	37.4	0-1.6	YBM	NA	NA	NA	NA	NA
BC- 21	39.4	0-1.5	YBM	6770	846	3.2%	50.2%	46.5%
BC- 21,23,24	various	various	OBM comp	551.8	276	NA	NA	NA
BC- 22	39.4	0-1.4	YBM	NA	NA	NA	NA	NA
BC- 23	40.3	0-1.6	YBM	2255.3	161	4.2%	51.4%	44.3%
BC- 24	41.2	0-2.7	YBM	3451	216	4.1%	59.1%	36.8%
Santa Fe Channel								
SF- 28	43.3	approx 0-0.4	YBM	582	36.4	4.9%	44.1%	51.0%
SF- 29	38.5	approx 0-0.5	YBM	NA	NA	NA	NA	NA

Table 12. (cont'd)

Station ID	Mudline (-ft MLLW)	Vertical Segment (ft below mudline)	Sediment Type	Total DDT (µg/kg dry wt)	DDT (mg/kg OC)	%DDE	%DDD	%DDT
<u>Parr Canal</u>								
PC- 25	2.2	0-0.2	YBM	1172	19.2	10.4%	37.1%	52.5%
PC- 25	2.2	0.2-1.1	Sand	NA	NA	NA	NA	NA
PC- 25	2.2	1.1-2.5	YBM	NA	NA	NA	NA	NA
PC- 26	2.1	0-1.0	Sand	NA	NA	NA	NA	NA
PC- 26	2.1	1.0-2.7	YBM	NA	NA	NA	NA	NA
PC- 27	4.4	0.2-0.7	Sand	NA	NA	NA	NA	NA
PC- 27	4.4	0.7-1.5	YBM	825	68.7	8.7%	33.8%	57.5%
Creosoted Piliings								
CR- 30	NA	NA	wood	200530	NA	7.0%	92.3%	0.7%
CR- 31	NA	NA	wood	63200	NA	7.5%	88.4%	4.1%
CR- 32	NA	NA	wood	50340	NA	6.5%	90.8%	2.7%
CR- 33	NA	NA	wood	1720	NA	ND	100%	ND
CR- 34	NA	NA	wood	155350	NA	5.7%	93.3%	0.9%
CR- 35	NA	NA	wood	NA	NA	NA	NA	NA

NA Not applicable; sample not analyzed for pesticides and PCBs (see Table 5 for sample selection rationale).

4.4 CONCLUSIONS

Only minor changes have occurred in Parr Canal since remedial actions taken in 1996-1997. The sand layer appears to be intact and effective in isolating any remaining contaminated YBM. There has been very little deposition of recent YBM on top of the sand layer.

DDT concentrations exceed the remedial goal of 590 µg/kg dry weight in nearly all the surface YBM, sand, and disturbed OBM in Lauritzen Channel. Sediment concentrations greater than 590 µg/kg were first measured in October 1998 by Anderson et al. (2000), confirmed in November 1998 (Antrim and Kohn, 2000b), and verified in detail in the present study. The source of contaminated sediment could not be confirmed by this study; there was no clear correlation between high DDT concentrations and sediment remaining between the pilings, as was originally suspected. There was also no correlation between high DDT concentrations in sediment and the locations of outfalls, although some of the contamination retained by the creosote-treated wood did appear to be highest close to the known outfalls.

5.0 REFERENCES

Anderson. B. S., J. W. Hunt, B. M. Phillips, M. Stoelting, J. Becker, R. Fairey, H. M. Puckett, M. Stephenson, R. S. Tjeerdema, and M. Martin. 2000. "Ecotoxicologic Change at a Remediated Superfund Site in San Francisco, California, USA." *Environmental Toxicology and Chemistry* 19(4): 879-887.

Antrim, L. D., and N. P. Kohn. 2000a. *Post-Remediation Biomonitoring of Pesticides in Marine Waters Near the United Heckathorn Superfund Site, Richmond, California.* PNNL-11911-Rev. 1. Prepared for the U. S. Environmental Protection Agency, Region 9, by Battelle/Marine Sciences Laboratory, Sequim, Washington; published by Pacific Northwest National Laboratory, Richland, Washington.

Antrim, L. D., and N. P. Kohn. 2000b. *Post-Remediation Biomonitoring of Pesticides and Other Contaminants in Marine Waters and Sediment Near the United Heckathorn Superfund Site, Richmond, California.* PNNL-13059-Rev. 1. Prepared for the U. S. Environmental Protection Agency, Region 9, by Battelle/Marine Sciences Laboratory, Sequim, Washington; published by Pacific Northwest National Laboratory, Richland, Washington.

ASTM (American Society for Testing and Materials). 1984. "Standard Practice for Description and Identification of Soils (visual-manual procedure): Procedure D2488-84." American Society for Testing and Materials, Philadelphia, Pennsylvania.

EPA (U. S. Environmental Protection Agency). 1996. *Method 4042 Soil Screening for DDT by Immunoassay (Revision 0, December 1996).* Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. SW-846. U.S. Document No. 955-001-00000, U. S. Environmental Protection Agency, Washington, D.C.

EPA (U. S. Environmental Protection Agency). 1998. *Method 8081b Organochlorine Pesticides by Gas Chromatography (Revision 2, January 1998).* Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. SW-846. U.S. Document No. 955-001-00000, U. S. Environmental Protection Agency, Washington, D.C.

White, P. J., N. P. Kohn, W. W. Gardiner, and J. Q. Word. 1994. *The Remedial Investigation of Marine Sediment at the United Heckathorn Superfund Site.* PNL-9383. Prepared for the U. S. Environmental Protection Agency, Region 9, by Battelle/Marine Sciences Laboratory, Sequim, Washington; published by Pacific Northwest National Laboratory, Richland, Washington.

APPENDIX A

GEOLOGIC CORE DATA LOGS AND CORE PHOTOGRAPHS

KEY TO CORE DATA LOGS

Lithology:

Lithology
Clay
Silty Clay to Clayey Silt
Silt
Clayey Sand
Sandy Silt to Silty Sand
Sand
Pebbles
Mollusc Shells
Concentrated Organic Matter
Root Traces
Gradational Change
Animal Burrows

Dilatancy:
N None
S Slow
R Rapid

Sediment Type:
GW Well-graded gravels, gravel sand mixtures, little or no fines
SW Well-graded sands, gravelly sands, little or no fines
SP Poorly graded sands, gravelly sands, little or no fines
SM Silty sands, sand-silt mixtures
SC Clayey sands, sand-clay mixtures
ML Silts, very fine sands, silty or clayey fine sands, or clayey silts, with slight plasticity
CL Clays of low to medium plasticity, gravelly clays, sandy or silty clays, lean clays
MH Silts or fine sandy silts with moderate plasticity
CH Clays of high plasticity, fat clays

Color (wet):
Selected from Munsell Soil Color Chart

Consistency:
H Hard
F Firm
S Soft
VS Very Soft

Cementation:
N Not cemented
W Weakly cemented
M Moderately cemented
S Strongly cemented

Structure:
S Stratified
L Laminated
F Fissured
SL Slickensided
Ln Lensed
Bl Blocky
M Mottled
H Homogeneous

HCl Reaction:
N None
W Weak
S Strong

Maximum Particle Size:
P Pebble
G Granule
VCS Very coarse sand
CS Coarse sand
MS Medium sand
FS Fine sand
VFS Very fine sand
Z silt

Odor:
N None
S Sulfide
HC Hydrocarbon
O Other
w/HCl Odor apparent after HCl application

0' - 2.0'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION   Logged By: S. GOODWIN   Core ID: PL - 01

Project Number: 20212   Date: 8/5/99   Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-7.9	0		R	CL	N 2.5/ BLACK	VS	N	H	N	FS	HC S w/ HC		YBM SHELLS WOOD FRAG. OILY SHEEN STAIN HC ODOR
	.5												
	1.0											47	
	1.5												X = PLASTIC SHEETING
										CP			
-9.9	2.0												
-10.4	2.5												

0' – 2.5'

CORE DATA LOG

Project Name: Heckathorn 1999 Sediment Investigation | Logged By: S. Goodwin | Core ID: PL-01A

Project Number: 20212 | Date: 8/5/99 | Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-9.9	0		R	CL	N 2.5/ Black	VS	N	H	N	FS	HC S w/ Hd	45	YBM Strong HC odor Oily sheen Shells & wood; Black garbage bag?; Tape electrical?
	1.0			SW						MS			Sand lens 1.0 – 1.2'
				CL						FS			Foam rubber; Hard plastic; Tape electrical?
	2.3		S		10Y 3/1 Dark green. gray	S				FP	SL. HC	46	2.3 Disturbed OBM soft, some YBM mottles
-12.4	2.5												

0' – 0.5'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION	Logged By: S. GOODWIN	Core ID: PL-02
Project Number: 20212	Date: 8/5/99	Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-12.9	0	C	R	CL	N 2.5/ BLACK	VS	N	H	N	FS	HC / S / SHELL	44	Y&M SHELL GRAVEL HC / WOOD FRAG.
-13.4	.5												.5
	1.0												
	1.5												
	2.0												
	2.5												

0' - 2.2'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: PL-03

Project Number: 20212 Date: 8/5/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-12.7	0 – 1.3		R	CL	N 2.5/ Black	VS	N	H	N	FS	HC O	41	4BM Shells; Strong HC odor; Oily sheen
	1.3 – 1.7			OL/OH w/ CL	10YR 3/2 V. Dark Gray. Brn.					FS	HC	42	1.3 Organic mat: twigs, etc. Strong odor – "moth balls"? (creosote?
-14.9	1.7 – 2.2		S	CL	10Y 3/1 D. Green Gray.			S		FP		43	1.7 Disturbed OBM "Clay balls" Trace wood fiber
	2.2												2.2 Firmer @ bottom of core
	2.5												

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: PL-04

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-12.6	0		R	CL	N 2.5/ BLACK	VS	N	H	N	VCP FS	HC S W/H2		4BM; SHELLS/GRAVEL @ TOP; WORM (LIVE); GRAVEL = UP TO VCP/NA WASHED IN?
	.5												
			S		5GY 4/1	F					N	3B	0.6 OBM ROOTLETS; OBM COMPOSITE
-13.5					D. GREEN GRAY								0.9
	1.0												
	1.5												0 – 0.6': DETERMINED ON 8/5/99 THAT NO SAMPLE WAS TAKEN.

0' - 0.8'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. Goodwin Core ID: PL-05

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-11.9	0		R	LL	N 2.5/ BLACK	VS	N	H	N	FS	S w/ HCL	40		4BM
	0.5												0.6
-12.6			S		10GY 4/1 D. Greenish Gray.	F					N	38	0.7	OBM 38 comp.
	1.0												
	1.5												

CORE DATA LOG

Project Name: Heckathorn · 1999 Sediment Investigation Logged By: S. Goodwin Core ID: PL-06

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-15.9	0		S	CL	N 2.5/ w 10YR 4/4	F	N	M	N	VCP	S w/ HCL	39	Rootlets 4BM Mottled OBM w/ 4BM
													0.2
				SC	10YR 4/4			H		FS	N	38	OBM
-16.3													0.4
	0.5												
													N 2.5/ = Black
													10 GY 4/1 = Dark Greenish Gray
	1.0												10 YR 4/4 = Dark Yellowish Brown

0' - 1.1'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION | Logged By: S. Goodwin | Core ID: PL - 07

Project Number: 20212 | Date: 8/4/99 | Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-12.0	0		S	CL	N 2.5/ BLACK	S	N	H	N	VCP FS	N	37	YBM ORGANICS; CP (VA) @ TOP WASHED IN?
	.5												
-13.1	1.0				10GY 4/1 DARK GREEN GRAY	F						38	1.0 OBM 38 COMP.; 1.1
	1.5												
	2.0												

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: PL-08

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-21.8	0		R	CL w/G	10Y 3/2	S	N	H	N	VCP	N	35	UBM SHELLS ANGULAR PEBBLES
			S	SC/GC	10Y 3/2 w/ 10YR 4/4	F		M				36	0.2 OBM CLAY BALLS DISTURBED OBM DREDGED MATERIAL? REDEPOSITED?
-22.4	.5												0.6
	1.0												YBM CONTAM. OBM – .2 – .6
													YBM: RAN ALONG SIDES OF CORE LINER TO BOTTOM OF CORE
	1.5												
	2.0												
	2.5												

0' - 2.0'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: UL - 9

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-21.1	0 – 0.9	C	R	CL	N 2.5/ BLACK	VS	N	H	N	FS	HC S H/HC	32	YBM; WOOD
	0.9 – 1.4			SP		S				MS		33	0.9 SAND CAP BROWN SHELLS; OBM CLAY CLAST
	1.4 – 2.0		S	SC	10YR 4/4 w/ 5GY 4/1	F		M		SP	N	34	1.4 OBM; OBM MOTTLED w/ YBM & SAND FILL WASH; UL-10 & UL-9 COMP.
-23.1	2.0												

Depth scale (ft below mudline): 0, .5, 1.0, 1.5, 2.0, 2.5, 3.0

10 YR 4/4 w/ 5 GY 4/1 = DARK YELLOWISH BROWN w/ DARK GREENISH GRAY.

0' – 1.1'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: UL-10

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-19.3'	0		S	CL	N 3/	VS	N	H	N	FS	S HC w/ HCL	30	HBM; SLIGHT HC ODOR; ORGANICS
	.5		R	SP		S							SAND CAP @ 0.6' Bnrrow SHELLS
-20.4	1.0		S	CL	10GY 4/1	F					N	1.0 / 1.1	OBM
	1.5												
	2.0												
	2.5												
	3.0												

0' - 0.5'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: UL-11

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-22.4'	0		S	SC	10YR 4/4 (DARK YELLOWISH BROWN)	F	N	H	N	MP	N	2B	OBM; OCCASIONAL PEBBLES; OBM COMPOSITE
-22.9	.5												
													SAMPLE FROM JAR
	1.0												

0'- 1.0'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: UL - 12

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-15.3	0		S	SC	10YR 4/4	F	N	H	N	FS	N		OBM Shell YBM INTERMIXED
YBM 10Y 4/1	.5											28	YBM = 10Y 4/1 (D. GREEN. GRAY)
													UL-14, 11, 12 COMP
-16.3	1.0				DARK YELLOW. BROWN								YBM, CONTAM. IN OBM DRILLING INDUCED ALONG SIDES OF LEXAN
	1.5												OBM IN GLASS JAR

0' – 1.1'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: VL-13

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-22.9	0		R	CL GC	10Y 3/1 D. Green. Gray	VS F	N	H	N	MS VCP?	Ac	31	YBM OBM "Clay Balls" Shell; Pebbles up to VCP VA – SR
-24.0	1.0	OBC		GC	10YR 4/4 D. Yellow. Brown						N?		1.1 Disturbed OBM? Wood
	1.5												
	2.0												

0' - 2.0'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: UL - 14

Project Number: 20212 Date: 8/4/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-22.8'	0		R	CL	N 2.5/	VS	N	M	N	FS	S w/ HCL	27	4BM GRADATIONAL COLOR Δ
	0.3			SC	5GY 4/1	S					N	28	0.3 INTERMIXED 4BM/OBM OBM GRADATIONAL COLOR Δ
	0.8				10YR 4/4	F		H					0.8 28 = OBM COMPOSITE
	1.0											28	
	1.5												
-24.8'	2.0												
	2.5												
	3.0												

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: SW-15 REP. 2

Project Number: 20212 Date: 8/3/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-17.0	0		R	SP	2.5Y 3/2 V.D GRAY. BRN.	F	N	H	N	MS LP SP MS	N	10	BROKEN SHELLS SAND CAP; VA LARGE PEBBLE
	.5		S	CL	N 2.5/ w/ 10Y 3/1	S	N S N	M	N S N	FS	S w/HCL	11	0.5'; FS STRINGERS; OBM? (INTERMIXED); CEMENTED CLAY CLAST ST. RX TO HCL; 1.2'
-18.2	1.0												
	1.5				BLACK w/ DARK GREEN. GRAY.								
	2.0												
	2.5												
	3.0												

0' – 1.0'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION | Logged By: S. Goodwin | Core ID: SW-16

Project Number: 20212 | Date: 8/3/99 | Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-23.8'	0		R	CL	10Y 3/1, N 2.5/, 10Y 3/1	VS	N	M	N	MS	SL HC & H2S	12	Broken Shell Frags. Sandy @ Top. YBM: N 2.5/ Black; 10Y 3/1 D. Green. Gray
	0.5			SC	10YR 4/4	F					N	13	OBM: Grain D Gradational. Decrease in clay ⊥
-24.8'	1.0				D. Yellow Band.								
	1.5												
	2.0												
	2.5												
	3.0												

0' - 1.0'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: SW - 17

Project Number: 20212 Date: 8/3/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-21.8'	0		R	CL	10Y 2.5/1 N 2.5/ Black	VS	N	H	N	FS	Hc S H	14	4BM 10Y 2.5/1 = Green. Black
	0.5												
-22.8'	1.0		S	SC	5GY 4/1 D. Green. Gray	F					N	15	0BM
	1.5												
	2.0												
	2.5												
	3.0												

0'-1.6'

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: BC-18

Project Number: 20212 Date: 8/3/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-38.4'	0		R	CL	N 2.5/ Black	VS	N	H	N	FS	HCS / H HCS	16	4BM
	0.5												
	0.7			SP	10Y 3/1	F					N N		0.7 Shell Fracs. Sand Fill (Wash?) 0.8
	0.8			CL	N 2.5/ Black	VS					S w/ HCS	17	4BM 10Y 3/1 = D. Greenish Gray
	1.0												
	1.3		S		5GY 4/1 D. Green. Gray	F					N	18	Oyster shells; 1.3 OBM Gas Vesicles
-40.0	1.5												1.6
	2.0												
	2.5												
	3.0												

CORE DATA LOG

Project Name: HECKATHORN · 1999 SEDIMENT INVESTIGATION Logged By: S. GOODWIN Core ID: BC-19

Project Number: 20212 Date: 8/3/99 Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-35.4'	0 – 1.2		R	CL	10Y 3/1 … N 2.5/ BLACK	VS	N	H	N	CP MS	H+	19	MOLLUSC SHELLS (WHITE) VA CP; 10Y 3/1 = D. GREENISH GRAY
	1.2 – 1.35			SP	10Y 3/1	F							BROKEN SHELLS — SAND FILL
-37.6'	1.35 – 2.2		S	CL	N 2.5/ BLACK	S				CP		20	RANDOM VA PEBBLES UP TO CP; "CLAY BALLS" - OBM; CLAY BALLS = 5GY 4/1 D. GREEN. GRAY

Depth scale (ft): 0, .5, 1.0, 1.5, 2.0, 2.5, 3.0

APPENDIX B

ANALYTICAL CHEMISTRY AND QUALITY CONTROL DATA

Cross-Reference for Laboratory and Field Sample Identifiers, in order of Laboratory Sample ID, Heckathorn 1999 Sediment Investigation

SubArea	Laboratory Sample ID	Field Station ID	Mudline (-ft MLLW)	Vertical Segment (ft)	Sediment Type
Parr Canal	HECK-99-01	PC-27	4.4	0-0.2	YBM
Parr Canal	HECK-99-02	PC-27	4.4	0.2-0.7	Sand
Parr Canal	HECK-99-03	PC-27	4.4	0.7-1.5	YBM
Parr Canal	HECK-99-04	PC-27	4.4	1.5-1.6	OBM
Parr Canal	HECK-99-05	PC-26	2.1	0-1.0	Sand
Parr Canal	HECK-99-06	PC-26	2.1	1.0-2.7	YBM
Parr Canal	HECK-99-07	PC-25	2.2	0-0.2	YBM
Parr Canal	HECK-99-08	PC-25	2.2	0.2-1.1	Sand
Parr Canal	HECK-99-09	PC-25	2.2	1.1-2.5	YBM
Southwest LC	HECK-99-10	SW-15	17.0	0-0.5	Sand
Southwest LC	HECK-99-11	SW-15	17.0	0.5-1.2	OBM-Dist
Southwest LC	HECK-99-12	SW-16	23.8	0-0.5	YBM
Southwest LC	HECK-99-13	SW-16	23.8	0.5-1.0	OBM
Southwest LC	HECK-99-14	SW-17	21.8	0-0.8	YBM
Southwest LC	HECK-99-15	SW-17	21.8	0.8-1.0	OBM
Levin Berth B,C	HECK-99-16	BC-18	38.4	0-0.7	YBM
Levin Berth B,C	NA	BC-18	38.4	0.7-0.8	Sand
Levin Berth B,C	HECK-99-17	BC-18	38.4	0.8-1.3	YBM
Levin Berth B,C	HECK-99-18	BC-18	38.4	1.3-1.6	OBM
Levin Berth B,C	HECK-99-19	BC-19	35.4	0-1.2	YBM
Levin Berth B,C	NA	BC-19	35.4	1.2-1.4	Sand
Levin Berth B,C	HECK-99-20	BC-19	35.4	1.4-2.2	YBM
Levin Berth B,C	HECK-99-21	BC-20	37.4	0-1.6	YBM
Levin Berth B,C	HECK-99-22	BC-21	39.4	0-1.5	YBM
Levin Berth B,C	HECK-99-23	BC-21	39.4	1.5-1.7	OBM
Levin Berth B,C	HECK-99-23	BC-23	39.4	1.6-1.7	OBM
Levin Berth B,C	HECK-99-23	BC-24	39.4	27.-2.8	OBM
Levin Berth B,C	HECK-99-24	BC-22	39.4	0-1.4	YBM
Levin Berth B,C	HECK-99-25	BC-23	40.3	0-1.6	YBM
Levin Berth B,C	HECK-99-26	BC-24	41.2	0-2.7	YBM
Upper LC	HECK-99-27	UL-14	22.8	0-0.3	YBM
Upper LC	HECK-99-28	UL-11	22.4	0-0.5 approx	OBM
Upper LC	HECK-99-28	UL-12	15.3	0-1.0	OBM
Upper LC	HECK-99-28	UL-14	22.9	0.8-2.0	OBM
Upper LC	HECK-99-29	UL-14	22.8	0.3-0.8	OBM-Dist

SubArea	Laboratory Sample ID	Field Station ID	Mudline (-ft MLLW)	Vertical Segment (ft)	Sediment Type
Upper LC	HECK-99-30	UL-10	19.3	0-1.0	YBM
Upper LC	HECK-99-31	UL-13	22.9	0-1.1	YBM
Upper LC	HECK-99-32	UL-09	21.1	0-0.9	YBM
Upper LC	HECK-99-33	UL-09	21.1	0.9-1.4	Sand
Upper LC	HECK-99-34	UL-09	21.1	1.4-2.0	OBM
Upper LC	HECK-99-34	UL-10	19.3	1.0-1.1	OBM
Pilings	HECK-99-35	PL-08	21.8	0-0.2	YBM
Pilings	HECK-99-36	PL-08	21.8	0.2-0.6	YBM
Pilings	HECK-99-37	PL-07	12.0	0.3-1.0	YBM
Pilings	NA	PL-04	12.6	0-0.6	YBM
Pilings	HECK-99-38	PL-04	15.9	0.6-0.9	OBM
Pilings	HECK-99-38	PL-05	15.9	0.6-0.7	OBM
Pilings	HECK-99-38	PL-06	15.9	0.2-0.4	OBM
Pilings	NA	PL-07	12.0	0-0.3	Rocks
Pilings	HECK-99-38	PL-07	15.9	1.0-1.1	OBM
Pilings	HECK-99-39	PL-06	15.9	0-0.2	OBM
Pilings	HECK-99-40	PL-05	11.9	0-0.6	YBM
Pilings	HECK-99-41	PL-03	12.7	0-1.3	YBM
Pilings	HECK-99-42	PL-03	12.7	1.3-1.7	YBM
Pilings	HECK-99-43	PL-03	12.7	1.7-2.2	YBM
Pilings	HECK-99-44	PL-02	12.9	0-0.5	YBM
Pilings	HECK-99-45	PL-01A	9.9	0-2.3	YBM
Pilings	HECK-99-46	PL-01A	9.9	2.3-2.5	OBM-dist
Pilings	HECK-99-47	PL-01	7.9	0-2.0	YBM
Santa Fe Channel	HECK-99-48	SF-28	43.3	approx 0-0.4	YBM
Santa Fe Channel	HECK-99-49	SF-29	38.5	approx 0-0.5	YBM
Creosote on Piling	HECK-99-CR-30	CR-30	NA	NA	wood
Creosote on Piling	HECK-99-CR-31	CR-31	NA	NA	wood
Creosote on Piling	HECK-99-CR-32	CR-32	NA	NA	wood
Creosote on Piling	HECK-99-CR-33	CR-33	NA	NA	wood
Creosote on Piling	HECK-99-CR-34	CR-34	NA	NA	wood
Creosote on Piling	HECK-99-CR-35	CR-35	NA	NA	wood

CONFIRMATORY PESTICIDE & PCB ANALYSIS

1392 Bat 1 NK org lab 223

Battelle
Pacific Northwest Division
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

SAMPLE CUSTODY RECORD

Date 8/25/99 Page 1 of 2

Project No. 20212
Project Name Heckathorn 1999 Sediment Investigation
Project Manager Nancy Kohn Phone 360 681 3687

Lab Battelle MSL
Address Sequim, WA
Attention Tim Foreman

Lab No.	Sample No.	Collection Date	Matrix	Pesticides/PCBs (Testing Parameters)	No. of Containers	Observations, Instructions
1392* 1	HECK99-PEST-01	8-3-99	Marine	✓	1	
2	-07		Sediment	✓	1	
3	-10			✓	1	
4	-11			✓	1	
5	-12			✓	1	
6	-14			✓	1	
7	-16			✓	1	QC for each batch
8	-17			✓	1	Blank
9	-19			✓	1	MS/MSD
10	-22	8/4/99		✓	1	Sample dup
11	-23			✓	1	SRM
12	-25			✓	1	
13	-26			✓	1	
14	-27			✓	1	
15	-30			✓	1	
16	-31			✓	1	
17	-32			✓	1	
18	-34			✓	1	
19	-35			✓	1	
20	-36			✓	1	
21	-37			✓	1	
22	-38			✓	1	(34) total samples
23	-39			✓	1	
1392*24	-40			✓	1	24 this page

Relinquished by: [signature] 8/25/99 0938
Signature Date Time
NANCY KOHN
Printed Name
BATTELLE MSL
Company

Received by: [signature] 08/25/99 0938
Signature Date Time
M L F McEahen
Printed Name
MSL
Company

Total No. of Containers

Shipment Method:

Special Requirements or Comments: Good Samples for QC: 48 (1 of 1), 23, possibly 30

Relinquished by:
Signature Date Time
Printed Name
Company

Received by:
Signature Date Time
Printed Name
Company

DISTRIBUTION:
1. Provide white and yellow copies to the Laboratory
2. Return pink copy to Project file or to project manager.
3. Laboratory to return signed white copy t Battelle for project files

BC-1800-192 (07/94)

1392 Bat I NK org lab 223

SAMPLE CUSTODY RECORD

Date 8/25/99 Page 2 of 2

Battelle
Pacific Northwest Division
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

Project No. 20212
Project Name Heckathorn 1999 Sediment Investigation
Project Manager N P Kohn Phone 360 681 3687

Lab Battelle MSL
Address Sequim, WA
Attention Tim Fortman

Testing Parameters

Lab No.	Sample No.	Collection Date	Matrix	BT/PCB						No. of Containers	Observations, Instructions
1392-25	HECK99-PEST-41	8/5/99	Marine Sediment	✓						1	
26	-43	↓	↓	✓						1	
27	-44			✓						1	
28	-47			✓						1	
29	-48 (1 of 2)			✓						1	note: -48 2 of 2 is not part of this shipment
30	HECK99-CR-30		Creosoted Wood	✓						1	
31	HECK99-CR-31			✓						1	
32	HECK99-CR-32			✓						1	
33	HECK99-CR-33	7/29/99		✓						1	
1392-34	HECK99-CR-34		↓	✓						1	

34 total

Relinquished by: [signature] 8/25/99 0938
Signature Date Time
NANCY KOHN
Printed Name
BATTELLE MSL
Company

Received by: [signature] 08/25/99 0938
Signature Date Time
[illegible]
Printed Name
MSL
Company

10 this page Total No. of Containers

Shipment Method:

Special Requirements or Comments:

Relinquished by:
Signature Date Time
Printed Name
Company

Received by:
Signature Date Time
Printed Name
Company

DISTRIBUTION:

1. Provide white and yellow copies to the Laboratory
2. Return pink copy to Project file or to project manager.
3. Laboratory to return signed white copy to Battelle for project files

BC-1800-192 (07/94)

cc: Project Manager/Central File
Login File 1392

SAMPLE LOGIN

Project Manager: KOHN
Date Received: 8/25/99
Batch: 1

PROJECT: HECKATHORN 1999 SEDIMENT INVESTAGATION

SPONSOR CODE	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
HECK99-PEST-01	1392-1	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-07	1392-2	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-10	1392-3	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-11	1392-4	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-12	1392-5	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-14	1392-6	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-16	1392-7	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-17	1392-8	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-19	1392-9	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/3/99	MLFM
HECK99-PEST-22	1392-10	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-23	1392-11	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-25	1392-12	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-26	1392-13	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-27	1392-14	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-30	1392-15	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-31	1392-16	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-32	1392-17	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-34	1392-18	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-35	1392-19	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-36	1392-20	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-37	1392-21	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM

Comments:

cc: Project Manager/Central File
Login File 1392

SAMPLE LOGIN

Project Manager: KOHN
Date Received: 8/25/99
Batch: 1

PROJECT: HECKATHORN 1999 SEDIMENT INVESTAGATION

SPONSOR CODE	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
HECK99-PEST-38	1392-22	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-39	1392-23	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-40	1392-24	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/4/99	MLFM
HECK99-PEST-41	1392-25	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/5/99	MLFM
HECK99-PEST-43	1392-26	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/5/99	MLFM
HECK99-PEST-44	1392-27	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/5/99	MLFM
HECK99-PEST-47	1392-28	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/5/99	MLFM
HECK99-PEST-48 1 of	1392-29	SEDIMENT	ORG. LAB FRIG. 5	PEST. / PCB'S	8/5/99	MLFM
HECK99-CR-30	1392-30	WOOD	ORG. LAB FRIG. 5	PEST. / PCB'S	7/29/99	MLFM
HECK99-CR-31	1392-31	WOOD	ORG. LAB FRIG. 5	PEST. / PCB'S	7/29/99	MLFM
HECK99-CR-32	1392-32	WOOD	ORG. LAB FRIG. 5	PEST. / PCB'S	7/29/99	MLFM
HECK99-CR-33	1392-33	WOOD	ORG. LAB FRIG. 5	PEST. / PCB'S	7/29/99	MLFM
HECK99-CR-34	1392-34	WOOD	ORG. LAB FRIG. 5	PEST. / PCB'S	7/29/99	MLFM

B.6

Comments:

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediments
Samples Received 8/25/99

MSL Code	1392-1	1392-2	1392-3	1392-4	1392-5	1392-6
SPONSOR ID	HECK99-01	HECK99-07	HECK99-10	HECK99-11	HECK99-12	HECK99-14
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Extract Date	09/02/1999	09/02/1999	09/02/1999	09/02/1999	09/02/1999	09/02/1999
Analysis Date	10/04/1999	10/04/1999	10/04/1999	10/04/1999	10/04/1999	10/04/1999
Analytical Batch	1	1	1	1	1	1
Wet Wt (g)	10.4	10.0	10.2	10.1	10.7	10.2
Percent WW	37.5	45.0	20.2	29.1	31.0	41.6
Analytical Rep	1	1	1	1	1	1
Units (dw)	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
A-BHC	30.9 U	36.3 U	24.5 U	27.9 U	37.0	33.7 U
B-BHC	30.9 U	36.3 U	24.5 U	27.9 U	27.0 U	33.7 U
G-BHC	21.3 U	25.1 U	17.0 U	19.3 U	18.7 U	23.3 U
D-BHC	30..9 U	36.3 U	24.5 U	27.9 U	28.0	33.7 U
HEPTACLOR	6.42 U	7.53 U	5.1 U	5.8 U	5.61 U	7.00 U
ALDRIN	20.8 U	24.4 U	16.5 U	18.8 U	101	97.0
HEPT EPOXIDE	30.3 U	35.5 U	24.0 U	27.4 U	26.5 U	33.0 U
g CHLORDANE	30.9 U	36.3 U	24.5 U	27.9 U	27.0 U	38.1
ENDO I	30.9 U	36.3 U	24.5 U	27.9 U	55.0	44.2
a CHLORDANE	49.6 U	58.3 U	39.4 U	44.9 U	43.4 U	54.1 U
DIELDRIN	20.3 U	85.1	217	45.6	887	701
4,4' -DDE	71.7	122	205	31.1	953	681
ENDRIN	30.9 U	36.3 U	24.5 U	27.9 U	27.0 U	33.7 U
ENDO II	30.9 U	36.3 U	24.5 U	27.9 U	27.0 U	33.7 U
4,4' -DDD	279	435	3000 D10	495	16200 D20	12600 D20
ENDRIN. ALDY.	30.9 U	36.3 U	24.5 U	27.9 U	27.0 U	33.7 U
ENDO SULFATE	30.9 U	36.3 U	24.5 U	27.9 U	27.0 U	33.7 U
4,4' -DDT	474	615	2460 D10	510	26200 D20	7270 D20
Toxaphene	282 U	282 U	282 U	282 U	282 U	282 U
Aroclor 1242	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1248	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1254	316 U	316 U	**10700**	316 U	316 U	316 U
Aroclor 1260	316 U	316 U	316 U	316 U	316 U	316 U
Surrogate Recoveries (%)						
PCB-103	75.2	77.7	79.1	80.6	74.8	78.5
PCB-198	79.4	77.2	80.2	83.8	78.1	78.4
PCB-198 (Dil)			95.4		94.2	95.9

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
* Outside SIS recovery limits
See narrative.

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediments
Samples Received 8/25/99

MSL Code	1392-7	1392-8	1392-9	1392-10	1392-11	1392-12
SPONSOR ID	HECK99-16	HECK99-17	HECK99-19	HECK99-22	HECK99-23	HECK99-25
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Extract Date	09/02/1999	09/02/1999	09/02/1999	09/02/1999	09/02/1999	09/02/1999
Analysis Date	10/04/1999	10/04/1999	10/04/1999	10/04/1999	10/04/1999	10/04/1999
Analytical Batch	1	1	1	1	1	1
Wet Wt (g)	10.2	10.4	10.4	10.2	10.6	10.3
Percent WW	53.7	46.4	49.1	46.6	25.7	57.3
Analytical Rep	1	1	1	1	1	1
Units (dw)	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
A-BHC	42.5 U	74.4	37.7 U	36.6 U	25.4 U	45.3 U
B-BHC	42.5 U	35.9 U	37.7 U	36.6 U	25.4 U	45.3 U
G-BHC	29.4 U	24.8 U	26.0 U	25.3 U	17.6 U	31.3 U
D-BHC	42.5 U	70.9	37.7 U	36.6 U	25.4 U	45.3 U
HEPTACLOR	8.83 U	7.45 U	7.83 U	7.60 U	5.28 U	9.41 U
ALDRIN	81.8	3210	56.0	27.0	17.1 U	30.4 U
HEPT EPOXIDE	41.6 U	35.2 U	36.9 U	35.9 U	24.9 U	44.4 U
g CHLORDANE	42.5 U	158	37.7 U	36.6 U	25.4 U	45.3 U
ENDO I	57.4	190	51.3	36.6 U	25.4 U	45.3 U
a CHLORDANE	68.3 U	142	60.6 U	58.8 U	40.8 U	72.8 U
DIELDRIN	881	3400	531	193	16.7 U	90.9
4,4' -DDE	1150	3240 D20	1030	220	14.8	95.3
ENDRIN	42.5 U	35.9 U	37.7 U	36.6 U	25.4 U	45.3 U
ENDO II	42.5 U	35.9 U	37.7 U	36.6 U	25.4 U	45.3 U
4,4' -DDD	7080 D20	85200 D20	7820 D20	3400 D10	343	1160
ENDRIN. ALDY.	42.5 U	35.9 U	37.7 U	36.6 U	25.4 U	45.3 U
ENDO SULFATE	42.5 U	35.9 U	37.7 U	36.6 U	25.4 U	45.3 U
4,4' -DDT	45900 D20	92400 D100	33500 D20	3150 D10	194	1000
Toxaphene	282 U	282 U	282 U	282 U	282 U	282 U
Aroclor 1242	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1248	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1254	**23800**	316 U	**14000**	**11400**	**1220**	316 U
Aroclor 1260	316 U	316 U	316 U	316 U	316 U	316 U
Surrogate Recoveries (%)						
PCB-103	85.2	83.7	85.1	85.8	85.0	82.8
PCB-198	84.9	87.7	88.1	82.9	86.6	85.9
PCB-198 (Dil)	98.3	96.3	98.7	94.8		

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
* Outside SIS recovery limits
See narrative.

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediments
Samples Received 8/25/99

MSL Code	1392-13	1392-14	1392-15	1392-16	1392-17	1392-18
SPONSOR ID	HECK99-26	HECK99-27	HECK99-30	HECK99-31	HECK99-32	HECK99-34
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Extract Date	09/02/1999	09/02/1999	09/02/1999	09/02/1999	09/02/1999	09/20/1999
Analysis Date	10/04/1999	10/04/1999	10/04/1999	10/04/1999	10/04/1999	10/08/1999
Analytical Batch	1	1	1	1	1	2
Wet Wt (g)	10.3	10.1	10.2	11.0	10.1	10.3
Percent WW	53.5	42.3	41.9	16.9	46.9	26.2
Analytical Rep	1	1	1	1	1	1
Units (dw)	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
A-BHC	41.9 U	89.6	33.6 U	21.9 U	37.3 U	26.4 U
B-BHC	41.9 U	43.2	33.6 U	21.9 U	37.3 U	26.4 U
G-BHC	28.9 U	23.8 U	23.2 U	15.1 U	25.8 U	18.3 U
D-BHC	41.9 U	64.3	33.6 U	21.9 U	37.3 U	26.4 U
HEPTACLOR	8.70 U	7.17 U	6.99 U	4.55 U	7.76 U	5.49 U
ALDRIN	28.2 U	305	22.6 U	94.1	93.2	17.8 U
HEPT EPOXIDE	41.0 U	33.8 U	33.0 U	21.5 U	36.6 U	25.9 U
g CHLORDANE	41.9 U	82.4	33.6 U	21.9 U	197	26.4 U
ENDO I	41.9 U	99.3	33.6 U	21.9 U	139	26.4 U
a CHLORDANE	67.3 U	55.4 U	54.1 U	35.2 U	110	42.5 U
DIELDRIN	132	3000	22.2 U	317	1910	17.4 U
4,4'-DDE	141	1940	15.4 U	254	2410 D10	12.1 U
ENDRIN	41.9 U	34.5 U	33.6 U	21.9 U	37.3 U	26.4 U
ENDO II	41.9 U	34.5 U	33.6 U	21.9 U	37.3 U	26.4 U
4,4'-DDD	2040	40100 D100	239	5600 D10	36300 D10	47.3
ENDRIN. ALDY.	41.9 U	34.5 U	33.6 U	21.9 U	37.3 U	26.4 U
ENDO SULFATE	41.9 U	34.5 U	33.6 U	21.9 U	37.3 U	26.4 U
4,4'-DDT	1270	62300 D100	78.9 U	2910 D10	6510 D10	62.0 U
Toxaphene	282 U	282 U	282 U	282 U	282 U	282 U
Aroclor 1242	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1248	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1254	**6330**	316 U	316 U	316 U	**3020**	316 U
Aroclor 1260	316 U	316 U	316 U	316 U	316 U	316 U
Surrogate Recoveries (%)						
PCB-103	86.8	82.8	84.6	91.0	80.9	82.9
PCB-198	95.2	83.8	91.8	89.9	84.1	72.4
PCB-198 (Dil)		102		96.1	87.2	

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
* Outside SIS recovery limits
See narrative.

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediments
Samples Received 8/25/99

MSL Code	1392-19	1392-20	1392-21	1392-22	1392-23	1392-24
SPONSOR ID	HECK99-35	HECK99-36	HECK99-37	HECK99-38	HECK99-39	HECK99-40
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Extract Date	09/20/1999	09/20/1999	09/20/1999	09/20/1999	09/20/1999	09/20/1999
Analysis Date	10/08/1999	10/08/1999	10/08/1999	10/08/1999	10/08/1999	10/08/1999
Analytical Batch	2	2	2	2	2	2
Wet Wt (g)	10.2	10.2	10.4	10.3	10.9	10.2
Percent WW	28.0	8.94	30.3	26.9	21.7	45.1
Analytical Rep	1	1	1	1	1	1
Units (dw)	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
A-BHC	32.8	21.5 U	27.5 U	26.7 U	23.4 U	35.9 U
B-BHC	32.1	21.5 U	27.5 U	26.7 U	23.4 U	35.9 U
G-BHC	18.8 U	14.9 U	19.0 U	18.4 U	16.2 U	24.8 U
D-BHC	27.2 U	21.5 U	27.5 U	26.7 U	23.4 U	35.9 U
HEPTACLOR	32.6	10.1	5.72 U	5.54 U	50.3	7.45 U
ALDRIN	487	190	18.5 U	17.9 U	68.7	24.1 U
HEPT EPOXIDE	26.7 U	21.1 U	27.0 U	26.1 U	22.9 U	35.2 U
g CHLORDANE	385	194	27.5 U	26.7 U	23.4 U	35.9 U
ENDO I	82.8	68.1	27.5 U	26.7 U	34.0	35.9 U
a CHLORDANE	389	212	44.2 U	42.8 U	71.4	57.0 U
DIELDRIN	2590 D40	1650	18.1 U	17.6 U	272	107
4,4' -DDE	1420	1110	12.6 U	12.2 U	220	202
ENDRIN	768 D40	21.5 U	27.5 U	26.7 U	495	35.9 U
ENDO II	27.2 U	21.5 U	27.5 U	26.7 U	23.4 U	35.9 U
4,4' -DDD	8340 D40	6230 D40	26.3	69.1	708	1720
ENDRIN. ALDY.	27.2 U	21.5 U	27.5 U	26.7 U	23.4 U	35.9 U
ENDO SULFATE	27.2 U	21.5 U	27.5 U	26.7 U	23.4 U	35.9 U
4,4' -DDT	20300 D40	14500 D40	64.6 U	62.5 U	2330	186
Toxaphene	282 U	282 U	282 U	282 U	282 U	282 U
Aroclor 1242	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1248	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1254	316 U	316 U	316 U	316 U	316 U	316 U
Aroclor 1260	316 U	316 U	316 U	316 U	316 U	316 U
Surrogate Recoveries (%)						
PCB-103	86.5	91.9	82.5	84.9	92.2	92.0
PCB-198	75.1	78.6	73.3	73.8	78.0	81.7
PCB-198 (Dil)	113	107				

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
* Outside SIS recovery limits
See narrative.

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediments
Samples Received 8/25/99

MSL Code	1392-25	1392-26	1392-27	1392-28	1392-29
SPONSOR ID	HECK99-41	HECK99-43	HECK99-44	HECK99-47	HECK99-48
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Extract Date	09/20/1999	09/20/1999	09/20/1999	09/20/1999	09/20/1999
Analysis Date	10/08/1999	10/08/1999	10/08/1999	10/08/1999	10/08/1999
Analytical Batch	2	2	2	2	2
Wet Wt (g)	10.4	11.0	10.4	10.8	10.6
Percent WW	52.6	31.5	54.7	55.0	65.3
Analytical Rep	1	1	1	1	1
Units (dw)	ng/g	ng/g	ng/g	ng/g	ng/g
A-BHC	40.8 U	26.5 U	42.6	59.5 U	54.7 U
B-BHC	40.8 U	26.5 U	42.6	41.4 U	54.7 U
G-BHC	28.2 U	18.3 U	29.4	28.6 U	37.8 U
D-BHC	40.8 U	26.5 U	42.6	60.7	54.7 U
HEPTACLOR	8.47 U	5.50 U	8.85	8.59 U	11.4 U
ALDRIN	27.4 U	17.8 U	46.1	301	36.8 U
HEPT EPOXIDE	39.9 U	25.9 U	41.7	40.5 U	53.6 U
g CHLORDANE	40.8 U	26.5 U	95.3	277	54.7 U
ENDO I	40.8 U	26.5 U	82.9	139	54.7 U
a CHLORDANE	65.5 U	42.5 U	68.4	173	87.9 U
DIELDRIN	68.0	17.4 U	1220	3200	36.0 U
4,4' -DDE	449 D20	58.7	1160 D40	2940	28.3
ENDRIN	40.8 U	26.5 U	42.6 U	41.4 U	54.7 U
ENDO II	40.8 U	26.5 U	42.6 U	41.4 U	54.7 U
4,4' -DDD	21100 D20	3260	18100 D40	51500 D40	257
ENDRIN. ALDY.	40.8 U	26.5 U	42.6 U	41.4 U	54.7 U
ENDO SULFATE	40.8 U	26.5 U	42.6 U	41.4 U	54.7 U
4,4' -DDT	2650 D20	200	18600 D40	30600 D40	297
Toxaphene	282 U	282 U	282 U	282 U	282 U
Aroclor 1242	316 U	316 U	316 U	316 U	316 U
Aroclor 1248	316 U	316 U	316 U	316 U	316 U
Aroclor 1254	316 U	316 U	316 U	316 U	316 U
Aroclor 1260	316 U	316 U	316 U	316 U	316 U
Surrogate Recoveries (%)					
PCB-103	73.0	84.2	72.0	83.0	84.8
PCB-198	69.0	83.1	72.6	78.7	78.4
PCB-198 (Dil)	91.9		98.0	111	

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
* Outside SIS recovery limits
See narrative.

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediments
Samples Received 8/25/99

MSL Code	1392-30	1392-31	1392-32	1392-33	1392-34
SPONSOR ID	HECK99-CR-30	HECK99-CR-31	HECK99-CR-32	HECK99-CR-33	HECK99-CR-34
Matrix	Wood	Wood	Wood	Wood	Wood
Extract Date	09/20/1999	09/20/1999	09/20/1999	09/20/1999	09/20/1999
Analysis Date	10/11/1999	10/11/1999	10/11/1999	10/11/1999	10/11/1999
Analytical Batch	2	2	2	2	2
Wet Wt (g)	11.7	9.47	10.3	10.1	10.1
Percent WW	51.7	35.5	53.9	42.7	44.1
Analytical Rep	1	1	1	1	1
Units (dw)	ng/g	ng/g	ng/g	ng/g	ng/g
A-BHC	132 D40	191 D40	42.1 U	34.4 U	812 D40
B-BHC	482 D40	459 D40	611 D40	34.4 U	35.6 U
G-BHC	24.4 U	22.6 U	29.1 U	23.8 U	24.7 U
D-BHC	35.4 U	221 D40	42.1 U	34.4 U	1360 D40
HEPTACLOR	7.35 U	6.81 U	8.75 U	20.9	7.39 U
ALDRIN	23.8 U	2070 D40	28.3 U	23.1 U	23.9 U
HEPT EPOXIDE	34.7 U	32.1 U	41.3 U	33.7 U	34.8 U
g CHLORDANE	2400 D40	1270 D40	42.1 U	34.4 U	1260 D40
ENDO I	1330 D40	553 D40	431 D40	34.4 U	1000 D40
a CHLORDANE	1370 D40	861 D40	282 D40	101	818 D40
DIELDRIN	24100 D40	26700 D40	10200 D40	22.6 U	6850 D40
4,4' -DDE	14100 D40	4710 D40	3270 D40	15.8 U	8880 D40
ENDRIN	14000 D40	23000 D40	2710 D40	34.4 U	6920 D40
ENDO II	35.4 U	32.8 U	42.1 U	34.4 U	35.6 U
4,4' -DDD	185000 D40	55900 D40	45700 D40	1720	145000 D40
ENDRIN. ALDY.	35.4 U	32.7 U	42.1 U	34.4 U	35.6 U
ENDO SULFATE	35.4 U	1070 D40	42.1 U	34.4 U	35.6 U
4,4' -DDT	1430 D40	2590 D40	1370 D40	80.7 U	1470 D40
Toxaphene	282 U	282 U	282 U	282 U	282 U
Aroclor 1242	316 U	316 U	316 U	316 U	316 U
Aroclor 1248	316 U	316 U	316 U	316 U	316 U
Aroclor 1254	316 U	316 U	316 U	316 U	316 U
Aroclor 1260	316 U	316 U	316 U	316 U	316 U
Surrogate Recoveries (%)					
PCB-103	250 *	190 *	428 *	42.3	346 *
PCB-198	69.6	76.7	74.2	83.2	73.2
PCB-198 (Dil)					

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
* Outside SIS recovery limits
See narrative.

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediment
Samples Received 8/25/99

MSL Code	Blank	*BSA* Blank Spike A	SPK AMT	Percent Recovery	*BSB* Blank Spike B	SPK AMT	Percent Recovery	
SPONSOR ID								***RPD***
Matrix	Sediment	Sediment			Sediment			
Extract Date	9/2/99	9/2/99			9/2/99			
Analysis Date	10/4/99	10/4/99			10/4/99			
Analytical Batch	1	1			1			
Wet Wt (g)	NA	NA			NA			
Percent WW	NA	NA			NA			
Analytical Rep	1	1			2			
Units (dw)	ng/g	ng/g	ng/g	%	ng/g	ng/g	%	%
A-BHC	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
B-BHC	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
G-BHC	27.7 U	1670	2000	**84%**	1760	2000	**88%**	***5%***
D-BHC	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
HEPTACLOR	8.32 U	520	2000	**26% #**	620	2000	**31% #**	***18%***
ALDRIN	26.9 U	1600	2000	**80%**	1640	2000	**82%**	***2%***
HEPT EPOXIDE	39.2 U	39.2 U	NS	NA	39.2 U	NS	NA	
g CHLORDANE	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
ENDO I	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
a CHLORDANE	64.3 U	64.3 U	NS	NA	64.3 U	NS	NA	
DIELDRIN	26.4 U	3910	4000	**98%**	3860	4000	**97%**	***1%***
4,4' -DDE	18.3 U	134	NS	NA	139	NS	NA	
ENDRIN	40.0 U	3810	4000	**95%**	3780	4000	**95%**	***1%***
ENDO II	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
4,4' -DDD	33.3 U	85.0	NS	NA	89.5	NS	NA	
ENDRIN.ALDY.	40.0 U	40.0 U	NS	NA	116 U	NS	NA	
ENDO SULFATE	40.9 U	40.0 U	NS	NA	40.0 U	NS	NA	
4,4' -DDT	93.9 U	4270	4000	**107%**	4460	4000	**112%**	***4%***
Toxaphene	282 U							
Aroclor 1242	316 U							
Aroclor 1248	316 U							
Aroclor 1254	316 U	20200	20000	**101%**	20300	20000	**102%**	***0%***
Aroclor 1260	316 U							
Surrogate Recoveries (%)								
PCB-103	81.7	80.8			80.9			
PCB-198	81.0	75.9			76.0			
PCB-198 (Dil)								

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
\# Outside spike recovery range of 40-120%
& Outside precision limits of ≤30%

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediment
Samples Received 8/25/99

		MSA			*MSB*			
MSL Code	1392-15	1392-15 Spike A	SPK AMT	Percent Recovery	1392-15 Spike B	SPK AMT	Percent Recovery	
SPONSOR ID	HECK99-30							***RPD***
Matrix	Sediment	Sediment			Sediment			
Extract Date	9/2/99	9/2/99			9/2/99			
Analysis Date	10/4/99	10/4/99			10/4/99			
Analytical Batch	1	1			1			
Wet Wt (g)	10.2	10.1			10.6			
Percent WW	41.9	41.9			41.9			
Analytical Rep	1	1			2			
Units (dw)	ng/g	ng/g	ng/g	%	ng/g	ng/g	%	%
A-BHC	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
B-BHC	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
G-BHC	23.2 U	1510	1700	**89%**	1430	1630	**88%**	*1%*
D-BHC	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
HEPTACLOR	6.99 U	1450	1700	**85%**	1440	1630	**88%**	*4%*
ALDRIN	22.6 U	1420	1700	**84%**	1320	1630	**81%**	*3%*
HEPT EPOXIDE	33.0 U	33.4 U	NS	NA	32.0 U	NS	NA	
g CHLORDANE	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
ENDO I	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
a CHLORDANE	54.1 U	54.8 U	NS	NA	52.5 U	NS	NA	
DIELDRIN	22.2 U	3440	3410	**101%**	3190	3260	**98%**	*3%*
4,4' -DDE	15.4 U	118	NS	NA	111	NS	NA	
ENDRIN	33.6 U	3300	3410	**97%**	3090	3260	**95%**	*2%*
ENDO II	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
4,4' -DDD	239	312	NS	NA	253	NS	NA	
ENDRIN.ALDY.	33.6 U	84.3	NS	NA	32.7 U	NS	NA	
ENDO SULFATE	33.6 U	34.1 U	NS	NA	32.7 U	NS	NA	
4,4' -DDT	78.9 U	3740	3410	**110%**	3560	3260	**109%**	*0%*
Toxaphene	282 U							
Aroclor 1242	316 U							
Aroclor 1248	316 U							
Aroclor 1254	316 U	17200	17000	**101%**	15700	16300	**96%**	*5%*
Aroclor 1260	316 U							
Surrogate Recoveries (%)								
PCB-103	84.6	85.7			81.9			
PCB-198	91.8	86.1			83.8			
PCB-198 (Dil)								

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
\# Outside spike recovery range of 40-120%
& Outside precision limits of ≤30%

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediment
Samples Received 8/25/99

		DUP		*SRM*		
MSL Code	1392-13	1392-13		1941A	1941A CERTIFIED VALUE	
SPONSOR ID	HECK99-26	HECK99-26	***RPD***			***RPD***
Matrix	Sediment	Sediment		Sediment	Sediment	
Extract Date	9/2/99	9/2/99		9/2/99		
Analysis Date	10/4/99	10/4/99		10/4/99		
Analytical Batch	1	1		1		
Wet Wt (g)	10.3	10.3		11.3		
Percent WW	53.5	53.5		NA		
Analytical Rep	1	2		1		
Units (dw)	ng/g	ng/g		ng/g	ng/g	
A-BHC	41.9 U	41.8 U		1.05		
B-BHC	41.9 U	41.8 U		0.36 U		
G-BHC	28.9 U	28.9 U		0.25 U		
D-BHC	41.9 U	41.8 U		0.36 U		
HEPTACLOR	8.70 U	8.68 U		0.07 U		
ALDRIN	28.2 U	28.1 U		0.24 U		
HEPT EPOXIDE	41.0 U	41.0 U		2.51		
g CHLORDANE	41.9 U	41.8 U		0.36 U		
ENDO I	41.9 U	41.8 U		0.36 U		
a CHLORDANE	67.3 U	67.1 U		2.75	2.33	***18%***
DIELDRIN	132	148	***11%***	0.23 U		
4,4' -DDE	141	143	***1%***	7.03	6.59	***7%***
ENDRIN	41.9 U	41.8 U		0.36 U		
ENDO II	41.9 U	41.8 U		1.31		
4,4' -DDD	2040	2690	***27%***	6.16	5.06	***22%***
ENDRIN.ALDY.	41.9 U	41.8 U		0.36 U		
ENDO SULFATE	41.9 U	41.8 U		0.36 U		
4,4' -DDT	1270	1990	***44% &***	8.63		
Toxaphene	282 U	282 U				
Aroclor 1242	316 U	316 U				
Aroclor 1248	316 U	316 U				
Aroclor 1254	6330	4730	***29%***			
Aroclor 1260	316 U	316 U				
Surrogate Recoveries (%)						
PCB-103	86.8	81.4		66.1		
PCB-198	95.2	89.2		49.8		
PCB-198 (Dil)						

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
\# Outside spike recovery range of 40-120%
& Outside precision limits of $\leq$30%

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediment
Samples Received 8/25/99

		BSA			BSB			
MSL Code	Blank	Blank Spike A	SPK AMT	Percent Recovery	Blank Spike B	SPK AMT	Percent Recovery	
SPONSOR ID								
Matrix	Sediment	Sediment			Sediment			
Extract Date	09/20/99	09/20/99			09/20/99			
Analysis Date	10/08/99	10/08/99			10/08/99			
Analytical Batch	2	2			2			
Wet Wt (g)	NA	NA			NA			
Percent WW	NA	NA			NA			
Analytical Rep	1	1			2			
Units (dw)	ng/g	ng/g	ng/g	%	ng/g	ng/g	%	
A-BHC	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
B-BHC	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
G-BHC	27.7 U	1730	2000	**87%**	1730	2000	**87%**	*0%*
D-BHC	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
HEPTACLOR	8.32 U	673	2000	**34% #**	861	2000	**43%**	*25%*
ALDRIN	26.9 U	1700	2000	**85%**	1730	2000	**87%**	*2%*
HEPT EPOXIDE	39.2 U	39.2 U	NS	NA	39.2 U	NS	NA	
g CHLORDANE	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
ENDO I	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
a CHLORDANE	64.3 U	64.3 U	NS	NA	64.3 U	NS	NA	
DIELDRIN	26.4 U	4460	4000	**112%**	4110	4000	**103%**	*8%*
4,4' -DDE	18.3 U	154	NS	NA	144	NS	NA	
ENDRIN	40.0 U	4510	4000	**113%**	4010	4000	**100%**	*12%*
ENDO II	40.0 U	40.0 U	NS	NA	40.0 U	NS	NA	
4,4' -DDD	33.3 U	136	NS	NA	142	NS	NA	
ENDRIN.ALDY.	40.0 U	161	NS	NA	241	NS	NA	
ENDO SULFATE	40.3 U	40.0 U	NS	NA	40.0 U	NS	NA	
4,4' -DDT	93.9 U	4790	4000	**120%**	4540	4000	**114%**	*5%*
Toxaphene	282 U							
Aroclor 1242	316 U							
Aroclor 1248	316 U							
Aroclor 1254	316 U	18300	20000	**92%**	17800	20000	**89%**	*3%*
Aroclor 1260	316 U							
Surrogate Recoveries (%)								
PCB-103	90.6	88.2			77.8			
PCB-198	83.0	75.5			69.5			
PCB-198 (Dil)								

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
\# Outside spike recovery range of 40-120%
& Outside precision limits of $\leq$30%

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediment
Samples Received 8/25/99

		MSA			*MSB*			
MSL Code	1392-29	1392-29 Spike A	SPK AMT	Percent Recovery	1392-29 Spike B	SPK AMT	Percent Recovery	
SPONSOR ID	HECK99-48							
Matrix	Sediment	Sediment			Sediment			
Extract Date	09/20/99	09/20/99			09/20/99			
Analysis Date	10/08/99	10/08/99			10/08/99			
Analytical Batch	2	2			2			
Wet Wt (g)	10.6	10.4			10.4			
Percent WW	65.3	65.3			65.3			
Analytical Rep	1	1			2			
Units (dw)	ng/g	ng/g	ng/g	%	ng/g	ng/g	%	
A-BHC	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
B-BHC	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
G-BHC	37.8 U	2430	2770	**88%**	2340	2760	**85%**	*3%*
D-BHC	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
HEPTACLOR	11.4 U	2380	2770	**86%**	2370	2760	**86%**	*0%*
ALDRIN	36.8 U	2310	2770	**83%**	2330	2760	**84%**	*1%*
HEPT EPOXIDE	53.6 U	54.3 U	NS	NA	54.2 U	NS	NA	
g CHLORDANE	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
ENDO I	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
a CHLORDANE	87.9 U	89.1 U	NS	NA	88.8 U	NS	NA	
DIELDRIN	36.0 U	5700	5540	**103%**	5600	5520	**101%**	*1%*
4,4' -DDE	28.3	227	NS	NA	244	NS	NA	
ENDRIN	54.7 U	6120	5540	**110%**	6440	5520	**117%**	*5%*
ENDO II	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
4,4' -DDD	257	819	NS	NA	447	NS	NA	
ENDRIN.ALDY.	54.7 U	161	NS	NA	137	NS	NA	
ENDO SULFATE	54.7 U	55.4 U	NS	NA	55.3 U	NS	NA	
4,4' -DDT	297	7480	5540	**135% #**	7290	5520	**132% #**	*2%*
Toxaphene	282 U							
Aroclor 1242	316 U							
Aroclor 1248	316 U							
Aroclor 1254	316 U	24500	27700	**88%**	26600	27600	**96%**	*9%*
Aroclor 1260	316 U							
Surrogate Recoveries (%)								
PCB-103	84.8	84.1			90.6			
PCB-198	78.4	78.8			78.7			
PCB-198 (Dil)								

- U — Not detected at or above DL shown
- D — Diluted
- NA — Not applicable/available
- NS — Not spiked
- # — Outside spike recovery range of 40-120%
- & — Outside precision limits of ≤30%

NOTE: Data were not blank corrected

BATTELLE MARINE SCIENCE LABORATORIES
1529 West Sequim Bay Road
Sequim, Washington 98382-9099
360/681-3687

UNITED HECKATHORN
PCBs in Sediment
Samples Received 8/25/99

		DUP		*SRM*		
MSL Code	1392-24	1392-24		1941A	1941A CERTIFIED	
SPONSOR ID	HECK99-40	HECK99-40	***RPD***		VALUE	***RPD***
Matrix	Sediment	Sediment		Sediment	Sediment	
Extract Date	09/20/99	09/20/99		09/20/99		
Analysis Date	10/08/99	10/08/99		10/11/99		
Analytical Batch	2	2		2		
Wet Wt (g)	10.2	10.1		NA		
Percent WW	45.1	45.1		NA		
Analytical Rep	1	2		1		
Units (dw)	ng/g	ng/g		ng/g	ng/g	
A-BHC	35.9 U	36.2 U		0.94		
B-BHC	35.9 U	36.2 U		1.45		
G-BHC	24.8 U	25.0 U		1.04		
D-BHC	35.9 U	36.2 U		0.38 U		
HEPTACLOR	7.45 U	7.52 U		0.08 U		
ALDRIN	24.1 U	24.3 U		0.25 U		
HEPT EPOXIDE	35.2 U	35.5 U		3.15		
g CHLORDANE	35.9 U	36.2 U		0.38 U		
ENDO I	35.9 U	36.2 U		0.38 U		
a CHLORDANE	57.0 U	58.2 U		2.77	2.33	*19%*
DIELDRIN	107	94.2	*13%*	0.25 U		
4,4'-DDE	202	167	*19%*	6.72	6.59	*2%*
ENDRIN	35.9 U	36.2 U		0.38 U		
ENDO II	35.9 U	36.2 U		1.35		
4,4'-DDD	1720	1210	*35% &*	5.84	5.06	*15%*
ENDRIN.ALDY.	35.9 U	36.2 U		0.72		
ENDO SULFATE	35.9 U	36.2 U		0.38 U		
4,4'-DDT	186	225	*19%*	8.66		
Toxaphene	282 U	282 U				
Aroclor 1242	316 U	316 U				
Aroclor 1248	316 U	316 U				
Aroclor 1254	316 U	316 U				
Aroclor 1260	316 U	316 U				
Surrogate Recoveries (%)						
PCB-103	92.0	91.1		48.4		
PCB-198	81.7	80.6		56.4		
PCB-198 (Dil)						

U Not detected at or above DL shown
D Diluted
NA Not applicable/available
NS Not spiked
\# Outside spike recovery range of 40-120%
& Outside precision limits of ≤30%

NOTE: Data were not blank corrected

GRAIN SIZE, TOC, TOTAL SOLIDS

Applied Marine Sciences, Inc.
502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

August 25, 1999

Ms. Nancy P. Kohn
Battelle Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, WA 98382

Re: Battelle Project No. 20212, Heckathorn 1999 Sediments, Purchase Order No. SEQ-25301-NPK. Grain Size, TOC, and Total Solids Results. AMS Project No. 9902-08.

Dear Nancy,

Applied Marine Sciences, Inc. (AMS) is pleased to submit the enclosed grain size, TOC, and total solids results in support of the above referenced project.

AMS appreciates the opportunity to be of service on this project. Please feel free to call me if you have any questions, or if I can be of further assistance.

Sincerely,

Kenneth S. Davis
President

Enclosures

s:\ams\battelle\1999\990208\lt082599.wpd

Battelle
Pacific Northwest Division
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

SAMPLE CUSTODY RECORD

Date 8/5/99 Page 1 of 2

Project No. 20212
Project Name HECKATHORN 1999 SEDIMENT
Project Manager NANCY KOHN Phone 360 681-3687

Lab APPLIED MARINE SCIENCES
Address LEAGUE CITY, TX
Attention KEN DAVIS

Lab No.	Sample No.	Collection Date	Matrix	GRAIN SIZE	TOC					No. of Containers	Observations, Instructions
	HECK99-GRA/TOC-02	8/3/99	Marine Sediment	✓	✓					1	Box 1
	-03			✓	✓					1	
	-05			✓	✓					1	
	-06			✓	✓					1	
	-07			✓	✓					1	
	-08			✓	✓					1	
	-09			✓	✓					1	
	-10			✓	✓					1	
	-11			✓	✓					1	
	-12			✓	✓					1	
	-13			✓	✓					1	
	-14			✓	✓					1	
	-15			✓	✓					1	BOX 2
	-16			✓	✓					1	
	-17			✓	✓					1	
	-19			✓	✓					1	
	-20			✓	✓					1	
	-21			✓	✓					1	
	-22	8/4/99		✓	✓					1	
	-23			✓	✓					1	Low sample volume
	-24			✓	✓					1	
	-25			✓	✓					1	
	-26			✓	✓					1	
	-27			✓	✓					1	

Relinquished by:	Received by:	
Signature: Nancy Kohn Date: 8/11/99 Time: 1230	Signature: Jennifer Davis Date: 8/12/99 Time: 10AM	24 this page Total No. of Containers
Printed Name: NANCY KOHN	Printed Name: Jennifer Davis	Shipment Method: FED EX
Company: BATTELLE MSL	Company: Applied Marine Sciences	Special Requirements or Comments:
Relinquished by: Signature Date Time Printed Name Company	Received by: Signature Date Time Printed Name Company	DISTRIBUTION: 1. Provide white and yellow copies to the Laboratory 2. Return pink copy to Project file or to project manager. 3. Laboratory to return signed white copy to Battelle for project files

BC-1800-192 (07/94)

Battelle
Pacific Northwest Division
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

SAMPLE CUSTODY RECORD

Date 8/5/99 Page 2 of 2

Project No. 20212
Project Name HECKATHORN 1999 SEDIMENT
Project Manager NP KOHN Phone 360 681 3687

Lab: Applied Marine Science
Address: League City, TX
Attention: Ken Davis

Testing Parameters: Grain Size, TOC

Lab No.	Sample No.	Collection Date	Matrix	Grain Size	TOC	No. of Containers	Observations, Instructions
	HECK99-GEA/TOC-28	8/4/99	Marine Sediment	✓	✓	1	BOX 3
	-29	↓	↓	✓	✓	1	↓
	-30			✓	✓	1	
	-31			✓	✓	1	
	-32			✓	✓	1	
	-33			✓	✓	1	
	-34			✓	✓	1	
	-36			✓	✓	1	
	-37			✓	✓	1	
	-38			✓	✓	1	
	-39			✓	✓	1	low volume
	-40	↓		✓	✓	1	↓
	-41	8/5/99		✓	✓	1	BOX 4
	-42	↓		✓	✓	1	↓
	-43			✓	✓	1	
	-44			✓	✓	1	
	-45			✓	✓	1	
	-47	↓	↓	✓	✓	1	
	~~-48(tot)~~						npk no entry this line
	-48	8/5/99	Marine	✓	✓	(2)	
	-49	↓	Sediment	✓	✓	1	↓
	~~HECK99-DDTScreen-46~~	~~8/5/99~~	↓	✓	✓	1	ignore crossout!
	HECK99-DDTScreen-18	8/3/99	↓	✓	✓	1	↓ 2 samples added 8/11/99

~~this page~~

Relinquished by: Nancy Kohn 8/11/99 1230
Signature Date Time
NANCY KOHN
Printed Name
BATTELLE MSL
Company

Received by: Jennifer Davis 8/12/99 10AM
Signature Date Time
Jennifer Davis
Printed Name
Applied Marine Sciences
Company

~~21~~ (23) Total No. of Containers individual (22 samples)
Shipment Method: FED EX
Special Requirements or Comments:

Relinquished by:
Signature Date Time
Printed Name
Company

Received by:
Signature Date Time
Printed Name
Company

DISTRIBUTION:
1. Provide white and yellow copies to the Laboratory
2. Return pink copy to Project file or to project manager.
3. Laboratory to return signed white copy to Battelle for project files

BC-1800-192 (07/94)

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

Summary Table

Project Number: 20212
Project Title: Heckathorn 1999 Sediment
Client: Battelle Marine Sciences Lab

AMS Project Number: 9902-08
Date Received: 8/12/99
Matrix: Soil
Methods: See Notes

Client Sample ID	AMS Sample ID	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	TOC (%)	Total Solids (%)
Heck99-GRA/TOC-34	4580	2.09	28.53	33.19	36.19	0.4	74.0
Heck99-GRA/TOC-36	4581	55.10	16.84	17.56	10.50	0.2	86.4
Heck99-GRA/TOC-37	4582	3.92	16.69	31.85	47.54	1.7	70.2
Heck99-GRA/TOC-38	4583	12.32	19.12	31.12	37.44	0.2	74.4
Heck99-GRA/TOC-39	4584	17.39	33.93	21.28	27.40	0.3	77.7
Heck99-GRA/TOC-40	4585	1.39	9.05	38.67	50.90	1.1	54.7
Heck99-GRA/TOC-41	4586	3.22	10.16	35.02	51.60	3.0	48.1
Heck99-GRA/TOC-42	4587	4.09	5.46	40.25	50.20	6.8	41.7
Heck99-GRA/TOC-43	4588	21.89	26.57	19.59	31.95	1.0	67.8
Heck99-GRA/TOC-44	4589	20.47	16.13	20.90	42.50	7.1	46.3
Heck99-GRA/TOC-45	4590	19.80	29.38	22.98	27.85	6.5	54.5
Heck99-GRA/TOC-47	4591	23.82	31.62	23.12	21.45	7.4	47.3
Heck99-GRA/TOC-48	4592	0.19	4.12	20.80	74.90	1.6	34.6
Heck99-GRA/TOC-49	4593	2.19	6.81	22.49	68.50	1.4	37.2
Heck99-DDT Screen-46	4594	9.68	39.44	20.28	30.60	0.5	75.6
Heck99-DDT Screen-18	4595	0.18	22.69	39.68	37.45	0.2	74.1

Notes: Grain Size (ASTM D2217/D422)
TOC (EPA SW9060M)
Total Solids (EPA 160.3)

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.
502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

Summary Table

Project Number: 20212
Project Title: Heckathorn 1999 Sediment
Client: Battelle Marine Sciences Lab

AMS Project Number: 9902-08
Date Received: 8/12/99
Matrix: Soil
Methods: See Notes

Client Sample ID	AMS Sample ID	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	TOC (%)	Total Solids (%)
Heck99-GRA/TOC-02	4550	0.83	94.85	1.12	3.19	0.2	82.3
Heck99-GRA/TOC-03	4551	17.54	29.99	9.96	42.50	1.2	64.3
Heck99-GRA/TOC-05	4552	1.31	96.96	0.25	1.48	0.1	81.8
Heck99-GRA/TOC-06	4553	0.05	13.68	44.77	41.50	4.2	56.2
Heck99-GRA/TOC-07	4554	0.20	58.69	19.34	21.77	6.1	54.9
Heck99-GRA/TOC-08	4555	0.37	96.27	0.85	2.52	0.5	79.7
Heck99-GRA/TOC-09	4556	0.20	24.06	39.24	36.50	6.9	54.4
Heck99-GRA/TOC-10	4557	3.80	85.16	4.64	6.40	0.2	80.8
Heck99-GRA/TOC-11	4558	4.49	33.00	36.51	26.00	0.7	69.5
Heck99-GRA/TOC-12	4559	0.97	66.50	13.38	19.15	0.7	69.7
Heck99-GRA/TOC-13	4560	0.86	68.60	17.29	13.25	0.2	77.0
Heck99-GRA/TOC-14	4561	2.62	37.59	27.33	32.45	0.9	59.1
Heck99-GRA/TOC-15	4562	2.99	53.63	27.88	15.50	0.2	77.1
Heck99-GRA/TOC-16	4563	0.97	22.49	24.54	52.00	1.5	46.2
Heck99-GRA/TOC-17	4564	4.60	21.57	31.33	42.50	1.2	53.0

Notes: Grain Size (ASTM D2217/D422)
TOC (EPA SW9060M)
Total Solids (EPA 160.3)

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

Summary Table

Project Number: 20212
Project Title: Heckathorn 1999 Sediment
Client: Battelle Marine Sciences Lab

AMS Project Number: 9902-08
Date Received: 8/12/99
Matrix: Soil
Methods: See Notes

Client Sample ID	AMS Sample ID	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	TOC (%)	Total Solids (%)
Heck99-GRA/TOC-19	4565	4.73	29.27	18.25	47.75	2.0	50.3
Heck99-GRA/TOC-20	4566	13.64	31.10	27.41	27.85	1.1	71.0
Heck99-GRA/TOC-21	4567	11.33	21.63	22.04	45.00	1.6	52.0
Heck99-GRA/TOC-22	4568	5.01	37.51	17.47	40.00	0.8	54.5
Heck99-GRA/TOC-23	4569	3.14	15.07	40.68	41.10	0.2	73.6
Heck99-GRA/TOC-24	4570	20.91	27.61	16.33	35.15	2.4	56.6
Heck99-GRA/TOC-25	4571	0.00	10.20	22.65	67.15	1.4	42.3
Heck99-GRA/TOC-26	4572	0.92	18.74	26.03	54.30	1.6	45.9
Heck99-GRA/TOC-27	4573	2.14	26.47	30.29	41.10	1.1	57.1
Heck99-GRA/TOC-28	4574	4.83	33.91	43.91	17.35	ND	77.6
Heck99-GRA/TOC-29	4575	1.85	34.17	36.13	27.85	0.1	74.8
Heck99-GRA/TOC-30	4576	1.53	14.82	38.90	44.75	1.2	57.1
Heck99-GRA/TOC-31	4577	73.33	17.16	3.11	6.40	0.2	86.6
Heck99-GRA/TOC-32	4578	1.17	49.19	19.49	30.15	1.5	51.7
Heck99-GRA/TOC-33	4579	0.53	85.38	4.47	9.63	0.3	75.9

Notes: Grain Size (ASTM D2217/D422)
TOC (EPA SW9060M)
Total Solids (EPA 160.3)

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

QUALITY CONTROL DOCUMENTATION

Applied Marine Sciences, Inc.
502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

QUALITY CONTROL REPORT

Project Number: 20212
Project Title: Heckathorn 1999 Sediment
Client: Battelle-MSL
Client Sample ID: HECK99-GRA/TOC-17
AMS Sample ID: 4564

AMS Project Number: 9902-08
Date Received: 8/12/99
Date Analyzed: 8/19-8/20/99
Matrix: Soil
Methods: See Note

Replicate Analysis

Size Class	U.S. Standard Sieve Size or Number	Diameter (mm)	Sample Result (%)	Duplicate Result (%)	RPD (%)	QC Limits (% RPD)
Gravel	#4	2.00	4.60	4.75	3.21	<20
Sand	#230	0.0625	21.57	22.64	4.84	<20
Silt		0.0625-0.0039	31.33	31.51	0.57	<20
Clay		<0.0039	42.50	41.10	3.35	<20

Samples in Batch (AMS ID):					
	4550	4553	4556	4559	4562
	4551	4554	4557	4560	4563
	4552	4555	4558	4561	4564

Note: ASTM D2217/D422

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

QUALITY CONTROL REPORT

Project Number:	20212	AMS Project Number:	9902-08
Project Title:	Heckathorn 1999 Sediment	Date Received:	8/12/99
Client:	Battelle-MSL	Date Analyzed:	8/23/99
Client Sample ID:	HECK99-GRA/TOC-33	Matrix:	Soil
AMS Sample ID:	4579	Methods:	See Note

Replicate Analysis

Size Class	U.S. Standard Sieve Size or Number	Diameter (mm)	Sample Result (%)	Duplicate Result (%)	RPD (%)	QC Limits (% RPD)
Gravel	#4	2.00	0.53	0.50	5.83	<20
Sand	#230	0.0625	85.38	86.02	0.75	<20
Silt		0.0625-0.0039	4.47	3.87	14.39	<20
Clay		<0.0039	9.63	9.60	0.31	<20

Samples in Batch (AMS ID):					
	4565	4568	4571	4574	4577
	4566	4569	4572	4575	4578
	4567	4570	4573	4576	4579

Note: ASTM D2217/D422

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

QUALITY CONTROL REPORT

Project Number: 20212
Project Title: Heckathorn 1999 Sediment
Client: Battelle-MSL
Client Sample ID: HECK99-GRA/TOC-48
AMS Sample ID: 4592

AMS Project Number: 9902-08
Date Received: 8/12/99
Date Analyzed: 8/24-8/25/99
Matrix: Soil
Methods: See Note

Replicate Analysis

Size Class	U.S. Standard Sieve Size or Number	Diameter (mm)	Sample Result (%)	Duplicate Result (%)	RPD (%)	QC Limits (% RPD)
Gravel	#4	2.00	0.19	0.20	5.13	<20
Sand	#230	0.0625	4.12	4.41	6.80	<20
Silt		0.0625-0.0039	20.80	19.14	8.31	<20
Clay		<0.0039	74.90	76.25	1.79	<20

Samples in Batch (AMS ID):						
	4580	4583	4586	4589	4592	4595
	4581	4584	4587	4590	4593	
	4582	4585	4588	4591	4594	

Note: ASTM D2217/D422

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.
502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

Quality Control Report

Project No.: 20212
Project Title: Heckethorn 1999 Sediment
Client: Battelle-MSL
Client Sample ID: HECK99-GRA/TOC-17

AMS Project No.: 9902-08
Date Sampled: 8/3/99
Date Analyzed: 8/18/99
Matrix: Soil
Methods: EPA SW 9060M

Continuing Calibration Data

AMS Sample ID	Parameter	SRM Result %	SRM Theoretical %	RPD %	QC Limits % RPD
Std1	TOC	4.83	4.80	0.62	<10

TOC Method Blank

AMS Sample ID	Weight (g)	Result (ug CO2)	TOC (%)	MDL (%)
Blank	0.5980	39.6	ND	0.1

Replicate Analysis

AMS Sample ID	Parameter	Sample Result %	Replicate Result %	RPD %	QC Limits % RPD
4564	TOC	1.2	1.2	0.86	<10

Samples in Batch (AMS ID):					
	4550	4553	4556	4559	4562
	4551	4554	4557	4560	4563
	4552	4555	4558	4561	4564

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.
502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

Quality Control Report

Project No.:	20212	AMS Project No.:	9902-08
Project Title:	Heckethorn 1999 Sediment	Date Sampled:	8/4/99
Client:	Battelle-MSL	Date Analyzed:	8/18/99
Client Sample ID:	HECK99-GRA/TOC-33	Matrix:	Soil
		Methods:	EPA SW 9060M

Continuing Calibration Data

AMS Sample ID	Parameter	SRM Result %	SRM Theoretical %	RPD %	QC Limits % RPD
Std1	TOC	4.79	4.80	0.21	<10

TOC Method Blank

AMS Sample ID	Weight (g)	Result (ug CO2)	TOC (%)	MDL (%)
Blank	0.5981	32.7	ND	0.1

Replicate Analysis

AMS Sample ID	Parameter	Sample Result %	Replicate Result %	RPD %	QC Limits % RPD
4579	TOC	0.3	0.3	0.00	<10

Samples in Batch (AMS ID):					
	4565	4568	4571	4574	4577
	4566	4569	4572	4575	4578
	4567	4570	4573	4576	4579

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.
502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

Quality Control Report

Project No.:	20212	AMS Project No.:	9902-08
Project Title:	Heckethorn 1999 Sediment	Date Sampled:	8/5/99
Client:	Battelle-MSL	Date Analyzed:	8/18/99
Client Sample ID:	HECK99-GRA/TOC-48	Matrix:	Soil
		Methods:	EPA SW 9060M

Continuing Calibration Data

AMS Sample ID	Parameter	SRM Result %	SRM Theoretical %	RPD %	QC Limits % RPD
Std1	TOC	4.93	4.80	2.67	<10

TOC Method Blank

AMS Sample ID	Weight (g)	Result (ug CO2)	TOC (%)	MDL (%)
Blank	0.5232	20.8	ND	0.1

Replicate Analysis

AMS Sample ID	Parameter	Sample Result %	Replicate Result %	RPD %	QC Limits % RPD
4592	TOC	1.6	1.6	3.17	<10

Samples in Batch (AMS ID):					
4580	4583	4586	4589	4592	4595
4581	4584	4587	4590	4593	
4582	4585	4588	4591	4594	

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

AMS QUALITY CONTROL REPORT

Project Number: 20212
Project Title: Heckathorn 1999 Sediments
Client: Battelle-MSL
Client Sample ID: HECK99-GRA/TOC-17
AMS Sample ID: 4564

AMS Project #: 9902-08
Date Sampled: 8/3/99
Date Received: 8/12/99
Matrix: Soil
Method: 160.3

Sample Result %	Replicate Result %	RPD %	QC Limits % RPD	Date Analyzed
53.0	54.5	2.8	<20	8/16/99

Samples in Batch (AMS ID):					
	4550	4553	4556	4559	4562
	4551	4554	4557	4560	4563
	4552	4555	4558	4561	4564

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

QUALITY CONTROL REPORT

Project Number: 20212
Project Title: Heckathorn 1999 Sediments
Client: Battelle-MSL
Client Sample ID: HECK99-GRA/TOC-33
AMS Sample ID: 4579

AMS Project #: 9902-08
Date Sampled: 8/4/99
Date Received: 8/12/99
Matrix: Soil
Method: 160.3

Sample Result %	Replicate Result %	RPD %	QC Limits % RPD	Date Analyzed
75.9	76.0	0.0	<20	8/16/99

Samples in Batch (AMS ID):					
	4565	4568	4571	4574	4577
	4566	4569	4572	4575	4578
	4567	4570	4573	4576	4579

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager

Applied Marine Sciences, Inc.

502 N. Highway 3, Suite B • League City, TX 77573 • (281) 554-7272 • Fax (281) 554-6356

QUALITY CONTROL REPORT

Project Number: 20212
Project Title: Heckathorn 1999 Sediments
Client: Battelle-MSL
Client Sample ID: HECK99-GRA/TOC-48
AMS Sample ID: 4592

AMS Project #: 9902-08
Date Sampled: 8/5/99
Date Received: 8/12/99
Matrix: Soil
Method: 160.3

Sample Result %	Replicate Result %	RPD %	QC Limits % RPD	Date Analyzed
34.6	34.1	0.2	<20	8/21/99

Samples in Batch (AMS ID):					
4580	4583	4586	4589	4592	4595
4581	4584	4587	4590	4593	
4582	4585	4588	4591	4594	

Quality Assurance: These analyses were performed in accordance with EPA guidelines for quality assurance.

AMS, Inc. Project Manager