DB

# SEDIMENT CHARACTERIZATION FOR THE HAMM CREEK RESTORATION PROJECT

**DUWAMISH TURNING BASIN**
**SEATTLE, WASHINGTON**

VOL. 1/2

September 12, 1997

Prepared for:

**U.S. Army Corps of Engineers**
**Seattle District**
**4735 East Marginal Way South**
**Seattle, Washington 98124-2255**

Prepared by

**Science Applications International Corporation**
**Environmental Sciences Division**
**18706 North Creek Parkway, Suite 110**
**Bothell, Washington 98011**

## TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

## 1.0 INTRODUCTION

As part of the U.S. Army Corps of Engineers (USACE) Restoration Program, the USACE plans to realign Hamm Creek and convert 7 acres of a 22-acre parcel of land adjacent to the Seattle City Light substation into a combined saltwater/freshwater wetland. The Hamm Creek restoration project, which will be accomplished under Section 1135 of the Water Resources Development Act of 1986, will include dredging approximately 80,000 cubic yards to provide a new outlet for the creek to the Duwamish River, to create a saltwater marsh in the riverside area, and to excavate upland for a freshwater wetland. These 80,000 cubic yards of dredged material are proposed for either open-water disposal at the Puget Sound Dredged Disposal Analysis (PSDDA) Elliott Bay disposal site or for beneficial use. An additional 10,000 cubic yards will be excavated in creating meanders in Hamm Creek along West Marginal Way. These 10,000 cubic yards of material will not be characterized for PSDDA disposal.

This report describes a study conducted by the USACE and Science Applications International Corporation (SAIC) to characterize the 80,000 cubic yards of material proposed for PSDDA disposal or for beneficial use. Based on a 1990 site assessment conducted by Boeing, and the fact that the site had never been developed for industrial use, a low-moderate rank was used to determine the sampling and analysis requirements for the project. The material was characterized under PSDDA (1989; 1990 a,b; 1991 a,b) and Sediment Management Standard (SMS) guidelines, which consisted of conventional, contaminant, and tiered biological testing. The results of the study will be used in making suitability determinations for disposal at the Elliott Bay disposal site or for beneficial use.



AR 023211

## 2.0 METHODS

Detailed sampling and analysis procedures are provided in the *Sampling and Analysis Plan for the Hamm Creek Restoration Project, Duwamish Turning Basin, Seattle, Washington* prepared by the USACE (Appendix A). This section provides and overview of the sampling scheme and the methods used in the collection, processing, and analysis of sediments, including any deviations from the Sampling and Analysis Plan (SAP).

### 2.1 Sampling Overview

Sampling for the Hamm Creek restoration project occurred on June 16 and 17, 1997. Sampling was conducted by Tacoma Pump and Drill using a hollow-stem auger and stainless steel, 2-ft. split-spoon samplers. According to the sampling scheme designed by the USACE, 4 stations were sampled to characterize the 80,000 cubic yards of material proposed for dredging.

The sampling and analysis scheme devised by the USACE was in accordance with PSDDA dredged material evaluation guidelines, Puget Sound Estuary Program (PSEP) recommended guidelines (PSEP 1986, 1995, 1997 a,b,c,d), and modifications made through the PSDDA annual review process. A full description of the sampling and compositing scheme can be found in the SAP. Based on the low-moderate ranking, the full characterization requirements included collecting both surface (0 to 4 feet) and subsurface (>4 feet) sediments from each of the four stations, and compositing surface and subsurface sediments into two samples: C1 (surface) and C2 (subsurface). The surface sample represents approximately 32,000 cubic yards of material, and the subsurface represents approximately 48,000 cubic yards. At two of the stations (C2 and C4), an additional foot was added to the total core length sampled in order to document the exposed subsurface sediment beyond the dredging overdepth. The sampling locations and compositing scheme are presented in Figure 2-1 and in Table B-1, Appendix B.

Once it was determined that bioassay analyses would be required, a reference sediment was collected from Carr Inlet, Washington, on July 17, 1997.

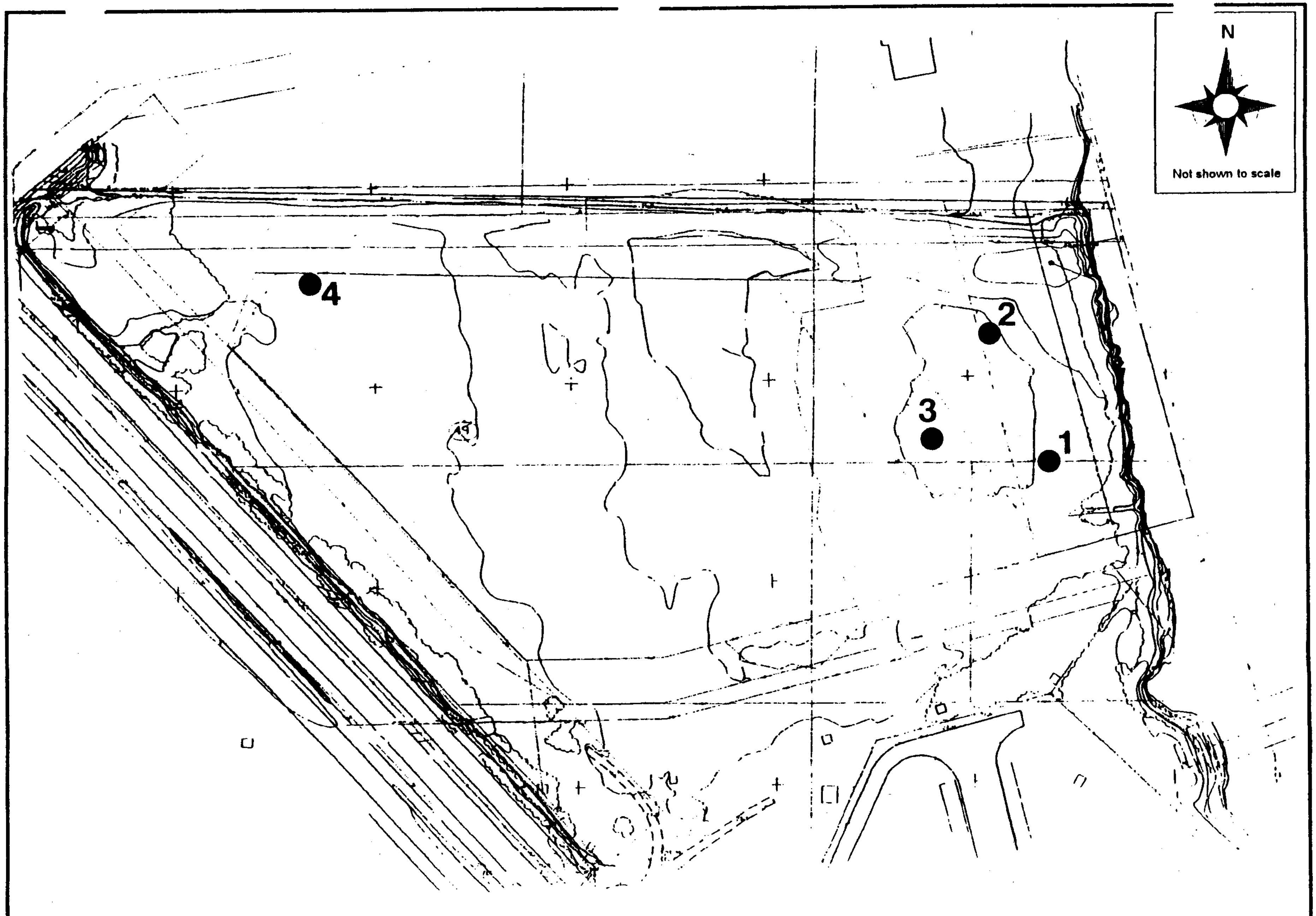



Figure 2-1. Locations of stations sampled for the Hamm Creek Restoration Project.

## 2.2 Positioning

Sampling locations were flagged by the USACE surveyors prior to the actual sampling effort. The flagged stations were used to position the drill auger for sampling. Sampling positions were marked on a survey map and Washington State Plane coordinates referenced to North American Datum 1927 (NAD 27) and elevations were determined from the map. The state plane coordinates were converted to latitude and longitude coordinates referenced to NAD 83 using the USACE's Corpscon coordinate conversion program. The elevations determined from the survey map were comparable to those provided in the Sampling and Analysis plan for all stations except Station 2. The elevation for this station was 22 feet instead of the 25 feet initially determined. Station positions and elevations referenced to Mean Lower Low Water (MLLW) are provided in Appendix B.

## 2.3 Sample Collection and Processing

Prior to sampling, all compositing equipment was decontaminated in accordance with PSEP and PSDDA protocols as described in the SAP. With the exception of the first three split-spoon samples collected, each split-spoon was also scrubbed with Alconox, and rinsed with distilled water, dilute nitric acid, methanol, and a final distilled water rinse. For the first three samples collected (Station 4: A1, A2, and B1), the split-spoons had been pre-cleaned but lacked the nitric and methanol rinses (refer to page 2 of the Field Log, Appendix C). Care was taken to avoid sampling material touching the sides of the core on these samples. Sample material touching the core catchers, which were plastic, was also avoided.

Samples were collected using a truck-mounted, hollow-stem auger drilling rig equipped with a split-spoon sampler. The first sample at a station was collected from 0 to 2 feet. Once a two-foot sample was collected, the split-spoon was opened, the recovery measured, and the core described in the field log. A portion of the sediment was removed and retained in a stainless steel pan for subsequent mixing and compositing. The pan was covered with aluminum foil in order to prevent contamination while subsequent samples for the composite were collected. The auger was then advanced to the bottom of the sample depth and the next two-foot sample collected. After the two samples for the surface composite at a station were collected (e.g., Station 1: A1 and A2), the pan was placed on ice in a cooler while collecting the subsurface samples at the station. This method of sampling, retrieval, and auger advancement at two-foot intervals was utilized until the design sample depth was reached. The subsurface samples were processed and stored in the same manner as the surface samples.

Due to the drillers' schedule, a second day of sampling was necessary. Therefore, the sediment collected for each composite (C1 and C2) on day one was homogenized, placed into the appropriate pre-cleaned, labeled sample jars, and stored on ice for subsequent mixing with material collected at the remaining stations on the second day. Once all material was collected from the four stations for each composite, the sediment was homogenized, placed in the pre-cleaned sample jars, and stored on ice until delivery to the laboratory or SAIC's storage facility in Woodinville, WA. Mercury and chemistry archive subsamples were stored at -18°C.

Subsamples for volatile organics analyses were collected from randomly chosen core sections. The subsample for C1 was collected from Station 2, core section A2 and the subsample for C2 was collected from Station 3, core section B2. According to the SAP, the subsample for C2 was planned for Station 3, core section B1. However, the split-spoon was opened before processing of the previous section was completed. In order to avoid potential loss of volatiles while the sample sat exposed, the decision was made to collect the volatiles from the next sample depth. The subsamples for both C1 and C2 volatile analyses were collected immediately after the samplers for each were opened.

In addition to the composite samples collected, samples were collected from a one-foot section beyond the design depth at Stations 2 and 4. These were collected to represent the exposed subsurface sediments once dredging is completed. The material for each one-foot or "Z" sample was placed in a separate stainless steel mixing pan, homogenized, and placed in a one-liter pre-cleaned glass jar. The two "Z" samples (Z2 and Z4) were archived at -18°C for potential future analysis.

While reviewing sample bore hole logs, it was discovered that an extra 1.3 feet were sampled at Station 3. The existing elevation at this station was +21.7 feet and the design elevation was +11 feet, so that a total core length of 10.7 feet was required. However, due to a calculation error, 12 feet were inadvertently sampled. Therefore, 1.3 extra feet of sediment were sampled for the subsurface composite, C2. Because this represented a maximum of 4% of the material collected for the C2 composite, and because there was no visible contamination based on color, texture, or odor, this is not expected to have had a significant contribution to contaminant levels measured in the sample. In addition, after the station locations were plotted, the actual elevation at Station 2 was determined to be 22 feet, instead of the expected 25 feet. A total of 13 feet were sampled from this station (Appendix B).

In order to measure the ammonia and sulfides levels in the test sediments when bioassays were begun, subsamples for ammonia and sulfides analyses were collected by the bioassay laboratory, Northwestern Aquatic Sciences, as the sediment for the bioassay testing was prepared and placed into bioassay test chambers. The subsamples for total sulfides analysis were preserved with zinc acetate. These subsamples for C1, C2, and Carr 4 were stored at 4°C and sent to the laboratory for ammonia and total sulfides analyses.

When transferring samples to the laboratories, samples were stored on ice or blue ice in coolers, transported to the various laboratories, and maintained at 4°C or -18°C (archived chemistry and mercury jars). All sample handling, subsampling, compositing, labeling, storage, and chain-of-custody procedures were conducted according to procedures outlined in PSEP, PSDDA, and the SAP. Copies of all chain-of-custody forms are provided in Appendix D.

## 2.4 Chemical Testing

The two composite samples collected from the Hamm Creek project site were tested for total solids, total volatile solids (TVS), total organic carbon (TOC), grain size, chromium, and PSDDA chemicals of concern. Upon evaluation of the chemistry results, the Carr 4 reference sediment was analyzed for total solids, TVS, TOC, and grain size. Subsamples collected by the bioassay laboratory for C1. C2. and Carr 4 were analyzed for total solids. ammonia. and total sulfides by AmTest. Inc. of Redmond. WA.

Target analytes and analytical methods used are presented in the SAP and in Table (Appendix A). The preparation procedures. method detection limits to be achieved by the laboratory, PSDDA screening levels. July 1996 draft SMS detection limits. SMS sediment quality standards (SQS), and 1988 LAET values are also included in the SAP. Methods followed those as specified in the PSDDA Management Plan Report (MPR) Unconfined. Open-water Disposal of Dredged Material. Phase II (North and South Puget Sound)", September 1989, and were analyzed in accordance with the latest PSDDA (1989) and PSEP (1986, 1997a,b) guidelines and review meetings (PSDDA 1991 a,b). A review of the quality control data is provided in Appendix E.

Analyses for most conventionals followed PSEP (1986). Ammonia was analyzed according to Plumb (1981) and TOC was analyzed according to EPA Standard Method SM5310B. The grain size distribution for each sample was determined in accordance with PSEP 1986 using a combination of standard sieves and hydrometer. Sieve sizes U.S. No. 4, 5, 10. 18. 35, 60, 120, and 230 were used for the grain size analyses. The strong acid digestion (SAD) method was used for the metals analyses. Specific analytical methods for contaminant chemistry are provided in the laboratory data report (Appendix E).

### 2.5 Biological Testing

Following evaluation of the chemistry results. the two composite sediment samples were selected for bioassay testing. Both C1 and C2 exceeded the PSDDA screening level for total DDT, and C1 also exceeded the screening level for total PCBs. Bioaccumulation trigger and PSDDA maximum levels (ML) were not exceeded, so that bioaccumulation testing was not required.

The bioassays included the 10-day amphipod (*Eohaustorius estuarius*) and echinoderm larval (*Dendraster excentricus*) acute toxicity tests, and the 20-day chronic sublethal biomass/growth test using *Neanthes arenaceodentata*. The amphipod and echinoderm larval tests were conducted by



AR 023217

Northwestern Aquatic Sciences, Newport, OR; Parametrix Inc., Kirkland, WA, performed the *Neanthes* bioassay. The PSDDA bioassays were conducted using the most recent PSEP guidelines (1995) with modifications specified by PSDDA (1989b), bioassay public workshops (PSDDA 1990b), the annual review minutes (ARM), and Sediment Management ARM (SMARM).

Because the test sediments were from an upland freshwater environment, and were proposed to be disposed at a saltwater environment, the salinity of the samples needed to be adjusted to emulate the saltwater environment. For the amphipod test, *Eohaustorius estuarius* was used as the test organism due to the sensitivity of *Rhepoxynius abronius* to lower salinity conditions (<25 ppt). According to PSEP, the interstitial and overlying salinities of the sediments should be adjusted to the ambient salinity conditions from which the amphipods were collected. The amphipods were collected at low tide from a location near Yaquina Bay, OR (Beaver Creek), which is exposed to a range of salinities from approximately 0-28 ppt. Therefore, it was decided, in consultation with the USACE, to run the test at approximately mid-range at 15 ppt. The salinity at the time of amphipod collection was about zero ppt, and the amphipods were slowly acclimated to 14 ppt prior to the start of the test. For the amphipod test, the salinity for the reference and control sediments also required adjusting.

## 2.6 Reference Sediment Collection

Once the results of the chemistry analyses were received and the necessity for bioassay testing determined, reference sediments were collected in Carr Inlet (Carr 4) on July 17, 1997. The reference sediment sample was collected using a 0.025 $m^2$ stainless steel van Veen grab sampler aboard the University of Washington's Boston whaler. Sediments were wet-sieved in the field in order to verify grain size compatibility to the Hamm Creek samples. Target fine fractions for the reference sediments were approximately 31-41% fines. Samples were collected from the top 10 cm of the grab. Material that appeared to be sulfidic was avoided. Several grabs were needed to obtain sufficient volume for a sample. Once a sufficient quantity of sediment was obtained, the material was mixed until homogenous and placed in pre-cleaned labeled sample jars. All decontamination, subsampling and processing was conducted according to PSEP/PSDDA as indicated above for sample processing and handling.

## 3.0 RESULTS

The sediment chemistry analyses and biological testing results for the Hamm Creek restoration project sediment characterization are summarized below. All sediment chemistry and bioassay laboratory reports and associated quality control documentation are provided in Appendices E and F. The QA1 level review reports and checklists are provided at the beginning of each of the appendices.

### 3.1 Sediment Core Descriptions

A detailed description of each core collected is provided in the borehole logs in Appendix C. The surface sediments (0 to 4 feet) generally consisted of a brown, silty fine sand with roots and organic fibers. Some small gravels were present in surface sediments collected from Station 4, and wood organics were present in surface sediments collected at Station 3. Occasional 1 to 2 mm lenses of a gray sandy clay to clayey sand were also present in the surface sediments.

Although the subsurface sediments varied with depth, these sediments were primarily a silty to clayey fine sand, and were more of a sandy clay in some sections. Wood debris was present at approximately 6 feet in core depth at Stations 3 and 4, and between 8 and 10 feet at Stations 1 and 2. Elevations corresponding to these depths at which woody debris occurred were between 13 and 17 feet MLLW at all stations. At Station 2, the core section between 8.4 and 10 feet core depth was a black silty clay to clayey silt and had a sulfidic odor. At stations Stations 1 and 3, pinkish-gray clayey fine sand lenses were present between 9 and 11 feet MLLW elevations.

### 3.2 Sediment Conventionals

The sediment conventional chemistry results are provided in Table 3-1. The subsurface sediment (C2) contained about 10% more fine material than the surface sediment (C1). Both sediments were primarily sand, with 68.7% sand for C1 and 58.8% sand for C2 (30.7% and 41.1% fines, respectively). The reference sediment, Carr 4, fine fraction was comparable to the Hamm Creek

Table 3-1. Conventional and contaminant chemistry results for the Hamm Creek Restoration Project.

| Station Number<br>Lab Number<br>Collection Date | PSDDA<br>SL | PSDDA<br>ML | Jul-96<br>Draft SMS<br>Det. Limits | 1988<br>LAET | C1<br>97-A008101<br>16-Jun-97 | Q | C2<br>97-A008102<br>16-Jun-97 | Q | Carr 4<br>97-A009723<br>17-Jul-97 | Q |
|---|---|---|---|---|---|---|---|---|---|---|
| **Conventionals** | | | | | | | | | | |
| Total Organic Carbon (% DW) | – | – | – | – | 1.9 | | 0.63 | | 0.39 | |
| Total Sulfides (mg/kg DW) | – | – | – | – | 16 | U | 96 | | 35 | |
| Ammonia (mg-N/kg DW) | – | – | – | – | 1.8 | | 30 | | 25 | |
| TVS (% DW) | – | – | – | – | 4.60 | | 2.37 | | 1.61 | |
| Total Solids (% DW) | – | – | – | – | 82.2 | | 77.2 | | 71.3 | |
| Grain Size | | | | | | | | | | |
| Percent Gravel (>2.0 mm) | – | – | – | – | 0.5% | | 0.1 % | | 0.0% | |
| Percent Sand (<2.0 mm - 0.06 mm) | – | – | – | – | 68.7% | | 58.8 % | | 70.6% | |
| Percent Silt (0.06 mm - 0.004 mm) | – | – | – | – | 24.3% | | 33.3 % | | 26.3% | |
| Percent Clay (<0.004 mm) | – | – | – | – | 6.4% | | 7.8 % | | 3.1% | |
| Percent Fines (<0.06 mm) | – | – | – | – | 30.7% | | 41.1 % | | 29.4% | |
| **Metals in mg/kg DW** | | | | | | | | | | |
| Antimony | 20 | 200 | – | 150 | 1.1 | U | 1.3 | U | NA | |
| Arsenic | 57 | 700 | 19 | 57 | 8.8 | | 6.3 | | NA | |
| Cadmium | 0.96 | 9.6 | 1.70 | 5.1 | 0.04 | | 0.03 | U | NA | |
| Chromium | – | – | 87 | 260 | 23 | | 19 | | NA | |
| Copper | 81 | 810 | 130 | 390 | 22 | | 18 | | NA | |
| Lead | 66 | 660 | 150 | 450 | 32 | | 24 | | NA | |
| Mercury | 0.21 | 2.1 | 0.14 | 0.59 | 0.074 | | 0.047 | | NA | |
| Nickel | 140 | – | – | 140 | 20 | | 11 | | NA | |
| Silver | 1.2 | 6.1 | 2.0 | 0.56 | 0.23 | | 0.13 | U | NA | |
| Zinc | 160 | 1600 | 137 | 410 | 66 | | 42 | | NA | |
| **LPAH in ug/kg DW** | | | | | | | | | | |
| Naphthalene | 210 | 2100 | 700 | 2100 | 17 | U | 19 | U | NA | |
| Acenaphthylene | 64 | 640 | 433 | 560 | 17 | U | 19 | U | NA | |
| Acenaphthene | 63 | 630 | 167 | 500 | 17 | U | 19 | U | NA | |
| Fluorene | 64 | 640 | 180 | 540 | 17 | U | 19 | U | NA | |
| Phenanthrene | 320 | 3200 | 500 | 1500 | 17 | U | 19 | U | NA | |
| Anthracene | 130 | 1300 | 320 | 960 | 17 | U | 19 | U | NA | |
| 2-Methylnaphthalene | 67 | 670 | 223 | 670 | 17 | U | 19 | U | NA | |
| Total LPAH | 610 | 6100 | – | 5200 | 17 | U | 19 | U | NA | |
| **HPAH in ug/kg DW** | | | | | | | | | | |
| Fluoranthene | 630 | 6300 | 567 | 1700 | 17 | U | 19 | U | NA | |
| Pyrene | 430 | 7300 | 867 | 2600 | 17 | U | 19 | U | NA | |
| Benzo(a)anthracene | 450 | 4500 | 433 | 1300 | 17 | U | 19 | U | NA | |
| Chrysene | 670 | 6700 | 467 | 1400 | 17 | U | 19 | U | NA | |
| Benzofluoranthenes | 800 | 8000 | 1067 | 3200 | 17 | U | 19 | U | NA | |
| Benzo(a)pyrene | 680 | 6800 | 533 | 1600 | 17 | U | 19 | U | NA | |
| Indeno(1,2,3-cd)pyrene | 69 | 5200 | 200 | 600 | 17 | U | 19 | U | NA | |
| Dibenz(a,h)anthracene | 120 | 1200 | 77 | 230 | 17 | U | 19 | U | NA | |
| Benzo(g,h,i)perylene | 540 | 5400 | 223 | 670 | 17 | U | 19 | U | NA | |
| Total HPAH | 1800 | 51000 | – | 12000 | 17 | U | 19 | U | NA | |
| **Chlorinated Aromatics in ug/kg DW** | | | | | | | | | | |
| 1,3-Dichlorobenzene | 170 | – | – | 170 | 3 | U | 3 | U | NA | |
| 1,4-Dichlorobenzene | 26 | 260 | 37 | 110 | 3 | U | 3 | U | NA | |
| 1,2-Dichlorobenzene | 19 | 350 | 35 | 35 | 3 | U | 3 | U | NA | |
| 1,2,4-Trichlorobenzene | 13 | 64 | 31 | 31 | 5 | U | 6 | U | NA | |
| Hexachlorobenzene | 23 | 230 | 22 | 22 | 10 | U | 11 | U | NA | |

Table 3-1. Conventional and contaminant chemistry results for the Hamm Creek Restoration Project. (Continued)

| Station Number<br>Lab Number<br>Collection Date | PSDDA<br>SL | PSDDA<br>ML | Jul-96<br>Draft SMS<br>Det. Limits | 1988<br>LAET | C1<br>97-A008101<br>16-Jun-97 | Q | C2<br>97-A008102<br>16-Jun-97 | Q | Carr 4<br>97-A009723<br>17-Jul-97 | Q |
|---|---|---|---|---|---|---|---|---|---|---|
| **Phthalate Esters in ug/kg DW** | | | | | | | | | | |
| Dimethyl phthalate | 160 | – | 24 | 71 | 17 | U | 19 | U | NA | |
| Diethyl phthalate | 97 | – | 67 | 48 | 17 | U | 19 | U | NA | |
| Di-n-butyl phthalate | 1400 | – | 467 | 1400 | 17 | U | 19 | U | NA | |
| Butyl benzyl phthalate | 470 | – | 21 | 63 | 17 | U | 19 | U | NA | |
| Bis(2-ethylhexyl)phthalate | 3100 | – | 433 | 1300 | 17 | U | 19 | U | NA | |
| Di-n-octyl phthalate | 6200 | – | 2067 | 420 | 17 | U | 19 | U | NA | |
| **Phenols in ug/kg DW** | | | | | | | | | | |
| Phenol | 120 | 1200 | 140 | 420 | 17 | U | 19 | U | NA | |
| 2-Methylphenol | 20 | 72 | 63 | 63 | 9 | U | 9 | U | NA | |
| 4-Methylphenol | 120 | 1200 | 223 | 670 | 17 | U | 19 | U | NA | |
| 2,4-Dimethylphenol | 29 | 50 | 29 | 29 | 9 | U | 9 | U | NA | |
| Pentachlorophenol | 100 | 690 | 120 | 140 | 43 | U | 47 | U | NA | |
| **Miscellaneous Extractables in ug/kg DW** | | | | | | | | | | |
| Benzyl Alcohol | 25 | 73 | 57 | 57 | 10 | U | 11 | U | NA | |
| Benzoic Acid | 400 | 690 | 217 | 650 | 87 | U | 93 | U | NA | |
| Dibenzofuran | 54 | 540 | 180 | 540 | 17 | U | 19 | U | NA | |
| Hexachloroethane | 1400 | 14000 | – | – | 17 | U | 19 | U | NA | |
| Hexachlorobutadiene | 29 | 290 | 11 | 11 | 14 | U | 15 | U | NA | |
| N-Nitrosodiphenylamine | 28 | 220 | 28 | 28 | 10 | U | 11 | U | NA | |
| **Volatile Organics in ug/kg DW** | | | | | | | | | | |
| Trichloroethene | 160 | 1600 | – | – | 3 | U | 3 | U | NA | |
| Tetrachloroethene | 14 | 210 | – | 57 | 3 | U | 3 | U | NA | |
| Ethylbenzene | 10 | 50 | – | 10 | 3 | U | 3 | U | NA | |
| Total Xylene | 12 | 160 | – | 40 | 3 | U | 3 | U | NA | |
| **Pesticides and PCBs in ug/kg DW** | | | | | | | | | | |
| Total DDT | 6.9 | 69 | – | – | **14** | | **11.3** | | NA | |
| 4,4'-DDE | – | – | – | 9 | 3.7 | | 2.9 | | NA | |
| 4,4'-DDD | – | – | – | 16 | 6.7 | | 5.3 | | NA | |
| 4,4'-DDT | – | – | – | 6 | 3.6 | | 3.1 | | NA | |
| Lindane | 10 | – | – | – | 0.52 | U | 0.55 | U | NA | |
| Heptachlor | 10 | – | – | – | 0.52 | U | 0.55 | U | NA | |
| Aldrin | 10 | – | – | – | 2.4 | | 1.3 | | NA | |
| Dieldrin | 10 | – | – | – | 6.1 | | 6.0 | | NA | |
| Chlordane | 10 | – | – | – | 4.4 | | 1.5 | | NA | |
| Aroclor-1016 | – | – | – | – | 8.6 | U | 9.2 | U | NA | |
| Aroclor-1221 | – | – | – | – | 34 | U | 37 | U | NA | |
| Aroclor-1232 | – | – | – | – | 8.6 | U | 9.2 | U | NA | |
| Aroclor-1242 | – | – | – | – | 8.6 | U | 9.2 | U | NA | |
| Aroclor-1248 | – | – | – | – | 8.6 | U | 9.2 | U | NA | |
| Aroclor-1254 | – | – | – | – | 160 | | 76 | | NA | |
| Aroclor-1260 | – | – | – | – | 8.6 | U | 9.2 | U | NA | |
| Total PCBs | 130 | 2500 | 6 | 130 | **160** | | 76 | | NA | |

U = Undetected
NA = Not Analyzed
Q = Qualifier

Note: Items in bold and highlighted exceeded the PSDDA screening level (SL).
Hexachlorobutadiene detection limits exceeded the SMS detection limit and 1988 LAET.



AR 023221

samples. The wet-sieve test conducted in the field indicated 34% fines; the analytical results fine fraction was 29.4% fines.

The total solids fractions for all three sediments were high, ranging from 71.3% for Carr 4 to 82.2% for C1. The total volatile solids fractions in all three samples were comparable, ranging from 1.61% for Carr 4 and 4.6% for C1. Similar to TVS, total organic carbon concentrations were comparable among the three samples, and these concentrations were quite low, the highest being in sample C1 at 1.9%. Total sulfides were highest in C2 at 96 mg/kg and undetected in sample C1. Similar to total sulfides, ammonia levels in C2 were highest at 30 mg/kg and lowest in C1 at 1.8 mg/kg.

### 3.3 Contaminant Chemistry

The results of the analytical chemistry analyses are summarized in Table 3-1. Concentrations that exceeded the PSDDA screening levels (SL) are highlighted in bold. With the exception of antimony, all metals analyzed were detected in C1. Antimony was undetected in both C1 and C2. Silver and cadmium were also undetected in C2, while all other metals were detected.

Volatile and semivolatile organics were undetected in both samples. However, the pesticides aldrin, chlordane, and dieldrin were detected at levels below the PSDDA SL in both samples. The screening level for total DDT was exceeded in both samples, with C1 having levels of 14 μg/kg and C2 showing levels of 11.3 μg/kg. However, these levels were well below the bioaccumulation trigger and PSDDA maximum levels. In addition, the concentration of PCB Arochlor-1254 measured for C1 (160 μg/kg) exceeded the PSDDA screening level for total PCBs (130 μg/kg). This analyte was detected below screening levels in C2 (76 μg/kg).

In addition to the PSDDA screening levels, Table 3-1 includes the July 1996 SMS detection limits and 1988 Lower Apparent Effects Threshold (LAET) values. The July 1996 SMS detection limits were met for all analytes except hexachlorobutadiene and total PCBs. The hexachlorobutadiene detection limit for C1 (14 μg/kg) and C2 (15 μg/kg) exceeded the SMS draft detection limit of 11 μg/kg. The detection limits for these two analytes also exceeded the SMS draft detection limit of 11 μg/kg. With the exception of Arochlor-1221, the detection limit for PCB arochlors for C1 and C2 was 8.6 and 9.2 μg/kg, respectively. Arochlor-1221 detection limits were 34 μg/kg (C1) and 37 μg/kg (C2). The draft SMS target detection limit for total PCBs was 6 μg/kg.

Table 3-2 compares the analytical results to marine sediment quality standards. Organic analyte results were TOC normalized for the comparison, with the exception of phenols, benzyl alcohol, benzoic acid, volatile organics, and pesticides. All metals results were well below SQS levels. With the exception of hexachlorobenzene in C1 and C2, and 1,2,4-trichlorobenzene for C2, all organics analysis results were below SQS levels. Hexachlorobenzene detection levels normalized to TOC were 0.53 mg/kg (C1) and 1.7 mg/kg (C2). The SQS chemical criterion for this analyte is 0.38 mg/kg. However, these detection limits were below the maximum chemical criteria/minimum clean-up levels. The detection level for 1,2,4-trichlorobenzene for C2 was 0.95 mg/kg, and the SQS chemical criterion for this analyte is 0.81 mg/kg. The maximum chemical criterion for this analyte is 1.8 mg/kg. The total PCB concentration of 12 mg/kg for C2 was equivalent to the SQS criterion of 12 mg/kg.

Based on the bioassay results, the USACE requested the laboratory to determine if any tentatively identified compounds (TICs) were measured during the analyses. The laboratory reviewed the data and found no semivolatile organic TICs detected.

### 3.4 Bioassays

Based on the results of the chemistry analyses, both C1 and C2 were identified for biological testing: C1 due to total DDT and total PCB exceedances, and C2 due to total DDT exceedances. One reference sediment collected from Carr Inlet (Carr 4) was tested with the Hamm Creek sediments. The results of the bioassays are summarized in Table 3-3 and provided in Appendix F. All bioassays were conducted within the 8-week holding time specified by PSDDA. Control mortalities for each test were within PSDDA/SMS recommended ranges for negative controls. The mean control growth rate for the *Neanthes* test met the PSDDA/SMS target growth rate of 0.72



AR 023223

Table 3-2. Hamm Creek project data compared to sediment management standards.

| Station Number<br>Lab Number<br>Collection Date | WA SMS<br>SQS<br>Chem Criteria | WA SMS<br>SQS<br>Max Chem Criteria | C1<br>97-A008101<br>16-Jun-97 | Q | C2<br>97-A008102<br>16-Jun-97 | Q |
|---|---|---|---|---|---|---|
| **Conventionals** | | | | | | |
| Total Organic Carbon (% DW) | – | – | 1.9 | | 0.63 | |
| Total Sulfides (mg/kg DW) | – | – | 16 | U | 96 | |
| Ammonia (mg-N/kg DW) | – | – | 1.8 | | 30 | |
| TVS (% DW) | – | – | 4.60 | | 2.37 | |
| Total Solids (% DW) | – | – | 82.2 | | 77.2 | |
| Grain Size | | | | | | |
| Percent Gravel (>2.0 mm) | – | – | 0.5% | | 0.1 % | |
| Percent Sand (< 2.0 mm - 0.06 mm) | – | – | 68.7% | | 58.8 % | |
| Percent Silt (0.06 mm - 0.004 mm) | – | – | 24.3% | | 33.3 % | |
| Percent Clay (< 0.004 mm) | – | – | 6.4% | | 7.8 % | |
| Percent Fines (< 0.06 mm) | – | – | 30.7% | | 41.1 % | |
| **Metals in mg/kg DW** | | | | | | |
| Antimony | – | – | 1.1 | U | 1.3 | U |
| Arsenic | 57 | 93 | 8.8 | | 6.3 | |
| Cadmium | 5.1 | 6.7 | 0.04 | | 0.03 | U |
| Chromium | 260 | 270 | 23 | | 19 | |
| Copper | 390 | 390 | 22 | | 18 | |
| Lead | 450 | 530 | 32 | | 24 | |
| Mercury | 0.41 | 0.59 | 0.074 | | 0.047 | |
| Nickel | – | – | 20 | | 11 | |
| Silver | 6.1 | 6.1 | 0.23 | | 0.13 | U |
| Zinc | 410 | 960 | 66 | | 42 | |
| **LPAH in mg/kg TOC** | | | | | | |
| Naphthalene | 99 | 170 | 0.89 | U | 3 | U |
| Acenaphthylene | 66 | 66 | 0.89 | U | 3 | U |
| Acenaphthene | 16 | 57 | 0.89 | U | 3 | U |
| Fluorene | 23 | 79 | 0.89 | U | 3 | U |
| Phenanthrene | 100 | 480 | 0.89 | U | 3 | U |
| Anthracene | 220 | 1200 | 0.89 | U | 3 | U |
| 2-Methylnaphthalene | 38 | 64 | 0.89 | U | 3 | U |
| Total LPAH | 370 | 780 | 0.89 | U | 3 | U |
| **HPAH in mg/kg TOC** | | | | | | |
| Fluoranthene | 160 | 1200 | 0.89 | U | 3 | U |
| Pyrene | 1000 | 1400 | 0.89 | U | 3 | U |
| Benzo(a)anthracene | 110 | 270 | 0.89 | U | 3 | U |
| Chrysene | 110 | 460 | 0.89 | U | 3 | U |
| Benzofluoranthenes | 230 | 450 | 0.89 | U | 3 | U |
| Benzo(a)pyrene | 99 | 210 | 0.89 | U | 3 | U |
| Indeno(1,2,3-cd)pyrene | 34 | 88 | 0.89 | U | 3 | U |
| Dibenz(a,h)anthracene | 12 | 33 | 0.89 | U | 3 | U |
| Benzo(g,h,i)perylene | 31 | 78 | 0.89 | U | 3 | U |
| Total HPAH | 960 | 5300 | 0.89 | U | 3 | U |
| **Chlorinated Aromatics in mg/kg TOC** | | | | | | |
| 1,3-Dichlorobenzene | – | – | – | | – | |
| 1,4-Dichlorobenzene | 3.1 | 9 | 0.16 | U | 0.48 | U |
| 1,2-Dichlorobenzene | 2.3 | 2.3 | 0.16 | U | 0.48 | U |
| 1,2,4-Trichlorobenzene | 0.81 | 1.8 | 0.26 | U | **0.95** | U |
| Hexachlorobenzene | 0.38 | 2.3 | 0.53 | U | **1.7** | U |

Table 3-2. Hamm Creek project data compared to sediment management standards. (Continued)

| Station Number<br>Lab Number<br>Collection Date | WA SMS<br>SQS<br>Chem Criteria | WA SMS<br>SQS<br>Max Chem Criteria | C1<br>97-A008101<br>16-Jun-97 | Q | C2<br>97-A008102<br>16-Jun-97 | Q |
|---|---|---|---|---|---|---|
| **Phthalate Esters in mg/kg TOC** | | | | | | |
| Dimethyl phthalate | 53 | 53 | 0.89 | U | 3 | U |
| Diethyl phthalate | 61 | 110 | 0.89 | U | 3 | U |
| Di-n-butyl phthalate | 220 | 1700 | 0.89 | U | 3 | U |
| Butyl benzyl phthalate | 4.9 | 64 | 0.89 | U | 3 | U |
| Bis(2-ethylhexyl)phthalate | 47 | 78 | 0.89 | U | 3 | U |
| Di-n-octyl phthalate | 58 | 4500 | 0.89 | U | 3 | U |
| **Phenols in ug/kg DW** | | | | | | |
| Phenol | 420 | 1200 | 17 | U | 19 | U |
| 2-Methylphenol | 63 | 63 | 9 | U | 9 | U |
| 4-Methylphenol | 670 | 670 | 17 | U | 19 | U |
| 2,4-Dimethylphenol | 29 | 29 | 9 | U | 9 | U |
| Pentachlorophenol | 360 | 690 | 43 | U | 47 | U |
| **Miscellaneous Extractables in ug/kg DW** | | | | | | |
| Benzyl Alcohol | 57 | 73 | 10 | U | 11 | U |
| Benzoic Acid | 650 | 650 | 87 | U | 93 | U |
| **Miscellaneous Extractables in mg/kg TOC** | | | | | | |
| Dibenzofuran | 15 | 58 | 0.89 | U | 3 | U |
| Hexachloroethane | – | – | – | | – | |
| Hexachlorobutadiene | 3.9 | 6.2 | 0.74 | U | 2.4 | U |
| N-Nitrosodiphenylamine | 11 | 11 | 0.53 | U | 1.7 | U |
| **Volatile Organics in ug/kg DW** | | | | | | |
| Trichloroethene | – | – | 3 | U | 3 | U |
| Tetrachloroethene | – | – | 3 | U | 3 | U |
| Ethylbenzene | – | – | 3 | U | 3 | U |
| Total Xylene | – | – | 3 | U | 3 | U |
| **Pesticides in ug/kg DW** | | | | | | |
| Total DDT | – | – | 14 | | 11.3 | |
| 4,4'-DDE | – | – | 3.7 | | 2.9 | |
| 4,4'-DDD | – | – | 6.7 | | 5.3 | |
| 4,4'-DDT | – | – | 3.6 | | 3.1 | |
| Lindane | – | – | 0.52 | U | 0.55 | U |
| Heptachlor | – | – | 0.52 | U | 0.55 | U |
| Aldrin | – | – | 2.4 | | 1.3 | |
| Dieldrin | – | – | 6.1 | | 6.0 | |
| Chlordane | – | – | 4.4 | | 1.5 | |
| **PCBs in mg/kg TOC** | | | | | | |
| Aroclor-1016 | – | – | 0.45 | U | 1.5 | U |
| Aroclor-1221 | – | – | 1.8 | U | 5.9 | U |
| Aroclor-1232 | – | – | 0.45 | U | 1.5 | U |
| Aroclor-1242 | – | – | 0.45 | U | 1.5 | U |
| Aroclor-1248 | – | – | 0.45 | U | 1.5 | U |
| Aroclor-1254 | – | – | 8.7 | | 12 | |
| Aroclor-1260 | – | – | 0.45 | U | 1.5 | U |
| Total PCBs | 12 | 65 | 8.7 | | 12 | |

U = Undetected
Q = Qualifier

Note: Items highlighted in bold represent detection limits that exceeded the SQS chemical criteria

**Table 3-3.** Results for the amphipod acute toxicity test, echinoderm larval test, and 20-day *Neanthes* growth test.

| Station | *Eohaustorius* Mortality (%) | Echinoderm Larval Mortality/Abnormality (NCMA) (%) | 20-Day *Neanthes* Mean Growth Rate (mg/individual/day) |
|---|---|---|---|
| Control | 1 | NA | 0.92 |
| C1 | 4 | **43.5*** | 0.91 |
| C2 | 4 | **33.8*** | 0.59* |
| Carr 4 | 4 | -10.2 | 0.84 |

* Denotes statistically significant difference from the reference (p = <0.05)

NA Normalized combined mortality/abnormality (NCMA) not applicable. Mortality in the seawater control was 23.3% (normal/initial).

Note Values highlighted in bold represent test sediment results which failed to meet reference sediment comparison criteria.

mg/individual/day. In addition, the *Neanthes* initial weights met the target of 0.5 mg/individual. Positive controls were within acceptable limits (laboratory performance standards and ranges reported in PSEP 1995). Results for positive controls are discussed in the QA1 review checklists in Appendix F. Reference sediment results were acceptable for all tests according to both PSDDA and SMS criteria.

There was no toxic response observed in either test sediment for the amphipod (*Eohaustorius*) test, which exhibited 96% survival in both C1, C2, and the reference sediment. All mortalities were less than the PSDDA guideline of <20% over the control mortality and the SQS of ≤25% mortality.

For the *Neanthes* test, the mean individual growth rate for C1 was 99% of the control and 108% of the reference, which indicated there was no toxic response for this sample. The mean individual growth rate for C2 was <80% of the control growth (64% of the control), and was significantly different from the reference sediment (Student's t-test: $p < 0.05$). However, it met the criteria of ≥70% of the reference. The mean individual growth rate for C2 equaled 70% of the reference.

All test sediment normalized combined mortality/abnormality (NCMA) results for the echinoderm larval test were greater than the control guidelines of <20% over the control NCMA. The NCMA results for both test sediments were significantly different from the reference sediment and exceeded the PSDDA suitability criteria of <30% over the reference sediment and the sediment impact zone cleanup level criteria of ≤30% over he reference. This represents a toxic response for both sediments for this bioassay test, and falls under the one-hit criteria for the echinoderm test for nondispersive disposal sites.

## 4.0 Summary

The sediments collected at the Hamm Creek restoration project site consisted primarily of a silty fine to medium sand. Organic fibers such as root material were abundant in the surface sediments. Pockets of wood chips were observed in both surface and subsurface sediments. Total solids levels were high in both samples, and TVS and TOC were low. Ammonia and sulfides were low in the surface sample, but somewhat elevated in the subsurface sample.

Metals were detected at concentrations below PSDDA screening levels and SQS chemical criteria. Semivolatile and volatile organics were undetected in both samples. Aldrin, chlordane, and dieldrin were detected below PSDDA screening levels in both samples. For both surface and subsurface samples total DDT levels measured exceeded the PSDDA SL, and screening levels for total PCBs were exceeded for sample C1. The detection limit for hexachlorobenzene for both samples exceeded the SQS chemical criterion, and the detection limit for 1,2,4-trichlorobenzene for C2 exceeded the SQS chemical criterion.

Based on the results of the chemistry analyses, bioassay testing was conducted for both surface and subsurface samples. Testing results indicated no significant effects for the acute amphipod test. In the 20-day *Neanthes* test, no toxic effect was observed for C1, and C2 just met the criterion of ≥70% of the reference sediment mean individual growth rate. For the echinoderm larval test, both surface and subsurface sediments had normalized combined mortalities/abnormalities that were greater than the control limit of <30% over the reference sediment. According to PSDDA interpretive criteria guidelines for nondispersive aquatic disposal sites, samples C1 and C2 fall under the one-hit criteria for the echinoderm larva test.

## 5.0 REFERENCES

Ecology. 1995. *Sediment Management Standards*. Chapter 173-204 WAC. Washington State Department of Ecology. December 1995.

Plumb, R.H. 1981. *Procedures for handling and chemical analysis of sediment and watersamples.* Technical Report EPA/CE-81-1. U.S. Army Corps of Engineers. Vicksburg,MS.

PSDDA. 1989. *Management Plan Report - Unconfined Open-Water Disposal of Dredged Material.Phase II (North and South Puget Sound).* Puget Sound Dredged Disposal Analysis Reports Series. Cooperatively published by (in alphabetical order) U.S. Army Corps of Engineers, Seattle District: U.S. Environmental Protection Agency, Region X; Washington State Department of Ecology; and Washington State Department of Natural Resources. September 1989.

PSDDA. 1990a. *Changes to the: Management Plan Report. Unconfined Open-Water Disposal of Dredged Material. Phase II.* Puget Sound Dredged Disposal Analysis Reports Series. February 1990.

PSDDA. 1990b. *Summary and conclusions of the Puget Sound Dredged Disposal Analysis (PSDDA) Bioassay Workshop. memorandum of record.* U.S. Army Corps of Engineers. Seattle District. July 1990.

PSDDA. 1991a. *Summary and Conclusions of the Puget Sound Dredged Disposal Analysis (PSDDA) Chemistry Quality Assurance/Quality Control (QA/QC) and PSDDA Streamlining Workshop* held on January 24, 1991 at Seattle District U.S. Army Corps of Engineers.

PSDDA. 1991b. *Changes to PSDDA Screening and Maximum Level Values for Dredged Material Management Year 1990.* Puget Sound Dredged Disposal Analysis Reports Series. May 1991.

PSDDA. 1995. *Sediment Management Annual Review Meeting.* Puget Sound Dredged Disposal Analysis Program. Cooperatively published by (in alphabetical order) U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10; Washington State Department of Ecology; and Washington State Department of Natural Resources. August, 1995.

PSDDA. 1996. *Sediment Management Annual Review Meeting.* Puget Sound Dredged Disposal Analysis Program. Cooperatively published by (in alphabetical order) U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10; Washington State Department of Ecology; and Washington State Department of Natural Resources. May, 1996.

PSEP. 1986. *Puget Sound Estuary Program. Recommended protocols for measuring selected environmental variables in Puget Sound. Final Report.* Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the U.S. Army Corps of Engineers. Tetra Tech Inc., Bellevue, Washington.

PSEP. 1991. *Puget Sound Estuary Program: Recommended protocols for conducting laboratory bioassays on Puget Sound sediments. Final Report.* Prepared for U.S. Environmental Protection Agency Region X, Office of Puget Sound and U.S. Army Corps of Engineers, Seattle, District. PTI Environmental Services, Inc., Bellevue, Washington.

PSEP. 1995. *Puget Sound Estuary Program: Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.* Prepared for U.S. Environmental Protection Agency Region X, Office of Puget Sound and Puget Sound Water Quality Authority, Olympia, WA. PTI Environmental Services, Inc., Bellevue, Washington.

PSEP 1997a. *Puget Sound Estuary Program. Recommended guidelines for measuring organic compounds in Puget Sound water, sediment, and tissue samples.* Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the Puget Sound Water Quality Authority. King County Water Pollution Control Division Environmental Laboratory.

PSEP 1997b. *Puget Sound Estuary Program. Recommended guidelines for measuring metals in Puget Sound water, sediment, and tissue samples.* Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the Puget Sound Water Quality Authority. King County Water Pollution Control Division Environmental Laboratory.

PSEP 1997c. *Puget Sound Estuary Program. Recommended guidelines for sampling marine sediment, water column, and tissues in Puget Sound.* Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the Puget Sound Water Quality Authority. King County Water Pollution Control Division Environmental Laboratory.

PSEP 1997d. *Puget Sound Estuary Program. Recommended quality assurance and quality control guidelines for the collection of environmental data in Puget Sound.* Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the Puget Sound Water Quality Authority. King County Water Pollution Control Division Environmental Laboratory.

# APPENDIX A

# SAMPLING AND ANALYSIS PLAN

# SAMPLING & ANALYSIS PLAN
# FOR THE
# HAMM CREEK RESTORATION PROJECT

## DUWAMISH TURNING BASIN
## SEATTLE, WASHINGTON

April 28, 1997

Prepared by:


**David Fox**
**Dredged Material Management Office**
Seattle District
Corps of Engineers

## 1.0 PROJECT DESCRIPTION, SITE HISTORY AND ASSESSMENT

**1.1 Project Description.** Hamm Creek will be realigned and 7 acres of a 22-acre piece of land adjacent to the Seattle City Light substation (see Figure 1) will be converted into a combined saltwater/freshwater wetland. This project is part of the Corps of Engineers Restoration Program and will be accomplished under Section 1135 of the Water Resources Development Act of 1986. Approximately 10,000 cubic yards will be excavated in creating meanders in Hamm Creek along West Marginal Way. This material will not be characterized for PSDDA disposal. An additional 80,000 cubic yards will be dredged in providing a new outlet for the creek to the Duwamish River, creating a saltwater marsh in the riverside area and excavating upland for a freshwater wetland. This material is proposed for open-water disposal at the Elliott Bay site or beneficial use and will therefore be characterized under PSDDA and SMS guidelines.

The PSDDA Evaluation Procedures Technical Appendix - Phase I (PSDDA, 1988 - page I-12) allows excavated material, that would otherwise not be allowed for open-water disposal, to be considered dredged material if an ecological benefit can be shown at the dredging site. This project has clear ecological benefit at the dredging site and therefore meets this criterion.

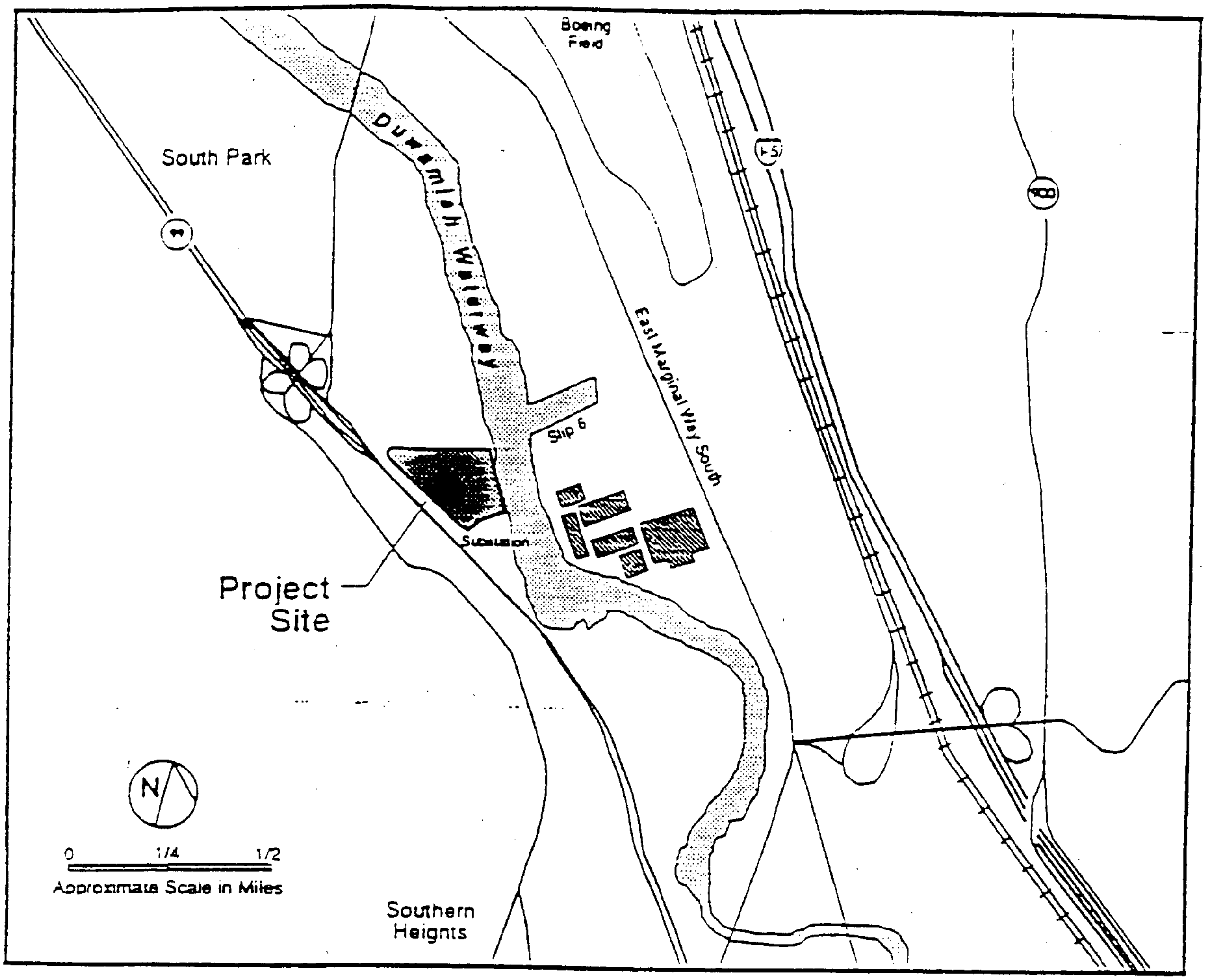
**1.2 Site History.** The Duwamish estuary was originally mudflat. Most of the area was subsequently filled and developed. A portion of the Seattle City Light property was filled and developed for use as a substation location. The remaining portion, upon which the proposed habitat restoration project will be located, was never developed for industrial or commercial purposes. It was however used as a dredged material stockpiling area. Following is a chronological listing of maps and dredged material placement events involving the site:

- Condition Survey - October 22, 1928 - U.S. Army Corps of Engineers. See Figure A1 in Appendix A. This map shows the Seattle City Light area platted but undeveloped. It is unknown whether the shoreline had been altered prior to this time, but the shoreline in this map was used as a baseline to show alterations at later times.

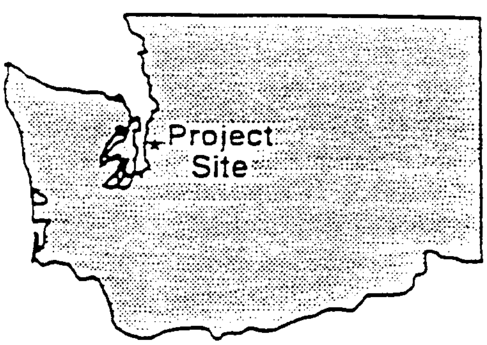
- Condition Survey - April 23, 1953 - U.S. Army Corps of Engineers. See Figure A2 in Appendix A. Development north of the site has begun (City Packing Company). While no records were found regarding fill on the site between 1928 and 1953, it appears that the shoreline has been straightened and a bulkhead has been constructed along the Duwamish River. If this map represents the actual configuration of the river in 1953, then it is likely that some fill has occurred in the area. There is no indication that Seattle City Light owned the property at this time.

- 1954 - U.S. Army Corps of Engineers dredging records indicate that a dike was constructed and 220,000 cubic yards of dredged material were placed on site as fill for construction of the Seattle City Light (City of Seattle Department of Lighting) substation. The disposal area was bounded by Ham and Schmitz Roads and W. Marginal Way, which encompasses the entire Seattle City Light property.

- Condition Survey - April 4, 1957 - U.S. Army Corps of Engineers. See Figure A3 in Appendix A. The bulkhead configuration has changed, with only that portion of the Seattle City Light property used for the substation now bulkheaded. Some dredging appears to have occurred along the rest of the Seattle City Light shoreline. Dredging records indicate that it was common practice to perform "clean-up" dredging along the shoreline of material that




Vicinity Map




Washington State

Project Site Locator Map

Figure 1

WESTON

JOB NUMBER: 3709-04-01 DATE: May 1990

AR 023234

had escaped from the disposal site during dredging operations. A "boundary of fill" is indicated on the map and includes the entire site.

- Condition Survey - April 19, 1960 - U.S. Army Corps of Engineers. See Figure A4 in Appendix A. The shoreline and bulkhead configuration has not changed since 1957. Transmission poles and towers are shown, as is a disposal area in the northern portion of the site. Records indicate that 294,000 cubic yards of dredged material were placed on site in 1960. Disposal area dikes, bulkheads and weirs were built with the cost reimbursed by the Department of Highways, which reused the dredged material for construction along Highway 1 (Pacific Coast Highway).

- 1968 - U.S. Army Corps of Engineers dredging records indicate that 375,000 cubic yards of dredged material were placed on site. The City of Seattle paid for the "extra diking" required and the Urban Renewal Department reused the dredged material for unspecified projects.

- 1971 - U.S. Army Corps of Engineers dredging records indicate that 325,000 cubic yards of dredged material were placed on site in May of 1971. General Construction leased the Seattle City Light property as a disposal area. Dikes were constructed by "cat and can" operation. Due to wet weather the top 4 feet of the dike was completed by dragline after the dredging started. The shoreline permit stated that the dike shall be constructed of pit run gravel or some other suitable material. Dredged material was not allowed to be used for dike construction. Bob Parker, the dredging manager for the Corps of Engineers at the time, indicated that pit run material would not have been used, that site material would have been scraped up and pushed into place to construct the dike.

- Condition Survey - November 21, 1975 - U.S. Army Corps of Engineers. See Figure A5 in Appendix A. The photograph was taken in September 1971, after the 1971 dredged material disposal event. It clearly shows the dredged material rehandling area and the diked perimeter. It appears from the bulldozer scrape marks that, within months of the May dredging event, much of the dredged material had already been rehandled and trucked off site. The shoreline differs from earlier drawings, showing perhaps that some filling had occurred.

- Condition Survey - July 31, 1983 - U.S. Army Corps of Engineers. See Figure A6 in Appendix A. The aerial photograph was taken in July 1980. The copy of the photograph is of poor quality but the site appears to be vegetated. The dike along the Duwamish River is still clearly visible and appears to have changed little since 1971. The shoreline had seen minor modifications since the earlier photograph.

- 1985 - Weston (1990) indicates that dredged material from the Duwamish Yacht Club was placed on site. See Appendix B for details.

<u>1.3 Site Description</u>. The following site description was taken from Weston (1990):

> "The property comprises approximately 20 acres of open grassy field. It is bounded to the south by Seattle City Light's Duwamish substation, to the north by the Delta Marine Industries facilities, to the east by the Duwamish Waterway, and to the west by West Marginal Place South, a frontage road of Highway 99...An open ditch runs along the west boundary of the property."

"The majority of the property is nearly level. A rectangular depression, approximately 200 feet on a side, is located in the east-central portion of the lease property. The depression apparently marks the area filled with dredged sediment in 1985. The depression appears to be an infilled impoundment in which dredged sediment was placed and allowed to drain."

"The easternmost portion of the property along the Duwamish Water [sic] contains several exposures of milled lumber debris mixed with sandy and clayey silt fill. The lumber-containing fill appears to be a separate fill unit from the 1968 or 1985 fills, although this is uncertain because the relationship between the fill units along the waterway is obscured by vegetation and recent sedimentation. Several decayed pilings are present along the waterway shoreline."

<u>1.4 Boeing Site Assessment.</u> Boeing conducted a site assessment in 1990 as part of its evaluation of a long-term lease option. The 1968 dredged fill was evaluated for metals and PAHs, while the 1985 dredged fill was evaluated for metals, semi-volatiles and PCBs. Additional soil samples were taken from the fence line along the substation perimeter and analyzed for PCBs and chlorinated pesticides. Groundwater was assessed for volatile organics to determine whether any spills had impacted the site.

Of the soil chemicals analyzed, only cadmium and mercury were detected above the PSDDA SL, with maximum concentrations of 1.3 and 0.51 mg/kg respectively. No organics were detected above PSDDA SLs. However, detection limits in the site assessment were geared toward meeting the Washington Model Toxics Control Act Cleanup Regulations rather than PSDDA testing requirements, therefore a number of detection limits were above the PSDDA SLs. For example, PCBs were not detected in the 1985 dredged fill, but the detection limit for Aroclor-1254 and Aroclor-1260 was 210 ug/kg (SL = 130). The only chemical detected in the groundwater was acetone, a common laboratory contaminant.

Weston (1990) includes the following description of the subsurface stratigraphy:

"The subsurface investigation indicates that the property is underlain by approximately 5 to 10 feet of stratified, heterogeneous fill that, in turn, overlies alluvium of the Duwamish River floodplain. Apart from the man-made levee along the present bank of the Duwamish Waterway, the fill appears to thicken progressively westward across the property. The fill is thinnest (5.5 to 6.2 feet) in the topographic depression in the east portion of the property that apparently coincides with the limits of the 1985 dredge fill."

"Relatively little lithologic or textural difference was noted between the 1968 and 1985 fills. The fill is composed predominantly of crudely layered silty sand and clayey silt. The upper 1 to 4 feet of the fill is typically a loose to medium-dense, moist, brown, silty sand. Dense, black, carbonaceous, fine sand and stiff, black, clayey silt typically occur beneath the surface layer. The black sand and silt often contain abundant wood fragments. In some borings, a saturated, gray, well-graded sand layer 0 to 4 feet thick occurs at or near the base of the fill."

"Fill overlying alluvium was also observed in an eroded exposure along the west bank of the Duwamish Waterway. Very abundant milled lumber debris occurs in a sandy to clayey matrix at low elevations along the bank and may be a separate fill unit from the 1968 and 1985 dredge fill units described here."

"Alluvium underlying the fill consists of approximately 2 to 3 feet of gray, mottled, massive, clayey silt that often contains plant fragments. Below the mottled clayey silt is a 1.5 to 4-foot-thick unit composed of thinly bedded, gray and brown, clayey silt and fine sand. In the three deepest borings, (i.e., MW-1, MW-2, and MW-3), a minimum of 3 to 7 feet of saturated, gray sand is present at the base of the explorations. The total thickness of this sand unit at the site is not known because it was not fully penetrated by any of the borings. The alluvium is interpreted to be fine-grained bioturbated and stratified overbank deposits and coarser channel sands of the Duwamish River."

See Appendix B for details of the site assessment.

## 2.0 SAMPLING AND ANALYSIS OBJECTIVES

The sediment characterization program objectives and constraints are summarized below:

- To characterize sediments to be dredged in conformance with PSDDA requirements to enable the PSDDA agencies to provide a suitability determination relative to PSDDA disposal.

- To provide detection limits comparable to SMS standards where practicable in order to allow determination of the acceptability of beneficial use of dredged material.

- To collect, handle and analyze representative sediment core samples characterizing the full dredging prism in accordance with protocols and QA/QC requirements outlined in the PSDDA Evaluation Procedures Technical Appendix (June 1988), the updated procedures documented in Chapter 5 and Appendix A of the PSDDA Phase II Management Plan Report (September, 1989), modifications made through the PSDDA Annual Review Process and procedures presented in PSEP Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound.

- To conduct core sampling, compositing and analyses in a timely manner to meet PSDDA requirements for sample holding times, including those related to possible biological analysis if needed.

## 3.0 PROJECT TEAM AND RESPONSIBILITIES

The sediment characterization program will include 1) project planning and agency coordination, 2) field sample collection, 3) laboratory preparation and analysis, 4) QA/QC management and 5) final data report. Staffing and responsibilities are outlined below:

Table 1. PSDDA characterization responsibilities

| Task/Responsibility | Pat Cagney | David Fox | Lisa Roach | Mark Fugiel | Ormerod/ Redmond |
|---|---|---|---|---|---|
| Overall project management | ✓ | | | | |
| Sampling plan development | | ✓ | | | |
| Positioning | | | ✓ | | |
| Sediment sampling | | | ✓ | | |
| Compositing/subsampling | | | ✓ | | |
| Chemical analysis & QA | | | | ✓ | |
| Biological analysis & QA | | | | | ✓ |
| Final Report | | | ✓ | | |

Pat Cagney, U.S. Army Corps of Engineers, Seattle District, Environmental Resources Section
David Fox, U.S. Army Corps of Engineers, Seattle District, Dredged Material Management Office
Lisa Roach, Science Application International Corporation, Bothell
Mark Fugiel, AmTest Laboratories, Seattle
Dayle Ormerod, Parametrix, Kirkland
Michelle Redmond, NW Aquatic Sciences, Newport

## 4.0 PSDDA SAMPLING AND ANALYSIS REQUIREMENTS

### 4.1 PSDDA Ranking.

The proposed restoration site is adjacent to the section of the Duwamish River where the rank for the federal navigation project changes from low-moderate to high-ranked. However, the site assessment completed by Boeing in 1990 indicates that the material proposed to be dredged for this project should be ranked low-moderate for PSDDA characterization. The maximum concentrations of the only detected metals, cadmium and mercury, were between SL and (SL+ML)/2, the range associated with a low-moderate rank (EPTA 1988). All detected concentrations of organics were below SLs. Detection limits for undetected organics were generally in the low to low-moderate range, including the detection limits for PCBs.

In addition, dike material appears to have come from onsite. Since the site had never been developed for industrial use and since the Boeing site assessment did not show any chemicals of concern at concentrations above those qualifying for a low-moderate rank, a low-moderate rank was used to determine the sampling and analysis requirements for this project.

### 4.2 Sampling and Analysis Requirements.

Based on a low-moderate rank, full characterization requirements for this project are outlined below:

| | |
|---|---|
| Surface Sediments:<br>(0 to 4 ft.) | One core section for every 8,000 cubic yards and one laboratory analysis for each 32,000 cubic yards. |
| Subsurface Sediments:<br>(> 4 ft.) | One core section for every 8,000 cubic yards and one laboratory analysis for each 48,000 cubic yards. |

The estimated total volume of material to be characterized for PSDDA disposal is 80,000 cubic yards. The quantity and related sampling requirements are distributed as follows:

Table 2. PSDDA sampling and testing requirements

| Depth Interval | Volume (cu.yds.) | Minimum No. of Core Sections | Number of Analyses |
|---|---|---|---|
| 0-4 ft. | 32,000 | 4 | 1 |
| >4 ft. | 48,000 | 6 | 1 |
| Total | 80,000 | 10 | 2 |

## 5.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

### 5.1 Sampling and Compositing Scheme.

Figure 2 shows the existing ground elevations, while Figure 3 shows the design elevations and PSDDA sampling locations. Table 3 includes the existing and design elevations at each sampling location, the total length of each PSDDA bore, and the core section designations at each location. Table 4 shows the corresponding core sections and laboratory composites. The "Z" samples will be taken from the first foot beyond the design depth at stations 2 and 4 and archived for potential future analysis.

Table 3. Sampling station elevations and boring depths

| Sampling Station Number | Existing Elevation (MLLW) | Design Elevation (MLLW) | Length of Sediment Bores (including "Z" samples) | Core Section Designations and Depths |
|---|---|---|---|---|
| 1 | +23 | +4 | 19 | A +23 to +19<br>B +19 to +15<br>C +15 to +11<br>D +11 to +7<br>E +7 to +4 |
| 2 | +25 | +13 | 13 | A +25 to +21<br>B +21 to +17<br>C +17 to +13<br>Z +13 to +12 |
| 3 | +21 | +11 | 10 | A +21 to +17<br>B +17 to +13<br>C +13 to +11 |
| 4 | +23 | +13 | 11 | A +23 to +19<br>B +19 to +15<br>C +15 to +13<br>Z +13 to +12 |

Table 4. Sample Compositing Plan

| DMMU | Core Sections | Volume (CY) |
|---|---|---|
| C1 | 1A/2A/3A/4A | 32,000 |
| C2 | 1BCDE/2BC/3BC/4BC | 48,000 |

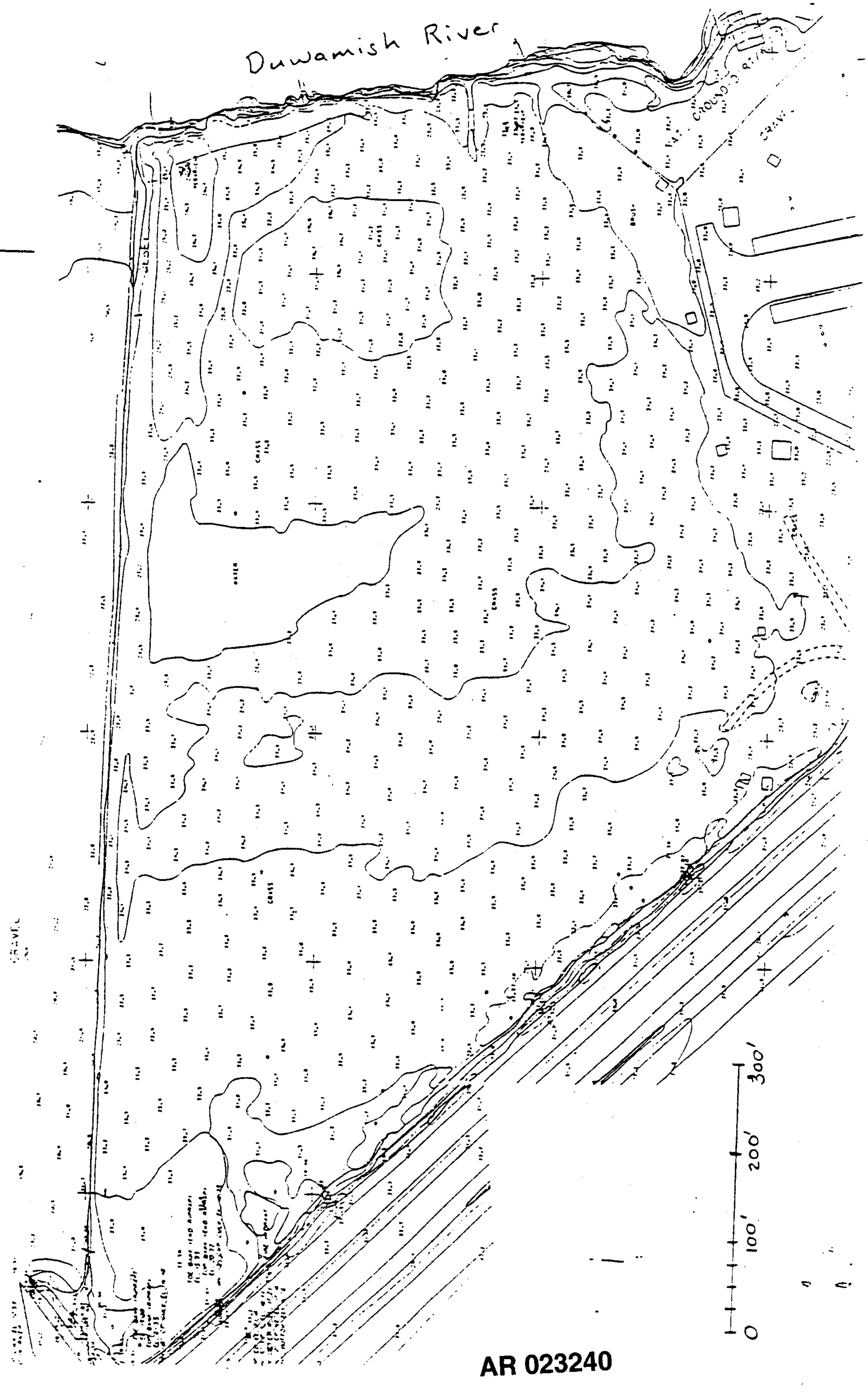



Figure 2

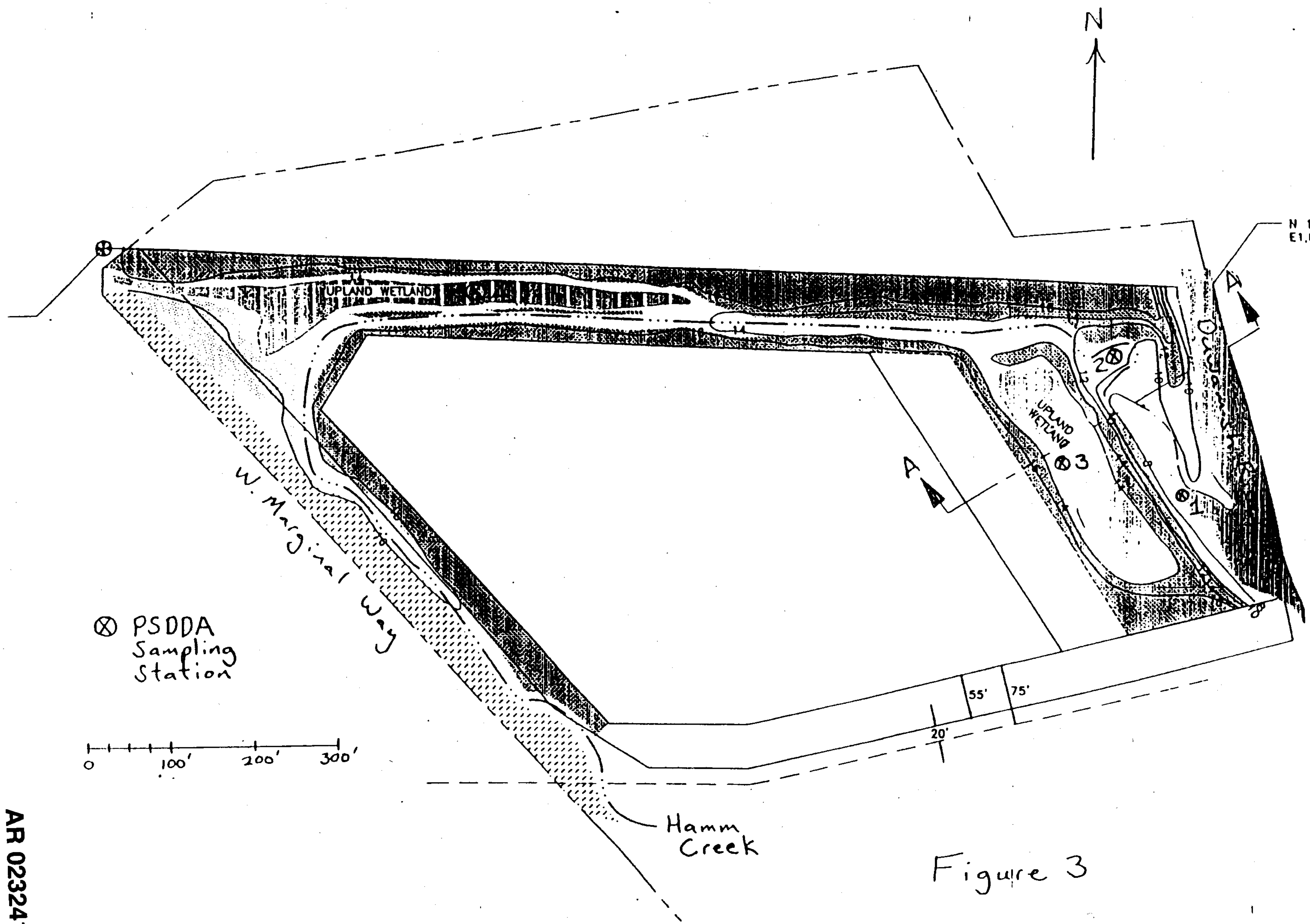



Figure 3

AR 023241

5.2 Field Sampling Schedule. Sampling is planned for May 1997. All sampling will be completed in a single day. Compositing will occur in the field and laboratory samples will be delivered the same day to AmTest.

5.3 Sample Collection Method. Samples will be collected using a truck-mounted, hollow-stem auger drilling rig equipped with a split-spoon sampler. The first sample will be collected from zero to two feet of depth. The auger will then be advanced to the bottom of the sample depth and the next two-foot sample will be taken. These two subsamples will be labeled "A1" and "A2" on the boring logs.

This method of sampling, retrieval and auger advancement at two foot intervals will be utilized until the total sample depth is reached. The recovered subsurface core-segments will be labeled in alphabetical order starting with "B". There will be two cores for each letter, except in those cases where the deepest core is two feet long or less. Compositing will follow the scheme presented in Table 4. The "Z" samples will be taken from stations 2 and 4, consisting of one foot of sediment beyond the design depth at these two stations.

5.4 Field Notes. Field notes will be maintained during sampling and compositing operations. Included in the field notes will be the following:

- Names of the drilling rig operator and person(s) collecting and logging in the samples.
- Weather conditions.
- Elevation of each boring station sampled as measured from mean lower low water (MLLW NAD83). This will be accomplished using a surveyor's level to determine the elevation at the sampling location referenced to an on-site vertical reference.
- Date and time of collection of each sediment split-spoon sample.
- The sample station number as derived from Figure 2 and Table 3, and individual designation numbers assigned for each individual core section.
- Descriptions of core sections.
- Any deviation from the approved sampling plan.

5.5 Positioning. Sampling locations will be surveyed and flagged prior to the actual sampling effort. The flagged stations will be used to position the drill auger during sampling. Elevations will be referenced to local MLLW (NOAA). Horizontal coordinates will be referenced to the Washington Coordinate System for proper North or South Zones NAD 83 (North American Datum 1983). Horizontal coordinates will be converted and identified as latitude and longitude (NAD 83) to the nearest 0.1 second.

5.6 Decontamination. The split-spoon, stainless steel compositing pans and sampling utensils will be thoroughly cleaned prior to use according to the following procedure:

- Wash with brush and Alconox soap
- Tap Water Rinse
- Rinse with distilled water
- Rinse with 10% nitric acid solution
- Rinse with methanol
- Rinse with distilled water

All hand work will be conducted with disposable latex gloves which will be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between composites to prevent cross contamination between the DMMUs.

5.7 Volatiles Subsampling. For one randomly chosen core section from each composite, two subsamples will be removed for volatile organics testing immediately upon opening the split-spoon. The samples will be taken from along the entire length of the core section, from sediment which has not had contact with the split spoon.

Two separate 4-ounce containers will be completely filled with sample sediment for volatiles. No headspace will be allowed to remain in either container. Two samples are collected to ensure that an acceptable sample with no headspace is submitted to the laboratory for analysis. Prior to sampling, the containers, screw caps, and cap septa (silicone vapor barriers) will have been washed with detergent, rinsed once with tap water, rinsed at least twice with distilled water, and dried at >105 C. A solvent rinse will not be used because it may interfere with the analysis.

To avoid leaving headspace in the containers, sample containers can be filled in one of two ways. If there is adequate water in the sediment, the vial will be filled to overflowing so that a convex meniscus forms at the top. Once sealed, the bottle will be inverted to verify the seal by demonstrating the absence of air bubbles. If there is little or no water in the sediment, jars will be filled as tightly as possible, eliminating obvious air pockets. With the cap liner's PTFE side down, the cap will be carefully placed on the opening of the vial, displacing any excess material.

The volatiles sampling jars will be clearly labeled with the project name, sample/composite identification, type of analysis to be performed, date and time, and initials of person(s) preparing the sample, and referenced by entry into the log book

Table 5 contains those cores, randomly selected, which will be used to collect representative sediment for volatiles sampling.

Table 5. Random core sections for volatiles samples

| DMMU | Random core section |
|---|---|
| C1 | 2A2 |
| C2 | 3B1 |

5.8 Core Logging. After the volatiles sample has been taken, each discrete core section will then be inspected and described. For each split-spoon sample, the following data will be recorded on the core log:

- Depth interval of each core section as measured from MLLW.
- Sample recovery
- Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, color)
- Odor (e.g., hydrogen sulfide, petroleum products)
- Visual stratifications and lenses
- Vegetation
- Debris

- Presence of oil sheen
- Any other distinguishing characteristics or features

<u>5.9 Compositing.</u> After the core section has been logged, the remaining contents of the split-spoon will be placed in a stainless-steel pan and the pan covered with foil. Separate pans will be kept for surface and subsurface core sections and for the individual "Z" samples. Once all core sections for a composite have been collected and placed into the same stainless steel pan, the sample will be stirred and homogenized until a consistent color and texture is achieved.

At least 7 liters of homogenized sample will be prepared to provide adequate volume for laboratory analyses. Physical, chemical and bioassay samples will be taken from the same homogenate. Portions of each composite sample will be placed in appropriate containers obtained from the chemical and biological laboratories ("Z" samples will be archived for physical and chemical testing only). Each sample container will be clearly labeled with the project name, sample/composite identification, type of analysis to be performed, date and time, and initials of person(s) preparing the sample, and referenced by entry into the log book. See Table 6 for sample volume and storage information.

Approximately 15-20 additional liters of sediment would be required for bioaccumulation testing. This additional volume will not be collected at this time, as the requirement to conduct bioaccumulation testing is not anticipated.

<u>5.10 Sample Transport and Chain-of-Custody Procedures.</u> After sample containers have been filled they will be packed on blue ice in coolers. The coolers will be transferred to AmTest at the end of the day. Chain-of-custody procedures will commence in the field and will track delivery of the samples to AmTest. Specific procedures are as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24.
- Individual sample containers will be packed to prevent breakage.
- The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler and SAIC's office name and address) to enable positive identification.
- A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- Signed and dated chain-of-custody seals will be placed on all coolers prior to shipping.

Upon transfer of sample possession to the compositing laboratory, the chain-of-custody form will be signed by the persons transferring custody of the coolers. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples will be recorded by the receiver.

Table 6. Sample volume and storage

| Sample Type | Holding Time | Sample Size[a] | Temperature[b] | Container | Archive[c] |
|---|---|---|---|---|---|
| Particle Size | 6 Months | 200g | 4°C | 1-liter Glass (combined) | X |
| Total Solids | 14 Days | 125g | 4°C | | |
| Total Volatile Solids | 14 Days | 125 g | 4°C | | |
| Total Organic Carbon | 14 Days | 125 g | 4°C | | |
| Metals (except Mercury) | 6 Months | 50 g | 4°C | | |
| Semivolatiles, Pesticides and PCBs | 14 Days until extraction<br><br>1 Year until extraction<br><br>40 Days after extraction | 150 g | 4°C<br><br>-18°C<br><br>4°C | | |
| Mercury | 28 Days | 5 g | -18°C | 125 ml Glass | |
| Volatile Organics | 14 Days | 100 g | 4°C | 2-40 ml Glass | |
| Bioassay | 8 Weeks | 4 L | 4°C | 6-1 liter Glass[d] | |

a. Required sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retests.
b. During transport to the lab, samples will be stored on blue ice.
c. For every DMMU, a 250 ml container is filled and frozen to run any or all of the analyses indicated.
d. Containers will be completely filled with no headspace allowed.

## 6.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

The surface and subsurface composited samples will be analyzed for all the parameters listed in Appendix C and will be compared to PSDDA guidelines for open-water disposal, as well as the SMS sediment quality standards (SQS) to determine the potential for beneficial use.

**6.1 Laboratory Analyses Protocols**. Laboratory testing procedures will be conducted in accordance with the PSDDA Evaluation Procedures Technical Appendix, June 1988; the PSDDA Phase II Management Plan Report, September 1989; and with the PSEP Recommended Protocols. Several details of these procedures are discussed below.

**6.1.1 Chain-of-custody.** A chain-of-custody record for each set of samples will be maintained throughout all sampling activities and will accompany samples and shipment to the laboratory. Information tracked by the chain-of-custody records in the laboratory include sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

**6.1.2 PSDDA Limits of Detection.** For purposes of PSDDA testing, detection limits of all chemicals of concern must be below PSDDA screening levels. Failure to achieve this may result in a requirement to reanalyze or perform bioassays. The testing laboratory will be specifically cautioned by SAIC to make certain that it complies with the PSDDA detection limit requirements. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-detection below PSDDA SLs. In addition, an aliquot (250 ml) of each sediment sample for analysis will be archived and preserved at -18 C for additional analysis if necessary.

The following scenarios are possible and will be handled appropriately:

1. One or more chemicals-of-concern (COC) have limits of detection exceeding screening levels while all other COCs are quantitated or have limits of detection at or below the screening levels: the requirement to conduct biological testing would be triggered solely by limits of detection. In this case the chemical testing subcontractor will do everything possible to bring limits of detection down to or below the screening levels, including additional cleanup steps, re-extraction, etc. This is the only way to prevent unnecessary biological testing. If problems or questions arise, the chemical testing subcontractor will be directed to contact the Dredged Material Management Office.

2. One or more COCs have limits of detection exceeding screening levels for a lab sample, but below respective bioaccumulation triggers (BT) and maximum levels (ML), and other COCs have quantitated concentrations above screening levels: The need to do bioassays is based on the detected exceedances of SLs and the limits of detection above SL become irrelevant. No further action is necessary.

3. One or more COCs have limits of detection exceeding SL and exceeding BT or ML, and other COCs have quantitated concentrations above screening levels: the need to do bioassays is based on the detected exceedances of SLs but all other limits of detection must be brought below BTs and MLs to avoid the requirement to do bioaccumulation testing or special biological testing. As in case i) everything possible will be done to lower the limits of detection.

4. One COC is quantitated at a level which exceeds ML by more than 100%, or more than one COC concentration exceeds ML: there is reason to believe that the test sediment is unsuited for open-water disposal without additional chronic sublethal testing data. In the absence of chronic sublethal data, problems with limits of detection for other COCs are irrelevant. No further action is necessary.

In all cases, to avoid potential problems and leave open the option for retesting, sediments or extracts will be kept under proper storage conditions until the chemistry data is deemed acceptable by the PSDDA agencies.

**6.1.3 SMS Limits of Detection.** For purposes of comparison to SQS, a tiered approach will be used to evaluate detection limits:

- Detection limits will be compared to the July 1996 draft SMS detection limits. While the laboratory will be instructed to attempt to meet these recommended detection limits, it should be noted that some of these are very low (e.g. Aroclors) and may be unobtainable.
- If the recommended SMS detection limits cannot be met, a secondary comparison will be made directly to SQS, carbon-normalizing where appropriate.
- In addition, the 1988 dry-weight LAETs may be used if necessary to evaluate detection limits.

See Appendix C for a complete listing of these guidelines.

**6.1.4 Sediment Conventionals.** All conventional parameters will be analyzed. Particle grain size distribution for each composite sample will be determined in accordance with ASTM D 422 (modified). Wet sieve analysis will be used for the sieve sizes U.S. No. 4, 10, 20, 40, 60, 140, 200 and 230. Hydrogen peroxide will not be used in preparations for grain-size analysis. Hydrometer analysis will used for particle sizes finer than the 230 mesh. Water content will be determined using ASTM D 2216. Sediment classification designation will be made in accordance with U.S. Soil Classification System, ASTM D 2487.

**6.1.5 Holding Times.** The tiered testing option will be implemented for biological testing (see Section 7, Biological Testing). To the maximum extent practicable all chemical results will be provided within 28 days of sampling to allow a timely decision for tiered biological testing. Sediment samples reserved for potential bioassays will be stored under chain-of-custody by SAIC.

All samples for physical, chemical and biological testing will be maintained at the testing laboratory at the temperatures specified in Table 6 and analyzed within the holding times shown in the table.

**6.1.6 Quality Assurance/Quality Control.** The chemistry QA/QC procedures found in Table 7 will be followed.

6.2 Laboratory Written Report. A written report will be prepared by the analytical laboratory documenting all the activities associated with sample analyses. As a minimum, the following will be included in the report:

- Results of the laboratory analyses and QA/QC results.
- All protocols used during analyses.
- Chain of custody procedures, including explanation of any deviation from those identified herein.

- Any protocol deviations from the approved sampling plan.
- Location and availability of data.

As appropriate, this sampling plan may be referenced in describing protocols.

In addition, QA2 data required by Ecology for the SEDQUAL database will be submitted to the DMMO along with the report (see Appendix D for QA2 requirements).

**Table 7. Minimum Laboratory QA/QC**

| Analysis Type | Method Blank[2] | Duplicate[2] | RM[2,4] | Matrix Spikes[2] | Surrogates[7] |
|---|---|---|---|---|---|
| Volatile Organics[1] | X | X[3] | | X | X |
| Semivolatiles[1] | X | X[3] | X[5] | X | X |
| Pesticides/PCBs[1] | X | X[3] | X[5] | X | X |
| Metals | X | X | X[6] | X | |
| Total Organic Carbon | X | X | X[6] | | |
| Total Solids | | X | | | |
| Total Volatile Solids | | X | | | |
| Particle Size | | X | | | |

1. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria. Ongoing calibration required at the beginning of each work shift, every 10-12 samples or every 12 hours (whichever is more frequent), and at the end of each shift.

2. Frequency of Analysis = one per batch

3. Matrix spike duplicate will be run

4. Reference Material

5. Canadian standard SRM-1

6. NIST certified reference material 2704

7. Surrogate spikes will be included with every sample, including matrix-spiked samples, blanks and reference materials

## 7.0 BIOLOGICAL TESTING

<u>7.1 Bioassay Laboratory Protocols.</u> The tiered testing approach will be used. Biological testing will be undertaken on any composite sample which has one or more chemicals of concern above the PSDDA screening level (SL). If more than one COC exceeds the PSDDA maximum level (ML) or if a single COC is greater than two times its ML, then biological testing will not be conducted. If any COC exceeds a bioaccumulation trigger (BT), a decision will be made as to whether or not to pursue biological testing. To the maximum extent practicable, chemical results will be provided for bioassay decisions within 28 days of first sample collection. The remaining four-week period will allow time for bioassay preparation as well as time for retests if necessary.

Bioassay testing requires that test sediments be matched and run with an appropriate PSDDA-approved reference sediment to factor out sediment grain-size effects on bioassay organisms. SAIC will coordinate with DMMO in making this match. Wet-sieving in the field, using a 63-micron sieve, will be utilized in identifying a suitable reference station.

The acute toxicity and chronic sublethal bioassays prescribed by PSDDA (amphipod, sediment larval, *Neanthes* growth) will be conducted on each sample identified for biological testing. All biological testing will be in strict compliance with *Recommended Protocols for Conducting Laboratory Bioassays on Puget Sound sediments* (1995), with appropriate modifications as specified by PSDDA in the MPR-Phase II, public workshops and the annual review process. General biological testing procedures and specific procedures for each sediment bioassay are summarized below:

<u>**7.2 General Biological Testing Procedures.**</u>

**7.2.1 Negative Controls.** Negative control sediments are used in the amphipod and *Neanthes* bioassays to check laboratory performance. Negative control sediments are clean sediments in which the test organism normally lives and which are expected to produce low mortality. The sediment larval test utilizes a negative seawater control rather than a control sediment. The amphipod, sediment larval and *Neanthes* tests all have performance standards for negative controls, which are identified in Section 7.3.

**7.2.2 Reference Sediment.** All bioassays have performance standards for reference sediments (see Section 7.3). Failure to meet these standards may result in the requirement to retest. All reference sediments will be analyzed for total solids, total volatile solids, total organic carbon and grain-size.

**7.2.3 Replication.** Five laboratory replicates of test sediments, reference sediments and negative controls will be run for each bioassay.

**7.2.4 Positive Controls.** A positive control will be run for each bioassay. Cadmium chloride will be used for all three bioassays.

**7.2.5. Interstitial salinity, ammonia and sulfides.** For the *Neanthes* and amphipod bioassays, sacrificial beakers will be used to determine interstitial salinity, ammonia and sulfides for all test and reference sediments at the beginning and end of the test period.

**7.2.6 Water Quality Monitoring.** Water quality monitoring will be conducted for the amphipod, sediment larval and *Neanthes* bioassays. This consists of daily measurements of salinity, temperature, pH and dissolved oxygen for the amphipod and sediment larval tests. These measurements will be made every three days for the *Neanthes* bioassay. Overlying ammonia and sulfides will be determined at test initiation and termination for the larval test. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls). Parameter measurements must be within the limits specified for each bioassay. Measurements for each treatment will be made on a separate chemistry beaker set up to be identical to the other replicates within the treatment group, including the addition of test organisms.

7.3 Bioassav-specific Procedures.

7.3.1 **Amphipod Bioassay**. NW Aquatic Sciences will conduct this test, which involves exposing the amphipod *Rhepoxynius abronius*, *Ampelisca abdita* or *Eohaustorius estuarius* to test sediment for ten (10) days and counting the surviving animals at the end of the exposure period. Daily emergence data and the number of amphipods failing to rebury at the end of the test will be recorded as well. The control sediment has a performance standard of 10 percent mortality. The reference sediment has a performance standard of 20 percent mortality greater than control.

7.3.2 **Sediment Larval Bioassay.** This test monitors larval development of a suitable bivalve or echinoderm species (e.g. *Stronglyocentrotus purpuratus* or *Dendraster excentricus*) in the presence of test sediment. The test is run until the appropriate stage of development is achieved in a sacrificial seawater control (PSDDA MPR-Phase II, pp. 5-20). At the end of the test, larvae from each test sediment exposure are examined to quantify abnormality and mortality.

The seawater control has a performance standard of 30 percent combined mortality and abnormality. The reference sediment has a performance standard of 35 percent combined mortality and abnormality normalized to seawater control.

Initial counts will be made for a minimum of five 10-ml aliquots. Final counts for seawater control, reference sediment and test sediment will be made on 10-ml aliquots.

The sediment larval bioassay has a variable endpoint (not necessarily 48 hours) which is determined by the developmental stage of organisms in a sacrificial seawater control (PSDDA MPR Phase II, page 5-20).

Aeration will be conducted throughout the test to minimize effects from sulfides.

7.3.4 ***Neanthes* Growth Test.** This test utilizes the polychaete *Neanthes arenaceodentata*, in a 20-day growth test. The growth rate of organisms exposed to test sediments is compared to the growth rate of organisms exposed to a reference sediment. *Neanthes* will be obtained from Dr. Don Reish in Long Beach, California. Neanthes worms from Don Reish's lab may take 2 or 3 weeks to culture and deliver and will be ordered regardless of the outcome of the chemical characterization.

The control sediment has a performance standard of 10 percent mortality. The reference sediment has performance standards of 80 percent of the control growth rate and 20 percent mortality.

**7.4 Interpretation.** Test interpretations consist of endpoint comparisons to controls and reference on an absolute percentage basis as well as statistical comparison to reference. Test interpretation will follow the guidelines established in the PSDDA Management Plan Report-Phase II (page 5-17) for the amphipod and sediment larval bioassays, and the minutes of the dredging year 1991 annual review meeting for the *Neanthes* bioassay, as modified by subsequent annual review proceedings and workshops.

**7.5 Bioassay Retest.** Any bioassay retests must be fully coordinated with, and approved by, the PSDDA agencies. The DMMO will be contacted to handle this coordination.

**7.6 Laboratory Written Report.** A written report will be prepared by the biological laboratory documenting all the activities associated with sample analyses. As a minimum, the following will be included in the report:

- Results of the laboratory bioassay analyses and QA/QC results, including all DAIS data found in Appendix E.
- All protocols used during analyses, including explanation of any deviation from PSEP and the approved sampling plan.
- Chain of custody procedures, including explanation of any deviation from the identified protocols.
- Location and availability of data, laboratory notebooks and chain-of-custody forms.

As appropriate, this sampling plan may be referenced in describing protocols.

## 8.0 REPORTING

**8.1 QA Report.** The project quality assurance representative will prepare a quality assurance report based upon activities involved with the field sampling and review of the laboratory analytical data. The laboratory QA/QC reports will be incorporated by reference. This report will identify any field and laboratory activities that deviated from the approved sampling plan and the referenced protocols and will make a statement regarding the overall validity of the data collected. The QA/QC report will be incorporated into the Final Report.

**8.2 Final Report.** A written report shall be prepared by SAIC documenting all activities associated with collection, compositing, transportation of samples, and chemical and biological analysis of samples. The chemical and biological reports will be included as appendices. As a minimum, the following will be included in the Final Report:

- Type of sampling equipment used.
- Protocols used during sampling and testing and an explanation of any deviations from the sampling plan protocols.
- Descriptions of each sample.
- Locations where the sediment samples were collected. Locations will be reported in latitude and longitude to the nearest tenth of a second.
- A plan view of the project showing the actual sampling location.
- Chain of-custody procedures used, and explanation of any deviations from the sampling plan procedures.
- Description of sampling and compositing procedures.
- Final QA report for Section 8.1 above.
- Chemical and biological testing data, with comparisons to PSDDA and SMS guidelines.
- QA2 data required by the Department of Ecology for data validation prior to entering data in their Sediment Quality database. These data are listed in Appendix D.
- Sampling and analysis cost data will be submitted upon project completion on forms provided by the Dredged Material Management Office.

## 9.0 REFERENCES

PSEP, *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*, 1986-1996, Puget Sound Estuary Program.

PSDDA, 1988. *Evaluation Procedures Technical Appendix - Phase I*, prepared by the PSDDA agencies.

Weston, 1990. *Baseline Soil and Groundwater Quality Assessment, Seattle City Light Long-Term Lease Option, Seattle, Washington*. Prepared for Boeing Environmental Affairs, Seattle, Washington by Roy F. Weston, Inc., Seattle, Washington.

# APPENDIX A

## Historical Maps and Photographs

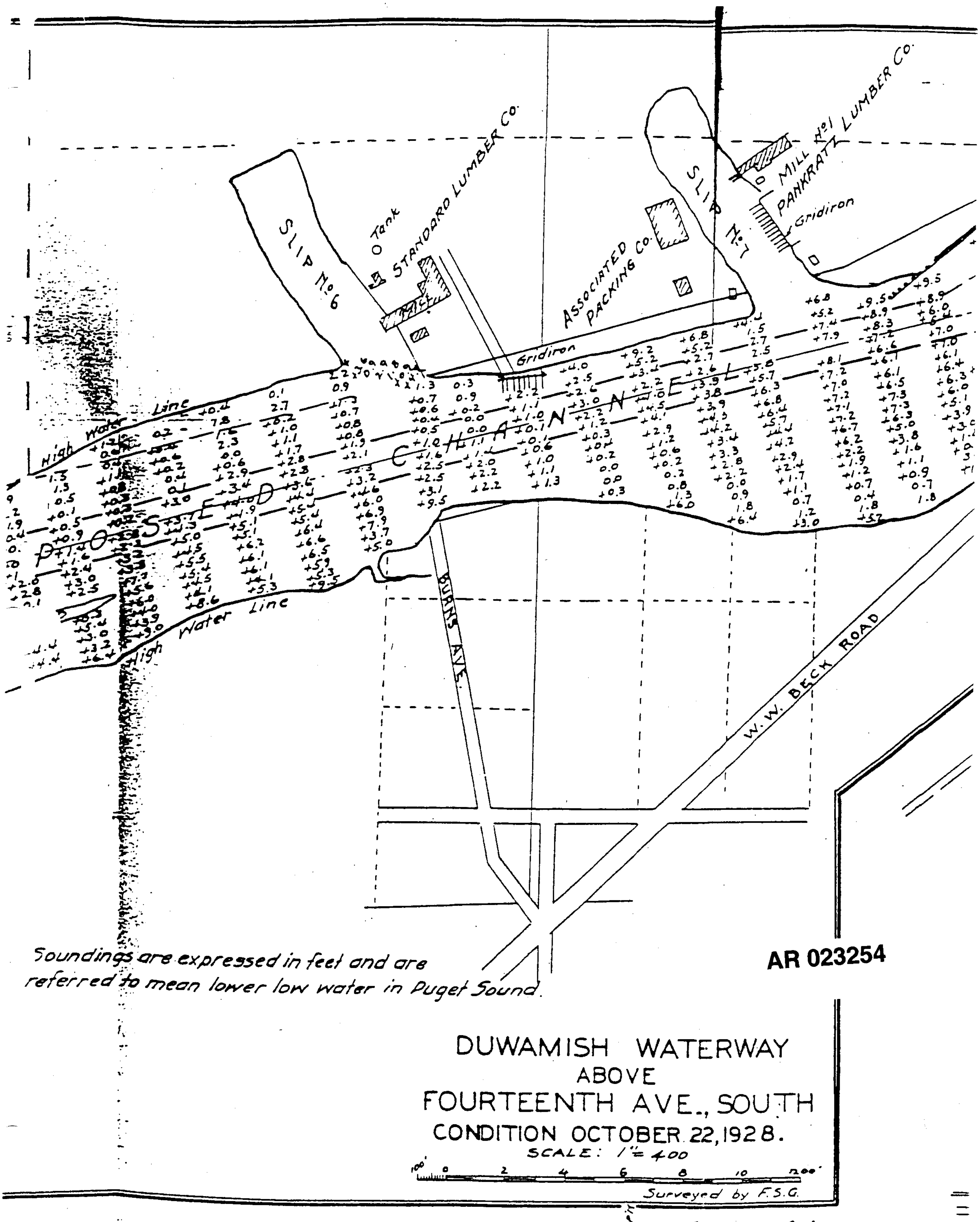

SLIP No 6
Tank
STANDARD LUMBER Co.
ASSOCIATED PACKING Co.
SLIP No 7
MILL No 1
PANKRATZ LUMBER Co.
Gridiron
Gridiron
High Water Line
PROPOSED CHANNEL
High Water Line
BURNS AVE.
W. W. BECK ROAD
Soundings are expressed in feet and are referred to mean lower low water in Puget Sound.
DUWAMISH WATERWAY
ABOVE
FOURTEENTH AVE., SOUTH
CONDITION OCTOBER 22, 1928.
SCALE: 1" = 400
Surveyed by F.S.G.



Figure A1

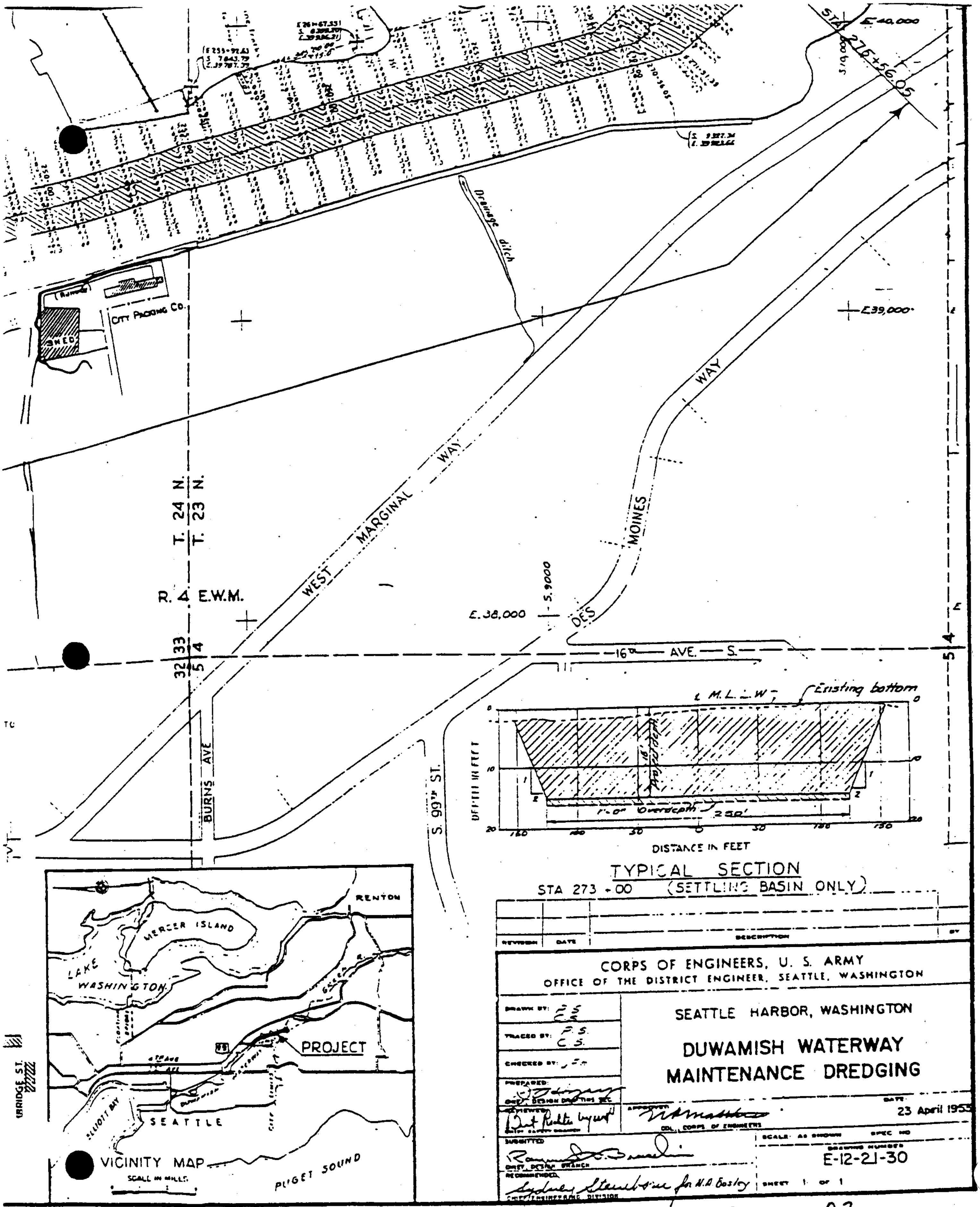
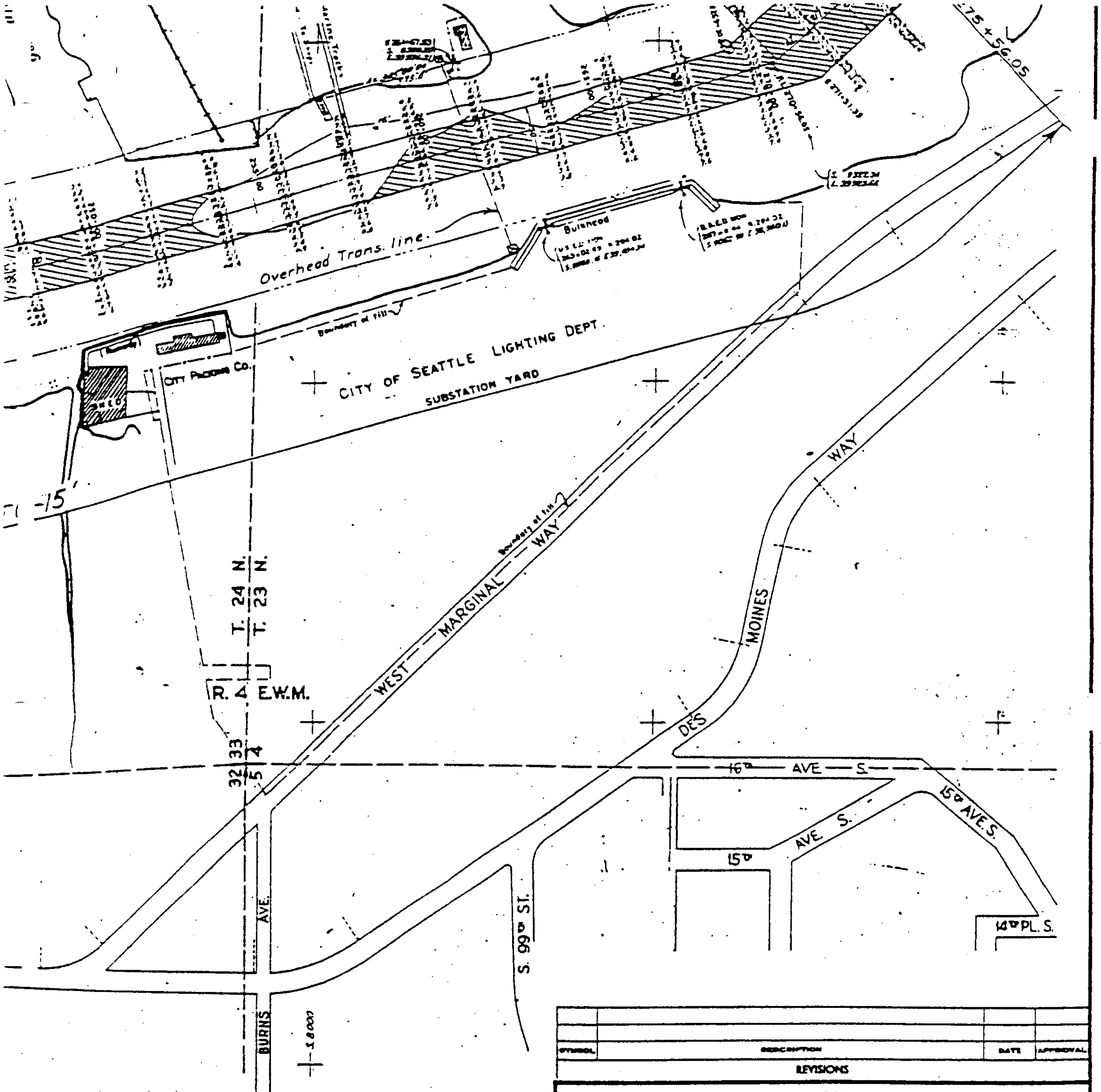

STA 276+56.05
E 40,000
E 39,000
E 38,000
S 9000
CITY PACKING CO.
SHED
Drainage ditch
WEST MARGINAL WAY
DES MOINES WAY
T. 24 N.
T. 23 N.
R. 4 E.W.M.
16TH AVE. S.
BURNS AVE
S. 99TH ST.
M.L.L.W.
Existing bottom
1'-0" Overdepth
250'
DEPTH IN FEET
DISTANCE IN FEET
TYPICAL SECTION
STA 273+00 (SETTLING BASIN ONLY)
RENTON
MERCER ISLAND
LAKE WASHINGTON
PROJECT
ELLIOTT BAY
SEATTLE
PUGET SOUND
VICINITY MAP
SCALE IN MILES
REVISION
DATE
DESCRIPTION
BY
CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, SEATTLE, WASHINGTON
SEATTLE HARBOR, WASHINGTON
DUWAMISH WATERWAY
MAINTENANCE DREDGING
DRAWN BY: F.S.
TRACED BY: F.S. C.S.
CHECKED BY:
PREPARED:
REVIEWED:
APPROVED:
COL., CORPS OF ENGINEERS
DATE: 23 April 1953
SUBMITTED
CHIEF, DESIGN BRANCH
RECOMMENDED:
for N.A. Easley
CHIEF, ENGINEERING DIVISION
SCALE: AS SHOWN
DRAWING NUMBER
E-12-21-30
SHEET 1 OF 1

Figure A2




Project dimensions 15' x 150

THIS DRAWING HAS BEEN REDUCED TO APPROXIMATELY ONE-HALF THE ORIGINAL SCALE.

200' 0 200' 400' 600'

GRAPHIC SCALE 1" = 200'

| SYMBOL | DESCRIPTION | DATE | APPROVAL |
|---|---|---|---|
| | | | |

REVISIONS

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, SEATTLE, WASHINGTON

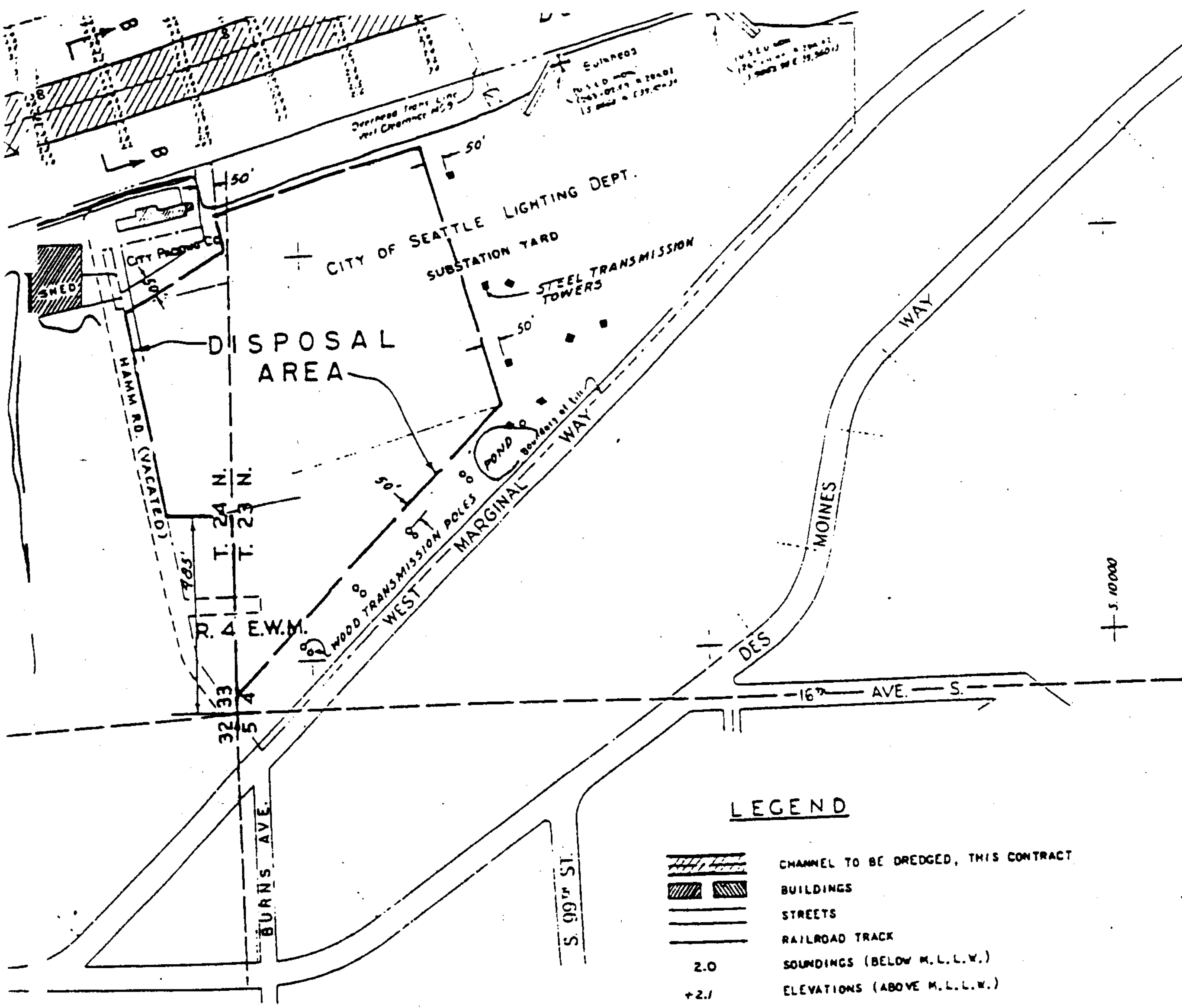
DRAWN BY: F.D.M.
TRACED BY: D.A.L.
CHECKED BY: W.L.P.
PREPARED: Carl G. Fein — CHIEF, DRAFTING SECT.
REVIEWED: Burt Rottsfar — CHIEF, SAFETY BRANCH
SUBMITTED: Frank J. Lock — ASST. FOR CIVIL WORKS, DESIGN BRANCH
RECOMMENDED: Sydney Steinborne — CHIEF, DESIGN BRANCH

SEATTLE HARBOR, WASHINGTON
DUWAMISH WATERWAY
MAINTENANCE DREDGING
DETAIL PLAN III

APPROVED FOR THE DISTRICT ENGINEER: Tusa A. Booley — CHIEF, ENGINEERING DIVISION
DATE: 4 Apr 1957
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER: E-12-2.1-41
SHEET 4 OF 4

Figure A3

AR 023256




THIS DRAWING HAS BEEN REDUCED TO APPROXIMATELY ONE-HALF THE ORIGINAL SCALE.

Figure A4

| SYMBOL | DESCRIPTION | DATE | APPROVAL |
|---|---|---|---|

REVISIONS

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS, SEATTLE, WASHINGTON

SEATTLE HARBOR WASHINGTON
DUWAMISH WATERWAY
MAINTENANCE DREDGING
DETAIL PLAN & SECTIONS

DESIGNED BY: W.K.M.
DRAWN BY: C.M.
CHECKED BY:
PREPARED: CHIEF, CIVIL AND DESIGN SECT.
REVIEWED: CHIEF, SAFETY BRANCH
SUBMITTED: ASST CHIEF, DESIGN BRANCH, CIVIL WORKS
APPROVED FOR THE DISTRICT ENGINEER: CHIEF, ENGINEERING DIVISION
DATE: 19 Apr 1960
SCALE: AS SHOWN
DRAWING NUMBER F-12-2.1-49

AR 023257

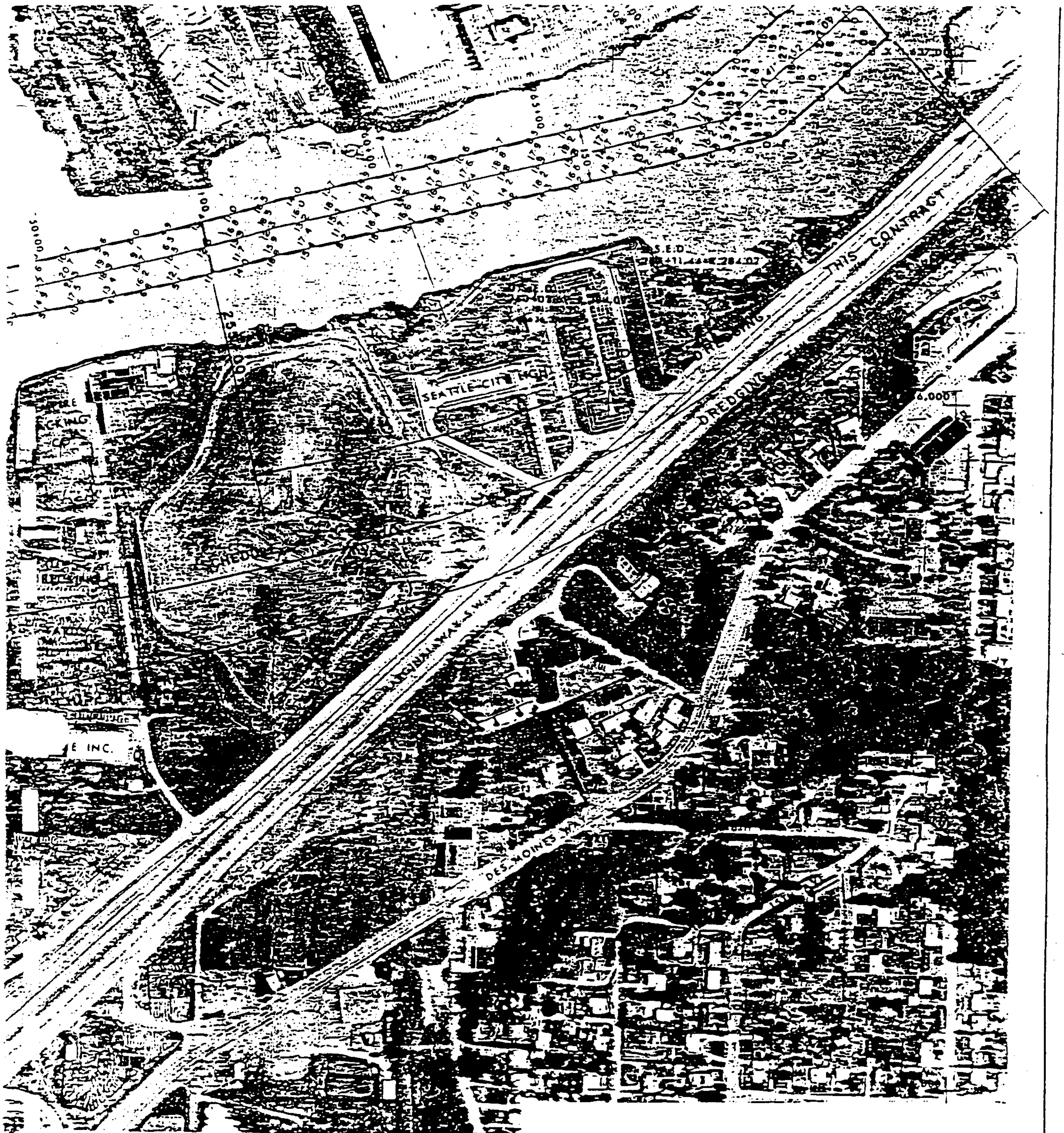



Figure A5

flown: 17 Sept 1971

PLAN

SCALE IN FEET

200' 0 200' 400'

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FY 76 MAINTENANCE DREDGING

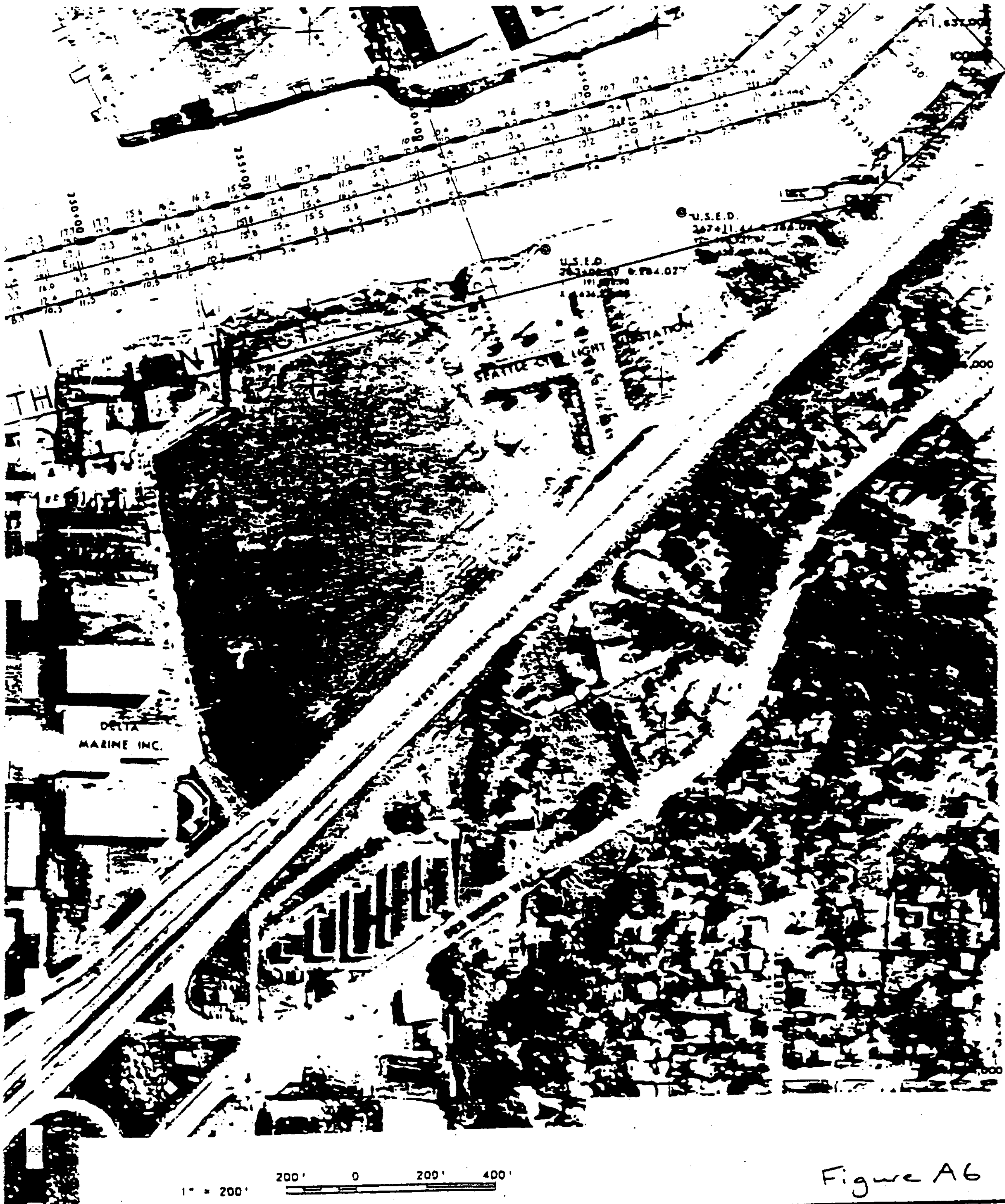
DETAIL PLAN AND SECTION

DUWAMISH WATERWAY

SEATTLE HARBOR WASHINGTON

| | | |
|---|---|---|
| PREPARED | CHIEF CIVIL DESIGN SECTION | |
| SUBMITTED | CHIEF DESIGN BRANCH | |
| VOL F | INVITATION NO | FILE NO E-12-2.1-74 |
| DATE 75 NOV 21 | DRAWN LUNDY | CHK HANSON | SHEET 2 |

AR 023258




1" = 200'    200'  0  200'  400'

The information depicted on this map represents the results of Surveys made in FEBRUARY, 1983 and can only be considered as indicating an estimated condition existing at the time of this Survey.

Horizontal control based on Lambert grid projection for Washington North Zone.

Soundings and elevations are in feet and are referred to plane of Mean Lower Low Water.

Soundings taken above the datum plane are prefixed with (−) sign.

Photo-Map prepared by Survey Branch, Engineering Division, C. of E.

Photography flown: 1 JULY 1980

Figure A6

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FY 84 MAINTENANCE DREDGING

DETAIL PLAN I

DUWAMISH WATERWAY

SEATTLE HARBOR    WASHINGTON

| SCD | INVITATION NO | FILE NO. | DATE | PLATE |
|---|---|---|---|---|
| | | E-12-2.1-89 | 83 JULY 31 | |
| DSGN PARRY | | CHK. SUMERI | SHEET 2 of 2 | |

AR 023259

APPENDIX B

Baseline Soil and Groundwater Quality Assessment
Seattle City Light Long-Term Lease Option
Seattle, Washington

APPENDIX C

# PSDDA PARAMETERS AND METHODS

| Parameter | Prep Method | Analysis Method | PSDDA SL | PSDDA BT | PSDDA ML | SMS SQS | July 96 draft SMS detection limits (1) | 1988 LAET |
|---|---|---|---|---|---|---|---|---|
| CONVENTIONALS: | | | | | | | | |
| Total Solids (%) | --- | Pg.17 (2) | --- | --- | --- | --- | --- | --- |
| Total Volatile Solids(%) | --- | Pg.20 (2) | --- | --- | --- | --- | --- | --- |
| Total Organic Carbon (%) | --- | DOE (3) | --- | --- | --- | --- | --- | --- |
| Grain Size | --- | Modified ASTM with Hydrometer | --- | --- | --- | --- | --- | --- |
| METALS | | | units: mg/kg dw (4) | | | units: mg/kg dw | units: mg/kg dw | |
| Antimony | 3050 (5) | GFAA (6) | 20 | 146 | 200 | --- | --- | 150 |
| Arsenic | 3050 | GFAA | 57 | 507.1 | 700 | 57 | 19 | 57 |
| Cadmium | 3050 | GFAA | 0.96 | --- | 9.6 | 5.1 | 1.7 | 5.1 |
| Chromium | 3050 | GFAA | --- | --- | --- | 260 | 87 | 260 |
| Copper | 3050 | ICP (7) | 81 | --- | 810 | 390 | 130 | 390 |
| Lead | 3050 | ICP | 66 | --- | 660 | 450 | 150 | 450 |
| Mercury | 7471 (8) | 7471 | 0.21 | 1.5 | 2.1 | 0.41 | 0.14 | 0.59 |
| Nickel | 3050 | ICP | 140 | 1022 | --- | --- | --- | >140 |
| Silver | 3050 | GFAA | 1.2 | 4.6 | 6.1 | 6.1 | 2.0 | >0.56 |
| Zinc | 3050 | ICP | 160 | --- | 1600 | 410 | 137 | 410 |
| ORGANICS | | | | | | | | |
| LPAH | | | units: ug/kg dw | | | units: mg/kg oc | units: ug/kg dw | |
| Naphthalene | 3550 (9) | 8270 (10) | 210 | --- | 2100 | 99 | 700 | 2100 |
| Acenaphthylene | 3550 | 8270 | 64 | --- | 640 | 66 | 433 | >560 |
| Acenaphthene | 3550 | 8270 | 63 | --- | 630 | 16 | 167 | 500 |
| Fluorene | 3550 | 8270 | 64 | --- | 640 | 23 | 180 | 540 |
| Phenanthrene | 3550 | 8270 | 320 | --- | 3200 | 100 | 500 | 1500 |
| Anthracene | 3550 | 8270 | 130 | --- | 1300 | 220 | 320 | 960 |
| 2-Methylnaphthalene | 3550 | 8270 | 67 | --- | 670 | 38 | 223 | 670 |
| Total LPAH | | | 610 | --- | 6100 | 370 | --- | 5200 |
| HPAH | | | units: ug/kg dw | | | units: mg/kg oc | units: ug/kg dw | |
| Fluoranthene | 3550 | 8270 | 630 | 4600 | 6300 | 160 | 567 | 1700 |
| Pyrene | 3550 | 8270 | 430 | --- | 7300 | 1000 | 867 | 2600 |
| Benzo(a)anthracene | 3550 | 8270 | 450 | --- | 4500 | 110 | 433 | 1300 |
| Chrysene | 3550 | 8270 | 670 | --- | 6700 | 110 | 467 | 1400 |
| Benzofluoranthenes | 3550 | 8270 | 800 | --- | 8000 | 230 | 1067 | 3200 |
| Benzo(a)pyrene | 3550 | 8270 | 680 | 4964 | 6800 | 99 | 533 | 1600 |
| Indeno(1,2,3-c,d)pyrene | 3550 | 8270 | 69 | --- | 5200 | 34 | 200 | 600 |
| Dibenzo(a,h)anthracene | 3550 | 8270 | 120 | --- | 1200 | 12 | 77 | 230 |
| Benzo(g,h,i)perylene | 3550 | 8270 | 540 | --- | 5400 | 31 | 223 | 670 |
| Total HPAH | | | 1800 | --- | 51000 | 960 | | 12000 |
| CHLORINATED HYDROCARBONS | | | units: ug/kg dw | | | units: mg/kg oc | units: ug/kg dw | |
| 1,3-Dichlorobenzene | P&T (11) | 8260 (11) | 170 | 1241 | --- | --- | --- | >170 |

| Parameter | Prep Method | Analysis Method | PSDDA SL | PSDDA BT | PSDDA ML | SMS SQS | July 96 draft SMS detection limits (1) | 1988 LAET |
|---|---|---|---|---|---|---|---|---|
| 1,4-Dichlorobenzene | P&T | 8260 | 26 | 190 | 260 | 3.1 | 37 | 110 |
| 1,2-Dichlorobenzene | P&T | 8260 | 19 | 37 | 350 | 2.3 | 35 | 35 |
| 1,2,4-Trichlorobenzene | 3550 | 8270 | 13 | --- | 64 | 0.81 | 31 | 31 |
| Hexachlorobenzene (HCB) | 3550 | 8270 | 23 | 168 | 230 | 0.38 | 22 | 22 |
| PHTHALATES | | | units: ug/kg dw | | | units: mg/kg oc | units: ug/kg dw | |
| Dimethyl phthalate | 3550 | 8270 | 160 | 1168 | --- | 53 | 24 | 71 |
| Diethyl phthalate | 3550 | 8270 | 97 | --- | --- | 61 | 67 | >48 |
| Di-n-butyl phthalate | 3550 | 8270 | 1400 | 10220 | --- | 220 | 467 | 1400 |
| Butyl benzyl phthalate | 3550 | 8270 | 470 | --- | --- | 4.9 | 21 | 63 |
| Bis(2-ethylhexyl)phthalate | 3550 | 8270 | 3100 | 13870 | --- | 47 | 433 | 1300 |
| Di-n-octyl phthalate | 3550 | 8270 | 6200 | --- | --- | 58 | 2067 | >420 |
| PHENOLS | | | units: ug/kg dw | | | units: ug/kg dw | units: ug/kg dw | |
| Phenol | 3550 | 8270 | 120 | 876 | 1200 | 420 | 140 | 420 |
| 2 Methylphenol | 3550 | 8270 | 20 | --- | 72 | 63 | 63 | 63 |
| 4 Methylphenol | 3550 | 8270 | 120 | --- | 1200 | 670 | 223 | 670 |
| 2,4-Dimethylphenol | 3550 | 8270 | 29 | --- | 50 | 29 | 29 | 29 |
| Pentachlorophenol | 3550 | 8270 | 100 | 504 | 690 | 360 | 120 | >140 |
| MISCELLANEOUS EXTRACTABLES | | | units: ug/kg dw | | | units: ug/kg dw | units: ug/kg dw | |
| Benzyl alcohol | 3550 | 8270 | 25 | --- | 73 | 57 | 57 | 57 |
| Benzoic acid | 3550 | 8270 | 400 | --- | 690 | 650 | 217 | 650 |
| | | | units: ug/kg dw | | | units: mg/kg oc | units: ug/kg dw | |
| Dibenzofuran | 3550 | 8270 | 54 | --- | 540 | 15 | 180 | 540 |
| Hexachloroethane | 3550 | 8270 | 1400 | 10220 | 14000 | --- | --- | --- |
| Hexachlorobutadiene | 3550 | 8270 | 29 | 212 | 290 | 3.9 | 11 | 11 |
| N-Nitrosodiphenylamine | 3550 | 8270 | 28 | 161 | 220 | 11 | 28 | 28 |
| VOLATILE ORGANICS | | | units: ug/kg dw | | | | units: ug/kg dw | |
| Trichloroethene | P&T | P&T | 160 | 1168 | 1600 | --- | --- | --- |
| Tetrachloroethene | P&T | P&T | 14 | 102 | 210 | --- | --- | 57 |
| Ethylbenzene | P&T | P&T | 10 | 27 | 50 | --- | --- | 10 |
| Total Xylene | P&T | P&T | 12 | --- | 160 | --- | --- | 40 |
| PESTICIDES & PCBs | | | units: ug/kg dw | | | units: mg/kg oc | units: ug/kg dw | |
| Total DDT | --- | --- | 6.9 | 50 | 69 | --- | --- | --- |
| p,p'-DDE | 3540 (12) | 8081 (12) | --- | --- | --- | --- | --- | 9 |
| p,p'-DDD | 3540 | 8081 | --- | --- | --- | --- | --- | 16 |
| p,p'-DDT | 3540 | 8081 | --- | --- | --- | --- | --- | >6 |
| Aldrin | 3540 | 8081 | 10 | 37 | --- | --- | --- | --- |
| Chlordane | 3540 | 8081 | 10 | 37 | --- | --- | --- | --- |
| Dieldrin | 3540 | 8081 | 10 | 37 | --- | --- | --- | --- |
| Heptachlor | 3540 | 8081 | 10 | 37 | --- | --- | --- | --- |
| Lindane | 3540 | 8081 | 10 | --- | --- | --- | --- | --- |
| Total PCBs | 3540 | 8081 | 130 | 38 (13) | 2500 | 12 | 6 | 130 |

1. *Recommended* Sample Preparation Methods, Cleanup Methods, Analytical Methods and Detection Limits for Sediment Management Standards, Chapter 173-204 WAC, Draft - July 1996.

2. *Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound*, Puget Sound Estuary Program, March, 1986.

3. *Recommended Methods for Measuring TOC in Sediments*, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May, 1993.

4. units: ug = microgram, mg = milligram, kg = kilogram, dw = dry weight, oc = organic carbon.

5. *Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods.* Method 3050, SW-846, 3rd ed., Vol 1A, Chapter 3, Sec 3.2, Rev 1. Office of Solid Waste and Emergency Response, Washington, DC.

6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA 1986.

7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA 1986.

8. *Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods.* Method 7471, SW-846, 3rd ed., Vol 1A, Chapter 3, Sec 3.3. Office of Solid Waste and Emergency Response, Washington, DC.

9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.

10. GCMS Capillary Column - Method 8270, SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA 1986.

11. Purge and Trap Extraction and GCMS Analysis - Method 8260, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA 1986.

12. Soxhlet Extraction and Method 8081, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA 1986.

13. Total PCBs BT value in mg/kg oc.

## CHECKLIST FOR SEMIVOLATILE ORGANIC COMPOUNDS IN SEDIMENT

Project Name Hamm Creek Restoration Project SAIC Project No. 01-0440-04-8357

Lab AmTest, Inc. Lab # 97-A008101 and 97-A008102

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared July 24, 1997

Date: Sampled June 16 and 17, 1997

Received by lab June 18, 1997

Analysis began Semivolatiles: extraction on June 30, 1997; analysis on July 10, 1997

Pesticides/PCBs: extraction June 27, 1997; pesticide analysis on July 3, 1997 and PCB analysis on July 8, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

All required documents submitted?[a] (Y/N) Yes

Analytical method Semivolatiles: SW3550/8270; Pest/PCB: SW3540/8081

## COMPLETENESS AND HOLDING CONDITIONS

| | # Samples Submitted | # Samples Analyzed |
|---|---|---|
| A/B/N | 2 | 2 |
| Pesticides/PCB | 2 | 2 |

Holding conditions acceptable? (Y/N) (1 year for frozen sediment or 14 days at 4°C until extraction: extracts must be processed within 40 days)[b] Yes

If no, identify samples

Extract conditions acceptable? (Y/N) (1 year for frozen sediment or 14 days at 4°C)[b] Yes

If no, identify samples

- Checklists adopted from PSDDA guidance manual: PTI, 1989. -

BIOASSAYS

### Amphipod Mortality Test

The following data should be reported by all laboratories performing this bioassay:

- Daily water quality measurements during testing (e.g., dissolved oxygen, temperature, salinity, pH) (plus ammonia & sulfides at test initiation and termination)
- Daily emergence for each beaker and the 10-day mean and standard deviation for each treatment
- 10-day survival in each beaker and the mean and standard deviation for each treatment
- Interstitial salinity values of test sediments
- 96-hour $LC_{50}$ values with reference toxicants.
- Any problems that may have influenced data quality.

### *Neanthes* Growth Test

The following data should be reported by all laboratories performing this bioassay:

- Water quality measurements at test initiation and termination and every three days during testing (e.g., dissolved oxygen, temperature, salinity, pH) (plus ammonia & sulfides at test initiation and termination)
- 20-day survival in each beaker and the mean and standard deviation for each treatment.
- Initial biomass
- Final biomass (20-day) for test, reference and control treatments.
- 96-hour $LC_{50}$ values with reference toxicants.
- Any problems that may have influenced data quality.

### Sediment Larval Test

The following data should be reported by all laboratories performing this bioassay:

- Daily water quality measurements (e.g., dissolved oxygen, temperature, salinity, pH) (plus ammonia + sulfides at test initiation & termination)
- Individual replicate and mean and standard deviation data for larval survival at test termination.
- Individual replicate and mean and standard deviation data for larval abnormalities at test termination
- 48-hour $LC_{50}$ and $EC_{50}$ values with reference toxicants.
- Any problems that may have influenced data quality.

DAIS DATA CHECKLIST

| Sample Locations and Compositing | Test Sediment | Reference Sediment | Control Sediment | Seawater Control |
|---|---|---|---|---|
| Latitude and Longitude (to nearest 0.1 second) | | | | |
| NAD 1927 or 1983 | | | | |
| USGS Benchmark ID | | | | |
| Station name (e.g. Carr inlet) | | | | |
| Water depth (corrected to MLLW) | | | | |
| Drawing showing sampling locations and ID numbers | | | | |
| Compositing scheme (sampling locations/depths for composites) | | | | |
| Sampling method | | | | |
| Sampling dates | | | | |
| Estimated volume of dredged material represented by each DMMU | | | | |
| Positioning method | | | | |
| **Sediment Conventionals** | | | | |
| Preparation and analysis methods | | | | |
| Sediment conventional data and QA/QC qualifiers | | | | |
| QA qualifier code definitions | | | | |
| Triplicate data for each sediment conventional for each batch | | | | |
| Units (dry weight except total solids) | | | | |
| Method blank data (sulfides, ammonia, TOC) | | | | |
| Method blank units (dry weight) | | | | |
| Analysis dates (sediment conventionals, blanks, TOC CRM) | | | | |
| TOC CRM ID | | | | |
| TOC CRM analysis data | | | | |
| TOC CRM target values | | | | |
| **Grain Size Analysis** | | | | |
| Fine grain analysis method | | | | |
| Analysis dates | | | | |
| Triplicate for each batch | | | | |
| Grain size data (complete sieve and phi size distribution) | | | | |

BIOASSAYS

| Amphipod Mortality and Emergence | Each Batch | Test Sediment | Reference Sediment | Control Sediment |
|---|---|---|---|---|
| Species Name | | | | |
| Mortality and Emergence: | | | | |
| Start date | | | | |
| Daily emergence (for 10 days) | | | | |
| Survival at end of test | | | | |
| Number failing to rebury at end of test | | | | |
| Positive Control: | | | | |
| Toxicant used | | | | |
| Toxicant concentrations | | | | |
| Exposure time | | | | |
| LC50 | | | | |
| LC50 method of calculation | | | | |
| Start date | | | | |
| Survival data | | | | |
| Water Quality Measurement Methods: | | | | |
| Dissolved oxygen | | | | |
| Ammonia | | | | |
| Interstitial salinity | | | | |
| Sulfide | | | | |
| Water salinity | | | | |
| Water Quality: | | | | |
| Temperature (day 0 through day 10) | | | | |
| pH (day 0 through day 10) | | | | |
| Dissolved oxygen (day 0 through day 10) | | | | |
| Water salinity (day 0 through day 10) | | | | |
| Sulfide (day 0, day 10) | | | | |
| Ammonia (day 0, day 10) | | | | |
| Interstitial water salinity (day 0) | | | | |

| Sediment Larval Mortality and Abnormality | Each Batch | Test Sediment | Reference Sediment | Seawater Control |
|---|---|---|---|---|
| Species Name | | | | |
| Bioassay Parameters | | | | |
| Inoculation time (hours) | | | | |
| Exposure time (hours) | | | | |
| Stocking beaker density (#/ml) | | | | |
| Stocking aliquot size (ml) | | | | |
| Aeration (yes/no) | | | | |
| Mortality and Abnormality: | | | | |
| Start date | | | | |
| Initial count (minimum of five 10-ml aliquots) | | | | |
| Final Count: | | | | |
| Aliquot size (ml) | | | | |
| Number normal per aliquot | | | | |
| Number abnormal per aliquot | | | | |
| Water Quality Measurement Methods: | | | | |
| Dissolved oxygen | | | | |
| Ammonia | | | | |
| Sulfide | | | | |
| Water salinity | | | | |
| Water Quality: | | | | |
| Temperature (daily) | | | | |
| pH (daily) | | | | |
| Dissolved oxygen (daily) | | | | |
| Water salinity (daily) | | | | |
| Sulfide (initial and final) | | | | |
| Ammonia (initial and final) | | | | |
| Positive Control: | | | | |
| Toxicant used | | | | |
| Toxicant concentrations | | | | |
| Exposure time | | | | |
| EC50 | | | | |
| EC50 method of calculation | | | | |
| Start date | | | | |
| Normal/abnormal counts | | | | |

# APPENDIX B

# STATION LOCATIONS AND COMPOSITING SCHEME

AR 023270

SAIC
An Employee-Owned Company

Table B Station locations and compositing scheme for the Hamm Creek restoration project.

| Station | Latitude (NAD83) | Longitude (NAD83) | Elevation (feet) | Length of Core Sampled (feet) | Core Section Designation (feet) | Sample |
|---|---|---|---|---|---|---|
| 1 | 47 30 58.8 N | 122 18 26.1 W | 23 | 19 | A +23 to +19 | C1 |
| | | | | | B +19 to +15<br>C +15 to +11<br>D +11 to +7<br>E +7 to +4 | C2 |
| 2 | 47 31 00.4 N | 122 18 27.0 W | 22 | 13 | A +22 to +18 | C1 |
| | | | | | B +18 to +14<br>C +14 to +10 | C2 |
| | | | | | D +10 to +9 | Z2 |
| 3 | 47 30 59.1 N | 122 18 28.1 W | 21.7 | 12 | A +21.7 to +17.7 | C1 |
| | | | | | B +17.7 to +13.7<br>C +13.7 to +9.7 | C2 |
| 4 | 47 31 01.0 N | 122 18 39.3 W | 22.5 | 11 | A +22.5 to +19.5 | C1 |
| | | | | | B +19.5 to +14.5<br>C +14.5 to +12.5 | C2 |
| | | | | | Z +12.5 to +11.5 | Z4 |

# APPENDIX C

# FIELD AND BOREHOLE LOGS

AR 023272

An Employee-Owned Company

0730 Hamm Creek 6/16/97

Crew:

Tacoma Pump + Drill

Drillers Mike Brankline

helper Dan Harris

geotech USACE Morty ~~[illegible]~~ Kaiser

SAIC Lisa Roach

weather: overcast, brief moments of sun, 60s

sampling equipment: hollow stem auger, split-spoon sampler

split-spoon is stainless steel; 2 foot

3 split-spoons available

core catchers how-ever were plastic (will avoid sampling material touching this)

Note: met at substation gate at 7:30 - drillers arrived at 8:00

Hamm Creek 6/16/97

0838 Station 4

Blow count 0-2 ft 4A1

12

16

18

24

stainless 2 ft split spoons

0-2 ft recovery 23in

brown silty sand

with ~~organic~~ fibers roots

few small gravel pieces

at about 80 cm some clay lense read wrong

worm

dry loose

note: drillers began sampling before I could tell them I wanted to do nitric + methanol rinses. They indicated they had been cleaned prior to coming out. I made sure I didn't sample material touching the sides of the sampler.

Station 4 2-4 ft, 4A2 6/16/97

845 13
18
14
15

recovery 19 in

brown ~~clayey~~ silty sand with some clay (fine sand)

damp
lens of gray clayey sand ~~at 50 cm~~ read wrong

Hamm Creek 6/16/97

~849 5
5
6
5

4-6ft
Station 4, 4B1

20 in recovery

top 30 cm brown silty sand slightly damp - some roots, organic fibers

at 30 cm becomes cleaner gray ~~&~~ silty fine sand - gets damper at depth

Need to decon the split spoons (full decon Alconox, distilled, nitric acid, methanol, distilled rinses)

Hamm Creek 6/16/97

930 6 - 8 ft

Blow count Station 4 4B2

10
12
16
14

recovery 24 in

dark grayey brown clayey silty fine sand - pockets of clay throughout
also some small gravels
some organics - pieces of wood chips in top 10 cm

damp to moist near bottom
makes thread in some parts
loose in others

Hamm Creek 6/16/97

935 8 - 10 ft

Station 4 4C1

6
8
12
14

Full recovery

top 10 cm
dark gray to brown clayey silty fine sand, sparse small pieces of gravel
below 10 cm:
at 50 cm down have woody organic fibers mixed in with the clay
at occasionally throughout above that
below the 10 cm it becomes a silty clay light gray
plastic, stiff

Hamm Creek 6/16/97

~945 10-12 ft Station 4 4Z ~~2-2de~~

Full recovery
sampling top foot for 2 sample

top foot
gray fine sandy silty clay (almost to clayey sand) has ~~spo~~ pockets of organic woody material - also pockets of clayey silty sand (darker + more brown

bottom foot similar - had sandy pocket (some coarse sand at depth) about 18 in down

7 Blow counts
8
9
12

Hamm Creek 6/16/97
Station 2

1040 0-2 ft Station 2 2A1

recovery 16 in
10
7
10
12

dry brown silty fine sand to sandy silt
some small pieces or clasts of clay throughout
(relatively sparse)

~~lots~~ abundant fibers (organic)/roots
loose to dense

Hamm Creek 19.5-20 6/16/97
1045 2-4 ft recovery ~~17~~ in plus
Station 2A2

13 blow count
23
26
25

top 3 in similar to the 0-2 ft
sample
below that is an orangy brown
fine to medium sand with
some silt - also lenses
~1-2mm of gray clay - particularly
in the bottom 20 cm
damp
collected the VOA sample from
this 2-4 ft depth sample

Hamm Creek 6/16/97
1052 Sta 2 4-6 ft 2B1

recovery 15 in

moist to wet loose fine to
medium sand with some silt
brown with dark browns
· some coarser sand particles also
homogenous throughout

11 blow count
23
23
23

Hamm Creek 6/16/97.

1135 Sta 2 6-8 2B2

15

17

22

20

recovery 23 in

top 11 in are similar to the previous sample

fine to medium sand with some silt

moist, loose

17 in ~43 cm 11-17 in similar material but slightly darker + more gray

43 cm + below has less silt + is grayer

Hamm Creek 6/16/97

1145 Sta 2 8-10 2C1

8

9

11

11

recovery about 23 in

top part to ~~at~~ about 14 in (35½ cm) in depth is

grayey fine to med sand with some silt - fairly clean thoug

moist

43 cm + below is Charcoal black silty clay with some fine sands (may be clayey silt)

mostly silty clay at bottom

plastic + moist

pieces of wood debris

organicy, sulfidic odor

Hamm Creek 6/16/97

1150 Sta. 2 10-12 ft 2C2

3
5
25
26

Full recovery ~~soft~~
top 10cm is fine to medium, sand with silt gray brown
below is ~~gray~~ fine to med sand pocket in a black ~~B~~ silty clay, organic with small wood fibers ~~soft~~ stiff
(above is 10cm - 47 cm)

below 47 cm is a lighter brownish gray clay which has more sand in it + is less moist & harder

Hamm Creek 6/16/97

1158 Sta 2 12-14 ft Z2

16
18
20
25

will sample top foot for the Z archive sample

Full recovery

~~top foot is a~~
top 3 cm is a soft black silty clay with some fine sand
below that to 30 cm is fine to med sand with some silt also pockets of clayey silt to silty clay (gray brown)
bottom 5 cm of that top 30 cm became a light gray brown silty clay that was denser than the black clay, -has some fine sands

Hamm Creek 6/16/97

-he bottom foot continues with.
the light brownish gray clay but
~~a pocket of~~ a lense of ~~c~~fine to med
sand occurs between 48 - 51 cm

Station 1 6/16/97

1250 0-2 ft 1A1

dry silty fine sand), brown
abundant roots +fibers on surface but
present throughout
dense
recovery 19 in (similar to
surface of station 4 + 2

7 blow counts
10
10
13

Hamm Creek 6/16/97
1300 Station 1 2-4 ft 1A2
6
9
20
32

recovery - full
top 28 cm similar to previous sample
28-34 cm - similar material but mottled with a gray clayey sand (fine)

34-44 cm lense that is sandier but similar to previous material

below 44 cm
Silty fine sand mottled with gray clayey material + an orangy organic (wood) material

dense to hard

Hamm Creek 6/16/97
1310 Station 1 4-6 ft 1B1
30
47
49
49

Recovery 20 in

Top 10 cm is the silty fine brown sand with organic fibers (roots etc) dense to hard

Bottom 10 cm
hard, damp black silty v.fine sand to sandy silt - minor clay
/doesn't for a thread

AR 023281

Hamm Creek Station 1 6/16/97

1315 ~~23 in~~ 6-8 ft 1B2

8

6

13

13

recovery 23 in actually top 3
are slough

top 18 cm is black silty sand
with some clay

18 to 30 black silty clay
stiff, forms thread

Below 30 cm
grayer clayey fine sand
(less clay than the 18-30 cm
mottled with the ~~less~~ black material

Hamm Creek 6/16/97

1340 Sta 1 1C1 8-10 ft

8

8

12

16

recovery 21 cm

top 8 cm black, gray sandy clay
moist

from 8-30 cm lighter gray brown
clayey sandy to sandy clay
mottled with the blacker sandy
clay - drier - still damp
dense

30-50 cm browner sandy clay
clayey sand (fine)
has a bit more ~~sand~~ silt + clay
than the brown layer
hard + dense

lenses of silty fine sand on bottom
dry + loose

Note 2 mm lenses of wood debris in the
gray

AR 023282

Hamm Creek 6/16/97

1400 Drillers had to leave for the day

Because we are not done sampling for both composites, I needed to jar up the mud collected (after mixing) and will combine these with material collected tomorrow (i.e., once material for C1+C2 collected from sta 1 + 3, will pour out material collected on 6/16 + will homogenize with that collected 6/17).

note: between sampling, the stainless steel pan with the sample was kept on ice in a large cooler

Hamm Creek

Day 2 6/17/97

Crew:

Tacoma Pump and Drill: Mike Brankline
Dan Harris

USACE Monty Kaiser

SAIC Lisa Roach

weather: quite variable drizzles then sunshine, then rain etc. Windy. Warm upper 60's

0735 Met (MK) at Seattle City Light substation
Will set up for processing while wait for drillers.

(Drillers arrived within 15 min)

AR 023283

Hamm Creek 6/17/97
0805 Station 1 10-12 1C2

10 Blow Counts
11
14
14

Full recovery
to 7 cm may be slough
silty clay, ~~soft~~ stiff dark gray + b ¢

7-11 cm fine to med sand lense
with some minor silt gray brown

11 cm - bottom
silty fine sand with clay
dense, damp, organic fibers
present

Hamm Creek 6/17/97
0810 Station 1 12-14 1D1
7
8
8
10

Recovery 22 in

Top 6 cm similar to 10/12
sample

below which is the silty clayey
fine sand - dense
gray brown gets grayer
with depth
has thin (1mm) lenses of
a pinker clayey fine sand
throughout

26

Hamm Creek 6/17/97
1820 Station 1 14-16 1D2

6
28
40
45

Recovery Full

top 34 cm
moist silty clayey fine sand
mottled brownish with gray +
charcoal black + some
pinkish lenses

below 34 cm is a fine to
med sand with some silt
moist dark gray

27

Hamm Creek 6/17/97
0851 Station 1 16-18 1E1

12
30
33
33

Recovery 20.5 in

wet fine to med sand, loose
with some silt
dark gray with brow

Hamm Creek 6/17/97
0855 Station 1 18-20 ft 1E2

9 blow counts
10
21
30

recovery 20.5 in

will sample top ft only

moist to wet ~~med~~ fine to
medium sand with silt
(same as previous split-spoon
sample
(rest of this core below the
top foot is the same)



Hamm Creek 6/17/97
0920 Station 3 0-2 ft
3A1

6
12
18
28

collected a
sulfides subsample
(did not analyze see
9/8/97)

Recovery 21 in

top 10 cm:
brown silty fine sand with abundant
roots, some clay present.
dry, worm
10-22 cm
fine sandy silty clay with
organics (wood) brown

22-36
silty fine sand brown

36 - bottom
clayey fine sand decomposed
brown mottled with gray, organic wood

Hamm Creek 6/17/97
0930 Sta 3 2-4 3A2

11
23
18
23

Recovery 21 cm

top 10 cm fine sandy clay
to clayey sand, damp
dense has root fibers

below 10 cm to 40 cm
coarser than top 10 cm clayey fine sand
brown, with organics wood
occasional pockets of tr clay
3 mm lenses of gray, fine sand
at 10 + 20 cm + at 40 cm
below 40 cm is a black silty
clayey & stiff
at 51 cm another lense of
fine sand (gray) with some
silt



Hamm Creek 6/17/97
0940 Station 3 4-6
3B1

12
20
18
20

recovery : 15.5 in

whole core is silty fine
to med sand, loose, moist
dark gray
wood chip + debris on bottom

Hamm Creek 6/17/97

~0950 Sta 3 6-8 3B2

8
12
18
20

Full recovery

will collect VOAS from this one - kept spoon closed till ready

filled 4 jars (includes MS/MSD)
difficult to fill with out air pockets due to texture (hard clay) of material + the need to fill 4 jars quickly

top 10 cm brown mottled with black silty clayey sand (fine sand)
~~moist~~ damp

10 cm - 34 cm
hard fine sandy +silty clay
dark gray mottled with black

34 to bottom hard
light gray fine sandy clay
(sandier than the 10-34 section



Hamm Creek 6/17/97

1020 Station 3 8-10
3C1

7
10
13
15

Recovery full

top 8 cm V. soft wet
black clayey silt with minor fine sand

8 - 54 cm
gray mottled with black + pinkish gray clayey fine sand to fine sandy clay damp

> 54 cm fine silty sand
(similar to 8-54 cm but a bit more sandy damp

Hamm Creek 6/17/97

1030 Sta 3 10-12 3C2

0
5
~~8~~9 (AP)
9

Full recovery

top 10 cm silty fine clayey sand
dense moist

10-20 cm fine sandy silt with
clay v. soft + wet

20 to bottom
Fine ~~clayey~~ sand with (dark gray)
pinkish lenses of sandy clay

collected sulfide subsample just
in case I misunderstood SAP
(note: did not analyze dER 9/8/97)



Hamm Creek 6/17/97

Composite C2 subsurface
collected extra material for
QA/QC analyses (MS/MSD,
dup, trips etc)

homogenate:
dark gray wet, fine sandy silt
with clay, v. soft

raining again! Pouring!

Composite C1 surface (0-4 ft)
sta 1-4

brown silty fine sand with clay
abundant roots, loose, damp to dry

Completed compositing around
1400 - took a while to homogenize
due to the clay and also because
I had to empty out jars from
6/16 collection of stations 2+4
to composite with material
collected today!

Hamm Creek 6/17/97

~1430 Everything loaded up + heading back to the office to demobe.



Carr Inlet Ref Collection 7/17/97

0745 John Nakayama picked up UW Boston whaler

0830 JN + Lisa Roach met at Southcenter Mall - left off LR's car - headed to Carr Inlet

Crew: SAIC Lisa Roach, John Nakayama

weather: v. nice, sunny, 70's, calm at first (winds picked up in afternoon)

~1030 - ~~10~~ Arrived at boat launch at Horseshoe Bay - loaded up + prepared to launch

1140 Arrived at Carr Inlet attempting to collect 35-40% fines at Carr 4 (or Carr 23 - ~ same location)

Using 0.025 $m^2$ Stainless van Veen

Carr ~~Int~~ Ref. sed Collection 7/17/97

1145 First attempt
27953.6 44 ft
42215.0
LORAN TDs

(may be too deep - may need to be in ~25 ft based on notes from ~~PMX~~ (Parametrix)

45% sand

1219 2nd attempt - moved in toward shore
28.5 ft
~~2793~~ 27953.5
42215.0

55% sand

Moving a bit more west

Note: ~~positing~~ positioning using LORAN TDs to ~~??~~

Carr 4 Ref. Sed. Collection 7/17/97

1229 27953.7 34 ft
42214.6
≈ Carr 23W

too sandy (didn't save)

1235 27953.6 37 ft
42214.9

way too fine

1238 27953.5 ~~13~~ 17 ft
42214.8
too fine

1243 27953.6 ~~2~~5 ft
42214.8

sandier but can't get good grab

Carr 4 Rof Sed. Collection 7/17/97

1251 27953.6
42214.8
oops anchor didn't hold

1253 27953.5 23 ft
42214.8

too fine

1255 27953.6 26 ft
422 14.8

80% sand
too coarse

1313 27953.6 32 ft
42214.8
~~drifted~~ de
too fine



Carr Inlet Rof Sed Collection 7/17/97

1319 27953.6
42214.9

drifting
winds picking up

1322 27953.5 24 ft
42214.8

too fine

1328 27953.6 26 ft
42214.8
drifted off

1329 27953.5 24 ft
42214.8

65-66% sand

THIS IS IT!!
Carr 4
this location

Carr Inlet Ref Sed Collection 7/17/97
homogenate : olive silty sand
(fine sand)
abundant ophiuroids +
polychaetes
(noticed some sulfides in last
rep - avoided sulfidic pockets)

wet sieve: 63% sand

Headed back to boat launch to
demob

~0500 (JN) Dropped boat off at UW, rinsed
with freshwater

0630 Arrived at office, dropped samples
off at storage facility
(store at 4°C)

END OF DAY

# BOREHOLE LOG



## BOREHOLE NO. 1

| | | | |
|---|---|---|---|
| PROJECT NAME: | Sed. Char. for the Hamm Creek Restoration Project | | |
| LOCATION: | Hamm Creek, Seattle, WA | TOTAL DEPTH: | 20 ft |
| DRILLING COMPANY: | Tacoma Pump & Drill | GROUND ELEVATION: | 23 ft |
| DRILLING METHOD: | Hollow-stem auger/split-spoon sampler | DATE STARTED: | 6/16/97 |
| LOGGED BY: | Lisa E. Roach | DATE COMPLETED: | 6/17/97 |

| LAB SAMPLE NUMBER | BLOW COUNTS | INTERVAL SAMPLED | MLLW ELEVATION | DEPTH IN FEET | PERCENT RECOVERY | SPLIT-SPOON SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| C1 | 7<br>10<br>10<br>13 | | +23 | 1 | 79% | 1A1 | **0 to 4.3 feet:** Brown, dry, silty fine SAND with abundant roots and fibers; dense. The matrix becomes mottled with a gray clayey sand at about 3 feet, and organic woody material is present at 3.4 feet. |
| | 6<br>9<br>20<br>32 | | +21 | 2<br>3 | 100% | 1A2 | |
| C2 | 30<br>47<br>49<br>49 | | +19 | 4<br>5 | 83% | 1B1 | **4.3 to 7 feet:** Hard, damp black silty very fine SAND to sandy SILT with minor clay. There is a lense of black silty stiff clay between 6.5 and 7.0 feet. |
| | 8<br>6<br>13<br>13 | | +17 | 6<br>7 | 83% | 1B2 | **7 to 9 feet:** Gray-brown clayey fine SAND mottled with the black silty sand material; damp, dense. 3-inch lense of black gray sandy clay (moist). 2 mm lenses of wood debris. |
| | 8<br>8<br>12<br>16 | | +15 | 8<br>9 | 87% | 1C1 | **9 to 10 feet:** Brown sandy CLAY to clayey fine SAND; hard to dense; lense of silty fine sand - dry to loose on bottom. |
| | 10<br>11<br>14<br>14 | | +13 | 10<br>11 | 100% | 1C2 | **10 to 12.2 feet:** Gray-brown silty fine SAND with clay; moist; dense; organic fibers. |
| | 7<br>8<br>8<br>10 | | +11 | 12<br>13 | 92% | 1D1 | **12.2 to 15 feet:** Gray-brown silty clayey fine SAND (more clay than 10-12 ft section); dense with 1 mm lenses of pinkish-gray clayey fine sand; also gray to charcoal clayey sand lenses. |
| | 6<br>28<br>40<br>45 | | +9 | 14<br>15 | 100% | 1D2 | **15 to 20 feet:** Wet, loose; dark gray fine to medium SAND with some silt. |
| | 12<br>30<br>33<br>33 | | +7 | 16<br>17 | 85% | 1E1 | |
| | 9<br>10<br>21<br>30 | | +5<br>+4 | 18<br>19 | 85% | 1E2 | Total Depth: 20 feet |

NOTE:

DIV0440\HAMM.CR\CORE01.DSF 9/12/97

# BOREHOLE LOG



BOREHOLE NO. 2

| | |
|---|---|
| PROJECT NAME: | Sed. Char. for the Hamm Creek Restoration Project |
| LOCATION: | Hamm Creek, Seattle, WA |
| DRILLING COMPANY: | Tacoma Pump & Drill |
| DRILLING METHOD: | Hollow-stem auger/split-spoon sampler |
| LOGGED BY: | Lisa E. Roach |

| | |
|---|---|
| TOTAL DEPTH: | 14 ft |
| GROUND ELEVATION: | 22 ft |
| DATE STARTED: | 6/16/97 |
| DATE COMPLETED: | 6/16/97 |

| LAB SAMPLE NUMBER | BLOW COUNTS | INTERVAL SAMPLED | MLLW ELEVATION | DEPTH IN FEET | PERCENT RECOVERY | SPLIT-SPOON SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| C1 | 10 7 10 12 | | +22 | 0–2 | 67% | 2A1 | **0 to 2.2 feet:** Brown, dry, loose to dense silty fine SAND to a sandy silt, some small clay clasts throughout; abundant organic fibers (root material). |
| C1 | 13 23 26 25 | | +20 | 2–4 | 83% | 2A2 | **2.2 to 7.5 feet:** Orange-brown fine to medium SAND with some silt; moist; loose (more brown below 4 feet and becomes grayer by 7.5 feet). 1-2 mm lenses of gray clay between 3.5 and 4 feet. Some coarser sand present at 4-6 feet. Subsample for volatile analysis collected between 2 and 4 feet (C1 - volatiles) |
| C2 | 11 23 23 23 | | +18 | 4–6 | 62% | 2B1 | |
| C2 | 15 17 22 20 | | +16 | 6–8 | 96% | 2B2 | **7.5 to 8.4 feet:** Dark gray fine to medium SAND with little silt - fairly clean; moist. |
| C2 | 8 9 11 11 | | +14 | 8–10 | 96% | 2C1 | **8.4 ft to 12 feet:** Charcoal black silty clay to a clayey silt, with some fine sands; plastic and moist; pieces of wood debris; stiffer at depth. Lense (4 in.) of gray-brown fine to medium sand with silt at 10 feet. Material had sulfide odor in 8.4 to 10-foot section. Bottom 4 inches was a lighter brownish-gray clay with more sand; less moist; harder. |
| C2 | 3 5 25 26 | | +12 | 10–12 | 100% | 2C2 | |
| Z2 | 16 18 20 25 | | +10, +9 | 12–14 | 100% | 2D1 | **12 - 12.8 feet:** Top inch soft black silty clay with fine sands below which is a fine to medium sand with silt and pockets of gray-brown clayey silt. **12.8 to 14 feet:** Light brownish-gray silty clay with a lense of fine to medium sand at 13.6 feet (1 in lense). |
| | | | | 14–19 | | | Total Depth: 14 feet |

NOTE:

DIV0440\HAMM.CR\CORE02.DSF 9/12/97

# BOREHOLE LOG



BOREHOLE NO. 3

| | | | |
|---|---|---|---|
| PROJECT NAME: | Sed. Char. for the Hamm Creek Restoration Project | | |
| LOCATION: | Hamm Creek, Seattle, WA | TOTAL DEPTH: | 12 ft |
| DRILLING COMPANY: | Tacoma Pump & Drill | GROUND ELEVATION: | 21.7 ft |
| DRILLING METHOD: | Hollow-stem auger/split-spoon sampler | DATE STARTED: | 6/17/97 |
| LOGGED BY: | Lisa E. Roach | DATE COMPLETED: | 6/17/97 |

| LAB SAMPLE NUMBER | BLOW COUNTS | INTERVAL SAMPLED | MLLW ELEVATION | DEPTH IN FEET | PERCENT RECOVERY | SPLIT-SPOON SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| C1 | 16 12 18 28 | | +21.7 | 0–2 | 87% | 3A1 | **0 to 2 feet:** Brown, silty fine SAND, some clay, and abundant roots; dry; worm present. Between 4 and 9 inches is a lense of fine sandy silty clay with organics (wood). At 9-14 inches is brown silty fine sand. At 14 inches is a brown, mottled with gray clayey fine sand with decomposed organic wood. |
| C1 | 11 23 18 23 | | +19.7 | 2–4 | 87% | 3A2 | **2 to 4 feet:** Top 4 inches is a fine sandy clay to clayey sand with root fibers, below which is a coarser brown clayey fine sand with wood organics and occasional pockets of clay. At 3.3 feet is black silty clay; very stiff. There were 0.2-in. lenses of gray fine sand at 2.3 feet, 2.6 feet, and 3.3 feet. |
| C2 | 12 20 18 20 | | +17.7 | 4–6 | 64% | 3B1 | **4 to 6 feet:** Dark gray silty fine to medium SAND; moist; loose; wood chip and debris at 6 feet. |
| C2 | 8 12 18 20 | | +15.7 | 6–8 | 100% | 3B2 | **6 to 8 feet:** Top 4 inches is brown mottled with black silty clayey fine SAND; damp. From 6.3 to 7.1 feet hard fine sandy silty clay (dark gray mottled with black). 7.1 feet to 8 feet - hard light gray fine sandy clay (sandier). Collected volatile organics subsample for C2. |
| C2 | 7 10 13 15 | | +13.7 | 8–10 | 100% | 3C1 | **8 to 10 feet:** Top 3 inches very soft wet black clayey silt with minor fine sand below which is a gray mottled with black and pinkish gray clayey fine sand to fine sandy clay (becomes sandier at depth). |
| C2 | 5 5 9 9 | | +11.7 | 10–12 | 100% | 3C2 | **10 to 12 feet**: Top 4 inches silty fine clayey SAND. 10.3-10.6 feet fine sandy silt with clay; very soft and wet; 10.6-12 feet dark gray fine clayey sand with pinkish lenses of sandy clay. |
| | | | +9.7 | 12 | | | Total Depth: 12 feet |

NOTE: Extra 1.3 feet was inadvertently sampled at this station.

DIV0440\HAMM.CR\CORE03.DSF 9/12/97

# BOREHOLE LOG



BOREHOLE NO. 4

PROJECT NAME: Sed. Char. for the Hamm Creek Restoration Project
LOCATION: Hamm Creek, Seattle, WA
DRILLING COMPANY: Tacoma Pump & Drill
DRILLING METHOD: Hollow-stem auger/split-spoon sampler
LOGGED BY: Lisa E. Roach

TOTAL DEPTH: 12 ft
GROUND ELEVATION: 22.5 ft
DATE STARTED: 6/16/97
DATE COMPLETED: 6/16/97

| LAB SAMPLE NUMBER | BLOW COUNTS | INTERVAL SAMPLED | MLLW ELEVATION | DEPTH IN FEET | PERCENT RECOVERY | SPLIT-SPOON SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|
| C1 | 12, 16, 18, 24 | | +22.5 | 0–2 | 96% | 4A1 | **0 to 5 feet:** Brown, dry, loose silty fine SAND with few small gravels and organic fibers and roots; occasional lenses of gray moist clayey sand; becomes more moist at depth; worm present in top 2 feet. |
| C1 | 13, 18, 14, 15 | | +20.5 | 2–4 | 79% | 4A2 | |
| C2 | 5, 5, 6, 5 | | +19.5 | 4–6 | 83% | 4B1 | **5 to 6 feet:** Gray, silty fine SAND; increasingly moist at depth. |
| C2 | 10, 12, 16, 14 | | +16.5 | 6–8 | 100% | 4B2 | **6 to 8.3 feet:** Dark gray to brown clayey, silty fine SAND with some small gravels and pockets of clay. At 6 to 6.3 feet were pieces of wood chips. |
| C2 | 6, 8, 12, 14 | | +14.5 | 8–10 | 100% | 4C1 | **8.3 ft to 12 feet:** Light gray, fine sandy, silty CLAY; plastic and stiff with occasional woody fibers; these were more abundant at 9.6 feet; pockets of organic woody material occurred below 10 feet; pockets of clayey silty sand in the bottom 2 feet. |
| Z4 | 7, 8, 9, 12 | | +12.5 / +11.5 | 10–12 | 100% | 4C2 | |
| | | | | 12 | | | Total Depth: 12 feet |

NOTE:

DIV0440\HAMM.CR\CORE04.DSF 9/12/97

AR 023297

APPENDIX D

CHAIN-OF-CUSTODY FORMS

SAIC

18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
206/485-5800 • FAX 485-5566

# MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 01-0440- Project Mgr.: John Lunz

Project Name: Hamm Creek Restoration Project

Project Location: Hamm Creek, near Duwamish Turning Basin Seattle, WA

Client Name: USACE

Shipment No.:
Shipping Container No.:
Custody Seal No.:
Date Shipped:
Carrier:
Shipper:
Shipper Bill No.:

| | Sampling Location | Sample Number | Sample Depth | Sample Matrix | Sampling Date | Sampling Time | Sample Collector(s) | Analyses: PSDDA Chemicals of Concern ① | TOC | Total Solids | Total Volatile Solids | Grain size | Hg (jar is frozen) ② | Volatile organics | Sample Containers/Preservatives: 1 L glass | 250 ml glass - Frozen ③ | 125 ml glass with septum lid for VOAs | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | Hamm Creek | C1 | 0-4 Ft | soil | 6/10/97 | 0838 | LR SAIC ML USACE | X | X | X | X | X | X | X | 1 | 1 | 2 | ① see SOW + Sampling + Analysis Plan (include chromium) metals, semivols, pest, VOAs) |
| 02 | ↓ | C2 | >4 Ft | ↓ | 6/10/97 | 0850 | ↓ | X | X | X | X | X | X | X | 2 | 2 | 4 | ② Hg jars are Frozen |
| | | | | | | | | | | | | | | | | | | ③ Extra material collected for C2 for QA/QC |
| | | | | | | | | | | | | | | | | | | Please report res in PSDDA + SMS Format |

| RELINQUISHED BY: | RECEIVED BY: | RELINQUISHED BY: | RECEIVED BY: |
|---|---|---|---|
| Signature: Lisa E Rauch | Signature: [signature] | Signature: | Signature: |
| Date/Time: 6/18/97 1:45 | Date/Time: 6/18/97 1:45 | Date/Time: | Date/Time: |
| Affiliation: SAIC | Affiliation: AM TEST | Affiliation: | Affiliation: |

• White Lab Returns to Originator Upon Receipt of Samples. • Canary Lab Retains. • Pink Lab Returns to Project Manager with Final Report. • Goldenrod Retained by Sampler

AR 023299

(AmTest, +

SAIC
18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
206/485-5800 • FAX: 485-5566

# MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 01-0440-04-8357 Project Mgr.:
Project Name: Hamm Creek Restoration Project
Project Location: Hamm Creek near Duwamish Turning Basin Seattle, WA
Client Name: USACE

Shipment No.: 1
Shipping Container No.: —
Custody Seal No.: —
Date Shipped: 7-21-97
Carrier: Drop Off
Shipper: —
Shipper Bill No.: —

| Sampling Location | Sample Number | Sample Depth | Sample Matrix | Sampling Date | Sampling Time | Sample Collector(s) | Analyses: PSDDA Conventionals: TOC | TVS | Total Solids | grain size | Sample Containers/Preservatives: 1 L glass | 8 oz glass (extra for QA/QC) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 77 Carr 4 Inlet | Carr 4 | 0-10cm | marine sediment | 7/17/97 | 1329 | LR JN | X | X | X | X | 1 | 1 | See Statement of work Note: ammonia + sulfides subsam will arrive from the bioassay lab (Northwestern Aquatic Sciences) |

| RELINQUISHED BY: | RECEIVED BY: | RELINQUISHED BY: | RECEIVED BY: |
|---|---|---|---|
| Signature: [illegible] | Signature: [illegible] | Signature: | Signature: |
| Date/Time: 7-21-97 1445 | Date/Time: [illegible] 7/21/97 | Date/Time: | Date/Time: |
| Affiliation: SAIC | Affiliation: [illegible] | Affiliation: | Affiliation: |

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

SAIC

18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
206/485-5800 • FAX: 485-5566

# MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 01-0440-04-8357 Project Mgr.: John Lunz
Project Name: Hamm Creek Restoration Project
Project Location: Hamm Creek near Duwamish Turning Basin Seattle, WA
Client Name: USACE

| Sampling Location | Sample Number | Sample Depth | Sample Matrix | Sampling Date | Sampling Time | Sample Collector(s) | PSDDA conventional: | ammonia | total sulfides | 4 oz glass jars | 4 oz glass with Zn acetate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 Hamm Creek | C1 | 0-4 ft | soil | 7-31-97 | 11:00 | LR MK | | X | X | 2 | 2 |
| 38 ↓ | C2 | 7-4 ft | ↓ | 7-31-97 | 10:40 | ↓ | | X | X | 1 | 1 |
| 38 Corr Inlet | Corr 4 | 0-10 cm | marine sed | 7-31-97 | 10:00 | LR JN | | X | X | 1 | 1 |

Sample Containers/Preservatives: (only data for ANAL)

Shipment No.:
Shipping Container No.:
Custody Seal No.:
Date Shipped:
Carrier:
Shipper:
Shipper Bill No.:

Comments:
Note: Sample dates + times are when subsamples were taken at the bioassay lab

Please analyze within 48 hr upon arrival at AmTest

Refer to Statement of Work - (include when Corr 4 was submitted for the rest of conventional analyses)

| RELINQUISHED BY: | RECEIVED BY: | RELINQUISHED BY: | RECEIVED BY: |
|---|---|---|---|
| Signature: Michele S. Redmond | Signature: [illegible] | Signature: | Signature: |
| Date/Time: 8/4/97 09:15 | Date/Time: 8/5/97 9:45 | Date/Time: | Date/Time: |
| Affiliation: Northwestern Aquatic Sciences | Affiliation: AmTest | Affiliation: | Affiliation: |

• White: Lab Returns to Originator Upon Receipt of Samples. • Canary: Lab Retains. • Pink: Lab Returns to Project Manager with Final Report. • Goldenrod: Retained by Sampler

AR 023301

D-~m-trix * ⁺

SAIC

18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
206/485-5800 • FAX: 485-5566

# MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 01-0440-04-8357 Project Mgr.: John Lunz

Project Name: Hamm Creek Restoration Project

Project Location: Hamm Creek near Duwamish Turning basin Seattle, WA

Client Name: USACE

Ship. No.: 1
Shipping Container No.: —
Custody Seal No.: —
Date Shipped: 7-21-97
Carrier: Drop Off
Shipper: —
Shipper Bill No.: —

| Sampling Location | Sample Number | Sample Depth | Sample Matrix | Sampling Date | Sampling Time | Sample Collector(s) | Analyses: * PSDDA Bioassays | Analyses: 20-day Neanthes biomass/growth | Sample Containers/Preservatives: N2 | Sample Containers/Preservatives: 1 L glass jars | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hamm Creek | C1 | 0-4 ft | soil | 6/16/97 | 0838 | LR SAIC ML USACE | X | | | 2 | * See Statement of Work |
| ↓ | C2 | >4 ft | Soil | 6/16/97 | 0850 | ↓ | X | | | 2 | |
| Carr Inlet | Carr 4 | 0-10 cm | marine sed. | 7/17/97 | 1329 | LR, JN SAIC | X | | X | 2 | |

Note: C1 + C2 were packed with no headspace + have not yet been purged with $N_2$. Carr 4 had some settling + has been purged

| RELINQUISHED BY: | RECEIVED BY: | RELINQUISHED BY: | RECEIVED BY: |
|---|---|---|---|
| Signature: VMMetcalfe | Signature: [illegible signature] | Signature: | Signature: |
| Date/Time: 7-21-97 1430 | Date/Time: 7/21/97 1428 | Date/Time: | Date/Time: |
| Affiliation: SAIC | Affiliation: PMX, INC | Affiliation: | Affiliation: |

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

AR 023302

SAIC
18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
206/485 5800 • FAX 485 5566

# MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No: 01-0140-04-8357 Project Mgr: John Lunz
Project Name: Hamm Creek Restoration Project
Project Location: Hamm Creek near Duwamish Turning Basin Seattle, WA
Client Name: USACE

Shipment No: 1
Shipping Container No: 1
Custody Seal No: 014 0
Date Shipped: 7-21-97
Carrier: UPS
Shipper: UPS
Shipper Bill No: —

| Sampling Location | Sample Number | Sample Depth | Sample Matrix | Sampling Date | Sampling Time | Sample Collector(s) | Analyses: PSDDA Bioassays* 10-day acute amphipod (Rhepox) | Analyses: echinoderm sediment larval (Dendraster) | Sample Containers/Preservatives: ** | Sample Containers/Preservatives: 1L glass jar | Sample Containers/Preservatives | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hamm Creek | C1 | 0-4 ft | soil | 6/16/97 | 0838 | LR SAIC MK USACE | X | X | | 4 | NAS# 8670E | * See Statement of work |
| ↓ | C2 | >4 ft | soil | 6/16/97 | 0850 | ↓ | X | X | | 4 | NAS# 8671E | |
| Carr Inlet | Carr 4 | 0-10cm | marine sediment | 7/17/97 | 1329 | LR, JN SAIC | X | X | X | 4 | NAS# 8672E | ** Per Dick Caldwell request, Carr 4 samples were purged with $N_2$. C1 + C2 were packed with no headspace + have not yet been purged |

1 Small Green/White Cooler w/ Jars inside for Ammonia + Sulfide Subsampling

| RELINQUISHED BY: | RECEIVED BY: | RELINQUISHED BY: | RECEIVED BY: |
|---|---|---|---|
| Signature: VM Metcalfe | Signature: [illegible] | Signature: | Signature: |
| Date/Time: 7-21-97 1230 | Date/Time: 7-22-97 / 11:30 | Date/Time: | Date/Time: |
| Affiliation: SAIC | Affiliation: NAS | Affiliation: | Affiliation: |

• White Lab Returns to Originator Upon Receipt of Samples. • Canary Lab Retains; • Pink Lab Returns to Project Manager with Final Report. • Goldenrod Retained by Sampler

Northwestern [illegible] [illegible]

SAIC ...orage Facility

**SAIC**

18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
425/485-5800 • FAX: 485-5566

# MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 01-0440-04-8357-000 Project Mgr.: John Lunz
Project Name: Hamm Creek Restoration Project
Project Location: Hamm Creek near Duwamish Turning Basin Seattle, WA
Client Name: USACE

| Sampling Location | Sample Number | Sample Depth | Sample Matrix | Sampling Date | Sampling Time | Sample Collector(s) | Analyses: Archive at 4°C | Analyses: Archive at -18°C | 1L glass 4°C | 500ml glass 4°C | 500 ml freeze -18°C | 125 ml freeze -18°C | 1L freeze -18°C | $N_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hamm Creek | C1 | 0-4ft | Soil | 6/16/97 | 0838 | LR MK SAIC USACE | X | X | | 1 | 1 | | | |
| ↓ | C2 | >4ft | ↓ | ↓ | 0850 | ↓ | X | X | | 1 | 1 | 1 | | |
| ↓ | Z4 | 10-11ft | ↓ | ↓ | 0945 | ↓ | | X | | | | | 1 | |
| ↓ | Z2 | 12-13Ft | ↓ | ↓ | 1158 | ↓ | | X | | | | | 1 | |
| Carr Inlet | Carr 4 | 0-10cm | marine sed | 7/17/97 | 1329 | LR JU SAIC | X | | 1 | | | | | ✓ |

Shipment No.:
Shipping Container No.:
Custody Seal No.:
Date Shipped:
Carrier:
Shipper:
Shipper Bill No.:

Comments:

Note: material stored at 4°C at SAIC storage is that remaining after bioassays conducted

Material stored at -18°C are C1, C2 chemistry archive samples plus two Z samples

| RELINQUISHED BY: | RECEIVED BY: | RELINQUISHED BY: | RECEIVED BY: |
|---|---|---|---|
| Signature: | Signature: | Signature: | Signature: |
| Date/Time: | Date/Time: | Date/Time: | Date/Time: |
| Affiliation: | Affiliation: | Affiliation: | Affiliation: |

• White Lab Returns to Originator Upon Receipt of Samples • Canary Lab Retains: Lab Returns to Project Manager with Final Report: • Goldenrod Retained by Sampler

AR 023304

## APPENDIX E

## CHEMISTRY LABORATORY RESULTS AND QA/QC MEMORANDUM

# CHEMISTRY DATA QUALITY SUMMARY AND QA/QC MEMORANDUM

AR 023306

An Employee-Owned Company

## HAMM CREEK RESTORATION PROJECT
## DATA QUALITY SUMMARY FOR
## CONVENTIONAL AND CONTAMINANT CHEMISTRY

A Quality Assurance/Quality Control (QA/QC) review was conducted for conventional and contaminant chemistry results using the most recent guidelines available in PSDDA/PSEP documentation (PSDDA 1989, 1990, 1991a,b; PSEP 1986, 1997a,b). The QA/QC review included an evaluation of the precision, accuracy, representativeness, and completeness of the analytical results. QA1 checklists, which supplemented the QA/QC review were completed, and are presented following this summary. The checklists (based on PTI 1989) include an evaluation of the sample holding times, QC sample results (i.e., matrix spikes, laboratory replicates, standard reference materials, method blanks, and surrogate recoveries), analytical methodology, and data format.

AmTest, Inc. of Redmond, WA performed all PSDDA conventional chemistry, metals, and organics analyses. Overall, results of the QC analyses for conventionals, metals, and organics were within procedural control limits recommended by PSDDA. Those which did not meet PSDDA criteria met control limits recommended by EPA SW-846 methods, or the laboratory. These will be described in more detail below. Samples were tracked following appropriate chain-of-custody procedures, and analytical results were reported in the proper format. All samples submitted were analyzed within appropriate holding times. All analytes were below detection limits in the method blanks. Similarly, all sample detection limits were equal to or below PSDDA screening levels (SL) for all analytes.

The QA/QC sample results with respect to precision, accuracy, representativeness, and completeness are discussed below.

**Precision**

<u>Conventionals</u>

A triplicate analysis was performed for conventional parameters for each batch of samples submitted to the laboratories. Relative standard deviations (RSDs) or coefficients of variation calculated for TS, TVS, TOC, ammonia, and sulfides were all less than 10%. Therefore, all replicate data were considered acceptable.

For grain size triplicates, precision was assessed using RSDs calculated from the gravel, sand, silt, and clay fractions determined for each triplicate. As with the other conventional analyses, the RSDs for the various sand, silt, and clay size fractions were within acceptable ranges, with values less than 10% RSD. The gravel fractions had a 90% and 156% RSD for the first and second batches, respectively. However, values only ranged from 0.1% to 1.0% gravel in Batch 1, and from 0.0 to 1.4% gravel in Batch 2. The high RSD was primarily an artifact of the small gravel fraction, so that any small variation could result in a relatively high standard deviation. Therefore, grain size results were determined to be acceptable.

Metals

A duplicate metals analysis was performed for the batch of samples submitted. The relative percent difference (RPD) between duplicate (and triplicate) analytical measurements for metals was used to evaluate the precision of the analyses. With the exception of cadmium (22% RPD), the analytical RPDs were within the PSDDA/PSEP recommended control limits (i.e., results were <20% RPD). According to CLP requirements, RPDs are used for sample values greater than 5 times the contract required detection limits. An alternate limit, the detection limit (±0.02 for Cd) was used as the control limit for sample values less than 5 times the reporting limit. The difference between the sample and duplicate cadmium measurements was 0.01 mg/kg, within the alternate limit of ± 0.02 mg/kg. Precision for the metals analyses was considered acceptable.

Organics

The relative percent difference between matrix spikes (MS) and matrix spike duplicates (MSD) was used to assess the precision of semivolatile, pesticide/PCB, and volatile analytical results. All RPDs were within the PSDDA/PSEP recommended control limit of <35% RPD. Therefore, the overall precision of the results was considered acceptable.

## Accuracy

### Conventionals

The standard reference material NBS 2704 was analyzed for TOC in order to assess the accuracy of the analytical results. Measured values for the TOC reference material were 3.32 mg/kg and 3.0 mg/kg, while the true value was 3.35 mg/kg (99% and 89% recovery, respectively). All recoveries were within recommended ranges. In addition to the standard reference material, matrix spikes were performed for TOC in the second batch of analyses, and for ammonia and sulfides in the third batch. Percent recoveries for ammonia, sulfides, and TOC were 100%, 107%, and 89%, respectively. Target recoveries are generally between 75 and 125 percent recovery. Matrix spikes were not performed for TOC in the first batch.

### Metals

Accuracy of the metals measurements was assessed by the use of matrix spikes and a standard reference material (SRM NBS 2704), and the resulting percent recoveries calculated. One matrix spike was analyzed for the batch of samples submitted. All recoveries fell within the recommended range of 75-125%. For the standard reference material, the recovery for chromium was 63%, outside the recommended range of 80-120%. The laboratory indicated that because chromium is a matrix component, strong acid digestion (SAD) is inadequate to extract all of the chromium from the sample. However, the measured value for chromium (85 mg/kg) was within acceptable laboratory control limits (81-104 mg/kg). In addition, the matrix spike recovery for chromium was excellent (101%). Recoveries of all other analytes in the SRM were within PSDDA recommended ranges.

### Organics

Matrix and surrogate spikes were used to evaluate the accuracy of the volatile organics analyses, and matrix spikes, surrogate spikes, and standard reference materials analyses were performed for the semivolatile organics and pesticide/PCBs. Matrix spike recoveries were within PSDDA recommended ranges for all organics. Surrogate recoveries were within recommended ranges for the pesticides/PCBs. Recoveries for 4-bromofluorobenzene (C1 = 76%, C2 = 73%, blank = 80%) and d4-1,2-dichloroethane (blank = 82%) were below the PSDDA recommended range of <85% for volatile organic surrogates. However, with the exception of C2, values were within SW846 quality control limits (70-121% recovery for d4-1,2-dichloroethane, and 74-121% for 4-bromofluorobenzene). Although the recovery of 4-bromofluorobenzene for C2 was below both PSDDA and SW846 recommended ranges, the other two volatile organic surrogates spiked in C2 had good recoveries (87% for d4-1,2-dichloroethane and 93% for d8-toluene). Therefore, data qualification was not necessary.

In addition, for the semivolatile organics analyses, the surrogate spike recovery for d5-nitrobenzene (C1 = 42%) was outside PSDDA recommended ranges of >50%. This value, however, was within SW846 QC limits. All results for the standard reference materials (HS-3, ERA Lot 340, and ERA Lot 87001) were within laboratory control limits and performance acceptance limits set by the manufacturer (Environmental Resource Associates - ERA - Arvada, CO). All data results for matrix spikes, surrogates, and reference materials were considered acceptable.

**Representativeness**

Representativeness, which is a measure of how closely results reflect the actual concentration of chemical compounds in the sample, is assessed using the matrix spike and surrogate recoveries in metals and organics analyses. All percent recoveries were considered acceptable.

**Completeness**

Completeness, which is based on the amount of valid data obtained from each analytical method, was acceptable for conventionals, metals, and organics. Data was 100 percent useable.

## References

EPA. 1988. Laboratory Data Validation: Functional Guidelines for Evaluating Organics Analyses. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division.

PSDDA. 1989. Management Plan Report - Unconfined Open-Water Disposal of Dredged Material, Phase II (North and South Puget Sound). Puget Sound Dredged Disposal Analysis Reports Series. Cooperatively published by (in alphabetical order) U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region X; Washington State Department of Ecology; and Washington State Department of Natural Resources. September 1989.

PSDDA. 1990. "Changes to the: Management Plan Report, Unconfined Open-Water Disposal of Dredged Material, Phase II." Puget Sound Dredged Disposal Analysis Reports Series. February 1990.

PSDDA. 1991a. Summary and Conclusions of the Puget Sound Dredged Disposal Analysis (PSDDA) Chemistry Quality Assurance/Quality Control (QA/QC) and PSDDA Streamlining Workshop held on January 24, 1991 at Seattle District U.S. Army Corps of Engineers.

PSDDA. 1991b. "Changes to PSDDA Screening and Maximum Level Values for Dredged Material Management Year 1990." Puget Sound Dredged Disposal Analysis Reports Series. May 1991.

PSEP. 1986. Puget Sound Estuary Program. Recommended protocols for measuring selected environmental variables in Puget Sound. Final Report. Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the U.S. Army Corps of Engineers. Tetra Tech Inc., Bellevue, Washington.

PSEP. 1997a. Puget Sound Estuary Program. Recommended guidelines for measuring organic compounds in Puget sound sediment and tissue samples. Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound and the Puget Sound Water Quality

PSEP. 1997b. Puget Sound Estuary Program. Recommended guidelines for measuring metals in Puget sound sediment and tissue samples. Prepared for the U.S. Environmental Protection Agency Region X, Office of Puget Sound, and the Puget Sound Water Quality Action Team, Olympia,WA.

PTI. 1989. Puget Sound Dredged Disposal Analysis Guidance Manual: Data quality evaluation for proposed dredged material disposal projects. Prepared for the Washington Department of Ecology, Olympia, Washington. PTI, Environmental Services, Bellevue, Washington.

SAIC

## CHECKLIST FOR CONVENTIONAL VARIABLES IN SEDIMENT

Project Name Hamm Creek Restoration Project

SAIC Project No: 01-0440-04-8357

Lab AmTest, Inc. Lab # 96-A008101 to A008102

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared July 24, 1997

Date: Sampled June 16 and 17, 1997

Received by lab June 18, 1997

Analysis began TOC, TS, TVS: June 19, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

## COMPLETENESS AND HOLDING CONDITIONS

| | TOC | TVS | Total Sulfides | Ammonia | Total Solids | Grain Size Distribution | AVS |
|---|---|---|---|---|---|---|---|
| Method (identify) | SM5310B | PSEP | -- | --- | PSEP | PSEP | --- |
| # Samples submitted | 2 | 2 | -- | -- | 2 | 2 | --- |
| # Samples analyzed | 2 | 2 | -- | -- | 2 | 2 | --- |

Holding conditions acceptable?[a] (Y/N) Yes

If no, identify samples None

## FORMAT

Standard data report sheet

Concentrations in proper units and significant figures Yes

Sample detection limit provided, when applicable (total sulfides, ammonia) Not applicable

Qualifiers defined (e.g., U = undetected)

< = below the detection limit

## QA/QC SAMPLES

### Method Blank

TOC Total # 1

Frequency 1 for the batch of 2 samples (50%)
(minimum 1 per 20 samples)[b]

Amount detected in blank Undetected (0.05 U)
(not a PSEP control limit)

### Certified Reference Materials

TOC Total # 1

Frequency 1 for the batch of 2 samples (50%)
(minimum 1 per survey)

CRM used NBS 2704

Within 95% confidence interval? Yes. NBS-2704 measured value = 3.32 mg/kg; true value = 3.35 mg/kg; laboratory control limits 2.5 - 4.2 mg/kg.
(not a PSEP control limit)

### Analytical Replicates

| | TOC | TVS | Total Sulfides | Ammonia | Total Solids | Grain Size Distribution | AVS |
|---|---|---|---|---|---|---|---|
| Total # of samples | 2 | 2 | — | — | 2 | 2 | — |
| Frequency (minimum 1 triplicate per 20 samples)[b] | 1 Trip (C1) | 1 Trip (C2) | — | — | 1 Trip (C2) | 1 Trip (C2) | — |
| Relative standard deviation (RSD) | 8.2% | 9.1% | | | 0.0% | | |

[a] PSDDA recommended holding times for sediment conventionals

| Variable | Refrigerated at 4°C | Frozen at -18°C |
|---|---|---|
| Grain Size | 6 months | not recommended[1] |
| Total Solids, Total Volatile Solids, and Total Organic Carbon | 14 days | 6 months |
| Total Sulfides | 7 days | not applicable |
| Ammonia | 7 days | not applicable |
| Acid Volatile Sulfides[2] | no guidance | no guidance |

[1] Samples most not be frozen or dried before analysis

[2] Allen, et al. (1991) recommend 14-day holding time at 4°C

[b] Recommended by PSEP (1986)

AR 023313

## CHECKLIST FOR CONVENTIONAL VARIABLES IN SEDIMENT

Project Name Hamm Creek Restoration Project

SAIC Project No: 01-0440-04-8357

Lab AmTest, Inc. Lab # 96-A009723

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared September 5, 1997

Date: Sampled July 17, 1997

Received by lab July 21, 1997

Analysis began TOC, TS, grain size: July 22, 1997 and TOC: July 24, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

### COMPLETENESS AND HOLDING CONDITIONS

| | TOC | TVS | Total Sulfides | Ammonia | Total Solids | Grain Size Distribution | AVS |
|---|---|---|---|---|---|---|---|
| Method (identify) | SM5310B | PSEP | — | — | PSEP | PSEP | — |
| # Samples submitted | 1 | 1 | — | — | 1 | 1 | — |
| # Samples analyzed | 1 | 1 | — | — | 1 | 1 | — |

Holding conditions acceptable?[a] (Y/N) Yes

If no, identify samples None

### FORMAT

Standard data report sheet

Concentrations in proper units and significant figures Yes

Sample detection limit provided, when applicable (total sulfides, ammonia) Not applicable

Qualifiers defined (e.g., U = undetected)

< = below the detection limit

## QA/QC SAMPLES

### Method Blank

TOC Total # 1

Frequency 1 for the batch of 1 sample (100%)
(minimum 1 per 20 samples)[b]

Amount detected in blank Undetected (0.05 U)
(not a PSEP control limit)

### Certified Reference Materials

TOC Total # 1

Frequency 1 for the batch of 1 sample (100%)
(minimum 1 per survey)

CRM used NBS 2704

Within 95% confidence interval? Yes. NBS-2704 measured value = 3.0 mg/kg;
true value = 3.35 mg/kg; laboratory control limits 2.5 - 4.2 mg/kg.
(not a PSEP control limit)

### Analytical Replicates

| | TOC | TVS | Total Sulfides | Ammonia | Total Solids | Grain Size Distribution | AVS |
|---|---|---|---|---|---|---|---|
| Total # of samples | 1 | 1 | --- | --- | 1 | 1 | --- |
| Frequency (minimum 1 triplicate per 20 samples)[b] | 1 Trip (Carr 4) | 1 Trip (Carr 4) | --- | --- | 1 Trip (Carr 4) | 1 Trip (Carr 4) | --- |
| Relative standard deviation (RSD) | 5.0% | 2.6% | | | 0.1% | | |

[a] PSDDA recommended holding times for sediment conventionals

| Variable | Refrigerated at 4°C | Frozen at -18°C |
|---|---|---|
| Grain Size | 6 months | not recommended[1] |
| Total Solids, Total Volatile Solids, and Total Organic Carbon | 14 days | 6 months |
| Total Sulfides | 7 days | not applicable |
| Ammonia | 7 days | not applicable |
| Acid Volatile Sulfides[2] | no guidance | no guidance |

[1] Samples most not be frozen or dried before analysis

[2] Allen, et al. (1991) recommend 14-day holding time at 4°C

[b] Recommended by PSEP (1986)

AR 023315

## CHECKLIST FOR CONVENTIONAL VARIABLES IN SEDIMENT

Project Name Hamm Creek Restoration Project

SAIC Project No: 01-0440-04-8357

Lab AmTest, Inc. Lab # 96-A010379 to 96-A010381

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared September 5, 1997

Date: Sampled July 31, 1997 (date subsamples collected during bioassay test preparation)

Received by lab August 5, 1997

Analysis began Total solids, ammonia, total sulfides: August 6, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

## COMPLETENESS AND HOLDING CONDITIONS

| | TOC | TVS | Total Sulfides | Ammonia | Total Solids | Grain Size Distribution | AVS |
|---|---|---|---|---|---|---|---|
| Method (identify) | --- | --- | PSEP | Plumb 1981 | PSEP | --- | --- |
| # Samples submitted | --- | --- | 3 | 3 | 3 | --- | --- |
| # Samples analyzed | --- | --- | 3 | 3 | 3 | --- | --- |

Holding conditions acceptable?[a] (Y/N) Yes

If no, identify samples None

## FORMAT

Standard data report sheet

Concentrations in proper units and significant figures Yes

Sample detection limit provided, when applicable (total sulfides, ammonia) Not applicable

Qualifiers defined (e.g., U = undetected)

< = below the detection limit

## QA/QC SAMPLES

### Method Blank

TOC Total # 1 (ammonia, total sulfides)

Frequency 1 for the batch of 3 samples (33%)
(minimum 1 per 20 samples)[b]

Amount detected in blank Undetected (ammonia = 1.0 U; total sulfides = 10 U)
(not a PSEP control limit)

### Certified Reference Materials

TOC Total # Not applicable

Frequency ______
(minimum 1 per survey)

CRM used ______

Within 95% confidence interval? ______

(not a PSEP control limit)

### Analytical Replicates

| | TOC | TVS | Total Sulfides | Ammonia | Total Solids | Grain Size Distribution | AVS |
|---|---|---|---|---|---|---|---|
| Total # of samples | — | — | 3 | 3 | 3 | — | — |
| Frequency (minimum 1 triplicate per 20 samples)[b] | — | — | 1 Trip (C1) | 1 Trip (C1) | 1 Trip (C1) | — | — |
| Relative standard deviation (RSD) | | | 0.0% | 6.2% | 0.8% | | |

[a] PSDDA recommended holding times for sediment conventionals

| Variable | Refrigerated at 4°C | Frozen at -18°C |
|---|---|---|
| Grain Size | 6 months | not recommended[1] |
| Total Solids, Total Volatile Solids, and Total Organic Carbon | 14 days | 6 months |
| Total Sulfides | 7 days | not applicable |
| Ammonia | 7 days | not applicable |
| Acid Volatile Sulfides[2] | no guidance | no guidance |

[1] Samples most not be frozen or dried before analysis

[2] Allen, et al. (1991) recommend 14-day holding time at 4°C

[b] Recommended by PSEP (1986)

AR 023317

## CHECKLIST FOR METALS IN SEDIMENT

Project Name Hamm Creek Restoration Project

SAIC Project No. 01-0440-04-8357

Lab AmTest, Inc. Lab # 97-A008101 and 97-A008102

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared July 24, 1997

Date: Sampled June 16 and 17, 1997

Received by lab June 18, 1997

Analysis began Digestion: June 23, 1997 Analysis: June 23 to July 3, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

Chromium recovery in the CRM was low (63% recovery). (See discussion under certified reference materials).

All required documents submitted?[a] (Y/N) Yes

Digestion procedure [Total Acid Digest (TAD) or Strong Acid Digest (SAD)] SAD

## COMPLETENESS AND HOLDING CONDITIONS

# Samples submitted 2 # Samples analyzed 2

Holding conditions acceptable? (Y/N) [2 years frozen -18°C and 6 months 4°C for metals except mercury; 28 days frozen and 7 days 4°C (in glass) for mercury] Yes

If no, identify samples

## FORMAT

Standard data report sheet

Concentrations in proper units and significant figures Yes

Qualifiers defined (e.g., U = undetected) < = below detection limit

Sample detection limits (DL) provided for each analyte? (Y/N) Yes

- Checklists adopted from PSDDA guidance manual: PTI, 1989. -

## QA/QC SAMPLES

### Preparation Blank

Total # 1

Frequency[b] 1 per batch (50%)
(minimum 5% or 1 per batch, whichever is more frequent)[c]

Chemicals observed above detection limits in one or more blanks[c]

None

### Certified Reference Materials

Total # 1

Frequency[b] 1 per batch (50%)
(minimum 5% or 1 per batch, whichever is more frequent)[c]

CRM used SRM NBS-2704

Chemicals outside 80-120% recovery[c]

Chromium = 63% recovery. The laboratory indicated that because chromium is a matrix component, SAD digestion is inadequate in terms of extracting all of the chromium from the sample. However, the measured chromium value (85 mg/kg) was within laboratory control limits of 81-104 mg/kg.

(for chemicals without certified values, use matrix spike results)

### Analytical Replicates

Total # 1 (C1)

Frequency[b] 1 per batch (50%)
(minimum 5% or 1 per batch, whichever is more frequent)[c]

Samples/chemicals with >20% relative percent difference (RPD) or coefficient of variation (CV)[c]

Cadmium = 22% RPD. According to CLP requirements, RPDs are used for sample values greater than 5 times the contract required detection limit. An alternate limit, the detection limit (± 0.02), was used as the control limit for sample values less than 5 times the reporting limit. Therefore, quality control limits were met.

## CHECKLIST FOR METALS IN SEDIMENT (cont.)

**Matrix Spikes**

Total # 1 (C2)

Frequency[b] 1 per batch (50%)
(minimum 5% or 1 per batch, whichever is more frequent)[c]

Chemicals with recovery outside 75-125%[c] None

Did any DL exceed SL? (Y/N) No

If yes, detection limits exceeding SL (identify samples)

| | | |
|---|---|---|
| Antimony ____ | Arsenic ____ | Cadmium ____ |
| Copper ____ | Lead ____ | Mercury ____ |
| Nickel ____ | Silver ____ | Zinc ____ |

**Preparation Blanks** (Relative blank contamination)

Are sample results <5 times blank values in any samples? (Y/N) No

If yes identify elements and samples

a Metals:
For metals, the data report package for analyses of each sample should include the following:

- Tabulated results in units as specified for each matrix in the analytical protocols, validated and signed in original by the laboratory manager
- Any data qualifications and explanation for any variance from the analytical protocols
- Results for all of the QA/QC checks initiated by the laboratory
- Tabulation of instrument and method detection limits.

All contract laboratories are required to submit metals results that are supported by sufficient backup data and quality assurance results to enable independent QA reviewers to conclusively determine the quality of the data. The laboratories should be able to supply legible photocopies of original data sheets with sufficient information to unequivocally identify:

- Calibration results
- Calibration and preparation blanks
- Samples and dilutions
- Duplicates and spikes
- Any anomalies in instrument performance or unusual instrumental adjustments.

b For batches of 5 samples or less, the minimum QA checks should be a blank and the analysis of a CRM (and matrix spikes for any analytes not certified in the CRM). In general, the priority of QA checks for batches of ≤5 samples should be as follows: CRM > analytical replicate > matrix spikes.

c PSEP control limit.

- Checklists adopted from PSDDA guidance manual: PTI, 1989. -

SAIC

## CHECKLIST FOR VOLATILE ORGANIC COMPOUNDS IN SEDIMENT

Project Name Hamm Creek Restoration Project SAIC Project No: 01-0440-04-8357

Lab AmTest, Inc. Lab # 97-A008101 and 97-A008102

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared July 24, 1997

Date: Sampled June 16, 1997

Received by lab June 18, 1997

Analysis began June 30, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

Some of the surrogate recoveries were less than the specified 85% recovery. All were within SW846 method recovery ranges, with the exception of 4-bromofluorobenzene in C2 (see next page). However, the other two spiked surrogates were greater than 85% recovery for C2 volatiles. Therefore, data qualification was not required.

All required documents submitted?[a] (Y/N) Yes

Analytical method SW8260

### COMPLETENESS AND HOLDING CONDITIONS

# Samples Submitted 2 # Samples Analyzed 2

Holding conditions acceptable? (Y/N) (14 days at 4°C) Yes

If no, identify samples

### FORMAT

Standard data report sheet

Concentrations in proper units and significant figures Reported to one significant figure

Qualifiers defined (e.g., U = undetected)

< = below detection limit

Sample detection limits (DL) provided for each analyte? (Y/N) Yes

- Checklists adopted from PSDDA guidance manual: PTI, 1989. -

## QA/QC SAMPLES

**Method Blank**

Total # 1

Frequency 1 per batch (50%)
(minimum 1 per batch or 1 per 12-hour shift, whichever is more frequent)[b]

Chemicals detected above 2.5 µg total in one or more blanks[b]

None

**Analytical Replicates**

Total # 1 matrix spike duplicate (C1)

Frequency 1 per batch (50%)
(<20 samples - 1 per set of samples submitted to lab; ≥20 samples - 1 triplicate and additional duplicate for minimum of 5% total replication overall)[b]

Samples/chemicals with >35% RPD or CV[c]
None

**Matrix Spikes** (not required if isotope dilution used)

Total # 1 (C1)

Frequency 1 per batch (50%)
(<20 samples - 1 per set of samples submitted to lab; ≥20 samples - 5% overall)[b]

Chemicals outside 70 - 150% recovery[c]

None

**Detection Limits**

Did any DL exceed SL? (Y/N) No

If yes, detection limits exceeding SL (identify samples)

Volatiles

**Surrogate Recovery**

Were surrogates added to all samples?[c] (Y/N) Yes

Identify compounds with <85 percent recovery[c] (also identify samples)

4-bromofluorobenzene: C1 = 76.0%, C2 = 73%, and blank = 80%; SW846 QA = 74-121%

D4-1,2-dichloroethane: blank = 82% ; SW846 QA recovery = 70-121%

**Method Blanks** (Relative blank contamination)

Were any sample concentrations less than 5 times the blank concentrations?[b] (Y/N) None

If yes, identify compounds and samples

Organic Compounds

The following documentation is needed for organic compounds:

- A cover letter referencing or describing the procedure used and discussing any analytical problems
- Reconstructed ion chromatograms for GC/MS analyses for each sample
- Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra
- GC/ECD and/or GC/flame ionization detection chromatograms for each sample
- Raw data quantification reports for each sample
- A calibration data summary reporting calibration range used [and decafluorotriphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses]
- Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit
- Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified)
- Quantification of all analytes in method blanks (ng/sample)
- Method blanks associated with each sample
- Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data)
- Data qualification codes and their definitions.

b PSEP control limit.

c Control limits determined at the PSDDA Chemistry QA/QC and PSDDA Streamlining Workshop held 24 January 1991. U.S. Army Corps of Engineers, Seattle District.

# CHECKLIST FOR SEMIVOLATILE ORGANIC COMPOUNDS IN SEDIMENT

Project Name Hamm Creek Restoration Project SAIC Project No. 01-0440-04-8357

Lab AmTest, Inc. Lab # 97-A008101 and 97-A008102

Responsible Technician Mark Fugiel, General Manager

Reviewed by Lisa Roach Date checklist prepared July 24, 1997

Date: Sampled June 16 and 17, 1997

Received by lab June 18, 1997

Analysis began Semivolatiles: extraction on June 30, 1997; analysis on July 10, 1997

Pesticides/PCBs: extraction June 27, 1997; pesticide analysis on July 3, 1997 and PCB analysis on July 8, 1997

Problems noted (e.g., deviations from prescribed methods, analytical problems)

All required documents submitted?[a] (Y/N) Yes

Analytical method Semivolatiles: SW3550/8270; Pest/PCB: SW3540/8081

## COMPLETENESS AND HOLDING CONDITIONS

| | # Samples Submitted | # Samples Analyzed |
|---|---|---|
| A/B/N | 2 | 2 |
| Pesticides/PCB | 2 | 2 |

Holding conditions acceptable? (Y/N) (1 year for frozen sediment or 14 days at 4°C until extraction: extracts must be processed within 40 days)[b] Yes

If no, identify samples

Extract conditions acceptable? (Y/N) (1 year for frozen sediment or 14 days at 4°C)[b] Yes

If no, identify samples

- Checklists adopted from PSDDA guidance manual: PTI, 1989. -

## CHECKLIST FOR SEMIVOLATILE ORGANIC COMPOUNDS IN SEDIMENT (cont.)

### FORMAT

Standard data report sheet

Concentrations in proper units and significant figures Yes

Qualifiers defined (e.g., U = undetected)

< = below detection limit

### QA/QC SAMPLES

**Method Blank**

Total # 1

Frequency 1 per batch (50%)
(minimum 1 per extraction batch)[c]

Chemicals detected above 5 ug total (for phthalates) and 25 ug total[d]
(for other organic compounds: lower levels may be appropriate for pesticides and PCBs)

None

**Certified Reference Materials**

Total # 1

Frequency 1 per batch
(<50 samples - 1 per set of samples submitted to lab: >50 samples - 1 per 50 samples analyzed)[c]

CRM used Semivolatiles - SRM HS-3: Pesticides - Environmental Resource Associates (ERA) Lot 340: PCBs = ERA 87001

Chemicals outside 95% confidence interval (for certified values)[d,e]

Recoveries were within laboratory control limits and advisory ranges set by the manufacturer.

**Analytical Replicates**

Total # 1 matrix spike duplicate (C2)

Frequency 1 per batch (50%)
(<20 samples - 1 per set of samples submitted to lab: ≥20 samples - 1 triplicate and additional duplicate for minimum of 5% total replication)[c]

Samples/chemicals with >35% RPD or CV[c]

None

**Matrix Spikes** (not required for A/B/N if isotope dilution used)

Total # 1 matrix spike/matrix spike duplicate (C2)

Frequency 1 per batch (50%)
(<20 samples - 1 per set of samples submitted to lab; ≥20 samples - 5% of total samples)[c]

Chemicals outside 50-150% recovery[c] None

**Detection Limits**

Did any DL exceed SL? (Y/N) No

If yes, detection limits exceeding SL (identify samples)

A/B/N (PAH) ______ A/B/N (phenols, benzoic acid, benzyl alcohol) ______

A/B/N (other) ______ PCB ______ Pesticides ______

**Surrogate Recovery** (A/B/N)

Were surrogates added to all samples?[c] (Y/N) Yes

Identify compounds with <50 percent recovery[d,e] (also identify samples)

D-5-Nitrobenzene: C2 = 42%; SW846 QA/QC recovery = 23-120%

**Surrogate Recovery** (Pesticides/PCBs)

Were surrogates added to all samples?[c] (Y/N) Yes

Identify samples with <60 percent surrogate recovery[c]

None

**Method Blanks** (Relative blank contamination)

For target compounds other than phthalates, were sample concentrations less than 5 times blank concentrations? (Y/N) No

If yes, identify compounds and samples

______

For phthalates, were sample concentrations less than 10 times blank concentrations?[d] (Y/N) No

If yes, identify compounds and samples

______

# APPENDIX F

# BIOASSAY LABORATORY RESULTS AND QA/QC CHECKLISTS

# BIOASSAY QA/QC CHECKLISTS

An Employee-Owned Company

## CHECKLIST FOR AMPHIPOD MORTALITY BIOASSAY

| | | | |
|---|---|---|---|
| Project Name: | Hamm Creek Restoration Project | SAIC Project No: | 01-0440-04-8357-000 |
| Laboratory: | Northwestern Aquatic Sciences | Lab Number | 534-6   Batch 1 |
| Responsible Technician | Michele Redmond, Project Manager | Reviewed By: | Lisa Roach |

Amphipod species (check one)

| | |
|---|---|
| *Rhepoxynius abronius* | |
| *Ampelisca abdita* | |
| *Eohaustorius estuarius* | X |

| | | | |
|---|---|---|---|
| Date Sampled | June 16, 1997; July 17, 1997 | Received by Lab | July 22, 1997 |
| Date Analysis Begun | August 1, 1997 | | |

Problems noted (e.g., deviations from prescribed methods, analytical problems)

Seawater was filtered to <1.0 um rather than the specified <0.45 um. Test animals were held for only 1 day rather than the specified 2 days before testing. Neither of these deviations is likely to have affected the test results. In addtion, pH and temperature were slightly outside specified ranges (see end of checklist). However, this had no apparent effect on the outcome of the tests.

### COMPLETENESS AND HOLDING CONDITIONS

\# Samples Submitted: 2 test, 1 reference

\# Samples Analyzed: 2 test, 1 reference

Holding conditions acceptable (Y/N)

PSEP ; 4° C under nitrogen < 2 weeks

PSDDA ; 4° C under nitrogen < 8 weeks: See below

If no, identify samples: Samples were packed with no headspace; therefore, storage under nitrogen was not required. However, the reference sediment was purged with nitrogen within 24 hours of sample collection.

### FORMAT

**Standard data report sheet (check off)**

| | | | |
|---|---|---|---|
| Number of amphipods reported for each replicate | X | Field samples | 2 |
| Percent mortality reported for each replicate | X | Positive controls | 1 |
| Daily emergence taken for each replicate | X | Negative controls | 1 |
| | | Reference samples | 1 |
| Individual replicate, plus sample mean and standard deviations for mortality? | | | X |

**Analytical Replicates**

| | |
|---|---|
| Number per Sample | 5 |
| Any < 5 replicates? | No |

**Water Quality Variable Reported for each Replicate (check)**

| | | | |
|---|---|---|---|
| Interstitial salinity for each sample (initiation) | X | Salinity (daily) | X |
| Dissolved Oxygen (daily) | X | pH (daily) | X |
| Temperature (daily) | X | Sulfide (initiation and termination) | X |
| Ammonia (initiation and termination) | X | | |

## CHECKLIST FOR AMPHIPOD MORTALITY BIOASSAY

### QA/QC SAMPLES

**Negative Control**

| | |
|---|---|
| Control Sediment Collection Site | Beaver Creek, Oregon |
| Water Source | Yaquina Bay, Oregon |
| Current priority pollutant scan available? | Not provided with report |
| Mean Control Mortality (%) | 1% |
| Exceed PSEP QA Limit of 10%? (Y/N) | No |
| Exceed PSEP QA limit of < 20% individual replicate mortality (Y/N) | No |

**Reference Sediment**

| | |
|---|---|
| Collection Site | Carr Inlet, Washington |
| Total Number of Analyses | 1 reference: Carr 4 |
| Reference grain size appropriate for test species? | Yes |
| Mean Mortality | 4% |
| Mean mortality exceed PSEP QA limit of > 20% over control? (Y/N) | No |

**Positive Controls**

| | |
|---|---|
| Reference Toxicant | Cadmium chloride |
| Exposure Concentrations | 0.0, 0.1, 0.3, 1.0, 3.0, 10.0 mg/L |
| % mortality/exposure concentration | 0%, 0%, 0%, 0%, 25%, 85% |
| Organism Response (LC50) | 4.91 mg/L Cd |
| Laboratory Performance Standards for Reference Toxicant | 0.67 to 7.89 mg/L |
| Did the test LC50 fall within lab standards (Y/N)? | Yes |

### WATER QUALITY

Rhepoxynius abronius

| | |
|---|---|
| Samples with temperature < 14 or > 16° C | |
| Samples with salinity < 27 or > 29 ppt | |
| Samples with pH < 7 or > 9 | |
| Samples with DO < 6 mg/L | |

Ampelisca abdita

| | |
|---|---|
| Samples with temperature < 19 or > 21° C | |
| Samples with salinity < 27 or > 29 ppt | |
| Samples with pH < 7 or > 9 | |
| Samples with DO < 6 mg/L | |

Eohaustorius estuarius

| | |
|---|---|
| Samples with temperature < 14 or > 16° C | Day 5: Carr 4 = 16.3, C1 = 16.1, C2 = 16.2 |
| Samples with salinity other than ambient interstitial salinity of test sediment | None; Salinity for this test was set between 14 and 16 ppt |
| Samples with pH < 7 or > 9 | See below |
| Samples with DO < 6 mg/L | None |

| Sample | Day | pH |
|---|---|---|
| C1 | 3 | 6.9 |
| | 6 | 6.7 |
| | 8 | 6.4 |
| | 9 | 6.2 |

# CHECKLIST FOR SEDIMENT LARVAL BIOASSAY (SOLID PHASE)

| | | | |
|---|---|---|---|
| Project Name: | Hamm Creek Restoration Project | SAIC Project No: | 01-0440-04-8357-000 |
| Laboratory: | Northwestern Aquatic Sciences | Lab Number | 534-5 |
| Responsible Technician | Michele Redmond, Project Manager | Batch | 1 |
| Date Sampled | June 16, 1997 and July 17, 1997 | Reviewed By: | Lisa Roach |
| Date Analysis Begun | July 31,1997 | Received by Lab | July 22, 1997 |

Problems noted (e.g., deviations from prescribed methods, analytical problems)

None

## COMPLETENESS AND HOLDING CONDITIONS

# Samples Submitted: 2 test, 1 reference — # Samples Analyzed: 2 test, 1 reference

Holding conditions acceptable (Y/N)
PSEP ; 4° C under nitrogen < 2 weeks
PSDDA ; 4° C under nitrogen < 8 weeks See below

If no, identify samples: Samples were packed with no headspace; therefore, storage under nitrogen was not required. However, the reference sediment was purged with nitrogen within 24 hours of sample collection.

## FORMAT

Standard data report sheet (check off)

| | | | |
|---|---|---|---|
| Number of larvae evaluated | X | Field samples | 2 |
| Percent mortality/abnormality reported for each replicate | X | Positive controls | 1 |
| Percent abnormality reported for each replicate | X | Negative controls | 1 |
| | | Reference samples | 1 |

Individual replicate, and sample mean and standard deviations for mortality and abnormality? X

Water quality variable reported for each replicate

| | | | |
|---|---|---|---|
| Dissolved Oxygen (daily) | X | Salinity (daily) | X |
| Temperature (daily) | X | pH (daily) | X |
| Ammonia (initiation and termination) | X | Sulfide (initiation and termination) | X |

## QA/QC SAMPLES

**Negative Control (seawater)**

| | |
|---|---|
| Water Source | Yaquina Bay, Oregon |
| Current priority pollutant scan available? | Not provided with report |
| Mean Control Mortality (%) | 23.3% |
| Mean Control Abnormality (%) | 14.1% |
| Exceed PSDDA/PSEP QA Limit of 30%? | No |

## CHECKLIST FOR SEDIMENT LARVAL BIOASSAY (SOLID PHASE)

**Analytical Replicates**

| | |
|---|---|
| Number per Sample | 5 |
| Any < 5 replicates? | No |

**Reference Sediment**

| | |
|---|---|
| Collection Site | Carr Inlet, Washington |
| Total Number of Analyses | 1 reference: Carr 4 |
| Mean Mortality/Abnormality | -10.2% (normalized to seawater control); 15.5% CMA |
| Mean Abnormality | 7.8% |
| Mean mortality and abnormality > 35% over control? (Y/N) | No |
| Standard deviation of reference sediment >20%? (Y/N) | No |
| If yes to above, is power of reference vs. control > 0.6? (Y/N) | |

**Test Sediment**

| | |
|---|---|
| Standard deviation of test sediment >20%? (Y/N) | No |
| If yes to above, is power of test vs. reference > 0.6? (Y/N) | |

**Positive Controls**

| | |
|---|---|
| Reference Toxicant | Cadmium chloride |
| Exposure Concentrations | 0.0, 1.0, 2.0, 4.0, 8.0, 15.0, 30.0 mg/L |
| % mortality/exposure concentration | 2.2%, 9.7%, 2.2%, 6.1%, 50.3%, 97.4%, 100% |
| Organism Response (LC50) | 8.13 mg/L |
| Laboratory Performance Standards for Reference Toxicant | 5.15 to 12.3 mg/L |
| Did the test LC50 fall within lab standards (Y/N)? | Yes |

**WATER QUALITY**

*Dendraster excentricus*

| | |
|---|---|
| Samples with temperature < 14 or > 16° C | None |
| Samples with salinity < 27 or > 29 ppt | None |
| Samples with pH < 7 or > 9 | None |
| Samples with DO < 6 mg/L | None |

*Crassostrea gigas*

| | |
|---|---|
| Samples with temperature < 19 or > 21° C | |
| Samples with salinity < 27 or > 29 ppt | |
| Samples with pH < 7 or > 9 | |
| Samples with DO < 6 mg/L | |

*Mytilus spp.*

| | |
|---|---|
| Samples with temperature < 15 or > 17° C | |
| Samples with salinity < 27 or > 29 ppt | |
| Samples with pH < 7 or > 9 | |
| Samples with DO < 6 mg/L | |

*Stronglyocentrotus purpuratus*

| | |
|---|---|
| Samples with temperature < 14 or > 16° C | |
| Samples with salinity < 27 or > 29 ppt | |
| Samples with pH < 7 or > 9 | |
| Samples with DO < 6 mg/L | |

## CHECKLIST FOR 20-DAY NEANTHES BIOASSAY

| | | | |
|---|---|---|---|
| Project Name: | Hamm Creek Restoration Project | SAIC Project No: | 01-0440-04-8357-000 |
| Laboratory: | Parametrix, Inc. | Lab Number | 55-1738-6 Batch 1 |
| Responsible Technician | Nathaniel Merrill, Project Manager | Reviewed By: | Lisa Roach |
| Date Sampled | June 16, 1997; July 17, 1997 (Carr 4) | Received by Lab | July 21, 1997 |
| Date Analysis Begun | July 24, 1997 | | |

Problems noted (e.g., deviations from prescribed methods, analytical problems)

The reported water quality measurement for C1 on Day 3 was taken from a different replicate beaker than the previous and subsequent measurements. This was because air had stopped overnight in the beaker from which water quality measurements had been made (DO in this beaker was 2.5 mg/L). This had no apparent effect on the survival of the test organisms. In addition, during the water quality change, Neanthes were observed on the sides of two replicate beakers for the control. Dissolved oxygen and pH were slightly outside control limits in in some of the samples on Days 0, 3, and 20 (see end of this checklist). This did not appear to have an effect on the survival and growth rate of the organisms.

### COMPLETENESS AND HOLDING CONDITIONS

# Samples Submitted: 2 test, 1 reference

# Samples Analyzed: 2 test, 1 reference

Holding conditions acceptable (Y/N)

PSEP ; 4° C under nitrogen < 2 weeks

PSDDA ; 4° C under nitrogen < 8 weeks

See below

If no, identify samples: Samples were packed with no headspace; therefore, storage under nitrogen was not required. However, samples were purged with nitrogen upon arrival at the laboratory.

### FORMAT

**Standard data report sheet (check off)**

| | |
|---|---|
| Initial Biomass for 3 groups of 5 worms each | X |
| Number of worms reported for each replicate | X |
| Percent Mortality reported for each replicate | X |
| Final Biomass reported for each replicate | X |
| Final Mean Growth Rate reported for each replicate | X |

| | |
|---|---|
| Field samples | 2 |
| Positive controls | 1 |
| Negative controls | 1 |
| Reference samples | 1 |

Individual replicate, plus sample mean and standard deviations for mortality, biomass, and growth rate? X

**Analytical Replicates**

| | |
|---|---|
| Number per Sample | 5 |
| Any < 5 replicates? | No |

**Water Quality Variable Reported for each Replicate (check)**

| | |
|---|---|
| Interstitial salinity for each sample (initiation) | X |
| Dissolved Oxygen (every third day) | X |
| Temperature (every third day) | X |
| Ammonia (initiation and termination) | X |
| Worms fed every second day | X |

| | |
|---|---|
| Seawater change every three days? | X |
| Salinity (every third day) | X |
| pH (every third day) | X |
| Sulfide (initiation and termination) | X |

# CHECKLIST FOR 20-DAY NEANTHES BIOASSAY

## QA/QC SAMPLES

**Negative Control**

| | |
|---|---|
| Control Sediment Collection Site | West Beach, Whidbey Island, WA |
| Water Source | Natural seawater collected from NMFS, Mukilteo, WA |
| Current priority pollutant scan available? | Data follows the Neanthes bioassay report |
| Mean Control Mortality (%) | 8% |
| Exceed PSEP QA Limit of 10%? | No |
| Mean Control Biomass (mg/individual) | 19.1 mg |
| Mean Control Growth Rate (mg/individual/day) | 0.92 mg/indiv/day |

Note: the mean control growth rate met the target growth rate of 0.72 mg/individual/day. In addition, the initial weight target of 0.5 mg/indiv. was also met.

**Positive Controls**

| | |
|---|---|
| Reference Toxicant | Cadmium chloride |
| Exposure Concentrations | 0.0, 1.8, 3.0, 5.0, 8.4, 14.0 mg/L |
| Percent mortality/exposure concentration | 0%, 0%, 0%, 0%, 0%, 90% |
| Organism Response (LC50) | 11.16 mg/L Cd |
| Laboratory Performance Standards for Reference Toxicant | 3.54 to 12.42 mg/L Cd |
| Did the test LC50 fall within lab standards (Y/N)? | Yes |

**Reference Sediment**

| | |
|---|---|
| Collection Site | Carr Inlet, WA |
| Total Number of Analyses | 1 reference, Carr 4 |
| Mean Mortality | 4% |
| Mean mortality > 20% over control? (Y/N) | No |
| Mean Biomass (mg/individual) | 17.5 mg |
| Mean Growth Rate (mg/individual/day) | 0.84 mg/indiv/day |
| Mean growth rate less than PSDDA QA limit of >80% of the control (Y/N)? | No (91%of control) |

## WATER QUALITY

| | |
|---|---|
| Samples with temperature < 19 or > 21° C | None |
| Samples with salinity < 26 or > 30 ppt | None |
| Samples with pH < 7.0 or > 9.0 | See below |
| Samples with DO < 6 mg/L | See below |

| Sample | Day | pH | DO |
|---|---|---|---|
| C1 | 0 | 6.8 | |
| | 3 | 6.4 | |
| | 20 | 6.6 | |
| C2 | 20 | 6.7 | |
| Control | 3 | | 5.2 |
| | 20 | 6.8 | |

NORTHWESTERN AQUATIC SCIENCES

Toxicity Test Report
Amphipod Bioassay

An Employee-Owned Company

# TOXICITY TEST REPORT

## TEST IDENTIFICATION

Test No.: 534-6

Title: *Eohaustorius estuarius* 10-day sediment toxicity test.

Protocol: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP 1995), with modifications as specified by the Puget Sound Dredged Disposal Analysis Program, the Sampling and Analysis Plan for the Hamm Creek Restoration Project, and the SAIC statement of work.

## STUDY MANAGEMENT

Study Sponsor: SAIC, 18706 N. Creek Parkway, Suite 110, Bothell, Washington 98011.

Sponsor's Study Monitor: Ms. Lisa Roach

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, Oregon 97365.

Test Location: Newport Laboratory.

Laboratory's Study Personnel: M.S. Redmond, M.S., Proj. Mngr./Study Dir.; L.K. Nemeth, B.A., QA Officer; G.A. Buhler, B.S., Aq. Toxicol.; G.J. Irissarri, B.S., Aq. Toxicol.; B.D. Crowe, B.S., Sr. Tech; E. Coffey, B.S., Tech.

Study Schedule:
- Test Beginning: 8-1-97, 3:00 p.m.
- Test Ending: 8-11-97, 2:00 p.m.

Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 334 S.W. 7th Street, Suite B, Newport, OR 97365.

Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989. (40 CFR Part 792).

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

## TEST MATERIAL

Control Sediment: The control sediment was collected from Beaver Creek, OR on 7-31-97. It was sieved through a 1.0 mm screen, stored at 4°C in the dark, and then homogenized before use in the test.

Test Sediments: Sediment samples from Hamm Creek, Duwamish Waterway, Washington. Details are as follows:

| NAS Sample No. | 8670E | 8671E | 8672E |
|---|---|---|---|
| Description | C1 | C2 | CARR4 |
| Collection Date | 6-16-97 | 6-16-97 | 7-17-97 |
| Receipt Date | 7-22-97 | 7-22-97 | 7-22-97 |
| Interstitial Salinity (ppt) | -- | 2.0 | 29.0 |

Storage: Stored at 4°C in the dark in a capped container until used. 8672E was stored under nitrogen; 8670E and 8671E were packed with no headspace.

Treatments: Each sample was thoroughly homogenized and aliquots distributed to the appropriate beakers. Additional aliquots were weighed for use in test 534-5, and samples taken for ammonia and sulfide analyses. The ammonia and sulfide subsamples were refrigerated, and then shipped cold under chain-of-custody to AmTest, Inc. Each beaker containing sediment for use in test 534-6 was filled to the 950 mL mark with salinity-adjusted seawater calculated to achieve a final salinity of 15 ppt, and gently stirred. Sediments were allowed to settle in test beakers for 4 hours. Overlying water salinity after settling was 15.0 ± 1.5 ppt. 600 mL of overlying water was decanted from each beaker, and then each beaker filled to the 750 mL mark with 15.0 ppt seawater.

## TEST WATER

Source: Yaquina Bay, Oregon

Date of Collection: 7-31-97

Water Quality: Salinity 15.0 ppt; pH 7.7.

Pretreatment: Filtered to ≤1.0 µm, aerated, salinity adjusted using Milli-Q® deionized water.

## TEST ORGANISMS

Species: Eohaustorius estuarius, amphipod

Size/Weight: adults

Source: Field collected on 7-31-97 from Beaver Creek, Oregon.

Acclimation: Mean conditions during acclimation were: temperature 13.2°C; salinity 14.0 ppt; dissolved oxygen 10.2 mg/L; pH 7.7.

## TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. Refer to the test protocols cited above for a more detailed description of the test procedures used in this study.

Test Chambers: 1 L borosilicate glass beakers.

Test Volumes: 175 ml of test or control sediment; 950 ml total volume.

Replicates/Treatment: 6 (5 plus one water quality replicate)

Sediment Salinity Adjustment: see sample treatment discussion above.

Organisms/Treatment: 120 (20/replicate).

Water Volume Changes per 24 hr: None

Aeration: Yes, at least 2 cm above the sediment surface.

Feeding: None.

Acceptance Criteria: Results are valid if mean control mortality does not exceed 10%, and does not exceed 20% in any one replicate.

Effects Criteria: 1) survival after 10 days, 2) daily emergence of amphipods from the test sediments, and 3) percentage of surviving amphipods reburying at the end of the exposure period. Death is defined as no visible appendage movement or response to tactile stimulation.

Water Quality and Other Test Conditions: The temperature, dissolved oxygen, salinity, and pH were measured in one replicate beaker on all test days. Ammonia and sulfides in overlying water were measured, using Hach test kits, in one replicate beaker on days 0 and 10 only. Sulfide and ammonia-N analyses were by the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14: 403, 1966) colorimetric methods, respectively. Samples were not distilled prior to analysis. The photoperiod was constant light.

## DATA ANALYSIS METHODS

Percent survival and percent reburial at the end of the test were determined from the final observations according to the formulas:

Percent survival = 100(no. of surviving amphipods/initial number of amphipods)
Percent reburial = 100(no. of surviving amphipods reburying/no. of surviving amphipods)

Another endpoint was the sum of observed daily sediment emergence events in a test beaker throughout the test.

Means and standard deviations for the biological endpoints described above and for water quality data were computed using Microsoft Excel Ver.5.0.

## PROTOCOL DEVIATIONS

1. Seawater was filtered to $\leq 1.0$ µm rather than the specified $\leq 0.45$µm.
2. Test animals were held for only 1 day rather than the specified 2 days before testing.

Neither of these deviations is likely to have affected the test results.

## REFERENCE TOXICANT TEST

The reference toxicant test is a standard multi-concentration toxicity test using cadmium as $CdCl_2$-2½$H_2O$, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory.

Test No.: 999-783
Reference Toxicant and Source: $CdCl_2$-2.5$H_2O$, Mallinckrodt, Lot No. TNZ.
Test Date: 8-1-97
Dilution Water Used: Yaquina Bay, Oregon seawater, salinity: 12.0 ppt.
Result: 96-hr LC50, 4.91 mg/L Cd. This result is within the laboratory's control chart warning limits (0.67 to 7.89 mg/L).

## RESULTS

Water quality data are summarized in Table 1. A detailed tabulation of the water quality results can be found in Appendix II. The means and standard deviations of the biological responses for each sediment are summarized in Table 2. Detailed data organized by sample and replicate, including the observations on emergence, survival and reburial and the summary statistics for these observations, are given in Appendix II. Table 3 gives the final interstitial salinities in the sediments of each test container.

All water quality measurements of temperature, dissolved oxygen, salinity, and pH were within the protocol specified ranges. Sulfides were not detected (detection limit, 0.01 mg/L) either at the beginning or end of the test. Total ammonia-N in the overlying water ranged from <0.2 (detection limit) to 2.5 mg/L.

The test met the acceptability criterion for control survival (≥90% and ≥80% in any one replicate); mean survival in controls was 99.0%. In addition, the results of the reference toxicant test were acceptable compared with the laboratory's historical data for this species.

Percent survival in all samples was 96.0%. The percent of surviving amphipods which reburied was 100% in all treatments except for C2 (8671E), where the percent reburied was 98.9%. Mean total emergence ranged from 0 (control, CARR4[8672E]) to 4.2 (C2).

**STUDY APPROVAL**

Michele S. Redmond 8/27/97
Proj. Manager/Study Director Date

Julie R. Fiore 8-26-97
Quality Assurance Unit Date

Rich D. Caldwell 8/27/97
Toxicology Manager Date

Table 1. Summary of water quality conditions prevailing during the Eohaustorius estuarius 10-day test.

| Parameter | Mean ± SD | Minimum | Maximum | N |
|---|---|---|---|---|
| Temperature (°C) | 15.5 ± 0.4 | 15.0 | 16.3 | 44 |
| Dissolved Oxygen (mg/L) | 9.1 ± 0.2 | 8.6 | 9.4 | 44 |
| Salinity (ppt) | 15.0 ± 0.4 | 14.0 | 16.0 | 44 |
| pH | 7.6 ± 0.5 | 6.2 | 8.3 | 44 |
| Total Sulfide (mg/L) | -- | <0.01 | <0.01 | 8 |
| Total Ammonia-N (mg/L) | -- | <0.2 | 2.5 | 8 |

Table 2. Means and standard deviations (n=5) of sediment emergence, 10-day percent survival, and percent reburial of *Eohaustorius estuarius* exposed to sediments.

| Sample Description | Emergence[1] (no./replicate) | Percent Survival (10-days) | Percent Reburial[2] |
|---|---|---|---|
| Control sediment | 0.0 ± 0.0 | 99.0 ± 2.2 | 100.0 ± 0.0 |
| CARR4 (NAS # 8672E) | 0.0 ± 0.0 | 96.0 ± 4.2 | 100.0 ± 0.0 |
| C1 (NAS # 8670E) | 3.0 ± 2.5 | 96.0 ± 5.5 | 100.0 ± 0.0 |
| C2 (NAS # 8671E) | 4.2 ± 4.2 | 96.0 ± 4.2 | 98.9 ± 2.4 |

1 Total number of amphipods observed daily over a 10-day period to have emerged from the sediment per test beaker.

2 Percentage of surviving amphipods able to rebury in clean sediment within 1 hr after a 10-day exposure.

Table 3. Interstitial salinity of test sediments at the conclusion of the 10-day test exposure.

| Sample Description | Replicate 1 | Replicate 2 | Replicate 3 | Replicate 4 | Replicate 5 |
|---|---|---|---|---|---|
| Control sediment | 14.5 | 15.0 | 14.0 | 14.0 | 15.0 |
| CARR4 (NAS # 8672E) | 15.0 | 15.0 | 15.5 | 15.5 | 15.5 |
| C1 (NAS # 8670E) | 14.5 | 14.0 | 15.0 | 14.5 | 15.0 |
| C2 (NAS # 8671E) | 15.0 | 14.5 | 15.0 | 14.0 | 14.0 |

APPENDIX I

TEST PROTOCOL
(Included by Reference)

APPENDIX II

RAW DATA

NORTHWESTERN AQUATIC SCIENCES
MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

PROTOCOL NO. NAS-XXX-RA4

Reviewed pgs. 1-26 29 MLR 8/24/97

Test No. 534-6 Client SAIC Investigator

STUDY MANAGEMENT

Client: SAIC, 18706 N. Creek Pkwy., Suite 110, Bothell, WA 98011
Client's Study Monitor: Ms. Lisa Roach
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. M.S. Redmond MLR
QA Officer L.K. Nemeth
1. G.J. IRISSARRI GJI 2. EABurch EAB
3. BD Crowe BC 4. Erin Coffey
Study Schedule:
Test Beginning: 8-1-97 15:00 Test Ending: 8-11-97 14:00

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | 8670E | 8671E | 8672E | | |
| Description: | C1 | C2 | CARR4 | control | |
| Collection Date: | 6-16-97 | 6-16-97 | 7-17-97 | 7-31-97 | |
| Receipt Date: | 7-22-97 | 7-22-97 | 7-22-97 | 7-31-97 | |
| Inters. Salinity (ppm): | — * | 2.0 | 29.0 | | |

* samples completely without free water for measurement - MLR 7-31-97

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | | | | | |
| Description: | | | | | |
| Collection Date: | | | | | |
| Receipt Date: | | | | | |
| Inters. Salinity (ppm): | | | | | |
| : | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | | | | | |
| Description: | | | | | |
| Collection Date: | | | | | |
| Receipt Date: | | | | | |
| Inters. Salinity (ppm): | | | | | |
| : | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | | | | | |
| Description: | | | | | |
| Collection Date: | | | | | |
| Receipt Date: | | | | | |
| Inters. Salinity (ppm): | | | | | |
| : | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | | | | | |
| Description: | | | | | |
| Collection Date: | | | | | |
| Receipt Date: | | | | | |
| Inters. Salinity (ppm): | | | | | |
| : | | | | | |

Test No. 534-6 Client SAIC Investigator

SEDIMENT DESCRIPTIONS--SUPLEMENTAL NOTES

| Sample No. | Description |
|---|---|
| 8672E | Brownish-gray sandy mud, well-sorted |
| 8670E | Brown soil; fine plant root material |
| 8671E | gray sandy mud |
| | control - brown sand, pre-sieved through 1.0 mm screen |

Preparation (7-31-97)

Each sample was thoroughly homogenized and aliquots distributed to the appropriate beakers. (Additional aliquots were weighed for use in test 534-5, and samples also taken for ammonia and sulfide analyses.) Each beaker was then filled (to the 950 mL mark) with salinity-adjusted seawater calculated to reach a final salinity of 15 ppt. Sediments were allowed to settle in test beakers for 4 hours.

Adjusted overlying water salinity in each beaker, after settling but before decanting:

| Beaker # | ppt | Beaker # | ppt |
|---|---|---|---|
| 1 | 14.5 | 13 | 13.5 |
| 2 | 14.5 | 14 | 14.0 |
| 3 | 16.0 | 15 | 14.0 |
| 4 | 16.0 | 16 | 13.5 |
| 5 | 14.0 | 17 | 15.5 |
| 6 | 14.0 | 18 | 15.0 |
| 7 | 15.5 | 19 | 15.0 |
| 8 | 14.0 | 20 | 14.0 |
| 9 | 15.0 | 21 | 14.0 |
| 10 | 14.0 | 22 | 16.0 |
| 11 | 14.0 | 23 | 15.5 |
| 12 | [illegible] | 24 | 16.0 |

After verifying salinity adjustment, 600 mL of overlying water was decanted using a siphon, and each beaker filled to about the 750 mL mark with 15.0 ppt seawater. Beakers then placed in constant temperature room, hooked up to aeration, and covered with watch glasses. - MSR 7-31-97

AR 023344

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator

**TEST ORGANISMS**

Species: Eohaustorius estuarius Date Collected: 7-31-97

Source: Beaver Creek Oregon

Field Conditions (interstitial) When Collected: Temp 20.2 Salinity 0.0

Acclimation Data:

| Date | Temp (°C) | DO (mg/L) | pH | Sal (ppt) | Comments |
|---|---|---|---|---|---|
| 7-31-97 | 13.4 | 10.2 | 7.7 | 13.0 | |
| 8-1-97 | 13.0 | 10.1 | 7.7 | 15.0 | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Mean | 13.2 | 10.2 | 7.7 | 14.0 | |
| S.D. | - | - | - | - | |
| (N) | 2 | 2 | 2 | 2 | |

**TEST PROCEDURES AND CONDITIONS**

Test chambers: 1 L glass beakers

Test volumes: 175 ml of test sediment: ~~1000~~ 950 TML 7-30-97 ml total volume

Replicates/treatment: ~~(5)~~ 6 * Organisms/treatment: ~~(100)~~ 120

Test water changes: None Aeration: Yes, 3 cm below water surface

Feeding: None

Beaker placement: Total randomization

**MISCELLANEOUS NOTES**

* 5 replicates plus one replicate for water quality measurements.

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator ____________

Control Sediment: Beaver Creek sediment, collected 7-31-97, sieved through 1.0 mm screen.

↑ ace of ailer

Randomization chart:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | | |
| 2 | 2 | 5 | 8 | 11 | 14 | 17 | 20 | 23 | | |
| 3 | 1 | 4 | 7 | 10 | 13 | 16 | 19 | 22 | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |

Randomization chart:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |

Randomization chart:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |

TEST WATER

Source: Yaquina Bay, Oregon

Date of Collection: 7-31-97 Salinity (ppt) 15.0 pH 7.7

Treatments: filtered to ≤10 µm, salinity-adjusted w/ Milli Q water, aerated.

AR 023346



Revised 12-30-92

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator ______

DAILY RECORD SHEET

Day 0 (8/1 97 CB/mel/BC Temperature beaker 14.8 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. ** Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 1 | OK | |
| 2 | | | | | | | 1 | OK | |
| 3 | | | | | | | 0 | OK | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| * 13 | 15.1 | 9.2 | ~~23~~ 15.0 | 8.0 | <0.01 | 2.1 | | | |
| * 14 | 15.1 | 9.2 | ~~26~~ 15.0 | 8.0 | <0.01 | 1.8 | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| * 19 | 15.1 | 9.1 | 15.0 | 7.5 | <0.01 | <0.2 | | | |
| 20 | | | | | | | | | |
| * 21 | 15.0 | 9.2 | 15.0 | 7.8 | <0.01 | <0.2 | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| 24 | | | | | | | | | |

Ammonia Standard

| Standard conc (ppm) | Measured conc (ppm) |
|---|---|
| 10 | 10.0 |
| 3 | 3.0 |
| 1 | 1.0 |

* water quality beakers

** number not buried after 15 min; these were replaced with others from the same sieved population.



Revised 12-30-92

AR 023347

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator ____________

DAILY RECORD SHEET

Day 1 (8/12/97 mLR/602 Temperature beaker ______ °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | Ø | all | |
| 2 | | | | | | | Ø | OK | |
| 3 | | | | | | | Ø F | | |
| 4 | | | | | | | Ø | | |
| 5 | | | | | | | Ø | | |
| 6 | | | | | | | Ø | | |
| 7 | | | | | | | Ø | | |
| 8 | | | | | | | Ø | | |
| 9 | | | | | | | Ø F | | |
| 10 | | | | | | | Ø | | |
| 11 | | | | | | | Ø | | |
| 12 | | | | | | | 3 F | | |
| * 13 | 15.4 | 9.1 | 15.0 | 7.2 | | | Ø | | |
| * 14 | 15.3 | 9.1 | 15.0 | 7.6 | | | Ø F | | |
| 15 | | | | | | | Ø | | |
| 16 | | | | | | | Ø | | |
| 17 | | | | | | | 1 | | |
| 18 | | | | | | | Ø F | | |
| * 19 | 15.4 | 9.1 | 15.0 | 7.9 | | | Ø F | | |
| 20 | | | | | | | Ø | | |
| * 21 | 15.3 | 9.1 | 15.0 | 7.5 | | | Ø | | |
| 22 | | | | | | | Ø | | |
| 23 | | | | | | | 1 F | | |
| 24 | | | | | | | Ø F | | |

* water quality beakers

F murky - hard to see through water column



Revised 12-30-92

AR 023348

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator

DAILY RECORD SHEET

Day 2 (8/3/97) MSR/GSI

Temperature beaker ______ °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | Ø | all | |
| 2 | | | | | | | Ø | OK | |
| 3 | | | | | | | Ø | | |
| 4 | | | | | | | 1 | | |
| 5 | | | | | | | Ø | | |
| 6 | | | | | | | Ø | | |
| 7 | | | | | | | Ø | | |
| 8 | | | | | | | Ø | | |
| 9 | | | | | | | 3 | | |
| 10 | | | | | | | Ø | | |
| 11 | | | | | | | Ø | | |
| 12 | | | | | | | 4 | | |
| * 13 | 15.3 | 9.0 | 15.0 | 8.0 | | | Ø | | |
| * 14 | 15.3 | 9.0 | 15.0 | 7.5 | | | 2 | | |
| 15 | | | | | | | Ø | | |
| 16 | | | | | | | Ø | | |
| 17 | | | | | | | Ø | | |
| 18 | | | | | | | 2 | | |
| * 19 | 15.3 | 8.9 | 15.0 | 7.2 | | | Ø | | |
| 20 | | | | | | | Ø | | |
| * 21 | 15.3 | 9.0 | 15.0 | 7.8 | | | Ø | | |
| 22 | | | | | | | Ø | | |
| 23 | | | | | | | 2 | | |
| 24 | | | | | | | Ø | | |

* water quality beakers



Revised 12-30-92

AR 023349

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator ________

DAILY RECORD SHEET

y 3 (8/4/97) mlR Temperature beaker 15.6 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | Ø | all | |
| 2 | | | | | | | Ø | OK | |
| 3 | | | | | | | 4 T | | |
| 4 | | | | | | | Ø | | |
| 5 | | | | | | | Ø | | |
| 6 | | | | | | | Ø | | |
| 7 | | | | | | | Ø | | |
| 8 | | | | | | | Ø | | |
| 9 | | | | | | | 2 T | | |
| 10 | | | | | | | Ø | | |
| 11 | | | | | | | Ø | | |
| 12 | | | | | | | Ø | | |
| * 13 | 15.4 | 9.1 | 16.0 | 8.0 | | | Ø | | |
| * 14 | 15.2 | 9.2 | 15.0 | 7.3 | | | 2 T | | |
| 15 | | | | | | | Ø | | |
| 16 | | | | | | | Ø | | |
| 17 | | | | | | | 1 T | | |
| 18 | | | | | | | 2 T | | |
| * 19 | 15.2 | 9.2 | 15.0 | 6.9 | | | Ø T | | |
| 20 | | | | | | | Ø | | |
| * 21 | 15.2 | 9.3 | 15.5 | 7.8 | | | Ø | | |
| 22 | | | | | | | Ø | | |
| 23 | | | | | | | Ø | | |
| 24 | | | | | | | 1 | | |

* water quality beakers T murky - hard to see emergence



Revised 12-30-92

AR 023350

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator ______

DAILY RECORD SHEET

Day 4 (8/15/97) ✓m Temperature beaker 15.5 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | All | |
| 2 | | | | | | | 0 | OK | |
| 3 | | | | | | | 1 | | |
| 4 | | | | | | | 2 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 2 | | |
| * 13 | 15.7 | 8.6 | 15.0 | 8.0 | | | 0 | | |
| * 14 | 15.7 | 8.6 | 15.0 | 7.4 | | | 1 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 2 | | |
| * 19 | 15.8 | 8.6 | 15.0 | 7.0 | | | 0 | | |
| 20 | | | | | | | 0 | | |
| * 21 | 15.7 | 8.7 | 15.0 | 7.7 | | | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | | |

* water quality beakers



Revised 12-30-92

AR 023351

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator ____________

DAILY RECORD SHEET

Day 5 (8/6/97) [illegible]

Temperature beaker 16.0 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | ALL | |
| 2 | | | | | | | 0 | OK | |
| 3 | | | | | | | 0 | | |
| 4 | | | | | | | 0 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 2 | | |
| * 13 | 16.3 | 9.2 | 15.0 | 8.1 | | | 0 | | |
| * 14 | 16.2 | 9.3 | 15.0 | 7.5 | | | 0 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 0 | | |
| * 19 | 16.1 | 9.2 | 15.0 | 7.0 | | | 0 | | |
| 20 | | | | | | | 0 | | |
| * 21 | 16.0 | 9.4 | 15.0 | 7.7 | | | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | ✓ | |

* water quality beakers



Revised 12-30-92

AR 023352

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator

DAILY RECORD SHEET

Day 6 (8/7/97) [illegible]/BC Temperature beaker 14.7 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | All | |
| 2 | | | | | | | 0 | OK | |
| 3 | | | | | | | 0 | | |
| 4 | | | | | | | 0 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 0 | | |
| * 13 | 15.9 | 9.2 | 15.5 | 8.1 | | | 0 | | |
| * 14 | 15.9 | 9.2 | 15.0 | 7.2 | | | 0 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 0 | | |
| * 19 | 15.9 | 9.2 | 15.0 | 6.7 | | | 0 | | |
| 20 | | | | | | | 0 | | |
| * 21 | 15.8 | 9.2 | 15.0 | 7.8 | | | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | | |

* water quality beakers



Revised 12-30-92

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator

DAILY RECORD SHEET

ay 7 (8/8/97) Ln/BC

Temperature beaker 15.2°C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | All | |
| 2 | | | | | | | 0 | OK | |
| 3 | | | | | | | 0 | | |
| 4 | | | | | | | 0 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 0 | | |
| * 13 | 15.4 | 9.0 | 15.0 | 8.2 | | | 0 | | |
| * 14 | 15.5 | 9.0 | 14.0 | 8.1 | | | 0 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 0 | | |
| * 19 | 15.5 | 9.0 | 14.0 | 7.7 | | | 0 | | |
| 20 | | | | | | | 0 | | |
| * 21 | 15.6 | 9.1 | 14.0 | 7.7 | | | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | | |

* water quality beakers



Revised 12-30-92

AR 023354

Test No. 534-6 Client SAIC Investigator

DAILY RECORD SHEET

Day 8 8.9.97 Temperature beaker 14.8 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | | |
| 2 | | | | | | | 0 | All | |
| 3 | | | | | | | 0 | ok | |
| 4 | | | | | | | 0 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 0 | | |
| * 13 | 15.1 | 9.1 | 15.0 | 8.1 | | | 0 | | |
| * 14 | 15.0 | 9.0 | 15.0 | 7.1 | | | 0 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 0 | | |
| * 19 | 15.3 | 9.0 | 14.5 | 6.4 | | | 0 | | |
| 20 | | | | | | | 0 | | |
| * 21 | 15.0 | 9.2 | 15.0 | 7.7 | | | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | | |

* water quality beakers



Revised 12-30-92

AR 023355

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator

DAILY RECORD SHEET

Day 9 (8/10/97) [illegible] Temperature beaker 15.0 °C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | | |
| 2 | | | | | | | 0 | All | |
| 3 | | | | | | | 0 | OK | |
| 4 | | | | | | | 0 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 0 | | |
| * 13 | 15.0 | 9.2 | 16.0 | 8.2 | | | 0 | | |
| * 14 | 15.0 | 9.1 | 15.0 | 7.0 | | | 0 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 0 | | |
| * 19 | 15.0 | 9.0 | 15.0 | 6.2 | | | 0 | | |
| 20 | ~~15.0~~ | | | | | | 0 | | |
| * 21 | 15.1 | 9.1 | 15.0 | 7.8 | | | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | | |

* water quality beakers



Revised 12-30-92

AR 023356

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 534-6 Client SAIC Investigator

DAILY RECORD SHEET

Day 10 (8/11/97) BC/6JZ Temperature beaker 15.7°C

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | No. Emerged | Air | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0 | OK | |
| 2 | | | | | | | 0 | | |
| 3 | | | | | | | 0 | | |
| 4 | | | | | | | 0 | | |
| 5 | | | | | | | 0 | | |
| 6 | | | | | | | 0 | | |
| 7 | | | | | | | 0 | | |
| 8 | | | | | | | 0 | | |
| 9 | | | | | | | 0 | | |
| 10 | | | | | | | 0 | | |
| 11 | | | | | | | 0 | | |
| 12 | | | | | | | 0 | | |
| * 13 | 15.6 | 9.0 | 15.0 | 8.3 | <0.01 | 2.5 | 0 | | |
| * 14 | 15.7 | 9.0 | 15.0 | 8.2 | <0.01 | 2.5 | 0 | | |
| 15 | | | | | | | 0 | | |
| 16 | | | | | | | 0 | | |
| 17 | | | | | | | 0 | | |
| 18 | | | | | | | 0 | | |
| * 19 | 15.7 | 9.0 | 16.0 | 7.8 | <0.01 | 0.2 | 0 | | |
| 20 | | | | | | | 0 | | |
| * 21 | 15.8 | 9.0 | 16.0 | 7.7 | <0.01 | <0.2 | 0 | | |
| 22 | | | | | | | 0 | | |
| 23 | | | | | | | 0 | | |
| 24 | | | | | | | 0 | | |

* water quality beakers



Revised 12-30-92

AR 023357

NORTHWESTERN AQUATIC SCIENCES
MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

PROTOCOL NO. NAS-XXX-RA4

Test No. 534-6 Client SAIC Investigator

DAY 10 TEST TERMINATION SHEET

| Beaker No. | Interstitial salinity (ppt) | Number of survivors | Number Reburied | Initial |
|---|---|---|---|---|
| 1 | 15.0 | 20 | 20 | GJI |
| 2 | 15.5 | 20 | 20 | GJI |
| 3 | 14.5 | 18 | 18 | GJI |
| 4 | 15.0 | 19 | 18 | GJI |
| 5 | 15.5 | 18 | 18 | GJI |
| 6 | 15.5 | 19 | 19 | BC |
| 7 | 15.0 | 20 | 20 | GJI |
| 8 | 15.0 | 19 | 19 | BC |
| 9 | 14.0 | 18 | 18 | GJI |
| 10 | 14.0 | 20 | 20 | BC |
| 11 | 14.0 | 19 | 19 | BC |
| 12 | 14.0 | 19 | 19 | BC |
| * 13 | | | | |
| * 14 | | | | |
| 15 | 14.5 | 20 | 20 | GJI |
| 16 | 15.0 | 20 | 20 | GJI |
| 17 | 14.5 | 20 | 20 | GJI |
| 18 | 14.5 | 18 | 18 | GJI |
| * 19 | | | | |
| 20 | 15.0 | 20 | 20 | BC |
| * 21 | | | | |
| 22 | 15.0 | 20 | 20 | BC |
| 23 | 14.0 | 20 | 20 | BC |
| 24 | 15.0 | 20 | 20 | GJI |

*water quality beakers



Revised 12-30-92

AR 023358

Test Number 534-6

Marine Amphipod Test
Randomization Key

7/25/97

| | NAS | CLIENT | |
|---|---|---|---|
| BKR | SMPL | DESCRIP | REPL |
| 15 | control | control | 1 |
| 20 | control | control | 2 |
| 11 | control | control | 3 |
| 10 | control | control | 4 |
| 16 | control | control | 5 |
| * 21 | control | control | 6 |
| 3 | 8670E | C1 | 1 |
| 23 | 8670E | C1 | 2 |
| 24 | 8670E | C1 | 3 |
| 18 | 8670E | C1 | 4 |
| 22 | 8670E | C1 | 5 |
| * 19 | 8670E | C1 | 6 |
| 7 | 8671E | C2 | 1 |
| 17 | 8671E | C2 | 2 |
| 4 | 8671E | C2 | 3 |
| 12 | 8671E | C2 | 4 |
| 9 | 8671E | C2 | 5 |
| * 14 | 8671E | C2 | 6 |
| 8 | 8672E | CARR4 | 1 |
| 1 | 8672E | CARR4 | 2 |
| 6 | 8672E | CARR4 | 3 |
| 5 | 8672E | CARR4 | 4 |
| 2 | 8672E | CARR4 | 5 |
| * 13 | 8672E | CARR4 | 6 |

* water quality beakers.

## Endpoints Data Entry and Calculations File

INIT=initial number
SURV=number survivors
REBUR=number survivors which reburied
MORT=number dead=INIT-SURV
NOBURY=number survivors not reburied=SURV-REBUR
FINAL IW PPT=day 10 interstitial water salinity

TEM=total effective mortality=MORT+NOBURY
INIT=initial number of amphipods
SURV=number of surviving amphipods
REBUR=number of surviving amphipods reburying
PSURV=%survival=100(SURV/INIT)
PMORT=%mortality=100(MORT/INIT)
PBURY=%reburial=100(REBUR/SURV)
PNOBURY=%survivors not reburied=100(NOBURY/SURV)
PTEM=%total effective mortality=100(TEM/INIT)

| INDEX | BKR | NAS SMPL | CLIENT DESCRIP | REPL | INIT | FINAL IW PPT | SURV | REBUR | MORT | NOBURY | TEM | PSURV | PMORT | PBURY | PNOBURY | PTEM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | control | control | 1 | 20 | 14.5 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 2 | 20 | control | control | 2 | 20 | 15.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 3 | 11 | control | control | 3 | 20 | 14.0 | 19 | 19 | 1 | 0 | 1 | 95.0 | 5.0 | 100.0 | 0.0 | 5.0 |
| 4 | 10 | control | control | 4 | 20 | 14.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 5 | 16 | control | control | 5 | 20 | 15.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 6 | 21 | control | control | 6 | 20 | | | | | | | | | | | |
| 7 | 3 | 8670E | C1 | 1 | 20 | 14.5 | 18 | 18 | 2 | 0 | 2 | 90.0 | 10.0 | 100.0 | 0.0 | 10.0 |
| 8 | 23 | 8670E | C1 | 2 | 20 | 14.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 9 | 24 | 8670E | C1 | 3 | 20 | 15.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 10 | 18 | 8670E | C1 | 4 | 20 | 14.5 | 18 | 18 | 2 | 0 | 2 | 90.0 | 10.0 | 100.0 | 0.0 | 10.0 |
| 11 | 22 | 8670E | C1 | 5 | 20 | 15.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 12 | 19 | 8670E | C1 | 6 | 20 | | | | | | | | | | | |
| 13 | 7 | 8671E | C2 | 1 | 20 | 15.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 14 | 17 | 8671E | C2 | 2 | 20 | 14.5 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 15 | 4 | 8671E | C2 | 3 | 20 | 15.0 | 19 | 18 | 1 | 1 | 2 | 95.0 | 5.0 | 94.7 | 5.3 | 10.0 |
| 16 | 12 | 8671E | C2 | 4 | 20 | 14.0 | 19 | 19 | 1 | 0 | 1 | 95.0 | 5.0 | 100.0 | 0.0 | 5.0 |
| 17 | 9 | 8671E | C2 | 5 | 20 | 14.0 | 18 | 18 | 2 | 0 | 2 | 90.0 | 10.0 | 100.0 | 0.0 | 10.0 |
| 18 | 14 | 8671E | C2 | 6 | 20 | | | | | | | | | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 20 | 15.0 | 19 | 19 | 1 | 0 | 1 | 95.0 | 5.0 | 100.0 | 0.0 | 5.0 |
| 20 | 1 | 8672E | CARR4 | 2 | 20 | 15.0 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 21 | 6 | 8672E | CARR4 | 3 | 20 | 15.5 | 19 | 19 | 1 | 0 | 1 | 95.0 | 5.0 | 100.0 | 0.0 | 5.0 |
| 22 | 5 | 8672E | CARR4 | 4 | 20 | 15.5 | 18 | 18 | 2 | 0 | 2 | 90.0 | 10.0 | 100.0 | 0.0 | 10.0 |
| 23 | 2 | 8672E | CARR4 | 5 | 20 | 15.5 | 20 | 20 | 0 | 0 | 0 | 100.0 | 0.0 | 100.0 | 0.0 | 0.0 |
| 24 | 13 | 8672E | CARR4 | 6 | 20 | | | | | | | | | | | |

| | FINAL IW PPT | SURV | MORT | NOBURY | PSURV | PMORT | PBURY | PNOBURY | PTEM |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 14.5 | 19.8 | 0.2 | 0.0 | 99.0 | 1.0 | 100.0 | 0.0 | 1.0 |
| SD | 0.5 | 0.4 | 0.4 | 0.0 | 2.2 | 2.2 | 0.0 | 0.0 | 2.2 |
| n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Mean | 14.6 | 19.2 | 0.8 | 0.0 | 96.0 | 4.0 | 100.0 | 0.0 | 4.0 |
| SD | 0.4 | 1.1 | 1.1 | 0.0 | 5.5 | 5.5 | 0.0 | 0.0 | 5.5 |
| n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Mean | 14.5 | 19.2 | 0.8 | 0.2 | 96.0 | 4.0 | 98.9 | 1.1 | 5.0 |
| SD | 0.5 | 0.8 | 0.8 | 0.4 | 4.2 | 4.2 | 2.4 | 2.4 | 5.0 |
| n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Mean | 15.3 | 19.2 | 0.8 | 0.0 | 96.0 | 4.0 | 100.0 | 0.0 | 4.0 |
| SD | 0.3 | 0.8 | 0.8 | 0.0 | 4.2 | 4.2 | 0.0 | 0.0 | 4.2 |
| n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

Data entry verified against bench sheets - MWR 8-19-97.

# Emergence Data File

| INDEX | BKR | NAS SMPL | CLIENT DESCRIP | REPL | DAY | EMERG | TOTAL EMERG | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 | control | control | 1 | 1 | 0 | | | |
| 1 | 15 | control | control | 1 | 2 | 0 | | | |
| 1 | 15 | control | control | 1 | 3 | 0 | | | |
| 1 | 15 | control | control | 1 | 4 | 0 | | | |
| 1 | 15 | control | control | 1 | 5 | 0 | | | |
| 1 | 15 | control | control | 1 | 6 | 0 | | | |
| 1 | 15 | control | control | 1 | 7 | 0 | | | |
| 1 | 15 | control | control | 1 | 8 | 0 | | | |
| 1 | 15 | control | control | 1 | 9 | 0 | | | |
| 1 | 15 | control | control | 1 | 10 | 0 | 0 | | |
| 2 | 20 | control | control | 2 | 1 | 0 | | | |
| 2 | 20 | control | control | 2 | 2 | 0 | | | |
| 2 | 20 | control | control | 2 | 3 | 0 | | | |
| 2 | 20 | control | control | 2 | 4 | 0 | | | |
| 2 | 20 | control | control | 2 | 5 | 0 | | | |
| 2 | 20 | control | control | 2 | 6 | 0 | | | |
| 2 | 20 | control | control | 2 | 7 | 0 | | | |
| 2 | 20 | control | control | 2 | 8 | 0 | | | |
| 2 | 20 | control | control | 2 | 9 | 0 | | | |
| 2 | 20 | control | control | 2 | 10 | 0 | 0 | | |
| 3 | 11 | control | control | 3 | 1 | 0 | | | |
| 3 | 11 | control | control | 3 | 2 | 0 | | | |
| 3 | 11 | control | control | 3 | 3 | 0 | | | |
| 3 | 11 | control | control | 3 | 4 | 0 | | | |
| 3 | 11 | control | control | 3 | 5 | 0 | | | |
| 3 | 11 | control | control | 3 | 6 | 0 | | | |
| 3 | 11 | control | control | 3 | 7 | 0 | | | |
| 3 | 11 | control | control | 3 | 8 | 0 | | | |
| 3 | 11 | control | control | 3 | 9 | 0 | | | |
| 3 | 11 | control | control | 3 | 10 | 0 | 0 | | |
| 4 | 10 | control | control | 4 | 1 | 0 | | | |
| 4 | 10 | control | control | 4 | 2 | 0 | | | |
| 4 | 10 | control | control | 4 | 3 | 0 | | | |
| 4 | 10 | control | control | 4 | 4 | 0 | | | |
| 4 | 10 | control | control | 4 | 5 | 0 | | | |
| 4 | 10 | control | control | 4 | 6 | 0 | | | |
| 4 | 10 | control | control | 4 | 7 | 0 | | | |
| 4 | 10 | control | control | 4 | 8 | 0 | | | |
| 4 | 10 | control | control | 4 | 9 | 0 | | | |
| 4 | 10 | control | control | 4 | 10 | 0 | 0 | | |
| 5 | 16 | control | control | 5 | 1 | 0 | | | |
| 5 | 16 | control | control | 5 | 2 | 0 | | | |
| 5 | 16 | control | control | 5 | 3 | 0 | | Mean | 0.0 |
| 5 | 16 | control | control | 5 | 4 | 0 | | SD | 0.0 |
| 5 | 16 | control | control | 5 | 5 | 0 | | n | 5 |
| 5 | 16 | control | control | 5 | 6 | 0 | | | |
| 5 | 16 | control | control | 5 | 7 | 0 | | | |
| 5 | 16 | control | control | 5 | 8 | 0 | | | |

Data entry verified against bench sheets -MLR 8-20-97



AR 023361

| | | NAS | CLIENT | | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| INDEX | BKR | SMPL | DESCRIP | REPL | DAY | EMERG | EMERG | | |
| 5 | 16 | control | control | 5 | 9 | 0 | | | |
| 5 | 16 | control | control | 5 | 10 | 0 | 0 | | |
| 7 | 3 | 8670E | C1 | 1 | 1 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 2 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 3 | 4 | | | |
| 7 | 3 | 8670E | C1 | 1 | 4 | 1 | | | |
| 7 | 3 | 8670E | C1 | 1 | 5 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 6 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 7 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 8 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 9 | 0 | | | |
| 7 | 3 | 8670E | C1 | 1 | 10 | 0 | 5 | | |
| 8 | 23 | 8670E | C1 | 2 | 1 | 1 | | | |
| 8 | 23 | 8670E | C1 | 2 | 2 | 2 | | | |
| 8 | 23 | 8670E | C1 | 2 | 3 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 4 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 5 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 6 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 7 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 8 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 9 | 0 | | | |
| 8 | 23 | 8670E | C1 | 2 | 10 | 0 | 3 | | |
| 9 | 24 | 8670E | C1 | 3 | 1 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 2 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 3 | 1 | | | |
| 9 | 24 | 8670E | C1 | 3 | 4 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 5 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 6 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 7 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 8 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 9 | 0 | | | |
| 9 | 24 | 8670E | C1 | 3 | 10 | 0 | 1 | | |
| 10 | 18 | 8670E | C1 | 4 | 1 | 0 | | | |
| 10 | 18 | 8670E | C1 | 4 | 2 | 2 | | | |
| 10 | 18 | 8670E | C1 | 4 | 3 | 2 | | | |
| 10 | 18 | 8670E | C1 | 4 | 4 | 2 | | | |
| 10 | 18 | 8670E | C1 | 4 | 5 | 0 | | | |
| 10 | 18 | 8670E | C1 | 4 | 6 | 0 | | | |
| 10 | 18 | 8670E | C1 | 4 | 7 | 0 | | | |
| 10 | 18 | 8670E | C1 | 4 | 8 | 0 | | | |
| 10 | 18 | 8670E | C1 | 4 | 9 | 0 | | | |
| 10 | 18 | 8670E | C1 | 4 | 10 | 0 | 6 | | |
| 11 | 22 | 8670E | C1 | 5 | 1 | 0 | | | |
| 11 | 22 | 8670E | C1 | 5 | 2 | 0 | | | |
| 11 | 22 | 8670E | C1 | 5 | 3 | 0 | | Mean | 3.0 |
| 11 | 22 | 8670E | C1 | 5 | 4 | 0 | | SD | 2.5 |
| 11 | 22 | 8670E | C1 | 5 | 5 | 0 | | n | 5 |
| 11 | 22 | 8670E | C1 | 5 | 6 | 0 | | | |
| 11 | 22 | 8670E | C1 | 5 | 7 | 0 | | | |
| 11 | 22 | 8670E | C1 | 5 | 8 | 0 | | | |



AR 023362

| | | NAS | CLIENT | | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| INDEX | BKR | SMPL | DESCRIP | REPL | DAY | EMERG | EMERG | | |
| 11 | 22 | 8670E | C1 | 5 | 9 | 0 | | | |
| 11 | 22 | 8670E | C1 | 5 | 10 | 0 | 0 | | |
| 13 | 7 | 8671E | C2 | 1 | 1 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 2 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 3 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 4 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 5 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 6 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 7 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 8 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 9 | 0 | | | |
| 13 | 7 | 8671E | C2 | 1 | 10 | 0 | 0 | | |
| 14 | 17 | 8671E | C2 | 2 | 1 | 1 | | | |
| 14 | 17 | 8671E | C2 | 2 | 2 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 3 | 1 | | | |
| 14 | 17 | 8671E | C2 | 2 | 4 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 5 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 6 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 7 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 8 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 9 | 0 | | | |
| 14 | 17 | 8671E | C2 | 2 | 10 | 0 | 2 | | |
| 15 | 4 | 8671E | C2 | 3 | 1 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 2 | 1 | | | |
| 15 | 4 | 8671E | C2 | 3 | 3 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 4 | 2 | | | |
| 15 | 4 | 8671E | C2 | 3 | 5 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 6 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 7 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 8 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 9 | 0 | | | |
| 15 | 4 | 8671E | C2 | 3 | 10 | 0 | 3 | | |
| 16 | 12 | 8671E | C2 | 4 | 1 | 3 | | | |
| 16 | 12 | 8671E | C2 | 4 | 2 | 4 | | | |
| 16 | 12 | 8671E | C2 | 4 | 3 | 0 | | | |
| 16 | 12 | 8671E | C2 | 4 | 4 | 2 | | | |
| 16 | 12 | 8671E | C2 | 4 | 5 | 2 | | | |
| 16 | 12 | 8671E | C2 | 4 | 6 | 0 | | | |
| 16 | 12 | 8671E | C2 | 4 | 7 | 0 | | | |
| 16 | 12 | 8671E | C2 | 4 | 8 | 0 | | | |
| 16 | 12 | 8671E | C2 | 4 | 9 | 0 | | | |
| 16 | 12 | 8671E | C2 | 4 | 10 | 0 | 11 | | |
| 17 | 9 | 8671E | C2 | 5 | 1 | 0 | | | |
| 17 | 9 | 8671E | C2 | 5 | 2 | 3 | | | |
| 17 | 9 | 8671E | C2 | 5 | 3 | 2 | | Mean | 4.2 |
| 17 | 9 | 8671E | C2 | 5 | 4 | 0 | | SD | 4.2 |
| 17 | 9 | 8671E | C2 | 5 | 5 | 0 | | n | 5 |
| 17 | 9 | 8671E | C2 | 5 | 6 | 0 | | | |
| 17 | 9 | 8671E | C2 | 5 | 7 | 0 | | | |
| 17 | 9 | 8671E | C2 | 5 | 8 | 0 | | | |



AR 023363

| | NAS | | CLIENT | | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| INDEX | BKR | SMPL | DESCRIP | REPL | DAY | EMERG | EMERG | | |
| 17 | 9 | 8671E | C2 | 5 | 9 | 0 | | | |
| 17 | 9 | 8671E | C2 | 5 | 10 | 0 | 5 | | |
| 19 | 8 | 8672E | CARR4 | 1 | 1 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 2 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 3 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 4 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 5 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 6 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 7 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 8 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 9 | 0 | | | |
| 19 | 8 | 8672E | CARR4 | 1 | 10 | 0 | 0 | | |
| 20 | 1 | 8672E | CARR4 | 2 | 1 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 2 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 3 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 4 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 5 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 6 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 7 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 8 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 9 | 0 | | | |
| 20 | 1 | 8672E | CARR4 | 2 | 10 | 0 | 0 | | |
| 21 | 6 | 8672E | CARR4 | 3 | 1 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 2 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 3 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 4 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 5 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 6 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 7 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 8 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 9 | 0 | | | |
| 21 | 6 | 8672E | CARR4 | 3 | 10 | 0 | 0 | | |
| 22 | 5 | 8672E | CARR4 | 4 | 1 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 2 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 3 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 4 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 5 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 6 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 7 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 8 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 9 | 0 | | | |
| 22 | 5 | 8672E | CARR4 | 4 | 10 | 0 | 0 | | |
| 23 | 2 | 8672E | CARR4 | 5 | 1 | 0 | | | |
| 23 | 2 | 8672E | CARR4 | 5 | 2 | 0 | | | |
| 23 | 2 | 8672E | CARR4 | 5 | 3 | 0 | | Mean | 0.0 |
| 23 | 2 | 8672E | CARR4 | 5 | 4 | 0 | | SD | 0.0 |
| 23 | 2 | 8672E | CARR4 | 5 | 5 | 0 | | n | 5 |
| 23 | 2 | 8672E | CARR4 | 5 | 6 | 0 | | | |
| 23 | 2 | 8672E | CARR4 | 5 | 7 | 0 | | | |
| 23 | 2 | 8672E | CARR4 | 5 | 8 | 0 | | | |

| INDEX | BKR | NAS SMPL | CLIENT DESCRIP | REPL | DAY | EMERG | TOTAL EMERG | | |
|---|---|---|---|---|---|---|---|---|---|
| 23 | 2 | 8672E | CARR4 | 5 | 9 | 0 | | | |
| 23 | 2 | 8672E | CARR4 | 5 | 10 | 0 | 0 | | |



AR 023365

## Water Quality Data

| BKR | NAS SMPL | CLIENT DESCRIP | REPL | DAY | TEMP | DO | SAL | pH | SI | NH3 |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 8672E | CARR4 | 6 | 0 | 15.1 | 9.2 | 15.0 | 8.0 | <0.01 | 2.1 |
| 14 | 8671E | C2 | 6 | 0 | 15.1 | 9.2 | 15.0 | 8.0 | <0.01 | 1.8 |
| 19 | 8670E | C1 | 6 | 0 | 15.1 | 9.1 | 15.0 | 7.5 | <0.01 | <0.2 |
| 21 | control | control | 6 | 0 | 15.0 | 9.2 | 15.0 | 7.8 | <0.01 | <0.2 |
| 13 | 8672E | CARR4 | 6 | 1 | 15.4 | 9.1 | 15.0 | 7.2 | | |
| 14 | 8671E | C2 | 6 | 1 | 15.3 | 9.1 | 15.0 | 7.6 | | |
| 19 | 8670E | C1 | 6 | 1 | 15.4 | 9.1 | 15.0 | 7.9 | | |
| 21 | control | control | 6 | 1 | 15.3 | 9.1 | 15.0 | 7.5 | | |
| 13 | 8672E | CARR4 | 6 | 2 | 15.3 | 9.0 | 15.0 | 8.0 | | |
| 14 | 8671E | C2 | 6 | 2 | 15.3 | 9.0 | 15.0 | 7.5 | | |
| 19 | 8670E | C1 | 6 | 2 | 15.3 | 8.9 | 15.0 | 7.2 | | |
| 21 | control | control | 6 | 2 | 15.3 | 9.0 | 15.0 | 7.8 | | |
| 13 | 8672E | CARR4 | 6 | 3 | 15.4 | 9.1 | 16.0 | 8.0 | | |
| 14 | 8671E | C2 | 6 | 3 | 15.2 | 9.2 | 15.0 | 7.3 | | |
| 19 | 8670E | C1 | 6 | 3 | 15.2 | 9.2 | 15.0 | 6.9 | | |
| 21 | control | control | 6 | 3 | 15.2 | 9.3 | 15.5 | 7.8 | | |
| 13 | 8672E | CARR4 | 6 | 4 | 15.7 | 8.6 | 15.0 | 8.0 | | |
| 14 | 8671E | C2 | 6 | 4 | 15.7 | 8.6 | 15.0 | 7.4 | | |
| 19 | 8670E | C1 | 6 | 4 | 15.8 | 8.6 | 15.0 | 7.0 | | |
| 21 | control | control | 6 | 4 | 15.7 | 8.7 | 15.0 | 7.7 | | |
| 13 | 8672E | CARR4 | 6 | 5 | 16.3 | 9.2 | 15.0 | 8.1 | | |
| 14 | 8671E | C2 | 6 | 5 | 16.2 | 9.3 | 15.0 | 7.5 | | |
| 19 | 8670E | C1 | 6 | 5 | 16.1 | 9.2 | 15.0 | 7.0 | | |
| 21 | control | control | 6 | 5 | 16.0 | 9.4 | 15.0 | 7.7 | | |
| 13 | 8672E | CARR4 | 6 | 6 | 15.9 | 9.2 | 15.5 | 8.1 | | |
| 14 | 8671E | C2 | 6 | 6 | 15.9 | 9.2 | 15.0 | 7.2 | | |
| 19 | 8670E | C1 | 6 | 6 | 15.9 | 9.2 | 15.0 | 6.7 | | |
| 21 | control | control | 6 | 6 | 15.8 | 9.2 | 15.0 | 7.8 | | |
| 13 | 8672E | CARR4 | 6 | 7 | 15.4 | 9.0 | 15.0 | 8.2 | | |
| 14 | 8671E | C2 | 6 | 7 | 15.5 | 9.0 | 14.0 | 8.1 | | |
| 19 | 8670E | C1 | 6 | 7 | 15.5 | 9.0 | 14.0 | 7.7 | | |
| 21 | control | control | 6 | 7 | 15.6 | 9.1 | 14.0 | 7.7 | | |
| 13 | 8672E | CARR4 | 6 | 8 | 15.1 | 9.1 | 15.0 | 8.1 | | |
| 14 | 8671E | C2 | 6 | 8 | 15.0 | 9.0 | 15.0 | 7.1 | | |
| 19 | 8670E | C1 | 6 | 8 | 15.3 | 9.0 | 14.5 | 6.4 | | |
| 21 | control | control | 6 | 8 | 15.0 | 9.2 | 15.0 | 7.7 | | |
| 13 | 8672E | CARR4 | 6 | 9 | 15.0 | 9.2 | 16.0 | 8.2 | | |
| 14 | 8671E | C2 | 6 | 9 | 15.0 | 9.1 | 15.0 | 7.0 | | |
| 19 | 8670E | C1 | 6 | 9 | 15.0 | 9.0 | 15.0 | 6.2 | | |
| 21 | control | control | 6 | 9 | 15.1 | 9.1 | 15.0 | 7.8 | | |
| 13 | 8672E | CARR4 | 6 | 10 | 15.6 | 9.0 | 15.0 | 8.3 | <0.01 | 2.5 |
| 14 | 8671E | C2 | 6 | 10 | 15.7 | 9.0 | 15.0 | 8.2 | <0.01 | 2.5 |
| 19 | 8670E | C1 | 6 | 10 | 15.7 | 9.0 | 16.0 | 7.8 | <0.01 | 0.2 |
| 21 | control | control | 6 | 10 | 15.8 | 9.0 | 16.0 | 7.7 | <0.01 | <0.2 |
| | | | | | | | | | | |
| | | | Mean | | 15.5 | 9.1 | 15.0 | 7.6 | — | — |
| | | | SD | | 0.4 | 0.2 | 0.4 | 0.5 | — | — |
| | | | n | | 44 | 44 | 44 | 44 | 8 | 8 |
| | | | Max | | 16.3 | 9.4 | 16.0 | 8.3 | <0.01 | 2.5 |
| | | | Min | | 15.0 | 8.6 | 14.0 | 6.2 | <0.01 | <0.2 |

th. Entry
rified against
ab bench sheets
8/22/97 JRF



AR 023366

CUSTODY SEAL

Person Collecting Sample VMMetcalfe (signature) Sample No. 02

Date Collected 7-21-97 Time Collected 1730

CUSTODY SEAL

Person Collecting Sample VMMetcalfe (signature) Sample No. 04

Date Collected 7-21-97 Time Collected 1730

SAIC Received 7-22-97 11:30



AR 023367

DB

# SEDIMENT CHARACTERIZATION FOR THE HAMM CREEK RESTORATION PROJECT

## DUWAMISH TURNING BASIN
## SEATTLE, WASHINGTON

VOL. 2/2

September 12, 1997

Prepared for:

**U.S. Army Corps of Engineers**
**Seattle District**
**4735 East Marginal Way South**
**Seattle, Washington 98124-2255**

Prepared by


**Science Applications International Corporation**
**Environmental Sciences Division**
**18706 North Creek Parkway, Suite 110**
**Bothell, Washington 98011**

Reference Toxicant Test

## Acute 96-hr Toxicity Test-96 Hr Survival

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 8/1/97 15:20 | Test ID: | 999-783 | Sample ID: | REF-Ref Toxicant |
| End Date: | 8/5/97 16:50 | Lab ID: | ORNAS-Northwestern Aquatic | Sample Type: | CDCL-Cadmium chloride |
| mple Date: | | Protocol: | EPAA 91-EPA Acute | Test Species: | EE-Eohaustorius estuarius |
| mments: | | | | | |

| onc-mg/L | 1 | 2 |
|---|---|---|
| D-Control | 1.0000 | 1.0000 |
| 0.1 | 1.0000 | 1.0000 |
| 0.3 | 1.0000 | 1.0000 |
| 1 | 1.0000 | 1.0000 |
| 3 | 0.7000 | 0.8000 |
| 10 | 0.2000 | 0.1000 |

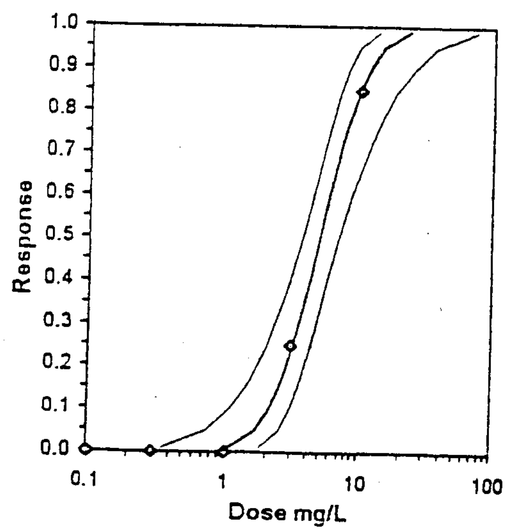
| | | | Transform: Arcsin Square Root | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Conc-mg/L | Mean | N-Mean | Mean | Min | Max | CV% | N | Number Resp | Total Number |
| D-Control | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 2 | 0 | 20 |
| 0.1 | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 2 | 0 | 20 |
| 0.3 | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 2 | 0 | 20 |
| 1 | 1.0000 | 1.0000 | 1.4120 | 1.4120 | 1.4120 | 0.000 | 2 | 0 | 20 |
| 3 | 0.7500 | 0.7500 | 1.0492 | 0.9912 | 1.1071 | 7.818 | 2 | 5 | 20 |
| 10 | 0.1500 | 0.1500 | 0.3927 | 0.3218 | 0.4636 | 25.550 | 2 | 17 | 20 |

| uxiliary Tests | Statistic | Critical | Skew | Kurt |
|---|---|---|---|---|
| ormality of the data set cannot be confirmed | | | | |
| Equality of variance cannot be confirmed | | | | |

### Maximum Likelihood-Probit

| meter | Value | SE | 95% Fiducial Limits | | Control | Chi-Sq | Critical | P-value | Mu | Sigma | Iter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| e | 3.50738 | 0.74292 | 2.05125 | 4.96351 | 0 | 0.23706 | 11.3449 | 0.97 | 0.6913 | 0.28511 | 3 |
| Intercept | 2.57534 | 0.5437 | 1.50969 | 3.641 | | | | | | | |
| TSCR | | | | | | | | | | | |

| int | Probits | mg/L | 95% Fiducial Limits | |
|---|---|---|---|---|
| EC01 | 2.674 | 1.06667 | 0.35192 | 1.75318 |
| EC05 | 3.355 | 1.66852 | 0.73759 | 2.46594 |
| 10 | 3.718 | 2.11794 | 1.08491 | 2.98342 |
| 15 | 3.964 | 2.48771 | 1.39898 | 3.41331 |
| EC20 | 4.158 | 2.82712 | 1.70333 | 3.81864 |
| EC25 | 4.326 | 3.15497 | 2.00662 | 4.22564 |
| 40 | 4.747 | 4.15976 | 2.94431 | 5.61737 |
| EC50 | 5.000 | 4.91248 | 3.61152 | 6.84505 |
| EC60 | 5.253 | 5.80141 | 4.33678 | 8.5202 |
| 75 | 5.674 | 7.64903 | 5.6595 | 12.7349 |
| 80 | 5.842 | 8.53607 | 6.23203 | 15.0763 |
| C85 | 6.036 | 9.70066 | 6.94184 | 18.4362 |
| C90 | 6.282 | 11.3943 | 7.91116 | 23.8664 |
| 95 | 6.645 | 14.4634 | 9.53583 | 35.2351 |
| C99 | 7.326 | 22.6242 | 13.3649 | 74.1145 |




ToxCalc v5.0.15N



AR 023370

Test: AT-Acute 96-hr Toxicity Test
Species: EE-Eohaustonus estuanus
Sample ID: REF-Ref Toxicant
Start Date: 8/1/97 15:20 End Date: 8/5/97 16:50

Test ID: 999-783
Protocol: EPAA 91-EPA Acute
Sample Type: CDCL-Cadmium chlonde
Lab ID: ORNAS-Northwestern Aquatic Sciences

| Pos | ID | Rep | Group | Start | 24 Hr | 48 Hr | 72 Hr | 96 Hr | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | D-Control | 10 | | | | 10 | |
| | 2 | 2 | D-Control | 10 | | | | 10 | |
| | 3 | 1 | 0.100 | 10 | | | | 10 | |
| | 4 | 2 | 0.100 | 10 | | | | 10 | |
| | 5 | 1 | 0.300 | 10 | | | | 10 | |
| | 6 | 2 | 0.300 | 10 | | | | 10 | |
| | 7 | 1 | 1.000 | 10 | | | | 10 | |
| | 8 | 2 | 1.000 | 10 | | | | 10 | |
| | 9 | 1 | 3.000 | 10 | | | | 7 | |
| | 10 | 2 | 3.000 | 10 | | | | 8 | |
| | 11 | 1 | 10.000 | 10 | | | | 2 | |
| | 12 | 2 | 10.000 | 10 | | | | 1 | |

Comments:

NORTHWESTERN AQUATIC SCIENCES

Toxicity Test Report
Sediment Larval Bioassay

An Employee-Owned Company

AR 023372

# TOXICITY TEST REPORT

## TEST IDENTIFICATION

Test No.: 534-5

Title: Toxicity of estuarine sediments using sand dollar, *Dendraster excentricus*, larval sediment bioassay.

Protocol: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP 1995), with modifications as specified by the Puget Sound Dredged Disposal Analysis Program, the Sampling and Analysis Plan for the Hamm Creek Restoration Project, and the SAIC statement of work.

## STUDY MANAGEMENT

Study Sponsor: SAIC, 18706 N. Creek Parkway, Suite 110, Bothell, Washington 98011.

Sponsor's Study Monitor: Ms. Lisa Roach

Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, Oregon 97365.

Test Location: Newport Laboratory.

Laboratory's Study Personnel: M.S. Redmond, M.S., Proj. Mngr./Study Dir.; L.K. Nemeth, B.A., QA Officer; R.S. Caldwell, Ph.D., Tox. Mngr.; G.A. Buhler, B.S., Aq. Toxicol.; G.J. Irissarri, B.S., Aq. Toxicol.

Study Schedule:

Test Beginning: 7-31-97, 8:00 p.m.

Test Ending: 8-3-97, 11:00 a.m.

Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 334 S.W. 7th Street, Suite B, Newport, OR 97365.

Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989. (40 CFR Part 792).

Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

## TEST MATERIAL

Test Sediments: Sediment samples from Hamm Creek, Duwamish Waterway, Washington. Details are as follows:

| | | | |
|---|---|---|---|
| NAS Sample No. | 8670E | 8671E | 8672E |
| Description | C1 | C2 | CARR4 |
| Collection Date | 6-16-97 | 6-16-97 | 7-17-97 |
| Receipt Date | 7-22-97 | 7-22-97 | 7-22-97 |
| Interstitial Salinity (ppt) | -- | 2.0 | 29.0 |

Storage: Stored at 4°C in the dark in a capped container until used. 8672E was stored under nitrogen; 8670E and 8671E were packed with no headspace.

Treatments: Each sample was thoroughly homogenized and aliquots were weighed for use in this test. Additional aliquots were distributed to the appropriate beakers for test 534-6. Samples were taken for ammonia and sulfide analyses. The ammonia and sulfide subsamples were refrigerated, and then shipped cold under chain-of-custody to AmTest, Inc.

## TEST WATER

Source: Yaquina Bay, Oregon

Date of Collection: 7-31-97

Water Quality: Salinity 28.0 ppt; pH 7.9.

Pretreatment: Filtered to ≤0.40 µm, aerated, salinity adjusted using Milli-Q® deionized water.

## TEST ORGANISMS

Species: Sand dollars, *Dendraster excentricus*

Age: 2.0 hr post-fertilization

Source: Purchased from Marinus, Inc., Long Beach, California, received 7-30-97.

Acclimation: Adults were held overnight in the shipping carton, then used directly from the box for spawning.

Source of Gametes: 29 females and 5 males..

## TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. Refer to the test protocols cited above for a more detailed description of the test procedures used in this study.

Test Chambers: 1 L borosilicate glass beakers.

Test Volumes: 18 g of test sediment brought up to a final volume of 900 ml with test water.

Replicates/Treatment: 5 (plus a 6th water quality replicate).

Sediment Salinity Adjustment: None required.

Initial Concentration of Test Organisms: 25.8/ml

Water Volume Changes per 24 hr: None (non-renewal static test).

Volume of Subsamples Taken for Counting: 10 ml

Aeration: Yes

Feeding: None.

Acceptance Criteria: The percent normal in the seawater control must be ≥70%.

Effects Criteria: The effects criteria used were: 1) mortality; 2) abnormal development; and 3) the combined mortality/abnormality endpoint. Data collected were: 1) the initial embryo density; 2) the number of abnormal larvae observed; and 3) the number of normal pluteus larvae observed. The results were expressed as percent combined mortality/abnormality and percent mortality, both normalized against the seawater control. The raw data also include the following endpoints not normalized to the seawater control, which are not summarized in this report: 1) percent abnormal, 2) percent combined mortality and abnormality, and 3) percent mortality.

Water Quality and Other Test Conditions: The temperature, dissolved oxygen, salinity, and pH were measured in seperate water quality replicates on days 0, 1, 2 and 3 of the test. Total sulfide and ammonia-N were measured, using Hach test kits, at the beginning and end of the test, also in the overlying water of the water quality replicate. Sulfide and ammonia-N analyses were by the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1966) colorimetric methods, respectively. Samples were not distilled prior to analysis. The photoperiod was 14:10 hr, L:D.

## DATA ANALYSIS METHODS

Prior to issuance of the July 1995 revision of the PSEP recommended guidelines for conducting laboratory bioassays, no specific guidance was given for the computation of endpoints. All three standard endpoints - percent abnormal, percent combined mortality/abnormality, and percent mortality - have occasionally been computed both with, and without, normalization for the seawater control. All endpoints given in this report are normalized for the seawater control. However, in order to be consistent with what we assume to be the historical format, the non-normalized endpoints were computed and are included in the raw data computer printouts (Appendix II). The formulas employed for each of these computations are as follows:

PABN (percent abnormality) = 100 (A/T)
PABND (combined percent mortality/abnormality) = 100 ((I-N)/I)
PMORT (percent mortality) = 100 ((I-T)/I)
NPM (normalized percent mortality) = 100 (1-(T-TS))
NCMA (normalized combined percent mortality/abnormality) = 100 (1-(N/NS))

where the following are counts per 10 mL subsample:

N = normal larvae counted
A = abnormal larvae counted
T = N+A = total larvae counted
I = number of inoculated embryos (from average of zero time counts)
TS = average of total larvae counted in seawater controls
NS = average of normal larvae counted in seawater controls

Means and standard deviations for the biological endpoints described above and for water quality data were computed using Microsoft Excel Ver.5.0. No statistical comparisons between samples were performed.

## PROTOCOL DEVIATIONS

None.

## REFERENCE TOXICANT TEST

The reference toxicant test is a standard multi-concentration toxicity test using cadmium, as $CdCl_2$-$2.5H_20$, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory.

Test No.: 999-782
Reference Toxicant and Source: $CdCl_2$-$2.5H_20$ (Mallinckrodt Lot #TNZ), 1.0 mg/mL stock solution prepared 7-16-97.
Test Date: 7-31-97
Dilution Water Used: Filtered (0.4 µM) Yaquina Bay, Oregon seawater, salinity: 28.0 ppt; pH 7.9.
Result: 48-hr EC50, 8.13 mg/L Cd. This result is within the laboratory's control chart warning limits (5.15 to 12.3 mg/L).

## RESULTS

The water quality data are summarized in Table 1. A detailed tabulation of the water quality results by sample and date can be found in Appendix II. All water quality measurements of temperature, dissolved oxygen, salinity, and pH were within the protocol specified ranges. Sulfides were not detected in any of the test vessels (detection limit, 0.01 mg/L) either at the beginning or end of the test. Ammonia-N ranged from <0.1 mg/L to a maximum of 0.3 mg/L.

A total of 10 test replicate subsamples were recounted (QC counts) by a second investigator as a check on the acceptability of the initial counts (Appendix II). In all instances the QC counts were close (coefficients of variance from 0 to 6 for counts of normal larvae) to the initial counts and were considered acceptable.

The test was considered to be acceptable because 76.7% of the innoculated embryos (25.8/ml based on average counts of zero time samples) produced normal pluteus larvae in the seawater controls. This exceeds the test acceptance criterion of ≥70% as specified in the protocol. In addition, the results of the reference toxicant test were acceptable compared with the laboratory's historical data for this species.

The means and standard deviations of the biological endpoint responses for each test sediment are summarized in Table 2. Detailed data, including the initial counts and the computed endpoint values for individual replicates are given in Appendix II. Since no statistical comparisons were performed between treatments and the control, no conclusions are given regarding toxicity of test sediments.

## STUDY APPROVAL

Michele J. Redmond 8/27/97
Proj. Manager/Study Director — Date

Julie R. Fine 8.26.97
Quality Assurance Unit — Date

[illegible] 8/27/97
Toxicology Manager — Date

Table 1. Summary of water quality conditions during the tests of sand dollar, *Dendraster excentricus*, larvae exposed to estuarine sediments.

| Parameter | Mean ± SD | Minimum | Maximum | N |
|---|---|---|---|---|
| Temperature (°C) | 15.6 ± 0.3 | 15.1 | 16.0 | 16 |
| Dissolved Oxygen (mg/L) | 8.2 ± 0.2 | 8.0 | 8.4 | 16 |
| Salinity (ppt) | 28.1 ± 0.5 | 27.5 | 29.0 | 16 |
| pH | 7.9 ± 0.1 | 7.7 | 8.0 | 16 |
| Total Sulfide (mg/L) | -- | <0.01 | <0.01 | 8 |
| Total Ammonia-N (mg/L) | -- | <0.1 | 0.3 | 8 |

Table 2. Means and standard deviations (n=5) of responses of sand dollar, *Dendraster excentricus*, larvae exposed to estuarine sediments. Endpoints are normalized to the seawater control.

| Sample Description | Percent Mortality | Percent Combined Abnormal & Dead |
|---|---|---|
| Seawater Control | 0.0 ± 4.9 | 0.0 ± 7.4 |
| CARR4 (NAS # 8672E) | -2.8 ± 4.7 | -10.2 ± 7.0 |
| C1 (NAS # 8670E) | 22.5 ± 3.7 | 43.5 ± 8.3 |
| C2 (NAS # 8671E) | 30.0 ± 8.7 | 33.8 ± 9.2 |

a Organic Compounds

The following documentation is needed for organic compounds:

- A cover letter referencing or describing the procedure used and discussing any analytical problems
- Reconstructed ion chromatograms for GC/MS analyses for each sample
- Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra
- GC/ECD and/or GC/flame ionization detection chromatograms for each sample
- Raw data quantification reports for each sample
- A calibration data summary reporting calibration range used [and decafluoro-triphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses]
- Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit
- Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified)
- Quantification of all analytes in method blanks (ng/sample)
- Method blanks associated with each sample
- Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data)
- Data qualification codes and their definitions

b Prototype sampling and analysis plan provided by David Fox, U.S. Army Corps of Engineers on 7 August 1991.

c For batches of 5 samples or less, the minimum QA checks should be a blank and the analysis of a CRM (and matrix spikes for any analytes not certified in the CRM). In general, the priority of QA checks for batches of ≤5 samples should be as follows: CRM > analytical replicate > matrix spikes.

d PSEP control limit.

e Control limits based on PSDDA Chemistry QA/QC and Streamlining Workshop held 24 January 1991, U.S. Army Corps of Engineers, Seattle District

# SEDIMENT CHEMISTRY DATA

*July 14, 1997*

*SAIC*
*18706 North Creek Parkway, Suite 110*
*Bothell, WA  98011*
*attn. John Lunz*

*Dear John,*

*Enclosed you will find the analytical data for the Corps of Engineers Hamm Creek Restoration project (contract DACW67-95-D-1020, delivery order #7).*

*On the 18th of June 1997, Am Test Inc. received a total of two (2) sediment samples from SAIC for chemical analysis (collected 6/16/97). A total of four sample containers were received for each sample. Please refer to the chain of custody form for additional information relative to sample submittal.*

*At the time of receipt, the samples were logged-in, stored, and handled in accordance with EPA protocols. The samples were prepared and analyzed for the following groups of parameters:*

*PSDDA COC's*
*Total Solids*
*Total Volatile Solids*
*Total Organic Carbon*
*Grain Size*
*Metals*
*Phenols*
*Polyaromatic Hydrocarbons*
*Chlorinated Aromatics and Aliphatics*
*Phthalate Esters*
*Volatile Organic Compounds*
*Miscellaneous Compounds*
*Pesticides and PCB's*

*The methods, holding times, QA/QC documentation, and the data report package reflect the analytical protocols described in "Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound", Puget Sound Estuary Program (PSEP), 1986.*

*Protocols for Conventional Sediment Variables 3/86*
*Protocols for Organic Compounds in Sediment and Tissue Samples 12/89*
*Protocols for Metals in Sediment and Tissue Samples 12/89*

*Although these documents specifically address environmental analyses in Puget Sound, the majority of the methods are derived from two notable EPA documents:*

*"Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW-846, June 1988*

*"Methods for Chemical Analysis of Water and Wastes", EPA 600/4-82-055, December 1982*

*The detection limits reported are in accordance with the PSDDA SL values defined in Phase II PSDDA Management Plan Report, September 1989.*

*The specific information relative to the chemical analyses for the Chemicals of Concern are summarized in the attached table. This table provides a detailed listing of the parameters, the reported units, method references, nominal detection limits, and the PSDDA SL's and ML's. A second table addresses the instrument detection limits.*

*The sediment samples were analyzed for metals using the Strong Acid Digestion (SAD) described in the PSEP documentation. Following the digestion with Nitric Acid, Hydrochloric Acid, and Hydrogen Peroxide, the subsequent solutions were analyzed by Graphite Furnace Atomic Absorption (GFAA) for Arsenic, Antimony, Cadmium, Silver. With the exception of Mercury (Cold Vapor), the remaining metals (Copper, Chromium, Lead, Nickel and Zinc) were analyzed by Inductively Coupled Plasma Emission Spectroscopy (ICP).*

*In order to obtain the lower limits of detection that were required for the analysis of the Semi-Volatile Organic compounds, two separate 35 gram subsamples were extracted (EPA 3550) and combined prior to the instrumental analysis (8270, 1ml final extract volume). All of the samples were subjected to GPC clean-up.*

*The Dichlorobenzenes were analyzed with the other Volatile Organic Compounds (8260), in order to obtain detection limits that were below PSDDA SL values.*

*Separate 35 gram subsamples were extracted (EPA 3540) and analyzed for the Pesticides and PCB's (method 8081, final extract volume 5ml). The clean-up techniques documented in the respective analytical procedures (florisil, alumina etc.) were employed in order to reduce any matrix problems. Dual column confirmation was utilized in the samples where target compounds were detected.*

*There were no major problems with any of the analyses. As a result of the relatively high total solids content of the samples (range 77-82%), there was a favorable relationship between the Method Detection Limits (MDL's) and the PSDDA Screening Levels (SL's). None of the MDL's exceeded any of the PSDDA SL's.*

*Following the analytical data you will find the quality control summary. Information in this section includes the dates of analyses, the sample weights, and the results of standard reference materials, blanks, duplicates (or MSD's), triplicates and matrix spikes.*

*For the organic parameters (8260, 8270, 8081), the surrogate spike recoveries, the matrix spike recoveries, and the method blanks were within the acceptable limits defined by the analytical procedures, as well as those of the laboratory.*

*The results of both the Pesticide and the PCB reference materials, certified using EPA methods, were well within the control limits established by the respective manufacturers.*

*Since the Standard Reference Material (HS-3) for the PAH's is not* *certified using the extraction (sonication) and instrumental methods (GC/MS) of PSEP, data quality assessment is somewhat difficult. For your assistance I have included the laboratory control limits so that you may compare the data with past laboratory performances using this material.*

*Where the metals results were significantly above detection (i.e. Cadmium duplicate), the matrix spikes (% recovery), duplicates (RPD) and SRM's were within the nominal EPA limits, with the exception of Chromium in the Standard Reference Material (NBS 2704). As this is a matrix component, the SAD digestion is inadequate in terms of extracting all of the Chromium from the sample. However, the values obtained for the SRM using this procedure, were within the acceptable laboratory control limits.*

*For the organic parameters, all of the detection limits are listed in terms of the specific sample detection limits. This is calculated as a function of the original sample weight, the final volume of the extract, the moisture content of the sample, and the instrument detection limit.*

*If you should have any questions pertaining to the data package, please feel free to contact me.*

*Sincerely,*

*Mark A. Fugiel*
*General Manager*
*Am Test Inc.*

AMTEST

PSDDA

| METALS (PPM) | D.L. | S.L. | M.L. | METHODS |
|---|---|---|---|---|
| Antimony | 2.5 | 20 | 200 | PSEP/GFAA/SAD |
| Arsenic | 2.5 | 57 | 700 | PSEP/GFAA/SAD |
| Cadmium | 0.3 | 0.96 | 10 | PSEP/GFAA/SAD |
| Copper | 15.0 | 81 | 810 | PSEP/ICP/SAD |
| Lead | 0.5 | 66 | 660 | PSEP/GFAA/SAD |
| Mercury | 0.02 | 0.21 | 2 | EPA/7471/CV |
| Nickel | 2.5 | 140 | | PSEP/ICP/SAD |
| Silver | 0.2 | 1.2 | 5 | PSEP/GFAA/SAD |
| Zinc | 15.0 | 160 | 1,600 | PSEP/ICP/SAD |

ORGANICS (PPB)

| | D.L. | S.L. | M.L. | METHODS |
|---|---|---|---|---|
| LPAH | | | | |
| Acenaphthalene | 20 | 64 | 640 | 3550/8270 |
| Acenaphthene | 20 | 63 | 630 | 3550/8270 |
| Anthracene | 20 | 130 | 1,300 | 3550/8270 |
| Fluorene | 20 | 64 | 640 | 3550/8270 |
| 2-Methylnaphthalene | 20 | 67 | 670 | 3550/8270 |
| Naphthalene | 20 | 210 | 2,100 | 3550/8270 |
| Phenanthrene | 20 | 320 | 3,200 | 3550/8270 |
| HPAH | | | | |
| Benzo(a)anthracene | 20 | 450 | 4,500 | 3550/8270 |
| Benzo(a)pyrene | 20 | 680 | 6,800 | 3550/8270 |
| Benzo(b)fluoranthene | 20 | 800 | 8,000 | 3550/8270 |
| Benzo(k)fluoranthene | 20 | | | 3550/8270 |
| Benzo(ghi)perylene | 20 | 540 | 5,400 | 3550/8270 |
| Chrysene | 20 | 670 | 6,700 | 3550/8270 |
| Dibenzo(a,h)anthracene | 20 | 120 | 1,200 | 3550/8270 |
| Fluoranthene | 20 | 630 | 6,300 | 3550/8270 |
| Indeno(1,2,3-cd)pyrene | 20 | 69 | 5,200 | 3550/8270 |
| Pyrene | 20 | 430 | 7,300 | 3550/8270 |
| CHLORINATED HYDROCARBONS | | | | |
| 1,2-Dichlorobenzene | 3.2 | 19 | 350 | 8260 |
| 1,3-Dichlorobenzene | 3.2 | 170 | | 8260 |
| 1,4-Dichlorobenzene | 3.2 | 26 | 260 | 8260 |
| Hexachlorobenzene | 12 | 23 | 230 | 3550/8270 |
| 1,2,4-Trichlorobenzene | 6.0 | 13 | 64 | 3550/8270 |
| PHTHALATES | | | | |
| Bis(2-ethylhexyl)phthalate | 20 | 3,100 | | 3550/8270 |
| Butyl benzyl phthalate | 20 | 470 | | 3550/8270 |
| Diethyl phthalate | 20 | 97 | | 3550/8270 |
| Dimethyl phthalate | 20 | 160 | | 3550/8270 |
| Di-n-butyl phthalate | 20 | 1,400 | | 3550/8270 |
| Di-n-octyl phthalate | 20 | 6,200 | | 3550/8270 |
| PHENOLS | | | | |
| 2,4-Dimethylphenol | 10 | 29 | 50 | 3550/8270 |
| 2 Methylphenol | 10 | 20 | 72 | 3550/8270 |
| 4 Methylphenol | 20 | 120 | 1,200 | 3550/8270 |

AMTEST

| | | | | |
|---|---|---|---|---|
| Pentachlorophenol | 61 | 100 | 690 | 3550/8270 |
| Phenol | 20 | 120 | 1,200 | 3550/8270 |
| MISCELLANEOUS COMPOUNDS | | | | |
| Benzoic acid | 100 | 400 | 690 | 3550/8270 |
| Benzyl alcohol | 10 | 25 | 73 | 3550/8270 |
| Dibenzofuran | 20 | 54 | 540 | 3550/8270 |
| Hexachloroethane | 20 | 1,400 | 14,000 | 3550/8270 |
| Hexachlorobutadiene | 20 | 29 | 290 | 3550/8270 |
| N-Nitrosodiphenylamine | 15 | 28 | 220 | 3550/8270 |
| VOLATILE ORGANICS | | | | |
| Ethylbenzene | 3.2 | 10 | 50 | 8260 |
| Tetrachloroethene | 3.2 | 14 | 210 | 8260 |
| Trichloroethene | 3.2 | 160 | 1,600 | 8260 |
| Xylene | 3.2 | 12 | 160 | 8260 |
| PESTICIDES | | | | |
| DDD | 3.3 | 6.9 | 69 | 3540/8081 |
| DDE | 2.3 | | | 3540/8081 |
| DDT | 6.7 | | | 3540/8081 |
| Aldrin | 1.7 | 10 | | 3540/8081 |
| Chlordane | 1.7 | 10 | | 3540/8081 |
| Dieldrin | 2.3 | 10 | | 3540/8081 |
| Heptachlor | 1.7 | 10 | | 3540/8081 |
| Lindane | 1.7 | 10 | | 3540/8081 |
| Total PCB's | 67 | 130 | 2,500 | 3540/8081 |

All values are on a dry weight basis
* 8270 Compounds MDL's based on two 35g extracts (70% solids)

| | |
|---|---|
| CONVENTIONALS | |
| Total Solids | PSEP p17 |
| Total Volatile Solids | PSEP p20 |
| Total Organic Carbon | SM 5310B |
| Grain Size Distribution | PSEP p9 |

AMTEST

# INSTRUMENT DETECTION LIMITS

| | |
|---|---|
| **METALS (PPM)** | |
| Antimony | 0.001 |
| Arsenic | 0.001 |
| Cadmium | 0.0003 |
| Copper | 0.002 |
| Lead | 0.020 |
| Mercury | 0.0002 |
| Nickel | 0.010 |
| Silver | 0.0003 |
| Zinc | 0.002 |
| Chromium | 0.006 |
| **ORGANICS (PPB)** | |
| **LPAH** | |
| Naphthalene | 2 |
| Acenaphthalene | 2 |
| Acenaphthene | 2 |
| Fluorene | 2 |
| Phenanthrene | 2 |
| Anthracene | 2 |
| 2-Methylnaphthalene | 2 |
| **HPAH** | |
| Fluoranthene | 2 |
| Pyrene | 2 |
| Benzo(a)anthracene | 2 |
| Chrysene | 2 |
| Benzo(b)fluoranthene | 2 |
| Benzo(k)fluoranthene | 2 |
| Benzo(a)pyrene | 2 |
| Indeno(1,2,3-cd)pyrene | 2 |
| Dibenzo(a,h)anthracene | 2 |
| Benzo(ghi)perylene | 2 |
| **CHLORINATED HYDROCARBONS** | |
| 1,3-Dichlorobenzene | 0.5 |
| 1,4-Dichlorobenzene | 0.5 |
| 1,2-Dichlorobenzene | 0.5 |
| 1,2,4-Trichlorobenzene | 0.3 |
| Hexachlorobenzene | 1.5 |
| **PHTHALATES** | |
| Dimethyl phthalate | 2 |
| Diethyl phthalate | 2 |
| Di-n-butyl phthalate | 2 |
| Butyl benzyl phthalate | 2 |
| Bis(2-ethylhexyl)phthalate | 2 |
| Di-n-octyl phthalate | 2 |
| **PHENOLS** | |
| Phenol | 2 |
| 2 Methylphenol | 1 |
| 4 Methylphenol | 2 |
| 2,4-Dimethylphenol | 1 |

| | |
|---|---|
| Pentachlorophenol | 5 |
| MISCELLANEOUS COMPOUNDS | |
| Benzyl alcohol | 1 |
| Benzoic acid | 5 |
| Dibenzofuran | 2 |
| Hexachloroethane | 2 |
| Hexachlorobutadiene | 2 |
| N-Nitrosodiphenylamine | 1 |
| VOLATILE ORGANICS | |
| Trichloroethene | 0.5 |
| Tetrachloroethene | 0.5 |
| Ethylbenzene | 0.5 |
| Xylene | 0.5 |
| PESTICIDES | |
| DDE | 0.06 |
| DDD | 0.08 |
| DDT | 0.16 |
| Aldrin | 0.04 |
| Dieldrin | 0.06 |
| Chlordane | 0.04 |
| Heptachlor | 0.04 |
| Lindane | 0.04 |
| Total PCB's | 2 |

AMTEST

SAIC
18706 North Creek Pkwy suite 110
Bothell, WA 98011
Attention: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

Project Name: Hamm Crk Restoration
Project #: 01-0440

PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A008101
CLIENT ID C1
DATE SAMPLED 6/16/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **CONVENTIONALS (DRY WEIGHT)** | | | | |
| Total Solids (%) | 82.2 | | | |
| Total Volatile Solids (%) | 4.60 | | | |
| Total Organic Carbon (%) | 1.9 | | | |

**GRAIN SIZE DISTRIBUTION**

| PHI | OPENING (MM) | % RETENTION |
|---|---|---|
| | 4.75 | 0.10 |
| -2, | 4.00 | < 0.1 |
| -1, | 2.00 | 0.40 |
| 0, | 1.00 | 1.30 |
| +1, | 0.50 | 6.20 |
| +2, | 0.25 | 23.8 |
| +3, | 0.125 | 21.5 |
| +4, | 0.063 | 15.9 |
| +5, | 0.032 | 9.30 |
| +6, | 0.016 | 6.80 |
| +7, | 0.008 | 4.80 |
| +8, | 0.004 | 3.40 |
| +9, | 0.002 | 2.10 |
| +10, | 0.001 | 1.20 |
| >+10, | <0.001 | 3.10 |

**METALS (MG/KG DRY WEIGHT)**

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| Antimony | < 1.1 | | 20 | 200 |
| Arsenic | 8.8 | | 57 | 700 |
| Cadmium | 0.04 | | 0.96 | 10 |
| Copper | 22 | | 81 | 810 |
| Lead | 32 | | 66 | 660 |
| Mercury | 0.074 | | 0.21 | 2 |
| Nickel | 20 | | 140 | |
| Silver | 0.23 | | 1.2 | 5 |
| Zinc | 66 | | 160 | 1,600 |
| Chromium | 23 | | | |

AMTEST

## PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A008101
CLIENT ID C1
DATE SAMPLED 6/16/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **ORGANICS (UG/KG DRY WEIGHT)** | | | | |
| **LPAH** | | | | |
| Acenaphthylene | < 17 | | 64 | 640 |
| Acenaphthene | < 17 | | 63 | 630 |
| Anthracene | < 17 | | 130 | 1,300 |
| Fluorene | < 17 | | 64 | 640 |
| Naphthalene | < 17 | | 210 | 2,100 |
| Phenanthrene | < 17 | | 320 | 3,200 |
| 2-Methylnaphthalene | < 17 | | 67 | 670 |
| **HPAH** | | | | |
| Benzo(a)anthracene | < 17 | | 450 | 4,500 |
| Benzo(a)pyrene | < 17 | | 680 | 6,800 |
| Benzo(b)fluoranthene | < 17 | | 800 | 8,000 |
| Benzo(k)fluoranthene | < 17 | | | |
| Benzo(ghi)perylene | < 17 | | 540 | 5,400 |
| Chrysene | < 17 | | 670 | 6,700 |
| Dibenzo(a,h)anthracene | < 17 | | 120 | 5,400 |
| Fluoranthene | < 17 | | 630 | 6,300 |
| Indeno(1,2,3-cd)pyrene | < 17 | | 69 | 5,200 |
| Pyrene | < 17 | | 430 | 7,300 |
| **CHLORINATED HYDROCARBONS** | | | | |
| Hexachlorobenzene | < 10 | | 23 | 230 |
| 1,2-Dichlorobenzene | < 3 | | 19 | 350 |
| 1,3-Dichlorobenzene | < 3 | | 170 | |
| 1,4-Dichlorobenzene | < 3 | | 26 | 260 |
| 1,2,4-Trichlorobenzene | < 5 | | 13 | 64 |
| **PHTHALATES** | | | | |
| Diethyl phthalate | < 17 | | 97 | |
| Dimethyl phthalate | < 17 | | 160 | |
| Di-n-butyl phthalate | < 17 | | 1,400 | |
| Di-n-octyl phthalate | < 17 | | 6,200 | |
| Bis(2-ethylhexyl)phthalate | < 17 | | 3,100 | |
| Butyl benzyl phthalate | < 17 | | 470 | |
| **PHENOLS** | | | | |
| Pentachlorophenol | < 43 | | 100 | 690 |
| Phenol | < 17 | | 120 | 1,200 |
| 2 Methylphenol | < 9 | | 20 | 72 |
| 4 Methylphenol | < 17 | | 120 | 1,200 |
| 2,4-Dimethylphenol | < 9 | | 29 | 50 |

## PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A008101
CLIENT ID C1
DATE SAMPLED 6/16/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **MISCELLANEOUS COMPOUNDS** | | | | |
| Benzoic acid | < 87 | | 400 | 690 |
| Benzyl alcohol | < 10 | | 25 | 73 |
| Dibenzofuran | < 17 | | 54 | 540 |
| Hexachlorobutadiene | < 14 | | 29 | 290 |
| Hexachloroethane | < 17 | | 1400 | 14,000 |
| N-Nitrosodiphenylamine | < 10 | | 28 | 220 |
| SURROGATES (% RECOVERY) | | | | |
| 2-Fluorophenol | 55.0 | | | |
| D-6-Phenol | 64.0 | | | |
| D-5-Nitrobenzene | 59.0 | | | |
| 2-Fluorobiphenyl | 75.0 | | | |
| 2,4,6-Tribromophenol | 99.0 | | | |
| D14-Terphenyl | 87.0 | | | |
| **VOLATILE ORGANICS** | | | | |
| Ethylbenzene | < 3 | | 10 | 50 |
| Tetrachloroethene | < 3 | | 14 | 210 |
| Trichloroethene | < 3 | | 160 | 1,600 |
| Xylene | < 3 | | 12 | 160 |
| SURROGATES (% RECOVERY) | | | | |
| D4-1,2-Dichloroethane | 87.0 | | | |
| D8-Toluene | 98.0 | | | |
| 4-Bromofluorobenzene | 76.0 | | | |
| **PESTICIDES & PCB's** | | | | |
| Aldrin | 2.4 | | 10 | |
| Chlordane | 4.4 | | 10 | |
| DDD | 6.7* | | 6.9 | 69 |
| DDE | 3.7 | | | |
| DDT | 3.6 | | | |
| Dieldrin | 6.1 | | 10 | |
| Heptachlor | < 0.52 | | 10 | |
| Lindane | < 0.52 | | 10 | |
| A-1016 | < 8.6 * | | 130 | 2,500 |
| A-1221 | < 34 | | Total | Total |
| A-1232 | < 8.6 | | | |
| A-1242 | < 8.6 | | | |
| A-1248 | < 8.6 | | | |
| A-1254 | 160 | | | |
| A-1260 | < 8.6 | | | |
| SURROGATE (% RECOVERY) | | | | |
| Hexabromobenzene | 98. | | | |
| Tetrachloro-m-xylene | 81. | | | |

VALUES ARE IN UG/KG DRY WEIGHT

* Value exceeds PSDDA SL

AMTEST

SAIC
18706 North Creek Pkwy suite 110
Bothell, WA 98011
Attention: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

Project Name: Hamm Crk Restoration
Project #: 01-0440

PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A008102
CLIENT ID C2
DATE SAMPLED 6/16/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **CONVENTIONALS (DRY WEIGHT)** | | | | |
| Total Solids (%) | 77.2 | | | |
| Total Volatile Solids (%) | 2.37 | | | |
| Total Organic Carbon (%) | 0.63 | | | |

**GRAIN SIZE DISTRIBUTION**

| PHI | OPENING (MM) | % RETENTION |
|---|---|---|
| | 4.75 | < 0.1 |
| -2, | 4.00 | < 0.1 |
| -1, | 2.00 | 0.10 |
| 0, | 1.00 | 0.90 |
| +1, | 0.50 | 10.6 |
| +2, | 0.25 | 24.6 |
| +3, | 0.125 | 13.2 |
| +4, | 0.063 | 9.50 |
| +5, | 0.032 | 10.3 |
| +6, | 0.016 | 11.9 |
| +7, | 0.008 | 7.00 |
| +8, | 0.004 | 4.10 |
| +9, | 0.002 | 3.00 |
| +10, | 0.001 | 1.60 |
| >+10, | <0.001 | 3.20 |

| METALS (MG/KG DRY WEIGHT) | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| Antimony | < 1.3 | | 20 | 200 |
| Arsenic | 6.3 | | 57 | 700 |
| Cadmium | < 0.03 | | 0.96 | 10 |
| Copper | 18 | | 81 | 810 |
| Lead | 24 | | 66 | 660 |
| Mercury | 0.047 | | 0.21 | 2 |
| Nickel | 11 | | 140 | |
| Silver | < 0.13 | | 1.2 | 5 |
| Zinc | 42 | | 160 | 1,600 |
| Chromium | 19 | | | |

AMTEST

# PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A008102
CLIENT ID C2
DATE SAMPLED 6/16/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **ORGANICS (UG/KG DRY WEIGHT)** | | | | |
| **LPAH** | | | | |
| Acenaphthylene | < 19 | | 64 | 640 |
| Acenaphthene | < 19 | | 63 | 630 |
| Anthracene | < 19 | | 130 | 1,300 |
| Fluorene | < 19 | | 64 | 640 |
| Naphthalene | < 19 | | 210 | 2,100 |
| Phenanthrene | < 19 | | 320 | 3,200 |
| 2-Methylnaphthalene | < 19 | | 67 | 670 |
| **HPAH** | | | | |
| Benzo(a)anthracene | < 19 | | 450 | 4,500 |
| Benzo(a)pyrene | < 19 | | 680 | 6,800 |
| Benzo(b)fluoranthene | < 19 | | 800 | 8,000 |
| Benzo(k)fluoranthene | < 19 | | | |
| Benzo(ghi)perylene | < 19 | | 540 | 5,400 |
| Chrysene | < 19 | | 670 | 6,700 |
| Dibenzo(a,h)anthracene | < 19 | | 120 | 5,400 |
| Fluoranthene | < 19 | | 630 | 6,300 |
| Indeno(1,2,3-cd)pyrene | < 19 | | 69 | 5,200 |
| Pyrene | < 19 | | 430 | 7,300 |
| **CHLORINATED HYDROCARBONS** | | | | |
| Hexachlorobenzene | < 11 | | 23 | 230 |
| 1,2-Dichlorobenzene | < 3 | | 19 | 350 |
| 1,3-Dichlorobenzene | < 3 | | 170 | |
| 1,4-Dichlorobenzene | < 3 | | 26 | 260 |
| 1,2,4-Trichlorobenzene | < 6 | | 13 | 64 |
| **PHTHALATES** | | | | |
| Diethyl phthalate | < 19 | | 97 | |
| Dimethyl phthalate | < 19 | | 160 | |
| Di-n-butyl phthalate | < 19 | | 1,400 | |
| Di-n-octyl phthalate | < 19 | | 6,200 | |
| Bis(2-ethylhexyl)phthalate | < 19 | | 3,100 | |
| Butyl benzyl phthalate | < 19 | | 470 | |
| **PHENOLS** | | | | |
| Pentachlorophenol | < 47 | | 100 | 690 |
| Phenol | < 19 | | 120 | 1,200 |
| 2 Methylphenol | < 9 | | 20 | 72 |
| 4 Methylphenol | < 19 | | 120 | 1,200 |
| 2,4-Dimethylphenol | < 9 | | 29 | 50 |

AMTEST

# PSDDA CHEMICALS OF CONCERN

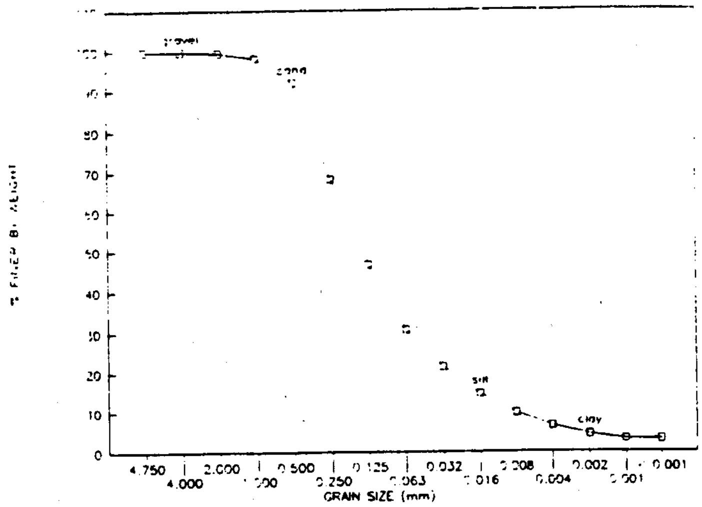
AM TEST ID 97-A008102
CLIENT ID C2
DATE SAMPLED 6/16/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **MISCELLANEOUS COMPOUNDS** | | | | |
| Benzoic acid | < 93 | | 400 | 690 |
| Benzyl alcohol | < 11 | | 25 | 73 |
| Dibenzofuran | < 19 | | 54 | 540 |
| Hexachlorobutadiene | < 15 | | 29 | 290 |
| Hexachloroethane | < 19 | | 1400 | 14,000 |
| N-Nitrosodiphenylamine | < 11 | | 28 | 220 |
| SURROGATES (% RECOVERY) | | | | |
| 2-Fluorophenol | 53.0 | | | |
| D-6-Phenol | 61.0 | | | |
| D-5-Nitrobenzene | 42.0 | | | |
| 2-Fluorobiphenyl | 53.0 | | | |
| 2,4,6-Tribromophenol | 93.0 | | | |
| D14-Terphenyl | 54.0 | | | |
| **VOLATILE ORGANICS** | | | | |
| Ethylbenzene | < 3 | | 10 | 50 |
| Tetrachloroethene | < 3 | | 14 | 210 |
| Trichloroethene | < 3 | | 160 | 1,600 |
| Xylene | < 3 | | 12 | 160 |
| SURROGATES (% RECOVERY) | | | | |
| D4-1,2-Dichloroethane | 87.0 | | | |
| D8-Toluene | 93.0 | | | |
| 4-Bromofluorobenzene | 73.0 | | | |
| **PESTICIDES & PCB's** | | | | |
| Aldrin | 1.3 | | 10 | |
| Chlordane | 1.5 | | 10 | |
| DDD | 5.3* | | 6.9 | 69 |
| DDE | 2.9 | | | |
| DDT | 3.1 | | | |
| Dieldrin | 6.0 | | 10 | |
| Heptachlor | < 0.55 | | 10 | |
| Lindane | < 0.55 | | 10 | |
| A-1016 | < 9.2 | | 130 | 2,500 |
| A-1221 | < 37 | | Total | Total |
| A-1232 | < 9.2 | | | |
| A-1242 | < 9.2 | | | |
| A-1248 | < 9.2 | | | |
| A-1254 | 76 | | | |
| A-1260 | < 9.2 | | | |
| SURROGATE (% RECOVERY) | | | | |
| Hexabromobenzene | 87. | | | |
| Tetrachloro-m-xylene | 82. | | | |

VALUES ARE IN UG/KG DRY WEIGHT

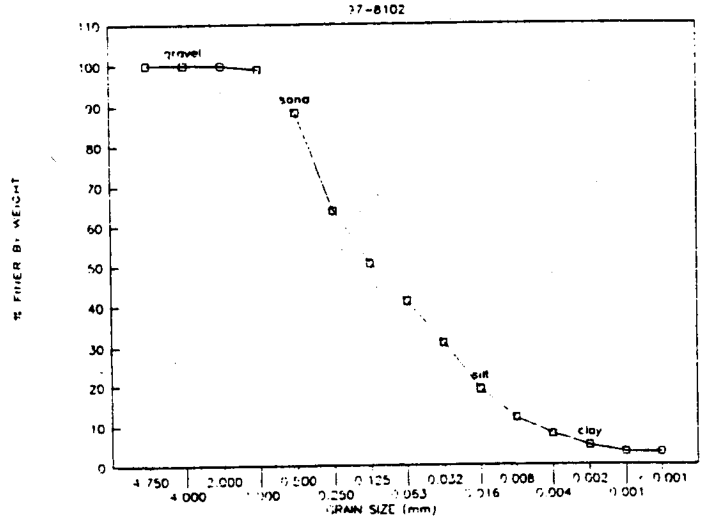
* Value exceeds PSDDA SL

## GRAIN SIZE DISTRIBUTION



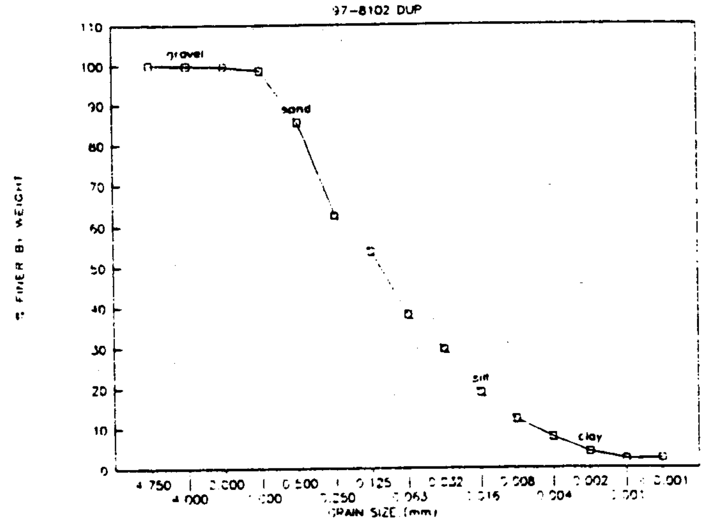

## GRAIN SIZE DISTRIBUTION

97-8102



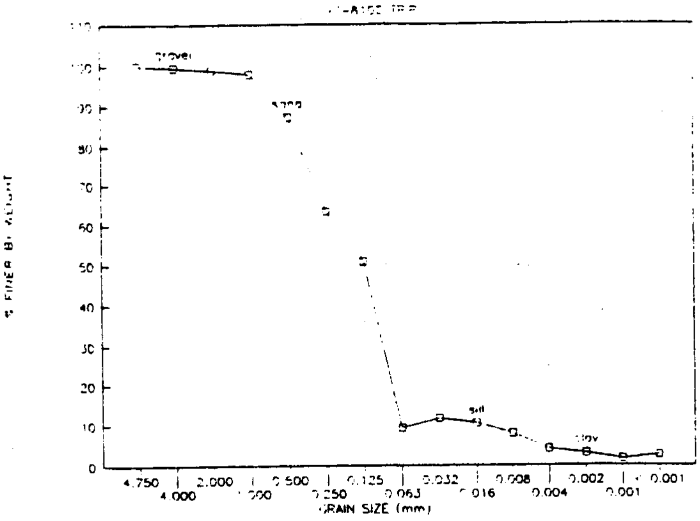

## GRAIN SIZE DISTRIBUTION

97-8102 DUP



[redacted]

## GRAIN SIZE DISTRIBUTION



:AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL - ANALYSIS DATES*

AmTest Sample Number: 97-A008101 through 8102

| | |
|---|---|
| Volatiles | 6/30/97 |
| Semi-Volatiles | |
| Extraction | 6/30/97 |
| Analysis | 7/10/97 |
| Pesticides | |
| Extraction | 6/27/97 |
| Analysis | 7/03/97 |
| Polychlorinated Biphenyls | |
| Extraction | 6/27/97 |
| Analysis | 7/08/97 |

## SAMPLE WEIGHTS
(Grams)

| AM TEST SAMPLE #'s | VOLATILES | SEMI-VOLATILES | PESTICIDES | PCB's |
|---|---|---|---|---|
| 97-A008101 | 2.00 | 70.20 | 35.31 | 35.31 |
| 97-A008102 | 2.15 | 70.80 | 35.67 | 35.69 |
| 97-A008101 MS | 2.03 | - | - | - |
| 97-A008101 MSD | 2.00 | - | - | - |
| 97-A008102 MS | - | 70.50 | 35.48 | 35.00 |
| 97-A008102 MSD | - | 71.00 | 35.04 | 35.17 |
| HS-3 | - | 1.00 | - | - |
| 340 | - | - | 2.00 | - |
| 67001 | - | - | - | 0.50 |

*Includes all associated Quality Control Samples (MS/MSD, SRM, Blanks, etc.).
= Matrix Spike MSD = Matrix Spike Duplicate

'IC
.tn: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

# QUALITY CONTROL - BLANK

| AM TEST Identification<br>Client Identification | BLANK |
|---|---|
| **ORGANICS (ug/kg) (PPB)** | |
| LPAH | |
| Naphthalene | < 14 |
| Acenaphthalene | < 14 |
| Acenaphthene | < 14 |
| Fluorene | < 14 |
| Phenanthrene | < 14 |
| Anthracene | < 14 |
| 2-Methylnaphthalene | < 14 |
| HPAH | |
| Fluoranthene | < 14 |
| Pyrene | < 14 |
| Benzo(a)anthracene | < 14 |
| Chrysene | < 14 |
| Benzo(b)fluoranthene | < 14 |
| Benzo(k)fluoranthene | < 14 |
| Benzo(a)pyrene | < 14 |
| Indeno(1,2,3-cd)pyrene | < 14 |
| Dibenzo(a,h)anthracene | < 14 |
| Benzo(ghi)perylene | < 14 |
| CHLORINATED HYDROCARBONS | |
| 1,3-Dichlorobenzene | < 3.0 |
| 1,4-Dichlorobenzene | < 3.0 |
| 1,2-Dichlorobenzene | < 3.0 |
| 1,2,4-Trichlorobenzene | < 5.0 |
| Hexachlorobenzene | < 10 |
| PHTHALATES | |
| Dimethyl phthalate | < 14 |
| Diethyl phthalate | < 14 |
| Di-n-butyl phthalate | < 14 |
| Butyl benzyl phthalate | < 14 |
| Bis(2-ethylhexyl)phthalate | < 14 |
| Di-n-octyl phthalate | < 14 |

= less than
.ALUES IN UG/KG DRY WEIGHT

SAIC
Attn: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL -BLANK

| AM TEST Identification<br>Client Identification | BLANK |
|---|---|
| **ORGANICS (ug/kg)** | |
| PHENOLS | |
| Phenol | < 14 |
| 2-Methylphenol | < 7.0 |
| 4-Methylphenol | < 14 |
| 2,4-Dimethylphenol | < 7.0 |
| Pentachlorophenol | < 36 |
| MISCELLANEOUS COMPOUNDS | |
| Benzyl alcohol | < 9.0 |
| Benzoic acid | < 71 |
| Dibenzofuran | < 14 |
| Hexachloroethane | < 14 |
| Hexachlorobutadiene | < 11 |
| N-Nitrosodiphenylamine | < 9.0 |
| SURROGATES RECOVERIES (%) | |
| 2-Fluorophenol | 58 |
| D6-Phenol | 66 |
| D5-Nitrobenzene | 50 |
| 2-Fluorobiphenyl | 56 |
| 2,4,6-Tribromophenol | 78 |
| D14-Terphenyl | 55 |
| VOLATILE ORGANICS | |
| Trichloroethene | < 3.0 |
| Tetrachloroethene | < 3.0 |
| Ethylbenzene | < 3.0 |
| Xylene | < 3.0 |
| SURROGATE RECOVERIES (%) | |
| D4-1,2-Dichloroethane | 82 |
| D8-Toluene | 111 |
| 4-Bromofluorobenzene | 80 |

< = less than
VALUES IN UG/KG DRY WEIGHT

IC
tn: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL -BLANK

| AM TEST Sample Number<br>Client Identification | BLANK |
|---|---|
| **ORGANICS (ug/kg)** | |
| PESTICIDES | |
| DDE | < 0.57 |
| DDD | < 0.71 |
| DDT | < 1.4 |
| Aldrin | < 0.43 |
| Dieldrin | < 0.57 |
| Chlordane | < 1.1 |
| Heptachlor | < 0.43 |
| Lindane | < 0.43 |
| PCB's | |
| A-1016 | < 7.1 |
| A-1221 | < 29 |
| A-1232 | < 7.1 |
| A-1242 | < 7.1 |
| A-1248 | < 7.1 |
| A-1254 | < 7.1 |
| A-1260 | < 7.1 |
| SURROGATE RECOVERIES (%) | |
| Hexabromobenzene | 87 |
| Tetrachloro-m-xylene | 82 |

< = less than
VALUES IN UG/KG DRY WEIGHT

-N TEST

n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

# QUALITY CONTROL
# VOLATILES
# MATRIX SPIKES

AM TEST Sample Number 97-A008101
MATRIX SPIKE

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Trichloroethene | < 3.0 | 72 | 75 | 96 |
| Tetrachloroethene | < 3.0 | 73 | 75 | 97 |
| Ethylbenzene | < 3.0 | 70 | 75 | 94 |
| Total Xylene | < 3.0 | 88 | 75 | 117 |
| 1,3-Dichlorobenzene | < 3.0 | 92 | 75 | 123 |
| 1,4-Dichlorobenzene | < 3.0 | 94 | 75 | 125 |
| 1,2-Dichlorobenzene | < 3.0 | 92 | 75 | 123 |

RROGATE RECOVERIES (%)

| | |
|---|---|
| D4-1,2-Dichloroethane | 94 |
| D8-Toluene | 100 |
| 4-Bromofluorobenzene | 108 |

= less than

TO
ATTN: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

# QUALITY CONTROL
# VOLATILES
# MATRIX SPIKES

AM TEST Sample Number: 97-A008101 MATRIX SPIKE DUPLICATE

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE DUPLICATE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Trichloroethene | < 3.0 | 65 | 75 | 85 |
| Tetrachloroethene | < 3.0 | 68 | 75 | 90 |
| Ethylbenzene | < 3.0 | 63 | 75 | 83 |
| Total Xylene | < 3.0 | 67 | 75 | 89 |
| 1,3-Dichlorobenzene | < 3.0 | 67 | 75 | 87 |
| 1,4-Dichlorobenzene | < 3.0 | 67 | 75 | 87 |
| 1,2-Dichlorobenzene | < 3.0 | 65 | 75 | 84 |

SURROGATE RECOVERIES (%)

| | |
|---|---|
| D4-1,2-Dichloroethane | 85 |
| D8-Toluene | 100 |
| 4-Bromofluorobenzene | 86 |

< = less than

AMTEST

~IC
~: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
VOLATILES
MATRIX SPIKE DUPLICATES

M TEST Sample Number 97-A008101 MS + MSD

| COMPOUNDS | MATRIX SPIKE (ug/kg) | MATRIX SPIKE DUPLICATE (ug/kg) | RELATIVE PERCENT DIFFERENCE (%) |
|---|---|---|---|
| 'richloroethene | 72 | 65 | 10 |
| 'etrachloroethene | 73 | 68 | 7.1 |
| Ethylbenzene | 70 | 63 | 11 |
| 'otal Xylene | 88 | 67 | 27 |
| .,3-Dichlorobenzene | 92 | 67 | 31 |
| 1,4-Dichlorobenzene | 94 | 67 | 33 |
| 1 2-Dichlorobenzene | 92 | 65 | 34 |

MS + MSD = Matrix Spike + Matrix Spike Duplicate

AMTEST

TC
. .n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

# QUALITY CONTROL
# SEMI-VOLATILES
# MATRIX SPIKES

M TEST Sample Number 97-A008102 MATRIX SPIKE

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Naphthalene | < 19 | 620 | 930 | 67 |
| Acenaphthalene | < 18 | 690 | 930 | 74 |
| Acenaphthene | < 19 | 730 | 930 | 78 |
| Fluorene | < 19 | 820 | 930 | 88 |
| Phenanthrene | < 19 | 840 | 930 | 90 |
| Anthracene | < 19 | 810 | 930 | 87 |
| 2-Methylnaphthalene | < 19 | 710 | 930 | 76 |
| Fluoranthene | < 19 | 930 | 930 | 100 |
| ·ene | < 19 | 790 | 930 | 84 |
| .izo(a)anthracene | < 19 | 860 | 930 | 92 |
| Chrysene | < 19 | 870 | 930 | 93 |
| Benzo(b)fluoranthene | < 19 | 820 | 930 | 88 |
| Benzo(k)fluoranthene | < 19 | 780 | 930 | 84 |
| Benzo(a)pyrene | < 19 | 810 | 930 | 86 |
| Indeno(1,2,3-cd)pyrene | < 19 | 970 | 930 | 104 |
| Dibenzo(a,h)anthracene | < 19 | 920 | 930 | 99 |
| Benzo(ghi)perylene | < 19 | 940 | 930 | 101 |
| 1,2,4-Trichlorobenzene | < 6.0 | 680 | 930 | 73 |
| Hexachlorobenzene | < 11 | 880 | 930 | 94 |
| Dimethyl phthalate | < 19. | 810 | 930 | 86 |
| Diethyl phthalate | < 19. | 870 | 930 | 93 |
| Di-n-butyl phthalate | < 19 | 860 | 930 | 92 |
| Butyl benzyl phthalate | < 19 | 880 | 930 | 94 |
| Bis(2-ethylhexyl)phthalate | < 19 | 900 | 930 | 97 |
| Di-n-octyl phthalate | < 19 | 960 | 930 | 102 |

< = less than

AMTEST

AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL
## SEMI-VOLATILES
## MATRIX SPIKES

AM TEST Sample Number 97-A008102 MATRIX SPIKE

| OMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| henol | < 19 | 520 | 930 | 56 |
| 2-Methylphenol | < 9.0 | 580 | 930 | 62 |
| -Methylphenol | < 19 | 600 | 930 | 64 |
| ,4-Dimethylphenol | < 9.0 | 590 | 930 | 63 |
| Pentachlorophenol | < 47 | 910 | 930 | 98 |
| enzyl alcohol | < 11 | 630 | 930 | 68 |
| enzoic acid | < 93 | 740 | 930 | 79 |
| Dibenzofuran | < 19 | 760 | 930 | 82 |
| Hexachloroethane | < 19 | 570 | 930 | 61 |
| achlorobutadiene | < 15 | 670 | 930 | 72 |
| Nitrosodiphenylamine | < 11 | 790 | 930 | 85 |

SURROGATES RECOVERIES (%)

| | |
|---|---|
| 2-Fluorophenol | 61 |
| D6-Phenol | 67 |
| 5-Nitrobenzene | 68 |
| -Fluorobiphenyl | 76 |
| 2,4,6-Tribromophenol | 104 |
| 14-Terphenyl | 86 |

< = less than

AR 023404

AMTEST

¨C
. ‿n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
SEMI-VOLATILES
MATRIX SPIKES

AM TEST Sample Number 97-A008102
MATRIX SPIKE DUPLICATE

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE DUPLICATE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Naphthalene | < 19 | 550 | 930 | 59 |
| Acenaphthalene | < 18 | 670 | 930 | 72 |
| Acenaphthene | < 19 | 700 | 930 | 75 |
| Fluorene | < 19 | 820 | 930 | 88 |
| Phenanthrene | < 19 | 820 | 930 | 89 |
| Anthracene | < 19 | 810 | 930 | 87 |
| 2-Methylnaphthalene | < 19 | 660 | 930 | 71 |
| :oranthene | < 19 | 880 | 930 | 95 |
| ,rene | < 19 | 800 | 930 | 86 |
| [illegible](a)anthracene | < 19 | 850 | 930 | 91 |
| [illegible]/sene | < 19 | 860 | 930 | 93 |
| [illegible]nzo(b)fluoranthene | < 19 | 860 | 930 | 93 |
| Benzo(k)fluoranthene | < 19 | 770 | 930 | 83 |
| Benzo(a)pyrene | < 19 | 810 | 930 | 87 |
| Indeno(1,2,3-cd)pyrene | < 19 | 980 | 930 | 105 |
| Dibenzo(a,h)anthracene | < 19 | 950 | 930 | 102 |
| Benzo(ghi)perylene | < 19 | 960 | 930 | 104 |
| 1,2,4-Trichlorobenzene | < 6.0 | 600 | 930 | 65 |
| Hexachlorobenzene | < 11 | 820 | 930 | 88 |
| Dimethyl phthalate | < 19 | 800 | 930 | 86 |
| Diethyl phthalate | < 19 | 830 | 930 | 90 |
| Di-n-butyl phthalate | < 19 | 880 | 930 | 95 |
| Butyl benzyl phthalate | < 19 | 890 | 930 | 96 |
| Bis(2-ethylhexyl)phthalate | < 19 | 900 | 930 | 97 |
| Di-n-octyl phthalate | < 19 | 980 | 930 | 106 |

< = less than

AMTEST

ATC
: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

**QUALITY CONTROL**
**SEMI-VOLATILES**
**MATRIX SPIKES**

M TEST Sample Number — 97-A008102
MATRIX SPIKE DUPLICATE

| OMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE DUPLICATE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Phenol | < 19 | 480 | 930 | 52 |
| -Methylphenol | < 9.0 | 580 | 930 | 62 |
| -Methylphenol | < 19 | 580 | 930 | 63 |
| 2,4-Dimethylphenol | < 9.0 | 530 | 930 | 57 |
| entachlorophenol | < 47 | 880 | 930 | 95 |
| enzyl alcohol | < 11 | 620 | 930 | 66 |
| Benzoic acid | < 93 | 760 | 930 | 82 |
| Dibenzofuran | < 19 | 720 | 930 | 78 |
| achloroethane | < 19 | 460 | 930 | 50 |
| exachlorobutadiene | < 15 | 560 | 930 | 60 |
| N-Nitrosodiphenylamine | < 11 | 800 | 930 | 86 |

URROGATES RECOVERIES (%)

| | |
|---|---|
| -Fluorophenol | 55 |
| 6-Phenol | 62 |
| D5-Nitrobenzene | 62 |
| 2-Fluorobiphenyl | 76 |
| ,4,6-Tribromophenol | 103 |
| 14-Terphenyl | 92 |

= less than

AMTEST

TC
: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
SEMI-VOLATILES
MATRIX SPIKE DUPLICATES

M TEST Sample Number 97-A008102
MS + MSD

| COMPOUNDS | SAMPLE VALUE (ug/kg) | DUPLICATE VALUE (ug/kg) | RELATIVE PERCENT DIFFERENCE (%) |
|---|---|---|---|
| Naphthalene | 620 | 550 | 12 |
| cenaphthalene | 690 | 670 | 2.9 |
| Acenaphthene | 730 | 700 | 4.2 |
| Fluorene | 820 | 820 | 0 |
| henanthrene | 840 | 820 | 2.4 |
| .nthracene | 810 | 810 | 0 |
| 2-Methylnaphthalene | 710 | 660 | 7.3 |
| oranthene | 930 | 880 | 5.5 |
| ene | 790 | 800 | 1.3 |
| Benzo(a)anthracene | 860 | 850 | 1.2 |
| Chrysene | 870 | 860 | 1.2 |
| enzo(b)fluoranthene | 820 | 860 | 4.8 |
| Benzo(k)fluoranthene | 780 | 770 | 1.3 |
| Benzo(a)pyrene | 810 | 810 | 0 |
| ndeno(1,2,3-cd)pyrene | 970 | 980 | 1.0 |
| ibenzo(a,h)anthracene | 920 | 950 | 3.2 |
| Benzo(ghi)perylene | 940 | 960 | 2.1 |
| ',2,4-Trichlorobenzene | 680 | 600 | 13 |
| exachlorobenzene | 880 | 820 | 7.1 |
| Dimethyl phthalate | 810 | 800 | 1.2 |
| Diethyl phthalate | 870 | 830 | 4.7 |
| i-n-butyl phthalate | 860 | 880 | 2.3 |
| Butyl benzyl phthalate | 880 | 890 | 1.1 |
| Bis(2-ethylhexyl)phthalate | 900 | 900 | 0 |
| i-n-octyl phthalate | 960 | 980 | 2.1 |

. = less than

AR 023407

AMTEST

AIC
: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL
## SEMI-VOLATILES
## MATRIX SPIKE DUPLICATES

AM TEST Sample Number 97-A008102 MS + MSD

| OMPOUNDS | SAMPLE VALUE (ug/kg) | DUPLICATE VALUE (ug/kg) | RELATIVE PERCENT DIFFERENCE (%) |
|---|---|---|---|
| henol | 520 | 480 | 8.0 |
| 2-Methylphenol | 580 | 580 | 0 |
| -Methylphenol | 600 | 580 | 3.4 |
| ,4-Dimethylphenol | 590 | 530 | 11 |
| Pentachlorophenol | 910 | 880 | 3.4 |
| Benzyl alcohol | 630 | 620 | 1.6 |
| zoic acid | 740 | 760 | 2.7 |
| benzofuran | 760 | 720 | 5.4 |
| Hexachloroethane | 570 | 460 | 21 |
| Iexachlorobutadiene | 670 | 560 | 18 |
| J-Nitrosodiphenylamine | 790 | 800 | 1.3 |

< = less than

AR 023408

AMTEST

¯¯C
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
SEMI-VOLATILES
STANDARD REFERENCE MATERIAL
HS-3

ample Date: 6/30/97
Date Analyzed: 7/09/97

| COMPOUNDS | MEASURED VALUE (ug/kg) | TRUE VALUE (ug/kg) | RECOVERY (%) | LABORATORY CONTROL LIMIT (ug/kg) |
|---|---|---|---|---|
| Naphthalene | 4,200 | 9,000 | 47 | 280-4,440 |
| Acenaphthene | 170 | 300 | 57 | 28-310 |
| Acenaphthene | 2,500 | 4,500 | 56 | 428-3,300 |
| Fluorene | 5,300 | 13,300 | 40 | 1,040-8,050 |
| nanthrene | 68,000 | 85,000 | 80 | 7,300-70,800 |
| hracene | 3,600 | 13,400 | 27 | 520-4,500 |
| Fluoranthene | 45,000 | 60,000 | 75 | 6,100-59,700 |
| Pyrene | 24,000 | 39,000 | 62 | 4,500-35,800 |
| Benzo(a)Anthracene | 8,600 | 14,600 | 59 | 1,490-12,100 |
| Chrysene | 10,000 | 14,100 | 71 | 1,700-13,400 |
| nzo(a)Pyrene | 5,200 | 7,400 | 70 | 1,600-5,600 |
| nzo(b)Fluoranthene | 6,000 | 7,700 | 78 | 2,800-10,300 |
| enzo(k)Fluoranthene | 5,700 | 2,800 | 204 | 430-7,200 |
| Benzo(ghi)perylene | 3,600 | 5,000 | 72 | 960-3,900 |
| Dibenzo(a,h)Anthracene | 1,200 | 1,300 | 92 | 240-1,200 |
| ndeno(1,2,3-cd)Pyrene | 3,500 | 5,400 | 65 | 1,040-4,020 |

SURROGATE RECOVERIES (%)

| | |
|---|---|
| -Fluorophenol | 57 |
| D5-Phenol | 61 |
| D5-Nitrobenzene | 54 |
| -Fluorobiphenyl | 63 |
| 2,4,6-Tribromophenol | 90 |
| D14-Terphenyl | 54 |

AMTEST

AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

# QUALITY CONTROL
# PESTICIDES
# MATRIX SPIKES

AM TEST Sample Number 97-A008102 MATRIX SPIKE

| OMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| indane | < 0.55 | 16 | 19 | 86 |
| Heptachlor | < 0.55 | 19 | 19 | 102 |
| Aldrin | 1.3 | 17 | 19 | 84 |
| Dieldrin | 6.0 | 24 | 19 | 99 |
| DDD | 5.3 | 23 | 19 | 93 |
| DDE | 2.9 | 20 | 19 | 89 |
| | 3.1 | 21 | 19 | 97 |

SURROGATE RECOVERIES (%)

| | |
|---|---|
| Iexabromobenzene | 79 |
| Tetrachloro-m-xylene | 76 |

. = less than

AMTEST

IC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

**QUALITY CONTROL**
**PESTICIDES**
**MATRIX SPIKES**

AM TEST Sample Number 97-A008102
MATRIX SPIKE DUPLICATE

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE DUPLICATE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Lindane | < 0.55 | 16 | 19 | 86 |
| Heptachlor | < 0.55 | 19 | 19 | 98 |
| Aldrin | 1.3 | 16 | 19 | 80 |
| Dieldrin | 6.0 | 24 | 19 | 94 |
| DDD | 5.3 | 23 | 19 | 92 |
| E | 2.9 | 20 | 19 | 88 |
| T | 3.1 | 21 | 19 | 92 |

SURROGATE RECOVERIES (%)

| | |
|---|---|
| Hexabromobenzene | 81 |
| trachloro-m-xylene | 76 |

< = less than

AMTEST

:AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
PESTICIDES
MATRIX SPIKE DUPLICATES

AM TEST Sample Number 97-A008102
MS + MSD

| :OMPOUNDS | MATRIX SPIKE (ug/kg) | MATRIX SPIKE DUPLICATE (ug/kg) | RELATIVE PERCENT DIFFERENCE (%) |
|---|---|---|---|
| Lindane | 16 | 16 | 0 |
| Heptachlor | 19 | 19 | 0 |
| Aldrin | 17 | 16 | 6.1 |
| Dieldrin | 24 | 24 | 0 |
| DDD | 23 | 23 | 0 |
| [illegible] | 20 | 20 | 0 |
| [illegible]T | 21 | 21 | 0 |

MS + MSD = Matrix Spike + Matrix Spike Duplicate

AR 023412

AMTEST

ˆIC
.n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

**QUALITY CONTROL**
**PESTICIDES**
**STANDARD REFERENCE MATERIAL**
**ERA - PPS-45, LOT #340***

| COMPOUNDS | MEASURED VALUE (ug/kg) | TRUE VALUE (ug/kg) | RECOVERY (%) | PERFORMANCE ACCEPTANCE LIMITS (ug/kg) |
|---|---|---|---|---|
| DDT | 350 | 397 | 88 | 158-429 |
| DDE | 230 | 275 | 84 | 163-316 |
| DD | 250 | 299 | 84 | 146-356 |
| Aldrin | 290 | 341 | 85 | 194-379 |
| Dieldrin | 260 | 329 | 79 | 172-372 |

* Environmental Resource Associates, Arvada, CO.

AR 023413

'AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL
## POLYCHLORINATED BIPHENYLS
## MATRIX SPIKES

AM TEST Sample Number 97-A008102

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Aroclor 1260 | < 9.2 | 85 | 94 | 90 |

| COMPOUNDS | SAMPLE VALUE (ug/kg) | SAMPLE + SPIKE DUPLICATE (ug/kg) | SPIKE CONCENTRATION (ug/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Aroclor 1260 | < 9.2 | 82 | 94 | 88 |

MATRIX SPIKE DUPLICATES

| COMPOUNDS | MATRIX SPIKE (ug/kg) | MATRIX SPIKE DUPLICATE (ug/kg) | RELATIVE PERCENT DIFFERENCE (%) |
|---|---|---|---|
| Aroclor 1260 | 85 | 82 | 3.6 |

< = less than
MS + MSD = Matrix Spike + Matrix Spike Duplicate

AMTEST

C
.n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
POLYCHLORINATED BIPHENYLS
STANDARD REFERENCE MATERIAL
ERA 87001*

| COMPOUND | MEASURED VALUE (mg/kg) | TRUE VALUE (mg/kg) | RECOVERY (%) |
|---|---|---|---|
| .roclor 1260 | 14 | 11.8 | 121 |

.dvisory Range: 6.6 - 24 mg/kg

Environmental Resource Associates, Arvada, CO.

AMTEST

:AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
CONVENTIONALS & METALS
ANALYSIS DATES

AmTest Sample Number: 97-A008101 through 8102

| ANALYTES | ANALYSES DATES |
|---|---|
| Total Solids | 6/19/97 |
| Total Volatile Solids | 6/19/97 |
| Total Organic Carbon | 6/19/97 |
| Metals Digestion | 6/23/97 |
| Antimony | 7/01/97 |
| Arsenic | 7/02/97 |
| imium | 7/01/97 |
| pper | 6/26/97 |
| Lead | 6/26/97 |
| Mercury | 6/23/97 |
| Nickel | 6/26/97 |
| Silver | 7/03/97 |
| Zinc | 6/26/97 |
| Chromium | 6/26/97 |

AR 023416

AMTEST

"TC
.n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

# QUALITY CONTROL
# METALS
# DUPLICATES

AM TEST Sample Number 97-A008101

| COMPOUNDS | SAMPLE VALUE (mg/kg) | DUPLICATE VALUE (mg/kg) | RELATIVE PERCENT DIFFERENCE (%) |
| --- | --- | --- | --- |
| Antimony | < 1.1 | < 1.1 | - |
| Arsenic | 8.8 | 9.5 | 7.6 |
| Cadmium | 0.04 | 0.05 | 22 |
| Copper | 22 | 19 | 15 |
| Lead | 32 | 30 | 6.5 |
| Mercury | 0.074 | 0.063 | 16 |
| Nickel | 20 | 17 | 16 |
| ver | 0.23 | 0.23 | 0 |
| Zinc | 66 | 64 | 3.0 |
| Chromium | 23 | 22 | 4.4 |

< = less than

AR 023417

AMTEST

AIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

## QUALITY CONTROL
## METALS
## MATRIX SPIKES

AM TEST Sample Number 97-A008102

| COMPOUNDS | SAMPLE VALUE (mg/kg) | SAMPLE + SPIKE (mg/kg) | SPIKE CONCENTRATION (mg/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Antimony | < 1.3 | 6.6 | 6.4 | 103 |
| rsenic | 6.3 | 17 | 13 | 82 |
| admium | < 0.03 | 0.29 | 0.26 | 112 |
| Copper | 18 | 150 | 130 | 102 |
| ead | 24 | 150 | 130 | 97 |
| ercury | 0.047 | 0.269 | 0.259 | 86 |
| Nickel | 11 | 140 | 130 | 99 |
| ver | < 0.13 | 2.2 | 2.6 | 85 |
| c | 42 | 180 | 130 | 106 |
| Chromium | 19 | 150 | 130 | 101 |

< = less than

AMTEST

ˉC
. ˉn: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
METALS & TOTAL ORGANIC CARBON
STANDARD REFERENCE MATERIAL

NBS 2704

| COMPOUNDS | MEASURED VALUE (mg/kg) | TRUE VALUE (mg/kg) | RECOVERY (%) | LABORATORY CONTROL LIMITS (mg/kg) |
|---|---|---|---|---|
| METALS | | | | |
| Antimony | 3.7 | 3.79 | 98 | 2.8 - 4.5 |
| Arsenic | 19 | 23.4 | 81 | 15 - 29 |
| Cadmium | 3.4 | 3.45 | 99 | 2.6 - 3.8 |
| Copper | 87 | 98.6 | 88 | 50 - 130 |
| Lead | 170 | 161 | 106 | 94 - 200 |
| Mercury | 1.36 | 1.44 | 94 | 1.0 - 1.8 |
| Nickel | 37 | 44.1 | 84 | 22 - 65 |
| inc | 430 | 438 | 98 | 330 - 530 |
| Chromium | 85 | 135 | 63 | 81 - 104 |
| otal Organic Carbon (%) | 3.32 | 3.35 | 97 | 2.5 - 4.2 |

AR 023419

AMTEST

ᴬᵀC
ı: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
METALS
BLANK

| ELEMENTS | RESULTS (mg/kg) |
|---|---|
| Antimony | < 1.0 |
| rsenic | < 1.0 |
| Cadmium | < 0.02 |
| Copper | < 2.0 |
| ead | < 10 |
| Mercury | < 0.02 |
| Nickel | < 10 |
| ilver | < 0.10 |
| Zinc | < 2.0 |
| Chromium | < 6.0 |

= less than

Analysis based on 2.0 grams in 200 mls.

AR 023420

AMTEST

# Duplicate/Triplicate Analysis

Lab I.D. 97-A008102

| phi/opening | (mm) | Sample | Duplicate | Triplicate |
|---|---|---|---|---|
| | | Retained % | | |
| | 4.75 | <0.1 | <0.1 | <0.1 |
| -2/ | 4.0 | <0.1 | 0.1 | 0.5 |
| -1/ | 1.7 | 0.1 | 0.3 | 0.5 |
| 0/ | 1.0 | 0.9 | 1.0 | 1.0 |
| +1/ | 0.5 | 10.6 | 13.0 | 10.7 |
| +2/ | .25 | 24.6 | 23.1 | 23.9 |
| +3/ | .125 | 13.2 | 8.8 | 12.7 |
| +4/ | .063 | 9.5 | 15.7 | 9.3 |
| +5/ | .032 | 10.3 | 8.6 | 11.7 |
| +6/ | .016 | 11.9 | 10.6 | 10.4 |
| +7/ | .008 | 7.0 | 6.7 | 7.9 |
| +8/ | .004 | 4.1 | 4.4 | 4.1 |
| +9/ | .002 | 3.0 | 3.6 | 3.0 |
| +10/ | .001 | 1.6 | 1.9 | 1.6 |
| Pass | | 3.2 | 2.4 | 2.6 |
| Total Solids % | | 77.19 | 77.21 | 77.27 |

AMTEST

SAIC
n: John Lunz

Date Received: 6/18/97
Date Reported: 7/14/97

QUALITY CONTROL
CONVENTIONALS
TRIPLICATES

| | #1 | #2 | #3 |
|---|---|---|---|
| Total Solids (%) 97-A008102 | 77 | 77 | 77 |
| Total Volatile Solids (%) 97-A008102 | 2.4 | 2.4 | 2.8 |
| Total Organic Carbon (%) 97-A008101 | 1.9 | 2.0 | 1.7 |

CONVENTIONALS
BLANKS

| AM TEST Sample Numbers<br>Client Identification | BLANK #1<br>--------- |
|---|---|
| Total Organic Carbon (%) | < 0.05 |

< less than

MAF/jb

REPORTED BY Mark A. Fugiel

SAIC
18706 North Creek Pkwy suite 110
Bothell, WA 98011
Attention: John Lunz

Date Received: 6/18/97
Date Reported: 7/10/97

Project Name: Hamm Crk Restoration
Project #: 01-0440

MARINE SEDIMENT QUALITY STANDARDS
WAC 173-204

AM TEST ID 97-A008101
CLIENT ID C1
DATE SAMPLED 6/16/97

| | RESULT | Q | CC | MCC |
|---|---|---|---|---|
| **METALS (MG/KG DRY WEIGHT)** | | | | |
| Arsenic | 8.8 | | 57 | 93 |
| Cadmium | 0.04 | | 5.1 | 6.7 |
| Chromium | 23. | | 260 | 270 |
| Copper | 22. | | 390 | 390 |
| Lead | 32. | | 450 | 530 |
| Mercury | 0.074 | | 0.41 | 0.59 |
| Silver | 0.23 | | 6.1 | 6.1 |
| Zinc | 66. | | 410 | 960 |
| **ORGANICS PPM (DRY WEIGHT) NORMALIZED TO TOC** | | | | |
| **LPAH'S** | | | | |
| Naphthalene | < 0.89 | | 99 | 170 |
| Acenaphthylene | < 0.89 | | 66 | 66 |
| Acenaphthene | < 0.89 | | 16 | 57 |
| Fluorene | < 0.89 | | 23 | 79 |
| Phenanthrene | < 0.89 | | 100 | 480 |
| Anthracene | < 0.89 | | 220 | 1200 |
| 2-Methylnaphthalene | < 0.89 | | 38 | 64 |
| **HPAH'S** | | | | |
| Fluoranthene | < 0.89 | | 160 | 1200 |
| Pyrene | < 0.89 | | 1000 | 1400 |
| Benzo(a)anthracene | < 0.89 | | 110 | 270 |
| Chrysene | < 0.89 | | 110 | 460 |
| Benzo(b)fluoranthene | < 0.89 | | 230 | 450 |
| Benzo(k)fluoranthene | < 0.89 | | | |
| Benzo(a)pyrene | < 0.89 | | 99 | 210 |
| Indeno(1,2,3-cd)pyrene | < 0.89 | | 34 | 88 |
| Dibenzo(a,h)anthracene | < 0.89 | | 12 | 33 |
| Benzo(ghi)perylene | < 0.89 | | 31 | 78 |
| **CHLORINATED BENZENES** | | | | |
| 1,2-Dichlorobenzene | < 0.16 | | 2.3 | 2.3 |
| 1,4-Dichlorobenzene | < 0.16 | | 3.1 | 9 |
| 1,2,4-Trichlorobenzene | < 0.26 | | 0.81 | 1.8 |
| Hexachlorobenzene | < 0.53 | | 0.38 | 2.3 |

# MARINE SEDIMENT QUALITY STANDARDS
## WAC 173-204

| | |
|---|---|
| AM TEST ID | 97-A008101 |
| CLIENT ID | C1 |
| DATE SAMPLED | 6/16/97 |

| | RESULT | Q | CC | MCC |
|---|---|---|---|---|
| **PHTHALATES ESTERS** | | | | |
| Dimethyl phthalate | < 0.89 | | 53 | 53 |
| Diethyl phthalate | < 0.89 | | 61 | 110 |
| Di-n-butyl phthalate | < 0.89 | | 220 | 1700 |
| Butyl benzyl phthalate | < 0.89 | | 4.9 | 64 |
| Bis(2-ethylhexyl)phthalate | < 0.89 | | 47 | 78 |
| Di-n-octyl phthalate | < 0.89 | | 58 | 4500 |
| **MISCELLANEOUS** | | | | |
| Dibenzofuran | < 0.89 | | 15 | 58 |
| Hexachlorobutadiene | < 0.74 | | 3.9 | 6.2 |
| N-Nitrosodiphenylamine | < 0.53 | | 11 | 11 |
| SURROGATES (% RECOVERY) | | | | |
| 2-Fluorophenol | 51.0 | | | |
| D-6-Phenol | 60.0 | | | |
| D-5-Nitrobenzene | 43.0 | | | |
| 2-Fluorobiphenyl | 52.0 | | | |
| 2,4,6-Tribromophenol | 93.0 | | | |
| D14-Terphenyl | 58.0 | | | |
| **PCB's** | | | | |
| Total PCB's | 8.7 | | 12 | 65 |
| Aroclor 1016 | < 0.45 | | | |
| Aroclor 1221 | < 1.8 | | | |
| Aroclor 1232 | < 0.45 | | | |
| Aroclor 1242 | < 0.45 | | | |
| Aroclor 1248 | < 0.45 | | | |
| Aroclor 1254 | 8.7 | | | |
| Aroclor 1260 | < 0.45 | | | |
| SURROGATES (% RECOVERY) | | | | |
| Hexabromobenzene | 98. | | | |
| Tetrachloro-m-xylene | 81.0 | | | |

MARINE SEDIMENT QUALITY STANDARDS
WAC 173-204

| | |
|---|---|
| AM TEST ID | 97-A008101 |
| CLIENT ID | C1 |
| DATE SAMPLED | 6/16/97 |

| | RESULT | Q | CC | MCC |
|---|---|---|---|---|
| **PHENOLS & MISC. (UG/KG DRY WEIGHT)** | | | | |
| Phenol | < 17 | | 420 | 1000 |
| 2 Methylphenol | < 9 | | 63 | 63 |
| 4 Methylphenol | < 17 | | 670 | 670 |
| 2,4-Dimethylphenol | < 9 | | 29 | 29 |
| Pentachlorophenol | < 43 | | 360 | 690 |
| Benzyl alcohol | < 10 | | 57 | 73 |
| Benzoic acid | < 87 | | 650 | 650 |

**CONVENTIONALS**

| | |
|---|---|
| Total Solids (%) | 82.2 |
| Total Volatile Solids (%) | 4.60 |
| Total Organic Carbon (%) | 1.9 |
| Total Petroleum | |

Conventional parameters are reported on a dry weight basis.

**GRAIN SIZE DISTRIBUTION**

| PHI | OPENING (MM) | % RETENTION |
|---|---|---|
| | 4.75 | 0.10 |
| -2, | 4.00 | < 0.1 |
| -1, | 2.00 | 0.40 |
| 0, | 1.00 | 1.30 |
| +1, | 0.50 | 6.20 |
| +2, | 0.25 | 23.8 |
| +3, | 0.125 | 21.5 |
| +4, | 0.063 | 15.9 |
| +5, | 0.032 | 9.30 |
| +6, | 0.016 | 6.80 |
| +7, | 0.008 | 4.80 |
| +8, | 0.004 | 3.40 |
| +9, | 0.002 | 2.10 |
| +10, | 0.001 | 1.20 |
| >+10, | <0.001 | 3.10 |

CC - Chemical Criteria
MCC - Maximum Chemical Criteria/Minimum Clean-up Levels
D - Associated Compound required a "Dilution" as a result of the matrix or the sample concentration

# MARINE SEDIMENT QUALITY STANDARDS
## WAC 173-204

AM TEST ID 97-A008102
CLIENT ID C2
DATE SAMPLED 6/16/97

| | RESULT | Q | CC | MCC |
|---|---|---|---|---|
| **METALS (MG/KG DRY WEIGHT)** | | | | |
| Arsenic | 6.3 | | 57 | 93 |
| Cadmium | < 0.01 | | 5.1 | 6.7 |
| Chromium | 19. | | 260 | 270 |
| Copper | 18. | | 390 | 390 |
| Lead | 24. | | 450 | 530 |
| Mercury | 0.047 | | 0.41 | 0.59 |
| Silver | < 0.03 | | 6.1 | 6.1 |
| Zinc | 42. | | 410 | 960 |
| **ORGANICS PPM (DRY WEIGHT) NORMALIZED TO TOC** | | | | |
| **LPAH'S** | | | | |
| Naphthalene | < 3 | | 99 | 170 |
| Acenaphthylene | < 3 | | 66 | 66 |
| Acenaphthene | < 3 | | 16 | 57 |
| Fluorene | < 3 | | 23 | 79 |
| Phenanthrene | < 3 | | 100 | 480 |
| Anthracene | < 3 | | 220 | 1200 |
| 2-Methylnaphthalene | < 3 | | 38 | 64 |
| **HPAH'S** | | | | |
| Fluoranthene | < 3 | | 160 | 1200 |
| Pyrene | < 3 | | 1000 | 1400 |
| Benzo(a)anthracene | < 3 | | 110 | 270 |
| Chrysene | < 3 | | 110 | 460 |
| Benzo(b)fluoranthene | < 3 | | 230 | 450 |
| Benzo(k)fluoranthene | < 3 | | | |
| Benzo(a)pyrene | < 3 | | 99 | 210 |
| Indeno(1,2,3-cd)pyrene | < 3 | | 34 | 88 |
| Dibenzo(a,h)anthracene | < 3 | | 12 | 33 |
| Benzo(ghi)perylene | < 3 | | 31 | 78 |
| **CHLORINATED BENZENES** | | | | |
| 1,2-Dichlorobenzene | < 0.48 | | 2.3 | 2.3 |
| 1,4-Dichlorobenzene | < 0.48 | | 3.1 | 9 |
| 1,2,4-Trichlorobenzene | < 0.95 | | 0.81 | 1.8 |
| Hexachlorobenzene | < 1.7 | | 0.38 | 2.3 |

MARINE SEDIMENT QUALITY STANDARDS
WAC 173-204

AM TEST ID 97-A008102
CLIENT ID C2
DATE SAMPLED 6/16/97

| | RESULT | Q | CC | MCC |
|---|---|---|---|---|
| **PHTHALATES ESTERS** | | | | |
| Dimethyl phthalate | < 3 | | 53 | 53 |
| Diethyl phthalate | < 3 | | 61 | 110 |
| Di-n-butyl phthalate | < 3 | | 220 | 1700 |
| Butyl benzyl phthalate | < 3 | | 4.9 | 64 |
| Bis(2-ethylhexyl)phthalate | < 3 | | 47 | 78 |
| Di-n-octyl phthalate | < 3 | | 58 | 4500 |
| **MISCELLANEOUS** | | | | |
| Dibenzofuran | < 3 | | 15 | 58 |
| Hexachlorobutadiene | < 2.4 | | 3.9 | 6.2 |
| N-Nitrosodiphenylamine | < 1.7 | | 11 | 11 |
| SURROGATES (% RECOVERY) | | | | |
| 2-Fluorophenol | 53.0 | | | |
| D-6-Phenol | 61.0 | | | |
| D-5-Nitrobenzene | 42.0 | | | |
| 2-Fluorobiphenyl | 53.0 | | | |
| 2,4,6-Tribromophenol | 93.0 | | | |
| D14-Terphenyl | 54.0 | | | |
| PCB's | | | | |
| Total PCB's | 12 | | 12 | 65 |
| Aroclor 1016 | < 1.5 | | | |
| Aroclor 1221 | < 5.9 | | | |
| Aroclor 1232 | < 1.5 | | | |
| Aroclor 1242 | < 1.5 | | | |
| Aroclor 1248 | < 1.5 | | | |
| Aroclor 1254 | 12 | | | |
| Aroclor 1260 | < 1.5 | | | |
| SURROGATES (% RECOVERY) | | | | |
| Hexabromobenzene | 87. | | | |
| Tetrachloro-m-xylene | 82.0 | | | |

# MARINE SEDIMENT QUALITY STANDARDS
WAC 173-204

| | |
|---|---|
| AM TEST ID | 97-A008102 |
| CLIENT ID | C2 |
| DATE SAMPLED | 6/16/97 |

| | RESULT | Q | CC | MCC |
|---|---|---|---|---|
| **PHENOLS & MISC. (UG/KG DRY WEIGHT)** | | | | |
| Phenol | < 19 | | 420 | 1000 |
| 2 Methylphenol | < 9 | | 63 | 63 |
| 4 Methylphenol | < 19 | | 670 | 670 |
| 2,4-Dimethylphenol | < 9 | | 29 | 29 |
| Pentachlorophenol | < 47 | | 360 | 690 |
| Benzyl alcohol | < 11 | | 57 | 73 |
| Benzoic acid | < 93 | | 650 | 650 |

**CONVENTIONALS**

| | |
|---|---|
| Total Solids (%) | 77.2 |
| Total Volatile Solids (%) | 2.37 |
| Total Organic Carbon (%) | 0.63 |
| Total Petroleum | |

Conventional parameters are reported on a dry weight basis.

**GRAIN SIZE DISTRIBUTION**

| PHI | OPENING (MM) | % RETENTION |
|---|---|---|
| | 4.75 | < 0.1 |
| -2, | 4.00 | < 0.1 |
| -1, | 2.00 | 0.10 |
| 0, | 1.00 | 0.90 |
| +1, | 0.50 | 10.6 |
| +2, | 0.25 | 24.6 |
| +3, | 0.125 | 13.2 |
| +4, | 0.063 | 9.50 |
| +5, | 0.032 | 10.3 |
| +6, | 0.016 | 11.9 |
| +7, | 0.008 | 7.00 |
| +8, | 0.004 | 4.10 |
| +9, | 0.002 | 3.00 |
| +10, | 0.001 | 1.60 |
| >+10, | <0.001 | 3.20 |

CC - Chemical Criteria
MCC - Maximum Chemical Criteria/Minimum Clean-up Levels
D - Associated Compound required a "Dilution" as a result of the matrix or the sample concentration

AMTEST

AmTest Inc
Professional Analytical Services
14603 N.E. ...
Redmond ...
98052
Fax: 206 883 ...
Tel. 206 885 ...

Aug 12 1997

SAIC
18706 North Creek Pkwy suite 110
Bothell, WA 98011
Attention: Lisa Roach

Dear Lisa Roach:

Enclosed please find the analytical data for your Hamm Creek Restor. project.

The following is a cross correlation of client and laboratory identifications for your convenience.

| CLIENT ID | MATRIX | AM TEST ID | TEST |
|---|---|---|---|
| Carr Inlet, Carr 4 | Sediment | 97-A009723 | CONV, GR SIZE, |

Your sample was received on Monday, July 21 1997. This was a total of 96 hours (4 days) after sample collection ( 7/17/97). At the time of receipt, the sample was logged in and properly maintained prior to its subsequent analyses.

The analytical procedures used at Am Test are well documented, and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the QC results and "Methodology Report". This table includes information relative to the detection limits, analyses dates and method references.

Please note that the detection limits that are listed in the body of the report refer to the Method Detection Limits (MDL's), as opposed to Practical Quantitation Limits (PQL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Mark A. Fugiel
General Manager

Project #: 01-0440-04-8357
PO Number: 4500155689

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics

AR 023429

AMTEST

AmTest Inc
Professional
Analytical
Services

14603 N.E. 87th St
Redmond, WA
98052

Fax: 206 883 3495
206 885 1664

SAIC
18706 North Creek Pkwy suite 110
Bothell, WA 98011

Date Received: 7/21/97
Date Reported: 8/12/97

Project Name: Hamm Creek Restor.
Project #: 01-0440-04-8357
PO Number: 4500155689

PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A009723
CLIENT ID Carr Inlet, Carr 4
DATE SAMPLED 7/17/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **CONVENTIONALS (DRY WEIGHT)** | | | | |
| Total Solids (%) | 71.3 | | | |
| Total Volatile Solids (%) | 1.61 | | | |
| Total Organic Carbon (%) | 0.39 | | | |

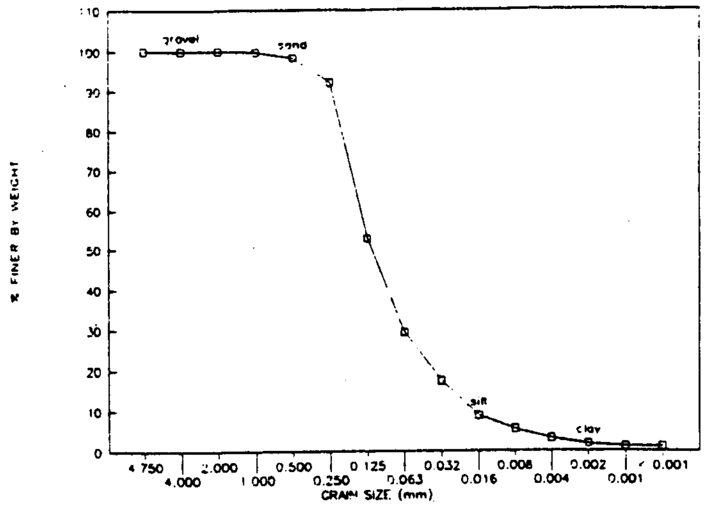
**GRAIN SIZE DISTRIBUTION**

| PHI | OPENING (MM) | % RETENTION |
|---|---|---|
| | 4.75 | < 0.1 |
| -2, | 4.00 | < 0.1 |
| -1, | 2.00 | < 0.1 |
| 0, | 1.00 | 0.30 |
| +1, | 0.50 | 1.50 |
| +2, | 0.25 | 6.20 |
| +3, | 0.125 | 39.3 |
| +4, | 0.063 | 23.3 |
| +5, | 0.032 | 11.9 |
| +6, | 0.016 | 8.70 |
| +7, | 0.008 | 3.40 |
| +8, | 0.004 | 2.30 |
| +9, | 0.002 | 1.30 |
| +10, | 0.001 | 0.70 |
| >+10, | <0.001 | 1.10 |

## GRAIN SIZE DISTRIBUTION

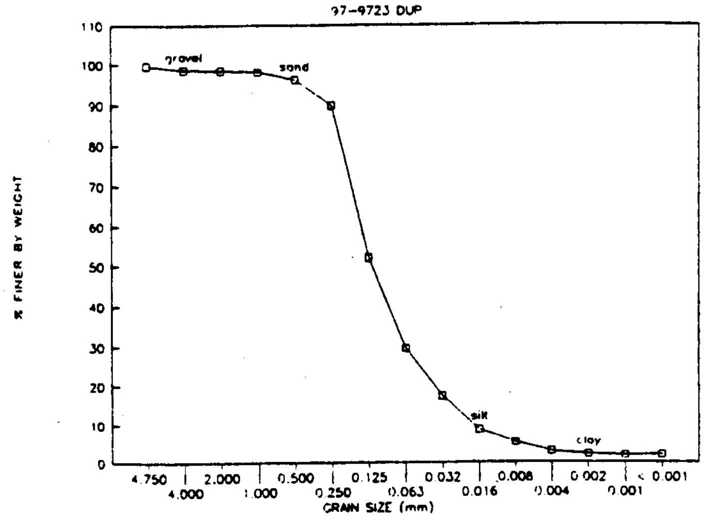
AMTEST

97-9723



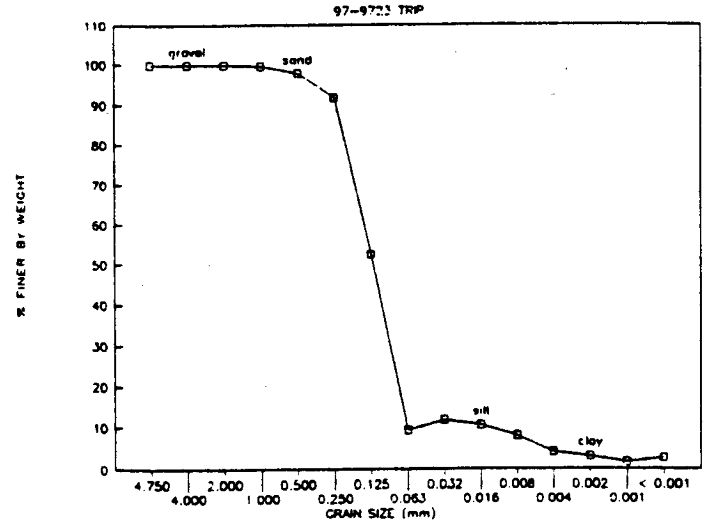

## GRAIN SIZE DISTRIBUTION

97-9723 DUP




## GRAIN SIZE DISTRIBUTION

97-9723 TRIP



AMTEST

'AIC

Date Received: 7/21/97
Date Reported: 8/12/97

## QUALITY CONTROL
## ANALYSIS DATES

AmTest Sample Number: 97-A009723

| ANALYTES | ANALYSES DATES |
|---|---|
| Total Solids | 7/22/97 |
| Total Volatile Solids | 7/22/97 |
| Total Organic Carbon | 7/24/97 |
| Grain Size | 7/22/97 |

## METHOD REFERENCES

| | |
|---|---|
| Total Solids | PSEP p17 |
| Total Volatile Solids | PSEP p20 |
| Total Organic Carbon | PSEP p23 |
| Grain Size | PSEP p9 |

AMTEST

:AIC

Date Received: 7/21/97
Date Reported: 8/12/97

## QUALITY CONTROL
## MATRIX SPIKES

AmTest Sample Number: 97-A009723

| COMPOUNDS | SAMPLE VALUE (mg/kg) | SAMPLE + SPIKE (mg/kg) | SPIKE CONCENTRATION (mg/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Total Organic Carbon (%) | 0.39 | 2.0 | 1.8 | 89 |

< = less than

## QUALITY CONTROL
## STANDARD REFERENCE MATERIAL

**NBS 2704**

| COMPOUNDS | MEASURED VALUE (mg/kg) | TRUE VALUE (mg/kg) | RECOVERY (%) |
|---|---|---|---|
| **Total Organic Carbon (%)** | 3.0 | 3.35 | 90 |

AMTEST

Duplicate/Triplicate Analysis

Lab I.D. 97-A009723

| phi/opening | (mm) | Retained % Sample | Duplicate | Triplicate |
|---|---|---|---|---|
| | 4.75 | <0.1 | 0.3 | 0.1 |
| -2/ | 4.0 | <0.1 | 1.0 | <0.1 |
| -1/ | 1.7 | <0.1 | 0.1 | <0.1 |
| 0/ | 1.0 | 0.3 | 0.4 | 0.4 |
| +1/ | 0.5 | 1.5 | 2.0 | 1.7 |
| +2/ | .25 | 6.2 | 6.3 | 6.0 |
| +3/ | .125 | 39.3 | 37.8 | 39.4 |
| +4/ | .063 | 23.3 | 22.6 | 24.2 |
| +5/ | .032 | 11.9 | 12.2 | 10.8 |
| +6/ | .016 | 8.7 | 8.6 | 8.6 |
| +7/ | .008 | 3.4 | 3.3 | 3.5 |
| +8/ | .004 | 2.3 | 2.3 | 2.1 |
| +9/ | .002 | 1.3 | 0.8 | 1.3 |
| +10/ | .001 | 0.7 | 0.3 | 0.7 |
| Pass | | 1.1 | 2.0 | 1.1 |
| Total Solids % | | 71.32 | 71.36 | 71.40 |

AMTEST

SAIC

Date Received: 7/21/97
Date Reported: 8/12/97

## QUALITY CONTROL
## TRIPLICATES

AmTest Sample Number: 97-A009723

| | #1 | #2 | #3 |
|---|---|---|---|
| Total Solids (%) | 71.3 | 71.4 | 71.4 |
| Total Volatile Solids (%) | 1.61 | 1.60 | 1.68 |
| Total Organic Carbon (%) | 0.39 | 0.43 | 0.42 |

## BLANKS

| | BLANK |
|---|---|
| Total Organic Carbon (%) | < 0.05 |

< less than

MAF/jb

REPORTED BY [signature]
Mark A. Fugiel

AR 023435

# AM TEST

professional
analytical
services

13603 N.E.
Redmond
98052

Fax: 206 883
Tel: 206 885 1664

Aug 13 1997

SAIC
18706 North Creek Pkwy Suite 110
Bothell, WA 98011
Attention: John Lunz

Dear John Lunz:

Enclosed please find the analytical data for your Hamm Creek Restor. project.

The following is a cross correlation of client and laboratory identifications for your convenience.

| CLIENT ID | MATRIX | AM TEST ID | TEST |
|---|---|---|---|
| C-1 | Sediment | 97-A010379 | CONV, |
| C-2 | Sediment | 97-A010380 | CONV, |
| Carr 4 | Sediment | 97-A010381 | CONV, |

Your three (3) samples were received on Tuesday, August 5 1997. This was a total of 120 hours (5 days) after sample collection ( 7/31/97). At the time of receipt, the samples were logged in and properly maintained prior to their subsequent analyses.

The analytical procedures used at Am Test are well documented, and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the QC results and "Methodology Report". This table includes information relative to the detection limits, analyses dates and method references.

Please note that the detection limits that are listed in the body of the report refer to the Method Detection Limits (MDL's), as opposed to Practical Quantitation Limits (PQL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Mark A. Fugiel
General Manager

Project #: 01-0440-04-8357

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics

AMTEST

Professional
Analytical
Services

14603 N.E. 87
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

SAIC
18706 North Creek Pkwy Suite 110
Bothell, WA 98011
Attention: John Lunz

Date Received: 8/ 5/97
Date Reported: 8/13/97

Project Name: Hamm Creek Restor.
Project #: 01-0440-04-8357

PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A010379
CLIENT ID C-1
DATE SAMPLED 7/31/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **CONVENTIONALS (DRY WEIGHT)** | | | | |
| Total Solids (%) | 97.2 | | | |
| Ammonia (mg/kg) | 1.8 | | | |
| Total Sulfides (mg/kg) | < 16 | | | |

AMTEST

SAIC
18706 North Creek Pkwy Suite 110
Bothell, WA 98011
Attention: John Lunz

Date Received: 8/ 5/97
Date Reported: 8/13/97

Project Name: Hamm Creek Restor.
Project #: 01-0440-04-8357

PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A010380
CLIENT ID C-2
DATE SAMPLED 7/31/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **CONVENTIONALS (DRY WEIGHT)** | | | | |
| Total Solids (%) | 87.5 | | | |
| Ammonia (mg/kg) | 30 | | | |
| Total Sulfides (mg/kg) | 96 | | | |

AR 023439

AMTEST

SAIC
18706 North Creek Pkwy Suite 110
Bothell, WA 98011
Attention: John Lunz

Date Received: 8/ 5/97
Date Reported: 8/13/97

Project Name: Hamm Creek Restor.
Project #: 01-0440-04-8357

PSDDA CHEMICALS OF CONCERN

AM TEST ID 97-A010381
CLIENT ID Carr 4
DATE SAMPLED 7/31/97

| | RESULT | Q | S.L. | M.L. |
|---|---|---|---|---|
| **CONVENTIONALS (DRY WEIGHT)** | | | | |
| Total Solids (%) | 80.6 | | | |
| Ammonia (mg/kg) | 25 | | | |
| Total Sulfides (mg/kg) | 35 | | | |

AMTEST

SAIC
tention: John Lunz

Date Received: 8/05/97
Date Reported: 8/13/97

Project Name: Hamm Creek Restor.
Project #: 01-0440-04-8357

**QUALITY CONTROL**
**ANALYSIS DATES**

AmTest Sample Numbers: 97-A010379 to 97-A010381

| ANALYTES | ANALYSES DATES |
|---|---|
| Total Solids | 8/06/97 |
| Total Sulfides | 8/06/97 |
| Ammonia | 8/06/97 |

**METHOD REFERENCES**

| | |
|---|---|
| al Solids | PSEP p17 |
| Total Sulfides | PSEP p32 |
| Ammonia | Plumb, 1981 |

AR 023441

AMTEST

C
Attention: John Lunz

Date Received: 8/05/97
Date Reported: 8/13/97

Project Name: Hamm Creek Restor.
Project #: 01-0440-04-8357

**QUALITY CONTROL**
**MATRIX SPIKES**

AmTest Sample Numbers: 97-A010379 to 97-A010381

| COMPOUNDS | SAMPLE VALUE (mg/kg) | SAMPLE + SPIKE (mg/kg) | SPIKE CONCENTRATION (mg/kg) | RECOVERY (%) |
|---|---|---|---|---|
| Ammonia (mg/kg) 97-A010380 | 30 | 43 | 13 | 100 |
| Total Sulfides (mg/kg) 97-A010380 | 96 | 160 | 60 | 107 |

**TRIPLICATES**

| Amtest Sample Number 97-A010379 | #1 | #2 | #3 |
|---|---|---|---|
| Total Solids (%) | 97.2 | 97.4 | 96.0 |
| Total Sulfides (mg/kg) | < 16 | < 16 | < 16 |
| Ammonia (mg/kg) | 1.8 | 1.8 | 2.0 |

**BLANKS**

| | BLANK |
|---|---|
| Ammonia (mg/kg) | < 1.0 |
| Total Sulfides (mg/kg) | < 10 |

< less than

REPORTED BY Mark C. Fugiel
Mark A. Fugiel

MAF/jb

AR 023442

APPENDIX I

TEST PROTOCOL
(Included by Reference)

APPENDIX II

RAW DATA

Test No. 534-5 Client SAIC Investigator Reviewed pp. 1-18 MSR 8/26/97

**STUDY MANAGEMENT**

Client: SAIC, 18706 N. Creek Pkwy., Suite 110, Bothell, WA 98011
Client's Study Monitor: Ms. Lisa Roach
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. M.S. Redmond MSR
QA Officer L.K. Nemeth
1. G.J. IRISSARRI GJI 2. [illegible]
3. D.S. Caldwell [illegible] 4.
Study Schedule:
Test Beginning: 7/31/97 2000 Test Ending: 8/3/97 1100

**TEST MATERIAL**

General description (see sample logbook/chain-of-custody for details):

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | 8670E | 8671E | 8672E | | |
| Description: | C1 | C2 | CARR4 | | |
| Collection Date: | 6-16-97 | 6-16-97 | 7-17-94 | | |
| Receipt Date: | 7-22-97 | 7-22-97 | 7-22-97 | | |
| Inters.Salinity (ppm): | —* | 2.0 | 29.0 | | |

*Samples Completely w/o Free Water for measurement [illegible] 8/27/97 as per MSR 7-31-97 (See test 534-6 raw data)

| | | | | | |
|---|---|---|---|---|---|
| NAS Sample No.: | | | | | |
| Description: | | | | | |
| Collection Date: | | | | | |
| Receipt Date: | | | | | |
| Inters.Salinity (ppm): | | | | | |
| : | | | | | |

**TEST WATER**

Source: Yaquina Bay, OR
Date of Collection: 7/31/97 Salinity (ppt) 28.0 pH 7.9
Treatments: Filtered to 0.40 µm; Aerated; Salinity adjusted with D.I. Water

**TEST ORGANISMS**

Species: Dendraster excentricus Date Received: 7/30/97
Source: Marinus, Inc., Long Beach, CA
Acclimation Data:

| Date | Temp (°C) | DO (mg/L) | pH | Sal (ppt) | Comments |
|---|---|---|---|---|---|
| Adults held overnight in shipping carton then used directly from box for spawning. No water quality data available. | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Mean | | | | | |
| S.D. | | | | | |
| (N) | | | | | |

Test No. 534-6 Client SAIC Investigator ____

## SEDIMENT DESCRIPTIONS--SUPLEMENTAL NOTES

| Sample No | Description |
|---|---|
| 8672E | brownish-gray sandy mud, well-sorted |
| 8670E | brown silt; fine plant root material |
| 8671E | gray sandy mud |
| | material - in brown sand, processed through 1.0 mm screen |

Preparation (7-31-97)

Each sample was thoroughly homogenized and aliquots distributed to the appropriate beakers. (Additional aliquots were weighed for Test 534-5, and samples also taken for ammonia and sulfide analyses.) Each beaker was then filled to the 950 mL mark with salinity-adjusted seawater calculated to produce a final salinity of 15 ppt. Sediments were allowed to settle into the beakers for 4 hours.

Adjusted overlying water salinity in each beaker after settling but before decanting:

| Beaker # | ppt | Beaker # | ppt |
|---|---|---|---|
| 1 | 14.5 | 13 | 13.5 |
| 2 | 14.5 | 14 | 14.0 |
| 3 | 16.0 | 15 | 14.0 |
| 4 | 16.0 | 16 | 13.5 |
| 5 | 14.0 | 17 | 15.5 |
| 6 | 14.0 | 18 | 15.0 |
| 7 | 15.5 | 19 | 15.0 |
| 8 | 14.0 | 20 | 14.0 |
| 9 | 15.0 | 21 | 14.0 |
| 10 | 14.0 | 22 | 16.0 |
| 11 | 14.0 | 23 | 15.5 |
| 12 | 15.0 | 24 | 16.0 |

After making salinity adjustment, 600 mL of overlying water was decanted using a siphon, and each beaker filled to about the 750 mL mark with 15.0 ppt seawater. Beakers then placed in constant temperature room, hooked up to aeration, and covered with watch glasses. - MLR 7-31-97

Test No. 534-5 Client SAIC Investigator ____________

**SPAWNING AND GAMETE HANDLING**

Spawning: Initial 1430 ~~AM/PM~~, Final 1600 ~~AM/PM~~. Fertilization 1800 ~~AM/PM~~
Number of Organisms Used: females 29; males 5
Egg Dilution (1 ml diluted to 100 ml):
Count/ml of dilution: 1. ____; 2. ____; 3. ____; Mean 62.5
DF (mean x 100/~~3000~~ 25,000 mlr 7-25-97) = ~~250~~ .25

**TEST PROCEDURES AND CONDITIONS**

Test chambers: 1 L glass containers (beakers or bottles)
mlr 7-25-97 Test volumes: ~~20g~~ 18 of test sediment; ~~1000~~ 900 ml of test water
Replicates/treatment: (~~5~~) 6 Organisms/treatment: (20-40/ml) 25.8
Use: 6th replicate/test sediment for WQ; development assessment beaker.
Test water changes: None Aeration: yes ; Feeding: None
Bottle placement: Total randomization
Larval stock (~~2,000 - 4,000~~ 20,000 - 30,000/ml) mlr 7-25-97 inoculation volume: ~~10~~ 1 ml; <2-hr old mlr 7-25-97
Subsample size for counting: 10 ml
Photoperiod: 14L:10D
Controls: Negative (~~clean sediment~~, no sediment)
Positive (reference toxicant test by ASTM 89 method)

Randomization chart:

South wall
Far left
bottom shelf

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | | |
| 2 | 2 | 5 | 8 | 11 | 14 | 17 | 20 | 23 | | |
| 3 | 1 | 4 | 7 | 10 | 13 | 16 | 19 | 22 | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |

Randomization chart:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |

MISCELLANEOUS NOTES

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 524-5 Client SAIC Investigator ______

## WATER QUALITY RECORD

Day 0 (7/31/97)

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | Comments |
|---|---|---|---|---|---|---|---|
| 4 | 16.0 | 8.4 | 29.0 | 7.8 | <.01 | 0.25 | |
| 7 | 15.9 | 8.3 | 29.0 | 7.7 | <.01 | <0.10 | |
| 8 | 15.9 | 8.4 | 29.0 | 7.8 | <.01 | 0.30 | |
| 19 | 16.0 | 8.4 | 28.0 | 7.8 | <.01 | <0.10 | |

Day 1 (8/1/97) GB

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | Comments |
|---|---|---|---|---|---|---|---|
| 4 | 15.1 | 8.4 | 28.0 | 7.9 | | | |
| 7 | 15.1 | 8.3 | 28.0 | 8.0 | | | |
| 8 | 15.1 | 8.4 | 28.0 | 7.9 | | | |
| 19 | 15.1 | 8.4 | 28.0 | 7.9 | | | |

Day 2 (8/2/97) MSR/GSL

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | Comments |
|---|---|---|---|---|---|---|---|
| 4 | 15.6 | 8.1 | 28.0 | 7.9 | | | |
| 7 | 15.7 | 8.1 | 28.0 | 7.8 | | | |
| 8 | 15.6 | 8.1 | 27.5 | 7.9 | | | |
| 19 | 15.7 | 8.2 | 28.0 | 8.0 | | | |



5/1/91 (Rev. 9-1-94)

Test No. 534-5 Client SAIC Investigator

WATER QUALITY RECORD

3 mlr 7-25-97
Day 8 (8/3/97) MSR/632

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | Comments |
|---|---|---|---|---|---|---|---|
| 4 | 15.7 | 8.1 | 27.5 | 7.9 | <0.01 | <0.10 | |
| 7 | 15.8 | 8.0 | 28.0 | 7.8 | <0.01 | <0.10 | |
| 8 | 15.7 | 8.1 | 28.0 | 7.9 | <0.01 | 0.20 | |
| 19 | 15.8 | 8.1 | 27.5 | 7.9 | <0.01 | <0.10 | |
| | | | | | < | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Day 1 ( / / )

mlr 7-25-97

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | Comments |
|---|---|---|---|---|---|---|---|
| 4 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 19 | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Day 2 ( / / )

| Beaker No. | Temp. (°C) | DO (ppm) | Sal. (ppt) | pH | S (ppm) | NH3 (ppm) | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 534-5 Client SAIC Investigator ____________

LARVAL COUNT DATA [illegible] 8/13/97

| Beaker No. | Response N | Response A | Beaker No. | Response N | Response A | Beaker No. | Response N | Response A |
|---|---|---|---|---|---|---|---|---|
| 1 | 206 | 22 | 49 | Zero Counts | | 97 | QC Counts | RB 8-14-97 |
| 2 | 198 | 37 | 50 A | 241 | | ~~98~~ 9 | 235 | 15 |
| 3 | 197 | 35 | 51 B | 237 | | ~~99~~ 10 | 158 | 21 |
| 4 | — | — | 52 C | 262 | | ~~100~~ 11 | 96 | 72 |
| 5 | 121 | 22 | 53 D | 278 | | ~~101~~ 12 | 118 | 66 |
| 6 | 137 | 35 | 54 E | 270 | | ~~102~~ 13 | 140 | 41 |
| 7 | — | — | 55 | | | ~~103~~ 14 | 210 | 17 |
| 8 | — | — | 56 | | | 104 | | |
| 9 | 236 | 17 | 57 | | | 105 | | |
| 10 | 160 | 22 | 58 | | | 106 | | |
| 11 | 89 | 76 | 59 | | | 107 | | |
| 12 | 120 | 61 | 60 | | | 108 | | |
| 13 | 128 | 46 | 61 | | | 109 | | |
| 14 | 212 | 23 | 62 | | | 110 | | |
| 15 | 100 | 83 | 63 | | | 111 | | |
| 16 | 224 | 15 | 64 | | | 112 | | |
| 17 | 207 | 30 | 65 | | | 113 | | |
| 18 | 174 | 36 | 66 | | | 114 | | |
| 19 | — | — | 67 | | | 115 | | |
| 20 | 116 | 20 | 68 | | | 116 | | |
| 21 | 121 | 64 | 69 | | | 117 | | |
| 22 | 221 | ~~51~~ 14 RB 8/13 | 70 | | | 118 | | |
| 23 | 120 | 51 | 71 | | | 119 | | |
| 24 | 202 | 24 | 72 | | | 120 | | |
| 25 | | | 73 | | | 121 | | |
| 26 | | | 74 | | | 122 | | |
| 27 | | | 75 | | | 123 | | |
| 28 | | | 76 | | | 124 | | |
| 29 | | | 77 | | | 125 | | |
| 30 | | | 78 | | | 126 | | |
| 31 | | | 79 | | | 127 | | |
| 32 | | | 80 | | | 128 | | |
| 33 | | | 81 | | | 129 | | |
| 34 | | | 82 | | | 130 | | |
| 35 | | | 83 | | | 131 | | |
| 36 | | | 84 | | | 132 | | |
| 37 | | | 85 | | | 133 | | |
| 38 | | | 86 | | | 134 | | |
| 39 | | | 87 | | | 135 | | |
| 40 | | | 88 | | | 136 | | |
| 41 | | | 89 | | | 137 | | |
| 42 | | | 90 | | | 138 | | |
| 43 | | | 91 | | | 139 | | |
| 44 | | | 92 | | | 140 | | |
| 45 | | | 93 | | | 141 | | |
| 46 | | | 94 | | | 142 | | |
| 47 | | | 95 | | | 143 | | |
| 48 | | | 96 | | | 144 | | |

AR 023450

Test number 534-5

Larval Sediment Test
Randomization Key

7/25/97

| BKR | NAS SMPL | CLIENT DESCRIP | REPL |
|---|---|---|---|
| 3 | swcontrol | swcontrol | 1 |
| 2 | swcontrol | swcontrol | 2 |
| 14 | swcontrol | swcontrol | 3 |
| 17 | swcontrol | swcontrol | 4 |
| 18 | swcontrol | swcontrol | 5 |
| * 19 | swcontrol | swcontrol | 6 |
| 15 | 8670E | C1 | 1 |
| 21 | 8670E | C1 | 2 |
| 13 | 8670E | C1 | 3 |
| 11 | 8670E | C1 | 4 |
| 12 | 8670E | C1 | 5 |
| * 7 | 8670E | C1 | 6 |
| 23 | 8671E | C2 | 1 |
| 20 | 8671E | C2 | 2 |
| 6 | 8671E | C2 | 3 |
| 5 | 8671E | C2 | 4 |
| 10 | 8671E | C2 | 5 |
| * 8 | 8671E | C2 | 6 |
| 1 | 8672E | CARR4 | 1 |
| 24 | 8672E | CARR4 | 2 |
| 16 | 8672E | CARR4 | 3 |
| 9 | 8672E | CARR4 | 4 |
| 22 | 8672E | CARR4 | 5 |
| * 4 | 8672E | CARR4 | 6 |

*water quality beakers

## Endpoints Data Entry and Calculations File

| | | | |
|---|---|---|---|
| er number | | | |
| INI ber of inoculated embryos (from average of zero-time counts) | zero counts | | |
| N IM=number normal | a | 241 | |
| A =number abnormal | b | 237 | |
| T AL=NORM+ABN | c | 262 | |
| PSURV=percent survival=100(TOTAL/INIT) | d | 278 | |
| PNORM=percent normal=100(NORM/TOTAL) | e | 270 | |
| P N=percent combined survival and normal=100(NORM/INIT) | Mean = | 258 | |
| P IRT=percent mortality=100((INIT-TOTAL)/INIT) | | | |
| PABN=percent abnormality=100(ABN/TOTAL) | | | |
| PABND=combined percent mortality and abnormality=100((INIT-NORM)/INIT) | NS (mean | TS (mean | |
| N =normalized percent mortality=100(1-(TOTAL/TS)), | normal) | total) | |
| where TS=average of total larvae counted in seawater controls | 197.6 | 229.8 | |
| NCMA=normalized combined percent mortality and abnormality=100(1-(NORM/NS)), | | | |
| where NS=average of normal larvae counted in seawater controls | | | |
| | %normal in SW cont | | |
| | relative to INIT | | |
| | | 76.7 | |

| IN | NAS BKR | SMPL | CLIENT DESCRIP | REP | INIT | NOR | ABN | TOTAL | PSURV | PNOR | PCSN | PMOR | PABN | PABND | NPM | NCMA | | PSUR | PNOR | PCSN | PMORT | PABN | PABND | NPM | NCMA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | swcontrol | swcontrol | 1 | 258 | 197 | 35 | 232 | 90.1 | 84.9 | 76.5 | 9.9 | 15.1 | 23.5 | -1.0 | 0.3 | | | | | | | | | |
| 2 | 2 | swcontrol | swcontrol | 2 | 258 | 198 | 37 | 235 | 91.2 | 84.3 | 76.9 | 8.8 | 15.7 | 23.1 | -2.3 | -0.2 | Mean | 89.2 | 85.9 | 76.7 | 10.8 | 14.1 | 23.3 | 0.0 | 0.0 |
| 3 | 14 | swcontrol | swcontrol | 3 | 258 | 212 | 23 | 235 | 91.2 | 90.2 | 82.3 | 8.8 | 9.8 | 17.7 | -2.3 | -7.3 | S.D. | 4.4 | 2.9 | 5.7 | 4.4 | 2.9 | 5.7 | 4.9 | 7.4 |
| 4 | 17 | swcontrol | swcontrol | 4 | 258 | 207 | 30 | 237 | 92.0 | 87.3 | 80.4 | 8.0 | 12.7 | 19.6 | -3.1 | -4.8 | n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 5 | 18 | swcontrol | swcontrol | 5 | 258 | 174 | 36 | 210 | 81.5 | 82.9 | 67.5 | 18.5 | 17.1 | 32.5 | 8.6 | 11.9 | | | | | | | | | |
| 6 | 19 | swcontrol | swcontrol | 6 | 258 | | | 0 | 0.0 | #DIV/0! | 0.0 | 100.0 | #DIV/0! | 100.0 | 100.0 | 100.0 | | | | | | | | | |
| 7 | 15 | 8670E | C1 | 1 | 258 | 100 | 33 | 183 | 71.0 | 54.6 | 38.8 | 29.0 | 45.4 | 61.2 | 20.4 | 49.4 | | | | | | | | | |
| 8 | 21 | 8670E | C1 | 2 | 258 | 121 | 64 | 185 | 71.8 | 65.4 | 47.0 | 28.2 | 34.6 | 53.0 | 19.5 | 38.8 | Mean | 69.2 | 62.8 | 43.3 | 30.8 | 37.4 | 56.7 | 22.5 | 43.5 |
| 9 | 13 | 8670E | C1 | 3 | 258 | 128 | 46 | 174 | 67.5 | 73.6 | 49.7 | 32.5 | 26.4 | 50.3 | 24.3 | 35.2 | S.D. | 3.3 | 8.3 | 6.4 | 3.3 | 8.3 | 6.4 | 3.7 | 8.3 |
| 0 | 11 | 8670E | C1 | 4 | 258 | 89 | 76 | 165 | 64.1 | 53.9 | 34.5 | 35.9 | 46.1 | 65.5 | 28.2 | 55.0 | n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 1 | 12 | 8670E | C1 | 5 | 258 | 120 | 64 | 184 | 71.4 | 65.2 | 46.6 | 28.6 | 34.8 | 53.4 | 19.9 | 39.3 | | | | | | | | | |
| 2 | 7 | 8670E | C1 | 6 | 258 | | | 0 | 0.0 | #DIV/0! | 0.0 | 100.0 | #DIV/0! | 100.0 | 100.0 | 100.0 | | | | | | | | | |
| 13 | 23 | 8671E | C2 | 1 | 258 | 120 | 51 | 171 | 66.4 | 70.2 | 46.6 | 33.6 | 29.8 | 53.4 | 25.6 | 39.3 | | | | | | | | | |
| | 20 | 8671E | C2 | 2 | 258 | 116 | 20 | 136 | 52.8 | 85.3 | 45.0 | 47.2 | 14.7 | 55.0 | 40.8 | 41.3 | Mean | 62.4 | 81.5 | 50.8 | 37.6 | 18.5 | 49.2 | 30.0 | 33.8 |
| | [illegible] | 8671E | C2 | 3 | 258 | 137 | 35 | 172 | 66.8 | 79.7 | 53.2 | 33.2 | 20.3 | 46.8 | 25.2 | 30.7 | S.D. | 7.8 | 7.0 | 7.1 | 7.8 | 7.0 | 7.1 | 8.7 | 9.[illegible] |
| | [illegible] | 8671E | C2 | 4 | 258 | 121 | 22 | 143 | 55.5 | 84.6 | 47.0 | 44.5 | 15.4 | 53.0 | 37.8 | 38.8 | n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| 7 | 10 | 8671E | C2 | 5 | 258 | 160 | 22 | 182 | 70.7 | 87.9 | 62.1 | 29.3 | 12.1 | 37.9 | 20.8 | 19.0 | | | | | | | | | |
| 18 | 8 | 8671E | C2 | 6 | 258 | | | 0 | 0.0 | #DIV/0! | 0.0 | 100.0 | #DIV/0! | 100.0 | 100.0 | 100.0 | | | | | | | | | |
| 19 | 1 | 8672E | CARR4 | 1 | 258 | 206 | 22 | 228 | 88.5 | 90.4 | 80.0 | 11.5 | 9.6 | 20.0 | 0.8 | -4.3 | | | | | | | | | |
| 0 | 24 | 8672E | CARR4 | 2 | 258 | 202 | 24 | 226 | 87.7 | 89.4 | 78.4 | 12.3 | 10.6 | 21.6 | 1.7 | -2.2 | Mean | 91.7 | 92.2 | 84.5 | 8.3 | 7.8 | 15.5 | -2.8 | -10.2 |
| 1 | 16 | 8672E | CARR4 | 3 | 258 | 224 | 15 | 239 | 92.8 | 93.7 | 87.0 | 7.2 | 6.3 | 13.0 | -4.0 | -13.4 | S.D. | 4.2 | 2.1 | 5.4 | 4.2 | 2.1 | 5.4 | 4.7 | 7.0 |
| 2 | 9 | 8672E | CARR4 | 4 | 258 | 236 | 17 | 253 | 98.2 | 93.3 | 91.6 | 1.8 | 6.7 | 8.4 | -10.1 | -19.4 | n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 23 | 22 | 8672E | CARR4 | 5 | 258 | 221 | 14 | 235 | 91.2 | 94.0 | 85.8 | 8.8 | 6.0 | 14.2 | -2.3 | -11.8 | | | | | | | | | |
| 24 | 4 | 8672E | CARR4 | 6 | 258 | | | 0 | 0.0 | #DIV/0! | 0.0 | 100.0 | #DIV/0! | 100.0 | 100.0 | 100.0 | | | | | | | | | |

Count data verified
against benchsheet
8/22/97 [illegible]

# Water Quality Data File

| BKR | NAS SMPL | CLIENT DESCRIP | REPL | DAY | TEMP | DO | SAL | PH | S | NH3 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 8672E | CARR4 | 6 | 0 | 16.0 | 8.4 | 29.0 | 7.8 | <0.01 | 0.3 |
| 7 | 8670E | C1 | 6 | 0 | 15.9 | 8.3 | 29.0 | 7.7 | <0.01 | <0.1 |
| 8 | 8671E | C2 | 6 | 0 | 15.9 | 8.4 | 29.0 | 7.8 | <0.01 | 0.3 |
| 19 | SW Cont | SW Cont | 6 | 0 | 16.0 | 8.4 | 28.0 | 7.8 | <0.01 | <0.1 |
| 4 | 8672E | CARR4 | 6 | 1 | 15.1 | 8.4 | 28.0 | 7.9 | | |
| 7 | 8670E | C1 | 6 | 1 | 15.1 | 8.3 | 28.0 | 8.0 | | |
| 8 | 8671E | C2 | 6 | 1 | 15.1 | 8.4 | 28.0 | 7.9 | | |
| 19 | SW Cont | SW Cont | 6 | 1 | 15.1 | 8.4 | 28.0 | 7.9 | | |
| 4 | 8672E | CARR4 | 6 | 2 | 15.6 | 8.1 | 28.0 | 7.9 | | |
| 7 | 8670E | C1 | 6 | 2 | 15.7 | 8.1 | 28.0 | 7.8 | | |
| 8 | 8671E | C2 | 6 | 2 | 15.6 | 8.1 | 27.5 | 7.9 | | |
| 19 | SW Cont | SW Cont | 6 | 2 | 15.7 | 8.2 | 28.0 | 8.0 | | |
| 4 | 8672E | CARR4 | 6 | 3 | 15.7 | 8.1 | 27.5 | 7.9 | <0.01 | <0.1 |
| 7 | 8670E | C1 | 6 | 3 | 15.8 | 8.0 | 28.0 | 7.8 | <0.01 | <0.1 |
| 8 | 8671E | C2 | 6 | 3 | 15.7 | 8.1 | 28.0 | 7.9 | <0.01 | 0.2 |
| 19 | SW Cont | SW Cont | 6 | 3 | 15.8 | 8.1 | 27.5 | 7.9 | <0.01 | <0.1 |

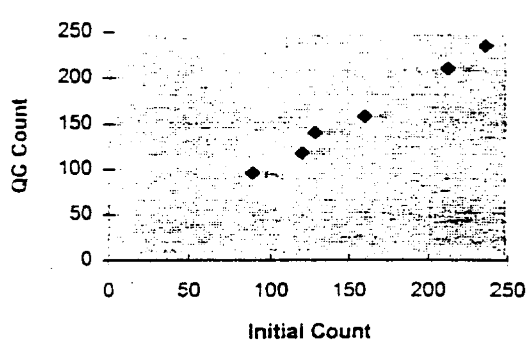
| | TEMP | DO | SAL | PH | S | NH3 |
|---|---|---|---|---|---|---|
| Mean | 15.6 | 8.2 | 28.1 | 7.9 | | |
| SD | 0.3 | 0.2 | 0.5 | 0.1 | | |
| n | 16 | 16 | 16 | 16 | 8 | 8 |
| Max | 16.0 | 8.4 | 29.0 | 8.0 | <0.01 | 0.3 |
| Min | 15.1 | 8.0 | 27.5 | 7.7 | <0.01 | <0.1 |

Verified against benchsheet
[illegible] 8/22/97



AR 023453

| Comparison of Initial Counts and QC Counts | | | | | |
|---|---|---|---|---|---|
| | Normal Larvae | | | | |
| Beaker | Initial Count | | QC Count | | |
| No. | Normal | Abnormal | Normal | Abnormal | cv(normal) |
| 9 | 236 | 17 | 235 | 15 | 0 |
| 10 | 160 | 22 | 158 | 21 | 1 |
| 11 | 89 | 76 | 96 | 72 | 5 |
| 12 | 120 | 61 | 118 | 66 | 1 |
| 13 | 128 | 46 | 140 | 41 | 6 |
| 14 | 212 | 23 | 210 | 17 | 1 |




| | |
|---|---|
| Intercept | 11.29893 |
| Slope | 0.940959 |
| r square | 0.991253 |

Verified against worksheet
DS 8/22/97



AR 023454

CUSTODY SEAL

Person Collecting Sample VMMetcalfe (Signature) Sample No. 02

Date Collected 7-21-97 Time Collected 1730

CUSTODY SEAL

Person Collecting Sample VMMetcalfe (Signature) Sample No. 07

Date Collected 7-21-97 Time Collected 1730

SAIC Received 7-22-97 11:30

PACKING LIST

PACKING LIST NO. 013843

MARINUS, INC.
1500 PIER C STREET •NEW ADDRESS•
LONG BEACH, CA 90813
(310) 435 6522 FAX 310 495 3120

DATE 7/29/97

SOLD TO NORTH WEST AQUATIC SCIENCES
GARY BUHLER
5144 YAQUINA BAY ROAD
NEWPORT , OR 97365

SHIP TO
SAME AS SOLD TO UNLESS OTHERWISE INDICATED HERE
NOWEST

| OUR ORDER NO. | YOUR ORDER NO. | CARTONS-PKGS. | TOTAL WEIGHT | PPD. OR COLL. | SHIPPED VIA |
|---|---|---|---|---|---|
| | G. Buhler. | 2 GK | | | Fed-ex your acct |

| QUANTITY ORDERED | QUANTITY BACK-ORD'D. | QUANTITY SHIPPED | DESCRIPTION |
|---|---|---|---|
| 150 | | 150 | Dendraster ZC115 |
| 2 | | 2 | CONTAINERS B900 |

rec'd 7-30-97

PLEASE NOTIFY US IMMEDIATELY IF ERROR IS FOUND IN SHIPMENT.

☐ ORDER COMPLETE

PACKED BY ______ CHECKED BY ______

☐ BALANCE TO FOLLOW

Reference Toxicant Test

## Bivalve Larval Survival and Development Test-Proportion Alive

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 7/31/97 20:00 | Test ID: | 999-782 | Sample ID: | REF-Ref Toxicant |
| End Date: | 8/3/97 13:00 | Lab ID: | ORNAS-Northwestern Aquat | Sample Type: | CDCL-Cadmium chloride |
| Sample Date: | | Protocol: | EPAW 95-EPA West Coast | Test Species: | DE-Dendraster excentricus |
| Comments: | | | | | |

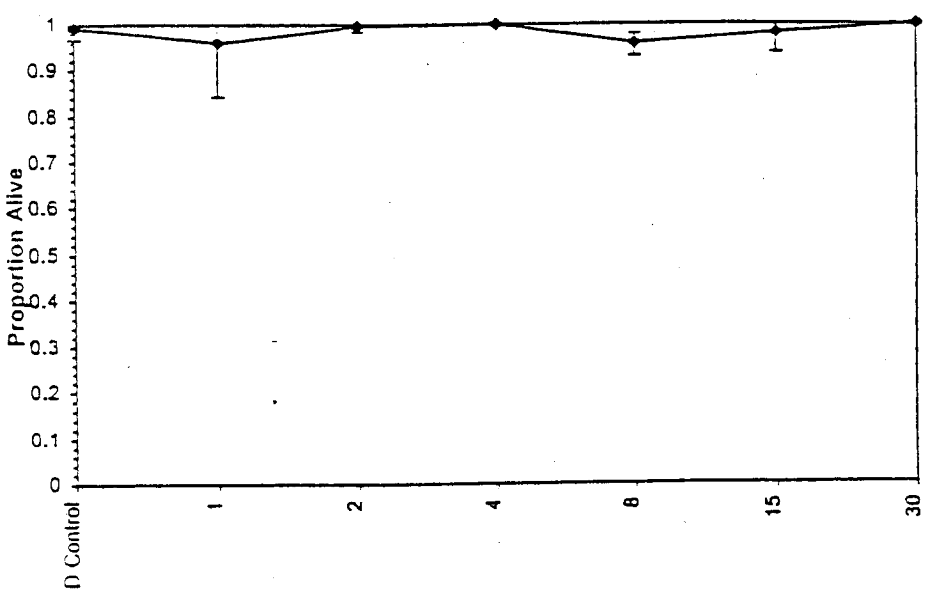
| Conc-mg/L | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| D-Control | 1.0000 | 1.0000 | 1.0000 | 0.9669 |
| 1 | 0.9959 | 0.8430 | 1.0000 | 1.0000 |
| 2 | 1.0000 | 0.9835 | 1.0000 | 1.0000 |
| 4 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 8 | 0.9298 | 0.9793 | 0.9545 | 0.9669 |
| 15 | 1.0000 | 0.9876 | 0.9380 | 1.0000 |
| 30 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

| | | | Transform: Arcsin Square Root | | | | | Rank | 1-Tailed |
|---|---|---|---|---|---|---|---|---|---|
| Conc-mg/L | Mean | N-Mean | Mean | Min | Max | CV% | N | Sum | Critical |
| D-Control | 0.9917 | 1.0000 | 1.5010 | 1.3880 | 1.5386 | 5.020 | 4 | | |
| 1 | 0.9597 | 0.9677 | 1.4368 | 1.1634 | 1.5386 | 12.731 | 4 | 16.00 | 10.00 |
| 2 | 0.9959 | 1.0042 | 1.5145 | 1.4419 | 1.5386 | 3.195 | 4 | 18.50 | 10.00 |
| 4 | 1.0000 | 1.0083 | 1.5386 | 1.5386 | 1.5386 | 0.000 | 4 | 20.00 | 10.00 |
| 8 | 0.9576 | 0.9656 | 1.3683 | 1.3025 | 1.4266 | 3.834 | 4 | 11.50 | 10.00 |
| 15 | 0.9814 | 0.9896 | 1.4639 | 1.3192 | 1.5386 | 7.070 | 4 | 16.00 | 10.00 |
| 30 | 1.0000 | 1.0083 | 1.5386 | 1.5386 | 1.5386 | 0.000 | 4 | 20.00 | 10.00 |

| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|---|---|---|---|---|
| Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01) | 0.83126 | 0.896 | -1.8306 | 4.77753 |
| Equality of variance cannot be confirmed | | | | |

| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU |
|---|---|---|---|---|
| Steel's Many-One Rank Test | 30 | >30 | | |

### Dose-Response Plot




AR 023458

Bivalve Larval Survival and Development Test-Proportion Normal

| | | | | | |
|---|---|---|---|---|---|
| art Date: | 7/31/97 20:00 | Test ID: | 399-782 | Sample ID: | REF-Ref Toxicant |
| End Date: | 8/3/97 13:00 | Lab ID: | CRNAS-Northwestern Aquat | Sample Type: | CDCL-Cadmium chloride |
| ample Date: | | Protocol: | EPAW 95-EPA West Coast | Test Species: | DE-Dendraster excentricus |
| ments: | | | | | |

| -mg/L | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| D-Control | 0.9711 | 1.0000 | 1.0000 | 0.9421 |
| 1 | 0.8471 | 0.7934 | 0.9711 | 1.0000 |
| 2 | 1.0000 | 0.9339 | 1.0000 | 0.9793 |
| 4 | 0.9711 | 0.9132 | 0.9463 | 0.9256 |
| 8 | 0.4215 | 0.4380 | 0.6240 | 0.5041 |
| 15 | 0.0124 | 0.0124 | 0.0331 | 0.0455 |
| 30 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | | Number | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conc-mg/L | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD | Resp | Number |
| D-Control | 0.9783 | 1.0000 | 1.4513 | 1.3279 | 1.5386 | 7.241 | 4 | | | | 21 | 968 |
| 1 | 0.9029 | 0.9229 | 1.3016 | 1.0989 | 1.5386 | 15.650 | 4 | 1.846 | 2.410 | 0.1954 | 94 | 968 |
| 2 | 0.9783 | 1.0000 | 1.4537 | 1.3107 | 1.5386 | 7.494 | 4 | -0.029 | 2.410 | 0.1954 | 21 | 968 |
| 4 | 0.9390 | 0.9599 | 1.3258 | 1.2718 | 1.3999 | 4.246 | 4 | 1.548 | 2.410 | 0.1954 | 59 | 968 |
| *8 | 0.4969 | 0.5079 | 0.7825 | 0.7066 | 0.9107 | 11.841 | 4 | 8.249 | 2.410 | 0.1954 | 487 | 968 |
| *15 | 0.0258 | 0.0264 | 0.1552 | 0.1116 | 0.2148 | 33.538 | 4 | 15.986 | 2.410 | 0.1954 | 943 | 968 |
| 30 | 0.0000 | 0.0000 | 0.0321 | 0.0321 | 0.0321 | 0.000 | 4 | | | | 968 | 968 |

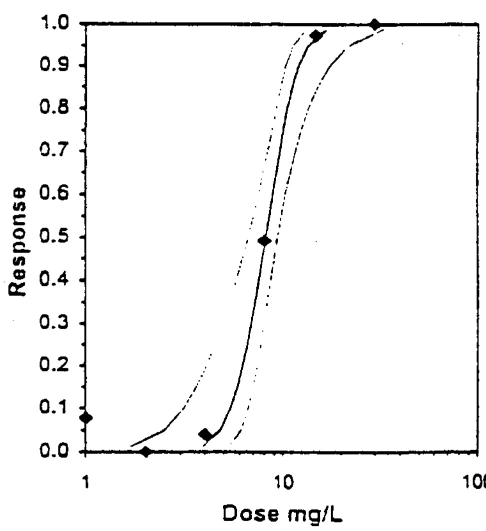
| Auxiliary Tests | | | | | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | | | | | 0.97492 | | 0.884 | | 0.13467 | 0.03207 |
| artlett's Test indicates equal variances (p = 0.24) | | | | | 6.78542 | | 15.0863 | | | |
| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU | MSDu | MSDp | MSB | MSE | F-Prob | df |
| Dunnett's Test | 4 | 8 | 5.65685 | | 0.08172 | 0.08289 | 1.06457 | 0.01315 | 1.1E-11 | 5, 18 |

Maximum Likelihood-Probit

| Parameter | Value | SE | 95% Fiducial Limits | | Control | Chi-Sq | Critical | P-value | Mu | Sigma | Iter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Slope | 7.22283 | 1.30503 | 3.59947 | 10.8462 | 0.02169 | 67.7567 | 13.2767 | 6.8E-14 | 0.91019 | 0.13845 | 7 |
| tercept | -1.5742 | 1.24782 | -5.0387 | 1.89035 | | | | | | | |
| SCR | 0.04717 | 0.01496 | 0.00563 | 0.0887 | | | | | | | |

| Point | Probits | mg/L | 95% Fiducial Limits | |
|---|---|---|---|---|
| 01 | 2.674 | 3.87355 | 1.52356 | 5.24696 |
| 05 | 3.355 | 4.81351 | 2.49245 | 6.10822 |
| EC10 | 3.718 | 5.40457 | 3.12526 | 6.6387 |
| EC15 | 3.964 | 5.84383 | 3.63494 | 7.03347 |
| 20 | 4.158 | 6.21827 | 4.09303 | 7.37405 |
| 25 | 4.326 | 6.55857 | 4.52551 | 7.68997 |
| EC40 | 4.747 | 7.50095 | 5.77382 | 8.62898 |
| 50 | 5.000 | 8.1319 | 6.60924 | 9.35435 |
| 60 | 5.253 | 8.81592 | 7.4584 | 10.2864 |
| EC75 | 5.674 | 10.0827 | 8.77308 | 12.5195 |
| EC80 | 5.842 | 10.6344 | 9.25107 | 13.6895 |
| 85 | 6.036 | 11.3158 | 9.78786 | 15.2748 |
| EC90 | 6.282 | 12.2355 | 10.4487 | 17.6319 |
| EC95 | 6.645 | 13.7379 | 11.4317 | 21.9624 |
| 99 | 7.326 | 17.0716 | 13.386 | 33.5199 |

gnificant heterogeneity detected (p = 6.75E-14)



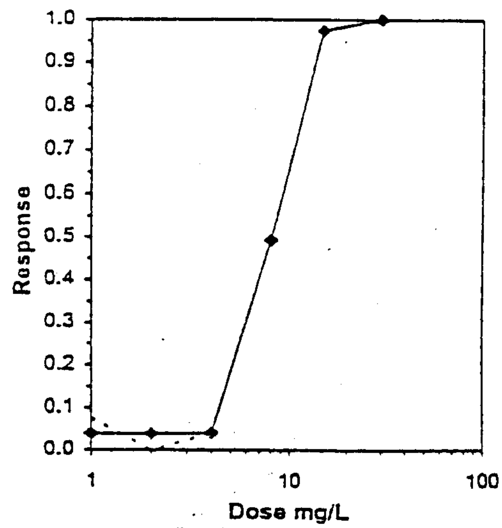
Bivalve Larval Survival and Development Test-Proportion Normal

| | | | | | |
|---|---|---|---|---|---|
| St t Date: | 7/31/97 20:00 | Test ID: | 999-782 | Sample ID: | REF-Ref Toxicant |
| End Date: | 8/3/97 13:00 | Lab ID: | ORNAS-Northwestern Aquat | Sample Type: | CDCL-Cadmium chloride |
| Sample Date: | | Protocol: | EPAW 95-EPA West Coast | Test Species: | DE-Dendraster excentricus |
| ients: | | | | | |

| mg/L | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| -Control | 0.9711 | 1.0000 | 1.0000 | 0.9421 |
| 1 | 0.8471 | 0.7934 | 0.9711 | 1.0000 |
| 2 | 1.0000 | 0.9339 | 1.0000 | 0.9793 |
| 4 | 0.9711 | 0.9132 | 0.9463 | 0.9256 |
| 8 | 0.4215 | 0.4380 | 0.6240 | 0.5041 |
| 15 | 0.0124 | 0.0124 | 0.0331 | 0.0455 |
| 30 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Linear Interpolation (80 Resamples)

| Point | mg/L | SD | 95% CL(Exp) | | Skew |
|---|---|---|---|---|---|
| IC 5 | 4.0874 | 1.5221 | 0.0000 | 4.4155 | -0.7005 |
| IC 0 | 4.5299 | 0.1359 | 4.0241 | 4.8408 | 0.1032 |
| IC15 | 4.9724 | 0.1492 | 4.5066 | 5.4469 | 0.2304 |
| ~~IC20~~ | ~~5.4150~~ | 0.1764 | 4.9307 | 5.9773 | 0.4189 |
| IC 5 | 5.8575 | 0.2122 | 5.3618 | 6.6176 | 0.5828 |
| IC .0 | 7.1850 | 0.3430 | 6.5246 | 8.6282 | 0.8269 |
| IC50 | 8.1151 | 0.4883 | 7.2219 | 10.0096 | 0.6232 |



Test: BV-Bivalve Larval Survival and Development Test | Test ID: 999-782
Species: DE-Dendraster excentricus | Protocol: EPAW 95-EPA West Coast
Sample ID: REF-Ref Toxicant | Sample Type: CDCL-Cadmium chloride
Start Date: 7/31/97 20:00 | End Date: 8/3/97 13:00 | Lab ID: ORNAS-Northwestern Aquatic Sci

| Pos | ID | Rep | Group | Initial Density | Final Density | Total Counted | Number Normal | Notes |
|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | D-Control | 242 | 245 | 242 | 235 | |
| | 2 | 2 | D-Control | 242 | 262 | 242 | 259 | |
| | 3 | 3 | D-Control | 242 | 265 | 242 | 257 | |
| | 4 | 4 | D-Control | 242 | 234 | 242 | 228 | |
| | 5 | 1 | 1.000 | 242 | 241 | 242 | 205 | |
| | 6 | 2 | 1.000 | 242 | 204 | 242 | 192 | |
| | 7 | 3 | 1.000 | 242 | 243 | 242 | 235 | |
| | 8 | 4 | 1.000 | 242 | 250 | 242 | 242 | |
| | 9 | 1 | 2.000 | 242 | 253 | 242 | 249 | |
| | 10 | 2 | 2.000 | 242 | 238 | 242 | 226 | |
| | 11 | 3 | 2.000 | 242 | 262 | 242 | 249 | |
| | 12 | 4 | 2.000 | 242 | 247 | 242 | 237 | |
| | 13 | 1 | 4.000 | 242 | 251 | 242 | 235 | |
| | 14 | 2 | 4.000 | 242 | 251 | 242 | 221 | |
| | 15 | 3 | 4.000 | 242 | 244 | 242 | 229 | |
| | 16 | 4 | 4.000 | 242 | 243 | 242 | 224 | |
| | 17 | 1 | 8.000 | 242 | 225 | 242 | 102 | |
| | 18 | 2 | 8.000 | 242 | 237 | 242 | 106 | |
| | 19 | 3 | 8.000 | 242 | 231 | 242 | 151 | |
| | 20 | 4 | 8.000 | 242 | 234 | 242 | 122 | |
| | 21 | 1 | 15.000 | 242 | 246 | 242 | 3 | |
| | 22 | 2 | 15.000 | 242 | 239 | 242 | 3 | |
| | 23 | 3 | 15.000 | 242 | 227 | 242 | 8 | |
| | 24 | 4 | 15.000 | 242 | 246 | 242 | 11 | |
| | 25 | 1 | 30.000 | 242 | 260 | 242 | 0 | |
| | 26 | 2 | 30.000 | 242 | 251 | 242 | 0 | |
| | 27 | 3 | 30.000 | 242 | 242 | 242 | 0 | |
| | 28 | 4 | 30.000 | 242 | 255 | 242 | 0 | |

Comments:

PARAMETRIX, INC.

**Sediment Monitoring Bioassays - 20-Day Neanthes**

AR 023462

An Employee-Owned Company

Parametrix, Inc.

[illegible] Lake Washington Blvd. N.E. Kirkland WA [illegible]
[illegible]-822-8880 • Fax 425-889-8808

Ms. Lisa Roach
SAIC, INC.
18706 North Creek Parkway, Suite 110
Bothell, Washington 98011

September 3, 1997
55-1738-63 (01)

**SUBJECT: HAMM CREEK SEDIMENT MONITORING BIOASSAYS**

Dear Ms. Roach:

Please find enclosed one bound and one unbound copy of the final report for Hamm Creek sediment monitoring bioassays and a diskette containing the final report and data tables.

Testing consisted of sediment bioassays conducted on two composite samples and one reference station using *Neanthes arenaceodentata*. All tests were conducted according to the Puget Sound Dredged Disposal Analysis Program (PSDDA) and Puget Sound Estuary Program (PSEP) with Sediment Management Annual Review Meeting 1996 modifications.

Control sediment location is as follows:

| | |
|---|---|
| **West Beach Control Sediment** | |
| Location: | North Whidbey Island, Washington |
| Latitude and Longitude: | 48°23.00′N,122°40.00′W |
| LORAN C TDD Readings for Station: | 28481.0 by 42338.8 |
| Grain Size Distribution: | 100% sand |

Should you have any questions or comments concerning the results, please call me at (425) 822-8880. Thank you.

Sincerely,

PARAMETRIX, INC.

Nat Merrill

Nathaniel Merrill
Project Manager, Toxicology Laboratory

Enclosures

cc: D. Ormerod

AR 023463

Printed on Recycled Paper

# SEDIMENT MONITORING BIOASSAYS

Prepared for

**SAIC, INC.**
18706 North Creek Parkway, Suite 110
Bothell, Washington 98011

Prepared by

**PARAMETRIX, INC.**
5808 Lake Washington Blvd. N.E.
Kirkland, Washington 98033

AUGUST 1997

# SIGNATURE PAGE

Submitted by: Parametrix's Environmental Toxicology Laboratory
5808 Lake Washington Blvd. NE
Kirkland, Washington 98033

Prepared by: Nat Merrill 8/28/97

Nathaniel Merrill
Manager, Toxicology Laboratory

Date

Approved by: Dayle Ormerod 8/29/97

Dayle Ormerod
Manager, Toxicology Laboratory

Date

Approved by: Charles S. Wisdom 9/3/97

Charles S. Wisdom, Ph.D.
QA/QC Officer

Date

## TABLE OF CONTENTS



## LIST OF TABLES

## EXECUTIVE SUMMARY OF TEST RESULTS

| Station | *Neanthes* sp. Mortality (%) | *Neanthes* sp. Mean Growth Rate (mg) |
|---|---|---|
| Control | 8 | 0.92 |
| C1 | 8 | 0.91 |
| C2 | 0 | 0.59 |
| N2 (Carr 4) | 4 | 0.84 |
| Reference Toxicant (LC50) | 11 ppm Cd | |

# 1. INTRODUCTION

Parametrix's Environmental Toxicology Laboratory was contracted by SAIC, Inc. to perform bioassays on two sediment samples and one reference sediment for Hamm Creek restoration project using *Neanthes arenaceodentata* (benthic dwelling polychaete worm) as the test organism.

All tests were conducted according to the Puget Sound Dredged Disposal Analysis Program (PSDDA) and Puget Sound Estuary Program (PSEP). In addition, the interim growth rate and mortality guidelines for the *Neanthes* bioassay were followed according to the Sediment Management Annual Review Meeting (SMARM) presented on 3 and 4 May 1995.

## 2. METHODS AND MATERIALS

### 2.1 Procedures

The bioassays were conducted according to the Parametrix protocol #1059:

- Bioassay Procedures for Conducting Static-Renewal 20-Day Chronic Sediment Toxicity Tests According To Recommended Guidelines for Conducting Laboratory Bioassays On Puget Sound Sediments (PSWQA, 1995) Using the Polychaete *Neanthes* sp.

A summary of test conditions is provided in Table 1. In addition to the biological observations, total ammonia and sulfide measurements were taken at initiation and termination of the *Neanthes* sp. tests.

### 2.2 Test Sediment

Sediment samples were provided to Parametrix's Environmental Toxicology Laboratory located in Kirkland, Washington on 21 July 1997. Upon arrival, appropriate chain-of-custody (COC) procedures were followed: sample labels were checked against the chain-of-custody form, containers inspected for damage during shipment, and sediment volumes were determined to be adequate. After completing the COC procedures, the samples were purged with nitrogen gas and stored in a refrigerator set at 4°C until test initiation. All bioassays were initiated within eight weeks of sample collection. Copies of the COC forms are located in Appendix A.

### 2.3 Control and Reference Sediment

The control sediment used for the *Neanthes* bioassay was collected from West Beach in Whidbey Island, Washington. Prior to initiation of the *Neanthes* test, the control sediment was sieved through a 500 $\mu$m screen and washed with clean seawater to ensure that no amphipods remained in the sediment. The reference sediment was collected on 21 July 1997 and provided by SAIC, Inc. personnel.

**Table 1. Summary of test conditions for the 20-day *Neanthes* sp. bioassay.**

Job Name: SAIC, Inc.

Job Number: 55-1738-63
Test Date: 24 July - 13 August 1997

| | |
|---|---|
| **Test Protocol:** | Parametrix Protocol #1059. Bioassay Procedures for Conducting Static-Renewal 20-Day Chronic Sediment Toxicity Tests According To Recommended Guidelines for Conducting Laboratory Bioassays On Puget Sound Sediments (PSWQA 1995) Using the Polychaete *Neanthes* sp. |
| **Test Material:** | Sediment provided by SAIC, Inc. |
| **Test Organisms:** | *Neanthes arenaceodentata* (polychaete worm) |
| **Source:** | Dr. Don Reish; Long Beach, California |
| **Number/Container:** | Five |
| **Test Concentrations:** | 175 mL of sediment in 950 mL of seawater |
| **Replicates:** | Five |
| **Reference Toxicant:** | Cadmium, as cadmium chloride |
| **Test Duration:** | 20 days |
| **Dilution Water:** | Natural seawater collected from National Marine Fisheries Service; Mukilteo, Washington |
| **Test Chambers:** | 1 liter glass beakers |
| **Lighting:** | Continuous overhead lighting |
| **Temperature:** | 20 ± 1° C |
| **Aeration:** | Gentle aeration at <100 bubbles/minute |
| **Renewals:** | Every third day |
| **Feeding:** | Ground TetraMarin® every other day (40 mg dry wt/test vessel) |
| **Chemical Data:** | Salinity, temperature, pH, and dissolved oxygen of overlying water at initiation and every third day; ammonia and sulfide at initiation and test termination. Interstitial salinity at test initiation. |
| **Effect Measured:** | Mortality and growth |
| **Test Acceptability:** | Mean control mortality ≤ 10%, and ≥ 0.72 mg/day growth |

# 3. RESULTS

## 3.1 Test Results

A summary of bioassay results is located in the Executive Summary and in Table 2. The results of the ammonia and sulfide analyses are given in Appendix B. All original raw data, chain-of-custody forms, and project notes are maintained in Parametrix project files.

Test acceptability criteria were met for all tests. No toxicity was observed for survival or growth in sample C1. Toxicity was observed for growth only in sample C2. No effects were observed in the reference sample.

**Table 2. Summary of Test Results**

| | *Neanthes* sp. | |
|---|---|---|
| Station | Mortality (%) | Mean Growth Rate (mg) |
| Control | 8 | 0.92 |
| C1 | 8 | 0.91 |
| C2 | 0 | 0.59 |
| N2 (Carr 4) | 4 | 0.84 |
| Reference Toxicant (LC50) | 11 ppm Cd | |

## 4. REFERENCES

Hamilton, M.A., R.C. Russo, and R.V. Thurston. 1977. Trimmed Spearman-Karber Method for Estimating Median Lethal Concentrations in Toxicity Bioassays. Environ. Sci. Technol. 11(7):714-719; Correction 12(4):417 (1978).

Parametrix, Inc. 1995. Protocol #1059. Bioassay Procedures for Conducting Static-Renewal 20-Day Chronic Sediment Toxicity Tests According To Recommended Guidelines for Conducting Laboratory Bioassays On Puget Sound Sediments (PSWQA, 1995) Using the Polychaete *Neanthes* sp. Parametrix, Inc., Kirkland, Washington.

PTI Environmental Services. 1991. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. U.S Environmental Protection Agency, Region 10. Puget Sound Estuary Program (PSEP).

Puget Sound Water Quality Authority. 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. U.S. Environmental Protection Agency, Region 10.

U.S. Army Corps of Engineers. 1989. Puget Sound Dredged Disposal Analysis (PSDDA) Management Plan Report, unconfined open-water disposal of dredged material phase II (north and south Puget Sound). U.S. Army Corps of engineers, Seattle district; U.S. Environmental Protection Agency, Region 10; Washington State Department of Natural Resources; Washington State Department of Ecology; Seattle, Washington.

*Neanthes arenaceodentata*

Hamm Creek/SAIC - *Neanthes* bioassay, 24 July - 13 August 1997

| Station | Lab I.D. | Alive | Found Dead | Dead | % Mortality | Station % Mortality | Mortality Std. Dev. | Weight of Pan (mg) | Dry Weight of Pan and Worms(mg) | Total Biomass (mg) | Mean Total Biomass(mg) | St Dev Total Biomass | Individual Biomass (mg/org.) | Mean Individual Biomass(mg) | St Dev Individual Biomass | Growth Ratio Endpoint | Mean Growth Ratio | St Dev Growth Ratio | p Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T initial | 1 | | | | | | | 22.08 | 25.92 | 3.84 | 3.27 | 0.41 | 0.8 | 0.7 | 0.1 | | | | |
| | 2 | | | | | | | 24.73 | 27.64 | 2.91 | | | 0.6 | | | | | | |
| | 3 | | | | | | | 21.00 | 24.07 | 3.07 | | | 0.6 | | | | | | |
| C2 | N101 | 5 | 0 | 0 | 0 | 0 | 0.00 | 81.94 | 149.88 | 67.94 | 62.03 | 11.97 | 13.6 | 12.4 | 2.4 | 0.65 | 0.59 | 0.12 | 0.017 |
| | N102 | 5 | 0 | 0 | 0 | | | 84.39 | 166.92 | 82.53 | | | 16.5 | | | 0.79 | | | |
| | N103 | 5 | 0 | 0 | 0 | | | 86.15 | 135.04 | 48.89 | | | 9.8 | | | 0.46 | | | |
| | N104 | 5 | 0 | 0 | 0 | | | 86.18 | 141.97 | 55.79 | | | 11.2 | | | 0.53 | | | |
| | N105 | 5 | 0 | 0 | 0 | | | 72.22 | 127.23 | 55.01 | | | 11.0 | | | 0.52 | | | |
| C1 | N106 | 5 | 0 | 0 | 0 | 8 | 9.80 | 86.17 | 168.94 | 82.77 | 85.54 | 9.30 | 16.6 | 18.8 | 2.7 | 0.79 | 0.91 | 0.13 | 0.275 |
| | N107 | 5 | 0 | 0 | 0 | | | 71.97 | 153.51 | 81.54 | | | 16.3 | | | 0.78 | | | |
| | N108 | 4 | 0 | 1 | 20 | | | 73.87 | 168.69 | 94.82 | | | 23.7 | | | 1.15 | | | |
| | N109 | 4 | 0 | 1 | 20 | | | 76.56 | 148.22 | 71.66 | | | 17.9 | | | 0.86 | | | |
| | N110 | 5 | 0 | 0 | 0 | | | 84.76 | 181.69 | 96.93 | | | 19.4 | | | 0.94 | | | |
| N2 (Carr 4) | N111 | 4 | 0 | 1 | 20 | 4 | 8.00 | 83.90 | 160.57 | 76.67 | 83.59 | 15.44 | 19.2 | 17.5 | 3.1 | 0.93 | 0.84 | 0.16 | |
| | N112 | 5 | 0 | 0 | 0 | | | 71.48 | 177.87 | 106.39 | | | 21.3 | | | 1.03 | | | |
| | N113 | 5 | 0 | 0 | 0 | | | 71.40 | 168.27 | 96.87 | | | 19.4 | | | 0.94 | | | |
| | N114 | 5 | 0 | 0 | 0 | | | 71.64 | 144.00 | 72.36 | | | 14.5 | | | 0.69 | | | |
| | N115 | 5 | 0 | 0 | 0 | | | 70.31 | 135.95 | 65.64 | | | 13.1 | | | 0.62 | | | |
| Control | N116 | 4 | 0 | 1 | 20 | 8 | 9.80 | 84.74 | 175.00 | 90.26 | 87.48 | 10.26 | 22.6 | 19.1 | 2.1 | 1.10 | 0.92 | 0.10 | |
| | N117 | 5 | 0 | 0 | 0 | | | 85.01 | 185.10 | 100.09 | | | 20.0 | | | 0.97 | | | |
| | N118 | 5 | 0 | 0 | 0 | | | 73.82 | 157.40 | 83.58 | | | 16.7 | | | 0.80 | | | |
| | N119 | 4 | 0 | 1 | 20 | | | 70.75 | 140.68 | 69.93 | | | 17.5 | | | 0.84 | | | |
| | N120 | 5 | 0 | 0 | 0 | | | 83.38 | 176.90 | 93.52 | | | 18.7 | | | 0.90 | | | |
| Reference Toxicant (CdC12) | | | | | | | | | | | | | | | | | | | |
| 0.0 | A | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| | B | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| 1.8 | A | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| | B | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| 3.0 | A | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| | B | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| 5.0 | A | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| | B | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| 8.4 | A | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| | B | 5 | 0 | 0 | 0 | | -- | | | | | | | | | | | | |
| 14.0 | A | 0 | 5 | 5 | 100 | | -- | | | | | | | | | | | | |
| | B | 1 | 4 | 4 | 80 | | -- | | | | | | | | | | | | |

1/ Note: Station standard deviations calculated on raw, untransformed data.

AR 023474

TRIMMED SPEARMAN-KARBER METHOD. MONTANA STATE UNIV

FOR REFERENCE, CITE:
HAMILTON, M.A., R.C. RUSSO, AND R.V. THURSTON, 1977.
TRIMMED SPEARMAN-KARBER METHOD FOR ESTIMATING MEDIAN
LETHAL CONCENTRATIONS IN TOXICITY BIOASSAYS.
ENVIRON. SCI. TECHNOL. 11(7): 714-719;
CORRECTION 12(4):417 (1978).

DATE: 7/24/97 TEST NUMBER: 1 DURATION: 96 HOURS
CHEMICAL: CDCL2 SPECIES: NEANTHES

RAW DATA:

| | | | | | |
|---|---|---|---|---|---|
| CONCENTRATION(MG/L) | 1.80 | 3.00 | 5.00 | 8.40 | 14.00 |
| NUMBER EXPOSED: | 10 | 10 | 10 | 10 | 10 |
| MORTALITIES: | 0 | 0 | 0 | 0 | 9 |

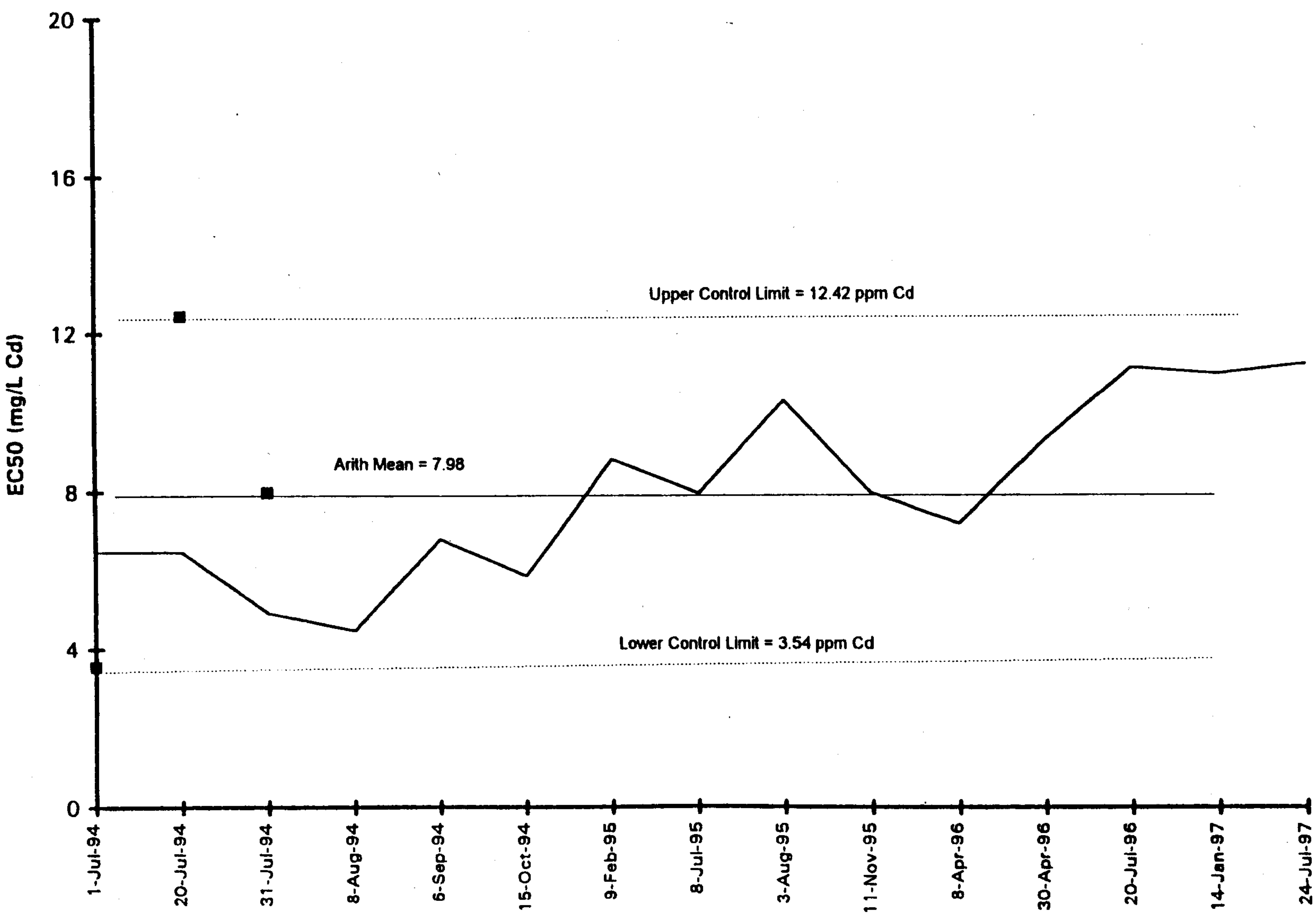
SPEARMAN-KARBER TRIM: 10.00%

SPEARMAN-KARBER ESTIMATES: LC50: 11.16
95% CONFIDENCE LIMITS
ARE NOT RELIABLE.

---

AR 023475

## Control Chart for *Neanthes*



# 20 DAY NEANTHES

*(Neathes arenaceodentata)*

## DATA PACKET

CLIENT: SAIC

PROJECT NAME: Hamm Creek

PROJECT NUMBER: 55-1738-63-01

20 DAY NEANTHES TEST NOTES AND OBSERVATIONS

Project Name: Hamm Creek / SAIC

Date: 

Project Number: 55-1738-63-01

7/23 - C1 and C2 samples soaked in Full strength seawater for 4 hours prior to Test chamber filling to raise salinity of Interstitial water to Test levels.

7/24 - Initial organism wts

| | | Pan wt (mg) | Pan + orgs |
|---|---|---|---|
| sample | 1 | 22.08 | 25.92 |
| | 2 | 24.73 | 27.64 |
| | 3 | 21.00 | 24.07 |

AR 023478

20 DAY NEANTHES SEDIMENT SETUP RECORD SHEET

Project Name: HAMM CREEK / SAIC

Date: 7/24/97

Project Number: 55-1738-63-01

| Station I.D. | Lab I.D. | Interstitial Salinity | Comments | Initials |
|---|---|---|---|---|
| C2 | N101-105 | ≈0 | Silty mud * final 25 | NM |
| | | | | N.M |
| C1 | N106-110 | NA | Dry Dirt w/ roots * final 26 | |
| | | | | |
| N2 (Carr 4) | N111-115 | 28 | | NM |
| | | | | |
| West beach | N116-120 | ~~[illegible]~~ 27 | | NM |
| | | | | |
| | | | | |
| | | | | |
| | | | * both sediments adjusted to | |
| | | | 28ppt Interstitial Salinity | |
| | | | by 4hr soak in 28ppt Sea | |
| | | | water | |

AR 023479

# 20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name Hamm Creek / SAIC

Job Number 55-1738-6301

Day 0 of Test

Date 7/24/97 Time 1330

Temp 20 °C

Observer(s) NM

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N101 | 7.1 | 6.4 | 26 | |
| N106 | 6.8 | 6.8 | 27 | |
| N111 | 7.6 | 6.2 | 27 | |
| N116 | 7.7 | 6.6 | 27 | |
| | | | | |
| Con A | 7.9 | 7.4 | 27 | |
| 14,0B | 7.9 | 7.4 | 27 | |

20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name Hamm Creek/SAIC

Job Number 55-1738-63-01

Day 3 of Test

Date 7/27/97 Time 1205

Temp 21 °C

Observer(s) NM

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N106 | 6.4 | 6.6* | 27 | *Reading from # N107 - 106 Air stopped |
| N116 | 7.2 | 5.2 | 27 | overnight DO. : 2.5, Air Started |
| N101 | 7.2 | 7.2 | 27 | |
| N111 | 7.7 | 7.4 | 27 | |
| | | | | |
| Con A | 7.7 | 8.6 | 27 | |
| 14.0 A | 7.9 | 8.6 | 27 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | *, During ΔH2O, neanthes were on the |
| | | | | side of the beaker in N118 + N120 |

AR 023481

# 20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name HAMM CREEK / SWTC

Job Number 55-1738-63-01

Day 6 of Test

Date 7/30/97

Time 1550

Temp 21 °C

Observer(s) PS

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N106 | 7.2 | 6.8 | 26 | |
| N116 | 7.6 | 6.7 | 27 | |
| N101 | 7.3 | 6.5 | 26 | |
| N111 | 8.0 | 6.9 | 27 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# 20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Day 9 of Test

Job Name HAMM CREEK/SAIC

Date 8/2/97

Time 0900

Temp 20 °C

Job Number 55-1738-63-01

Observer(s) JK

| Container | Water Quality Parameters | | | Comments |
|---|---|---|---|---|
| | pH | D.O. | Salinity | |
| N106 | 7.1 | 6.6 | 28 | |
| N116 | 7.4 | 6.4 | 28 | |
| N101 | 7.2 | 6.6 | 28 | |
| N111 | 7.9 | 6.6 | 28 | |

AR 023483

20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name Hamm Creek/SAIC

Job Number 55-1738-63-01

Day 12 of Test

Date 8/5/97 Time 1246

Temp 21 °C

Observer(s) PS

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N106 | 7.3 | 6.8 | 27 | |
| N116 | 7.6 | 7.0 | 27 | |
| N101 | 7.3 | 6.8 | 27 | |
| N111 | 8.0 | 7.1 | 27 | |

20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name HAMM CREEK/SHIC

Job Number 55-1738-63-01

Day 15 of Test

Date 8/8/97

Time 1530

Temp 21 °C

Observer(s) PS

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N106 | 7.2 | 6.4 | 27 | |
| N116 | 7.5 | 6.5 | 27 | |
| N101 | 7.3 | 6.4 | 27 | |
| N111 | 7.9 | 6.7 | 27 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name HAMM CREEK/SAIC

Job Number 55-1738-63-01

Day 18 of Test

Date 8/11/97

Temp 21 °C

Time 1310

Observer(s) AC

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N106 | 7.2 | 6.7 | 28 | |
| N116 | 7.4 | 6.6 | 28 | |
| N101 | 7.3 | 6.6 | 28 | |
| N111 | 7.7 | 7.0 | 28 | |
| | | | | |
| | | | | |

AR 023486

20 DAY NEANTHES BIOASSAY CHEMISTRY DATA

Job Name HAMM CREEK/SAIC

Job Number 55-1738-63-01

Day 20 of Test

Date 8/13/97

Time 0915

Temp 21 °C

Observer(s) AC

| Container | Water Quality Parameters pH | D.O. | Salinity | Comments |
|---|---|---|---|---|
| N 106 | 6.6 | 7.2 | 29 | |
| N 116 | 6.8 | 7.0 | 29 | |
| N 101 | 6.7 | 6.5 | 28 | |
| N 111 | 7.2 | 7.4 | 29 | |

AR 023487

20 DAY NEANTHES BIOASSAY BREAKDOWN
Positve Control-Reference Toxicant

Job Name Hamm Creek/SAIC

Reference Toxicant $CdCl_2$

Date Stock Prep. 2/4/97

Job Number 55-1738-6301

Date 7/24 - 7/28/97

| Container | Concentration (mg/l) | Found: Alive | Found: Dead | Initials |
|---|---|---|---|---|
| Con A | 0.0 | 5 | 0 | NM |
| B | 0.0 | 5 | 0 | NM |
| | | | | |
| 1.8 A | 1.8 | 5 | 0 | NM |
| B | | 5 | 0 | NM |
| | | | | |
| 3.0 A | 3.0 | 5 | 0 | NM |
| B | | 5 | 0 | NM |
| | | | | |
| 5.0 A | 5.0 | 5 | 0 | NM |
| B | | 5 | 0 | NM |
| | | | | |
| 8.4 A | 8.4 | 5 | 0 | NM |
| B | | 5 | 0 | NM |
| | | | | |
| 14.0 A | 14.0 | 0 | 5 | NM |
| B | | 1 | 4 | NM |

AR 023488

20 DAY NEANTHES BIOASSAY BREAKDOWN

Job Name HAMM CREEK/SAIC

Date 8/13/97

Job Number 55-1738-63-01

Day 20 of Test

| Container | Found Alive | Found Dead | Comments | Initials |
|---|---|---|---|---|
| N 101 | 5 | 0 | | JP |
| N 102 | 5 | 0 | | AC |
| N 103 | 5 | 0 | | AC |
| N 104 | 5 | 0 | | JP |
| N 105 | 5 | 0 | | AC |
| N 106 | 5 | 0 | | JP |
| N 107 | 5 | 0 | | AC |
| N 108 | 4 | 0 | | AC. |
| N 109 | 4 | 0 | | JP |
| N 110 | 5 | 0 | | AC |
| N 111 | 4 | 0 | | JP |
| N 112 | 5 | 0 | | AC |
| N 113 | 5 | 0 | | JP |
| N 114 | 5 | 0 | | JP |
| N 115 | 5 | 0 | | AC |
| N 116 | 4 | 0 | | JP |
| N 117 | 5 | 0 | | AC |
| N 118 | 5 | 0 | | AC |
| N 119 | 4 | 0 | | JP |
| N 120 | 5 | 0 | | JP |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

NEANTHES BIOMASS DATA

Job Name HAMM CREEK/SAIC

Job Number 55-1738-63-01 Date 8/14/97

Day of Test ______

| Replicate Number | Weight of Pan (~~g~~) mg | Dry Weight of Pan and Worms (~~g~~) mg | Dry Weight of Worms (~~g~~) mg |
|---|---|---|---|
| N101 | 81.94 | 149.88 | 67.94 |
| N102 | 84.39 | 166.92 | 82.53 |
| N103 | 86.15 | 135.04 | 48.89 |
| N104 | 86.18 | 141.97 | 55.79 |
| N105 | 72.22 | 12723 | 55.01 |
| N106 | 86.17 | 168.94 | 82.77 |
| N107 | 71.97 | 153.51 | 81.54 |
| N108 | 73.87 | 168.69 | 94.82 |
| N109 | 76.56 | 148.22 | 71.66 |
| N110 | 84.76 | 181.69 | 96.93 |
| N111 | 83.90 | 160.57 | 76.67 |
| N112 | 71.48 | 177.87 | 106.39 |
| N113 | 71.40 | 168.27 | 96.87 |
| N114 | 71.64 | 144.00 | 72.36 |
| N115 | 70.31 | 135.95 | 65.64 |
| N116 | 84.74 | 175.00 | 90.26 |
| N117 | 85.01 | 185.10 | 100.09 |
| N118 | 73.82 | 157.40 | 83.58 |
| N119 | 70.75 | 140.68 | 69.93 |
| N120 | 83.38 | 176.90 | 93.52 |

## APPENDIX A

## CHAIN-OF-CUSTODY FORM

# APPENDIX B

# AMMONIA AND SULFIDE WATER QUALITY DATA

SAIC, INC.

ORGANISM: *Neanthes arenaceodentata*

PROJECT NUMBER: 55-1738-63 (01)

ANALYSIS: Ammonia

TEST DATES: $T_{Initial}$ 7/24/97
$T_{Final}$ 8/13/97

DETECTION LIMIT: 0.01 (mg/L)

| **Sample I.D.** | **$T_{Initial}$ (mg/L)** | **$T_{Final}$ (mg/L)** |
|---|---|---|
| Control | 0.04 | 2.14 |
| C1 | 0.17 | 5.20 |
| C2 | 1.73 | 5.44 |
| N2 | 0.55 | 0.33 |

ANALYSIS: Total Sulfide

TEST DATES: $T_{Initial}$ 7/24/97
$T_{Final}$ 8/13/97

DETECTION LIMIT: 0.003 (mg/L)

| **Sample I.D.** | **$T_{Initial}$ (mg/L)** | **$T_{Final}$ (mg/L)** |
|---|---|---|
| Control (West Beach) | ND | ND |
| C1 | ND | ND |
| C2 | ND | ND |
| N2 | ND | ND |

ND = Not detected

Laboratory Analysis Record

Parametrix, Inc.

| | | | | | |
|---|---|---|---|---|---|
| Analysis: | Ammonia | Media: | | Staff: | JP |
| Organism: | | Round #: | | Date: | 8/5 |
| Project Name: | SAIC - N3an | Test Date: | 7/24 | Start Time: | |
| Project Number: | | | | End Time: | |

Instrument Calibrations — Unit 001: Orion Model #720A; Unit 002: Orion Model #250A

Orion Unit #

001) Specific Ion Probe # ______ Serial # ______ Slope % -59.7 (-56 to -60 mV/decade)

002) Specific Ion Probe # ______ Serial # ______ Slope % ______ (-56 to -60 mV/decade)

*Ammonia Standards* (SOP #PMX-AN-3)

- ______ 100 ppm ($NH_3$-N)
- 10 10 ppm ($NH_3$-N)
- 1 1.0 ppm ($NH_3$-N)
- .1 0.1 ppm ($NH_3$-N)
- ______ 0.05 ppm ($NH_3$-N)
- ______ 0.01 ppm ($NH_3$-N)
- ______ See Control Charts (reference)

NBS Standard
Orion Cat. No. 951207 @ 100 ppm
Lot # ______ Date ______

Method Detection Limit = 0.01 ppm $NH_3$-N
Reporting Limit = 0.1 ppm $NH_3$-N
Lab Temp: ______ °C

| Time (hrs) | Sample I.D. | Lab Sample I.D. | $NH_3$-N (ppm) | % Recovery | Time (hrs) | Sample I.D. | Lab Sample I.D. | $NH_3$-N (ppm) | % Recovery |
|---|---|---|---|---|---|---|---|---|---|
| | C2 | N101-105 | 1.73 | | | | | | |
| | | N101-105MS | 2.31 | | | | | | |
| | C1 | N106-110 | 0.168 | | | | | | |
| | | N106-110 Dup | 0.166 | | | | | | |
| | N2 | N111-115 | 0.554 | | | | | | |
| | WB | N116-120 | 0.0433 | | | | | | |

CS = Calibration Standard
MB = Method Blank (daily with each seawater batch)
DUP = Duplicate (laboratory) (1 in 20)
MS = Spike Analysis (laboratory) (1 in 20)
____ mls sample: ______ ml SAOB
____ mls spike @ ______ ppm

SPB = Sample Preservation Blanks
SOW = Synthetic Ocean Water (for standards preparation)
Std = Ammonia Standard (processed; 28 ppt)
SW = Seawater (0.2 μm filtered; UV processed; 28 ppt)
RS = Replicate Sample (field) (1 in 20)

AR 023494

| | | | | | |
|---|---|---|---|---|---|
| Analysis: | Ammonia | Media: | | Staff: | |
| Organism: | | Round #: | | Date: | 8/27/97 |
| Project Name: | SAIC | Test Date: | 8/13/97 | Start Time: | 9/5 |
| Project Number: | | | | End Time: | |

*Instrument Calibrations* Unit 001: Orion Model #720A
Unit 002: Orion Model #250A

Orion Unit # ______

001) Specific Ion Probe # ______ Serial # ______ Slope % ______ (-56 to -60 mV/decade)

002) Specific Ion Probe # ______ Serial # ______ Slope % ______ (-56 to -60 mV/decade)

*Ammonia Standards* (SOP #PMX-AN-3)

______100 ppm ($NH_3$-N)
______10 ppm ($NH_3$-N)
______1.0 ppm ($NH_3$-N)
______0.1 ppm ($NH_3$-N)
______0.05 ppm ($NH_3$-N)
______0.01 ppm ($NH_3$-N)
______See Control Charts (reference)

NBS Standard
Orion Cat. No. 951207 @ 100 ppm
Lot # ______ Date ______

Method Detection Limit = 0.01 ppm $NH_3$-N
Reporting Limit = 0.1 ppm $NH_3$-N
Lab Temp: ______ °C

| Time (hrs) | Sample I.D. | Lab Sample I.D. | $NH_3$-N (ppm) | % Recovery | Time (hrs) | Sample I.D. | Lab Sample I.D. | $NH_3$-N (ppm) | % Recovery |
|---|---|---|---|---|---|---|---|---|---|
| | 0.1 | | | | | | | | |
| | 1.0 | Slope: | -58.5 | | | | | | |
| | 10.0 | | | | | | | | |
| | 0.1 | | BE ~~1.07~~ .107 | | | | | | |
| | 1.0 | | .948 | | | | | | |
| | 10.0 | | 9.50 | | | | | | |
| | SAIC N101-105 | C2 | 5.44 | | | | | | |
| | SAIC N096-100 | C1 | 5.20 | | | | | | |
| | N106-110MS | | 4.22 | | | | | | |
| | N111-115 | N2 | .325 | | | | | | |
| | N111-115DUP | | .340 | | | | | | |
| | N116-120 | WB | 2.14 | | | | | | |

AR 023495

S = Calibration Standard
B = Method Blank (daily with each seawater batch)
DUP = Duplicate (laboratory) (1 in 20)
MS = Spike Analysis (laboratory) (1 in 20)
____mls sample:______ml SAOB
____mls spike @______ppm

SPB = Sample Preservation Blanks
SOW = Synthetic Ocean Water (for standards preparation)
Std = Ammonia Standard (processed; 28 ppt)
SW = Seawater (0.2 μm filtered; UV processed; 28 ppt)
RS = Replicate Sample (field) (1 in 20)

Laboratory Analysis Record

Parametrix Inc.

Analysis: Total Sulfide

Media:

Organism:

Project Name: SAIC

Project Number:

Test Date: 7/24/97 ~~7/22/97~~

Staff:

Date: 8/1/97

Start Time:

End Time:

*Instrument Calibrations* Unit 001: Orion Model #720A

001) Specific Ion Probe 9416 Serial # UP1 Slope % -29.1 (-25 to -30 mV/decade)

002) Specific Ion Probe # Serial # Slope % (-25 to -30 mV/decade)

*Sulfide Standards* (SOP # PMX-AN-2)

Orion Method Detection Limit = 0.005 ppm Sulfide

ASTM Method D4658 Lower Limit 0.04 ppm Sulfide

Reporting Limit 0.5 ppm Sulfide

Lab Temp: °C

| Time (hrs) | Sample I.D. | Lab Sample I.D. | Sulfide (ppm) | % Recovery | mV | Time (hrs) | Sample I.D. | Lab Sample I.D. | Sulfide (ppm) | % Recovery | mV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | .075 | Slope = -29.1 | | | | | | | | | |
| | .75 | | | | | | | | | | |
| | 7.5 | | | | | | | | | | |
| | .075 | ~~.064~~ | .064 | | | | | | | | |
| | .75 | ~~.72~~ | .72 | | | | | | | | |
| | 7.5 | ~~7.2~~ | 7.2 | | | | | | | | |
| | DI | | 0.0 | | | | | | | | |
| | ~~Sea H₂O~~ | | | | | | | | | | |
| | WMFS $H_2O$ | | ND | | | | | | | | |
| | WMFS $H_2O$ MS | | .119 | | | | | | | | |
| | W101-105 | C2 | ND | | | | | | | | |
| | W106-110 | C1 | ND | | | | | | | | |
| | W111-115 | N2 | ND | | | | | | | | |
| | W111-115 MS | | .125 | | | | | | | | |
| | W116-120 | WB | ND | | | | | | | | |
| | W116-120 Dup | | ND | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

CS - Calibration Standard

MB - Method Blank (daily with each seawater batch)

DUP - Duplicate (laboratory) (1 in 20)

MS - Spike Analysis (laboratory) (1 in 20)

_____mls sample _____ml SA08

_____mls spike @ _____ppm

SPB - Sample Preservation Blanks

SOW - Synthetic Ocean Water (for standards preparation)

Std - Sulfide Standard (prepared 3 ppt)

SW - Seawater (0.2 um filtered, UV processed 35 ppt)

RS - Replicate Sample (field) (1 in 20)

AR 023496

Laboratory Analysis Record — Parametrix, Inc.

Analysis: Total Sulfide
Media:
Organism:
Project Name: SAIC
Test Date: 8/13/97
Project Number:

Staff: JP/BE
Date: 8/20/97
Start Time:
End Time:

*Instrument Calibrations* Unit 001: Orion Model #720A

001) Specific Ion Probe 9416 Serial # UP1 Slope % -29.5 (-25 to -30 mV/decade)
002) Specific Ion Probe # Serial # Slope % (-25 to -30 mV/decade)

*Sulfide Standards* (SOP # PMX-AN-2)

Orion Method Detection Limit = 0.003 ppm Sulfide
ASTM Method D4658 Lower Limit 0.04 ppm Sulfide
Reporting Limit 0.5 ppm Sulfide
Lab Temp: °C

| Time (hrs) | Sample I.D. | Lab Sample I.D. | Sulfide (ppm) | % Recovery | mV | Time (hrs) | Sample I.D. | Lab Sample I.D. | Sulfide (ppm) | % Recovery | mV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90 H | | ND | | | | | | | | |
| | 90 H MS | | .145 | | | | | | | | |
| | N101-105 | C2 | ND | | | | | | | | |
| | N101-105 Dup | | ND | | | | | | | | |
| | N106-110 | C1 | ND | | | | | | | | |
| | N111-115 | N2 | ND | | | | | | | | |
| | N116-120 | WB | ND | | | | | | | | |
| | N116-120MS | | .131 | | | | | | | | |

AR 023497

- C = Calibration Standard
- MB = Method Blank (daily with each seawater batch)
- DUP = Duplicate (laboratory) (1 in 20)
- MS = Spike Analysis (laboratory) (1 in 20)
  - ___ mls sample ___ ml SAOB
  - ___ mls spike @ ___ ppm
- SPB = Sample Preservation Blanks
- SOW = Synthetic Ocean Water (for standards preparation)
- Std = Sulfide Standard (processed 25 ppt)
- SW = Seawater (0.2 um filtered UV processed 25 ppt)
- RS = Replicate Sample (field) (1 in 20)

**Parametrix, Inc.**

To: Lisa Roach
SAIC

Date: 9/9/97

Project No:

From:


*Washington*

☐ 5700 Kitsap Way
Suite 202
Bremerton, WA 98312-2234
360-377-0014 • Fax: 360-479-5961
E-mail: pmxbrem@parametrix.com

☐ 1231 Fryar Avenue
P.O. Box 460
Sumner, WA 98390-1516
253-863-5128 • Fax: 253-863-0946
E-mail: pmxsumner@parametrix.com

☒ 5808 Lake Washington Blvd. N.E.
Suite 200
Kirkland, WA 98033-7350
425-822-8880 • Fax: 425-889-8808
E-mail: pmx@parametrix.com

*Oregon*

☐ 7820 N.E. Holman
Suite B-6
Portland, OR 97218-2859
503-256-3444 • 360-694-5020
Fax: 503-256-4221

*Texas*

☐ 10510 Rockley Road
Suite 210
Houston, TX 77099-3531
281-... • Fax: 281-530-6744


We are transmitting the following materials: NMFS priority pollutant scan.

Comments:

These are:
- ☒ For your Request
- ☐ For your Information
- ☐ For your Review and Approval
- ☐ For your Files
- ☐ For your Action

Sent via:
- ☐ U.S. Mail
- ☐ Courier
- ☐ Express Overnight
- ☐ Other - Interoffice

**AR 023498**

Sincerely,

Dayle Ormerod

cc:

AD #3 - 7/97

# NORTH CREEK ANALYTICAL

Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Parametrix Inc
5808 Lake Washington Blvd
Kirkland, WA 98033

Project: Lab Water Analysis
Project Number: 124C7541 BI
Project Manager: Dayle Ormerod

Sampled: 7/25/97
Received: 7/25/97
Reported: 8/25/97 13:43

## Total Metals by EPA 6000/7000 Series Methods
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Specific Method | Reporting Limit | Result | Units | N |
|---|---|---|---|---|---|---|---|---|
| NMFS (PX-97-1984) | | | B707501-01 | | | | Water | |
| Antimony | 0770898 | 7/30/97 | 8/1/97 | EPA 6010A | 0.100 | ND | mg/l | |
| Beryllium | " | " | " | EPA 6010A | 0.00500 | ND | " | |
| Cadmium | " | " | " | EPA 6010A | 0.00500 | ND | " | |
| Chromium | " | " | " | EPA 6010A | 0.0100 | ND | " | |
| Copper | " | " | " | EPA 6010A | 0.0300 | ND | " | |
| Nickel | " | " | " | EPA 6010A | 0.0300 | ND | " | |
| Thallium | " | " | " | EPA 6010A | 0.200 | ND | " | |
| Zinc | " | " | " | EPA 6010A | 0.0200 | 0.0204 | " | |
| Arsenic | 0870053 | 8/4/97 | 8/6/97 | EPA 7060A | 0.00400 | ND | " | |
| Lead | " | " | 8/5/97 | EPA 7421 | 0.00200 | ND | " | |
| Mercury | 0770889 | 7/30/97 | 7/30/97 | EPA 7470A | 0.00100 | ND | " | |
| Selenium | 0870053 | 8/4/97 | 8/6/97 | EPA 7740 | 0.00500 | 0.0190 | " | |
| Silver | 0870337 | 8/12/97 | 8/13/97 | EPA 7760A | 0.0200 | 0.0600 | " | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitio

Kirk Gendron, Project Manager

# NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

## Organochlorine Pesticides and PCBs by EPA Method 8081
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | N |
|---|---|---|---|---|---|---|---|---|
| NMFS (PX-97-1984) | | | B707501-01 | | | | Water | |
| Aldrin | 0770854 | 7/29/97 | 8/2/97 | | 0.0400 | ND | ug/l | |
| alpha-BHC | " | " | " | | 0.0200 | ND | " | |
| beta-BHC | " | " | " | | 0.0300 | ND | " | |
| delta-BHC | " | " | " | | 0.0200 | ND | " | |
| gamma-BHC (Lindane) | " | " | " | | 0.0300 | ND | " | |
| Chlordane (tech) | " | " | " | | 0.150 | ND | " | |
| alpha-Chlordane | " | " | " | | 0.0200 | ND | " | |
| gamma-Chlordane | " | " | " | | 0.0200 | ND | " | |
| 4,4'-DDD | " | " | " | | 0.0400 | ND | " | |
| 4,4'-DDE | " | " | " | | 0.0300 | ND | " | |
| 4,4'-DDT | " | " | " | | 0.0900 | ND | " | |
| Dieldrin | " | " | " | | 0.0700 | ND | " | |
| Endosulfan I | " | " | " | | 0.0300 | ND | " | |
| Endosulfan II | " | " | " | | 0.0500 | ND | " | |
| Endosulfan sulfate | " | " | " | | 0.0700 | ND | " | |
| Endrin | " | " | " | | 0.0800 | ND | " | |
| Endrin aldehyde | " | " | " | | 0.0800 | ND | " | |
| Heptachlor | " | " | " | | 0.0300 | ND | " | |
| Heptachlor epoxide | " | " | " | | 0.0300 | ND | " | |
| Methoxychlor | " | " | " | | 0.500 | ND | " | |
| Toxaphene | " | " | " | | 1.50 | ND | " | |
| Aroclor 1016 | " | " | 8/3/97 | | 0.100 | ND | " | |
| Aroclor 1221 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1232 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1242 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1248 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1254 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1260 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1262 | " | " | " | | 0.100 | ND | " | |
| Aroclor 1268 | " | " | " | | 0.100 | ND | " | |
| *Surrogate: TCX* | " | " | " | *40.0-130* | | *87.8* | % | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitio*

Kirk Gendron, Project Manager

**NORTH CREEK ANALYTICAL**
*Environmental Laboratory Services*

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Paramctrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

## Volatile Organic Compounds by EPA Method 8260A
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | N |
|---|---|---|---|---|---|---|---|---|
| NMFS (PX-97-1984) | | | B707501-01 | | | | Water | |
| Acetone | 0870126 | 8/5/97 | 8/5/97 | | 10.0 | 14.5 | ug/l | |
| Benzene | " | " | " | | 1.00 | ND | " | |
| Bromobenzene | " | " | " | | 1.00 | ND | " | |
| Bromochloromethane | " | " | " | | 1.00 | ND | " | |
| Bromodichloromethane | " | " | " | | 1.00 | ND | " | |
| Bromoform | " | " | " | | 1.00 | ND | " | |
| Bromomethane | " | " | " | | 1.00 | ND | " | |
| 2-Butanone | " | " | " | | 10.0 | ND | " | |
| n-Butylbenzene | " | " | " | | 1.00 | ND | " | |
| sec-Butylbenzene | " | " | " | | 1.00 | ND | " | |
| tert-Butylbenzene | " | " | " | | 1.00 | ND | " | |
| Carbon disulfide | " | " | " | | 1.00 | ND | " | |
| Carbon tetrachloride | " | " | " | | 1.00 | ND | " | |
| Chlorobenzene | " | " | " | | 1.00 | ND | " | |
| Chloroethane | " | " | " | | 1.00 | ND | " | |
| Chloroform | " | " | " | | 1.00 | ND | " | |
| Chloromethane | " | " | " | | 1.00 | ND | " | |
| 2-Chlorotoluene | " | " | " | | 1.00 | ND | " | |
| 4-Chlorotoluene | " | " | " | | 1.00 | ND | " | |
| Dibromochloromethane | " | " | " | | 1.00 | ND | " | |
| 1,2-Dibromo-3-chloropropane | " | " | " | | 5.00 | ND | " | |
| 1,2-Dibromoethane | " | " | " | | 1.00 | ND | " | |
| Dibromomethane | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,3-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,4-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| Dichlorodifluoromethane | " | " | " | | 1.00 | ND | " | |
| 1,1-Dichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,1-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| cis-1,2-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| trans-1,2-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichloropropane | " | " | " | | 1.00 | ND | " | |
| 1,3-Dichloropropane | " | " | " | | 1.00 | ND | " | |
| 2,2-Dichloropropane | " | " | " | | 1.00 | ND | " | |
| 1,1-Dichloropropene | " | " | " | | 1.00 | ND | " | |
| cis-1,3-Dichloropropene | " | " | " | | 1.00 | ND | " | |
| trans-1,3-Dichloropropene | " | " | " | | 1.00 | ND | " | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitio*

Kirk Gendron, Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ■ (425) 481-9200 ■ FAX 485-2992
SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

Parametrix Inc
5808 Lake Washington Blvd
Kirkland, WA 98033

Project: Lab Water Analysis
Project Number: 124C7541 BI
Project Manager: Dayle Ormerod

Sampled: 7/25/97
Received: 7/25/97
Reported: 8/25/97 13:43

## Volatile Organic Compounds by EPA Method 8260A
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | N |
|---|---|---|---|---|---|---|---|---|
| NMFS (PX-97-1984) (continued) | | | B707501-01 | | | | Water | |
| Ethylbenzene | 0870126 | 8/5/97 | 8/5/97 | | 1.00 | ND | ug/l | |
| Hexachlorobutadiene | " | " | " | | 1.00 | ND | " | |
| 2-Hexanone | " | " | " | | 10.0 | ND | " | |
| Isopropylbenzene | " | " | " | | 1.00 | ND | " | |
| p-Isopropyltoluene | " | " | " | | 1.00 | ND | " | |
| Methylene chloride | " | " | " | | 5.00 | ND | " | |
| 4-Methyl-2-pentanone | " | " | " | | 10.0 | ND | " | |
| Naphthalene | " | " | " | | 1.00 | ND | " | |
| n-Propylbenzene | " | " | " | | 1.00 | ND | " | |
| Styrene | " | " | " | | 1.00 | ND | " | |
| 1,1,1,2-Tetrachloroethane | " | " | " | | 1.00 | ND | " | |
| 1,1,2,2-Tetrachloroethane | " | " | " | | 1.00 | ND | " | |
| Tetrachloroethene | " | " | " | | 1.00 | ND | " | |
| Toluene | " | " | " | | 1.00 | ND | " | |
| 1,2,3-Trichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,2,4-Trichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,1,1-Trichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,1,2-Trichloroethane | " | " | " | | 1.00 | ND | " | |
| Trichloroethene | " | " | " | | 1.00 | ND | " | |
| Trichlorofluoromethane | " | " | " | | 1.00 | ND | " | |
| 1,2,3-Trichloropropane | " | " | " | | 1.00 | ND | " | |
| 1,2,4-Trimethylbenzene | " | " | " | | 1.00 | ND | " | |
| 1,3,5-Trimethylbenzene | " | " | " | | 1.00 | ND | " | |
| Vinyl chloride | " | " | " | | 1.00 | ND | " | |
| o-Xylene | " | " | " | | 1.00 | ND | " | |
| m,p-Xylene | " | " | " | | 1.00 | ND | " | |
| *Surrogate: 2-Bromopropene* | " | " | " | *80.0-120* | | *97.0* | % | |
| *Surrogate: 1,2-DCA-d4* | " | " | " | *80.0-120* | | *113* | " | |
| *Surrogate: Toluene-d8* | " | " | " | *80.0-120* | | *101* | " | |
| *Surrogate: 4-BFB* | " | " | " | *80.0-120* | | *109* | " | |

North Creek Analytical, Inc.

Kirk Gendron, Project Manager

*Refer to end of report for text of notes and definitio

# NORTH CREEK ANALYTICAL

*Environmental Laboratory Services*

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Parametrix Inc
5808 Lake Washington Blvd
Kirkland, WA 98033

Project: Lab Water Analysis
Project Number: 124C7541 BI
Project Manager: Dayle Ormerod

Sampled: 7/25/97
Received: 7/25/97
Reported: 8/25/97 13:43

## Semivolatile Organic Compounds by EPA Method 8270B
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | N. |
|---|---|---|---|---|---|---|---|---|
| NMFS (PX-97-1984) (continued) | | | B707501-01 | | | | Water | |
| Acenaphthene | 9708193 | 7/31/97 | 8/7/97 | | | | | |
| Acenaphthylene | " | " | " | | 4.7 | ND | ug/l | |
| Aniline | " | " | " | | 4.7 | ND | " | |
| Anthracene | " | " | " | | 4.7 | ND | " | |
| Benzoic Acid | " | " | " | | 9.4 | ND | " | |
| Benzo (a) anthracene | " | " | " | | 4.7 | ND | " | |
| Benzo (b) fluoranthene | " | " | " | | 4.7 | ND | " | |
| Benzo (k) fluoranthene | " | " | " | | 4.7 | ND | " | |
| Benzo (ghi) perylene | " | " | " | | 4.7 | ND | " | |
| Benzo (a) pyrene | " | " | " | | 4.7 | ND | " | |
| Benzyl alcohol | " | " | " | | 4.7 | ND | " | |
| Bis(2-chloroethoxy)methane | " | " | " | | 4.7 | ND | " | |
| Bis(2-chloroethyl)ether | " | " | " | | 4.7 | ND | " | |
| Bis(2-chloroisopropyl)ether | " | " | " | | 4.7 | ND | " | |
| Bis(2-ethylhexyl)phthalate | " | " | " | | 4.7 | ND | " | |
| 4-Bromophenyl phenyl ether | " | " | " | | 9.4 | 56 | " | |
| Butyl benzyl phthalate | " | " | " | | 4.7 | ND | " | |
| Carbazole | " | " | " | | 4.7 | ND | " | |
| 4-Chloroaniline | " | " | " | | 9.4 | ND | " | |
| 2-Chloronaphthalene | " | " | " | | 4.7 | ND | " | |
| 4-Chloro-3-methylphenol | " | " | " | | 4.7 | ND | " | |
| 2-Chlorophenol | " | " | " | | 4.7 | ND | " | |
| 4-Chlorophenyl phenyl ether | " | " | " | | 4.7 | ND | " | |
| Chrysene | " | " | " | | 4.7 | ND | " | |
| Dibenzo (a,h) anthracene | " | " | " | | 4.7 | ND | " | |
| Dibenzofuran | " | " | " | | 4.7 | ND | " | |
| Di-n-butyl phthalate | " | " | " | | 4.7 | ND | " | |
| 1,3-Dichlorobenzene | " | " | " | | 9.4 | ND | " | |
| 1,4-Dichlorobenzene | " | " | " | | 4.7 | ND | " | |
| 1,2-Dichlorobenzene | " | " | " | | 4.7 | ND | " | |
| 3,3'-Dichlorobenzidine | " | " | " | | 4.7 | ND | " | |
| 2,4-Dichlorophenol | " | " | " | | 9.4 | ND | " | |
| Diethyl phthalate | " | " | " | | 4.7 | ND | " | |
| 2,4-Dimethylphenol | " | " | " | | 4.7 | ND | " | |
| Dimethyl phthalate | " | " | " | | 4.7 | ND | " | |
| 4,6-Dinitro-2-methylphenol | " | " | " | | 9.4 | ND | " | |
| 2,4-Dinitrophenol | " | " | " | | 9.4 | ND | " | |
| 2,4-Dinitrotoluene | " | " | " | | 4.7 | ND | " | |
| | | | | | 4.7 | ND | " | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions*

Laura L Dutton, Director, Analytical Services



18939 120th Avenue N.E., Suite 101, Bothell, WA 98011-9508
East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132

**NORTH CREEK ANALYTICAL**
*Environmental Laboratory Services*

BOTHELL ■ (425) 481-9200 ■ FAX 485-2992
SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

## Semivolatile Organic Compounds by EPA Method 8270B
### North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | N |
|---|---|---|---|---|---|---|---|---|
| **NMFS (PX-97-1984) (continued)** | | | **B707501-01** | | | | **Water** | |
| 2,6-Dinitrotoluene | 9708193 | 7/31/97 | 8/7/97 | | 4.7 | ND | ug/l | |
| Di-n-octyl phthalate | " | " | " | | 4.7 | ND | " | |
| Fluoranthene | " | " | " | | 4.7 | ND | " | |
| Fluorene | " | " | " | | 4.7 | ND | " | |
| Hexachlorobenzene | " | " | " | | 4.7 | ND | " | |
| Hexachlorobutadiene | " | " | " | | 4.7 | ND | " | |
| Hexachlorocyclopentadiene | " | " | " | | 9.4 | ND | " | |
| Hexachloroethane | " | " | " | | 4.7 | ND | " | |
| Indeno (1,2,3-cd) pyrene | " | " | " | | 4.7 | ND | " | |
| Isophorone | " | " | " | | 4.7 | ND | " | |
| 2-Methylnaphthalene | " | " | " | | 4.7 | ND | " | |
| 2-Methylphenol | " | " | " | | 4.7 | ND | " | |
| 3 & 4-Methylphenol | " | " | " | | 4.7 | ND | " | |
| Naphthalene | " | " | " | | 4.7 | ND | " | |
| 2-Nitroaniline | " | " | " | | 9.4 | ND | " | |
| 3-Nitroaniline | " | " | " | | 9.4 | ND | " | |
| 4-Nitroaniline | " | " | " | | 9.4 | ND | " | |
| Nitrobenzene | " | " | " | | 4.7 | ND | " | |
| 2-Nitrophenol | " | " | " | | 4.7 | ND | " | |
| 4-Nitrophenol | " | " | " | | 9.4 | ND | " | |
| N-Nitrosodiphenylamine | " | " | " | | 4.7 | ND | " | |
| N-Nitrosodi-n-propylamine | " | " | " | | 4.7 | ND | " | |
| Pentachlorophenol | " | " | " | | 9.4 | ND | " | |
| Phenanthrene | " | " | " | | 4.7 | ND | " | |
| Phenol | " | " | " | | 4.7 | ND | " | |
| Pyrene | " | " | " | | 4.7 | ND | " | |
| 1,2,4-Trichlorobenzene | " | " | " | | 4.7 | ND | " | |
| 2,4,5-Trichlorophenol | " | " | " | | 9.4 | ND | " | |
| 2,4,6-Trichlorophenol | " | " | " | | 4.7 | ND | " | |
| *Surrogate: 2-FP* | " | " | " | *21-110* | | *71* | % | |
| *Surrogate: Phenol-d6* | " | " | " | *10-110* | | *79* | " | |
| *Surrogate: 2,4,6-TBP* | " | " | " | *35-114* | | *72* | " | |
| *Surrogate: Nitrobenzene-d5* | " | " | " | *43-116* | | *83* | " | |
| *Surrogate: 2-FBP* | " | " | " | *10-123* | | *50* | " | |
| *Surrogate: p-Terphenyl-d14* | " | " | " | *33-141* | | *68* | " | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions*

Laura L Dutton, Director, Analytical Services



18939 120th Avenue N.E., Suite 101, Bothell, WA 98011-9508
East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132

**NORTH CREEK ANALYTICAL**
*Environmental Laboratory Services*

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

**Total Metals by EPA 6000/7000 Series Methods/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0770889** | **Date Prepared: 7/30/97** | | | | **Extraction Method: BrCl Digestion** | | | | | |
| **Blank** | **0770889-BLK1** | | | | | | | | | |
| Mercury | 7/30/97 | | | ND | mg/l | 0.00100 | | | | |
| **LCS** | **0770889-BS1** | | | | | | | | | |
| Mercury | 7/30/97 | 0.00500 | | 0.00570 | mg/l | 70.0-130 | 114 | | | |
| **Duplicate** | **0770889-DUP1** | | **B707501-01** | | | | | | | |
| Mercury | 7/30/97 | | ND | ND | mg/l | | | 20.0 | | |
| **Matrix Spike** | **0770889-MS1** | | **B707501-01** | | | | | | | |
| Mercury | 7/30/97 | 0.00500 | ND | 0.00503 | mg/l | 75.0-125 | 101 | | | |
| **Matrix Spike Dup** | **0770889-MSD1** | | **B707501-01** | | | | | | | |
| Mercury | 7/30/97 | 0.00500 | ND | 0.00507 | mg/l | 75.0-125 | 101 | 20.0 | 0 | |
| **Batch: 0770898** | **Date Prepared: 7/30/97** | | | | **Extraction Method: EPA 3010** | | | | | |
| **Blank** | **0770898-BLK1** | | | | | | | | | |
| Antimony | 8/1/97 | | | ND | mg/l | 0.100 | | | | |
| Beryllium | " | | | ND | " | 0.00500 | | | | |
| Cadmium | " | | | ND | " | 0.00500 | | | | |
| Chromium | " | | | ND | " | 0.0100 | | | | |
| Copper | " | | | ND | " | 0.0300 | | | | |
| Nickel | " | | | ND | " | 0.0300 | | | | |
| Thallium | " | | | ND | " | 0.200 | | | | |
| Zinc | " | | | ND | " | 0.0200 | | | | |
| **LCS** | **0770898-BS1** | | | | | | | | | |
| Antimony | 8/1/97 | 1.00 | | 0.958 | mg/l | 80.0-120 | 95.8 | | | |
| Beryllium | " | 1.00 | | 0.938 | " | 80.0-120 | 93.8 | | | |
| Cadmium | " | 1.00 | | 0.944 | " | 80.0-120 | 94.4 | | | |
| Chromium | " | 1.00 | | 0.984 | " | 80.0-120 | 98.4 | | | |
| Copper | " | 1.00 | | 0.954 | " | 80.0-120 | 95.4 | | | |
| Nickel | " | 1.00 | | 0.947 | " | 80.0-120 | 94.7 | | | |
| Thallium | " | 1.00 | | 0.972 | " | 80.0-120 | 97.2 | | | |
| Zinc | " | 1.00 | | 0.951 | " | 80.0-120 | 95.1 | | | |
| **Duplicate** | **0770898-DUP1** | | **B707501-01** | | | | | | | |
| Antimony | 8/1/97 | | ND | ND | mg/l | | | 20.0 | | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitic

Kirk Gendron, Project Manager

**NORTH CREEK ANALYTICAL**
*Environmental Laboratory Services*

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Parametrix Inc
5808 Lake Washington Blvd
Kirkland, WA 98033

Project: Lab Water Analysis
Project Number: 124C7541 BI
Project Manager: Dayle Ormerod

Sampled: 7/25/97
Received: 7/25/97
Reported: 8/25/97 13:43

**Total Metals by EPA 6000/7000 Series Methods/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Duplicate (continued)** | **0770898-DUP1** | | **B707501-01** | | | | | | | |
| | 8/1/97 | | ND | ND | mg/l | | | 20.0 | | |
| Beryllium | " | | ND | ND | " | | | 20.0 | | |
| Cadmium | " | | ND | ND | " | | | 20.0 | | |
| Chromium | " | | ND | ND | " | | | 20.0 | | |
| Copper | " | | ND | ND | " | | | 20.0 | | |
| Nickel | " | | ND | ND | " | | | 20.0 | | |
| Thallium | " | | ND | ND | " | | | 20.0 | | |
| Zinc | " | | 0.0204 | 0.0750 | " | | | 20.0 | 114 | |
| **Matrix Spike** | **0770898-MS1** | | **B707501-01** | | | | | | | |
| Antimony | 8/1/97 | 1.00 | ND | 0.839 | mg/l | 80.0-120 | 83.9 | | | |
| Beryllium | " | 1.00 | ND | 0.757 | " | 80.0-120 | 75.7 | | | |
| Cadmium | " | 1.00 | ND | 0.794 | " | 80.0-120 | 79.4 | | | |
| Chromium | " | 1.00 | ND | 0.745 | " | 80.0-120 | 74.5 | | | |
| Copper | " | 1.00 | ND | 0.839 | " | 80.0-120 | 83.9 | | | |
| Nickel | " | 1.00 | ND | 0.701 | " | 80.0-120 | 70.1 | | | |
| Thallium | " | 1.00 | ND | 0.789 | " | 80.0-120 | 78.9 | | | |
| Zinc | " | 1.00 | 0.0204 | 0.852 | " | 80.0-120 | 83.2 | | | |
| **Matrix Spike** | **0770898-MS2** | | **B707501-01** | | | | | | | |
| Antimony | 8/1/97 | 2.00 | ND | 1.84 | mg/l | 80.0-120 | 92.0 | | | |
| Beryllium | " | 2.00 | ND | 1.67 | " | 80.0-120 | 83.5 | | | |
| Cadmium | " | 2.00 | ND | 1.76 | " | 80.0-120 | 88.0 | | | |
| Chromium | " | 2.00 | ND | 1.70 | " | 80.0-120 | 85.0 | | | |
| Copper | " | 2.00 | ND | 1.78 | " | 80.0-120 | 89.0 | | | |
| Nickel | " | 2.00 | ND | 1.64 | " | 80.0-120 | 82.0 | | | |
| Thallium | " | 2.00 | ND | 1.79 | " | 80.0-120 | 89.5 | | | |
| Zinc | " | 2.00 | 0.0204 | 1.80 | " | 80.0-120 | 89.0 | | | |
| **Matrix Spike Dup** | **0770898-MSD1** | | **B707501-01** | | | | | | | |
| Antimony | 8/1/97 | 1.00 | ND | 0.813 | mg/l | 80.0-120 | 81.3 | 20.0 | 3.15 | |
| Beryllium | " | 1.00 | ND | 0.745 | " | 80.0-120 | 74.5 | 20.0 | 1.60 | |
| Cadmium | " | 1.00 | ND | 0.794 | " | 80.0-120 | 79.4 | 20.0 | 0 | |
| Chromium | " | 1.00 | ND | 0.743 | " | 80.0-120 | 74.3 | 20.0 | 0.269 | |
| Copper | " | 1.00 | ND | 0.841 | " | 80.0-120 | 84.1 | 20.0 | 0.238 | |
| Nickel | " | 1.00 | ND | 0.686 | " | 80.0-120 | 68.6 | 20.0 | 2.16 | |
| Thallium | " | 1.00 | ND | 0.798 | " | 80.0-120 | 79.8 | 20.0 | 1.13 | |
| Zinc | " | 1.00 | 0.0204 | 0.836 | " | 80.0-120 | 81.6 | 20.0 | 1.94 | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitio

Kirk Gendron, Project Manager

**NORTH CREEK ANALYTICAL**
*Environmental Laboratory Services*

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc | Project: Lab Water Analysis | Sampled: 7/25/97 |
| 5808 Lake Washington Blvd | Project Number: 124C7541 BI | Received: 7/25/97 |
| Kirkland, WA 98033 | Project Manager: Dayle Ormerod | Reported: 8/25/97 13:43 |

**Total Metals by EPA 6000/7000 Series Methods/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0870053** | **Date Prepared: 8/4/97** | | | | **Extraction Method: EPA 3020** | | | | | |
| **Blank** | **0870053-BLK1** | | | | | | | | | |
| Arsenic | 8/6/97 | | | ND | mg/l | 0.00400 | | | | |
| Lead | 8/5/97 | | | ND | " | 0.00200 | | | | |
| Selenium | 8/6/97 | | | ND | " | 0.00500 | | | | |
| **LCS** | **0870053-BS1** | | | | | | | | | |
| Arsenic | 8/6/97 | 0.0500 | | 0.0552 | mg/l | 75.0-125 | 110 | | | |
| Lead | 8/5/97 | 0.0260 | | 0.0269 | " | 75.0-125 | 103 | | | |
| Selenium | 8/6/97 | 0.0250 | | 0.0226 | " | 75.0-125 | 90.4 | | | |
| **Duplicate** | **0870053-DUP1** | | **B707523-04** | | | | | | | |
| Arsenic | 8/6/97 | | ND | ND | mg/l | | | 20.0 | | |
| Lead | 8/5/97 | | ND | ND | " | | | 20.0 | | |
| Selenium | 8/6/97 | | ND | ND | " | | | 20.0 | | |
| **Matrix Spike** | **0870053-MS1** | | **B707523-04** | | | | | | | |
| Arsenic | 8/6/97 | 0.0500 | ND | 0.0526 | mg/l | 70.0-130 | 105 | | | |
| Lead | 8/5/97 | 0.0260 | ND | 0.0260 | " | 70.0-130 | 100 | | | |
| Selenium | 8/6/97 | 0.0250 | ND | 0.0199 | " | 70.0-130 | 79.6 | | | |
| **Matrix Spike Dup** | **0870053-MSD1** | | **B707523-04** | | | | | | | |
| Arsenic | 8/6/97 | 0.0500 | ND | 0.0507 | mg/l | 70.0-130 | 101 | 20.0 | 3.88 | |
| Lead | 8/5/97 | 0.0260 | ND | 0.0264 | " | 70.0-130 | 102 | 20.0 | 1.98 | |
| Selenium | 8/6/97 | 0.0250 | ND | 0.0207 | " | 70.0-130 | 82.8 | 20.0 | 3.94 | |
| **Batch: 0870337** | **Date Prepared: 8/12/97** | | | | **Extraction Method: EPA 3010** | | | | | |
| **Blank** | **0870337-BLK1** | | | | | | | | | |
| Silver | 8/13/97 | | | ND | mg/l | 0.0200 | | | | |
| **LCS** | **0870337-BS1** | | | | | | | | | |
| Silver | 8/13/97 | 1.00 | | 0.933 | mg/l | 75.0-125 | 93.3 | | | |
| **Duplicate** | **0870337-DUP1** | | **B708007-01** | | | | | | | |
| Silver | 8/13/97 | | ND | ND | mg/l | | | 20.0 | | |
| **Matrix Spike** | **0870337-MS1** | | **B708007-01** | | | | | | | |
| Silver | 8/13/97 | 1.00 | ND | 0.914 | mg/l | 75.0-125 | 91.4 | | | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definiti

Kirk Gendron, Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

**Total Metals by EPA 6000/7000 Series Methods/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| <u>Matrix Spike Dup</u> | <u>0870337-MSD1</u> | | <u>B708007-01</u> | | | | | | | |
| Silver | 8/13/97 | 1.00 | ND | 0.853 | mg/l | 75.0-125 | 85.3 | 20.0 | 6.90 | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitic

Kirk Gendron, Project Manager

# NORTH CREEK ANALYTICAL
*Environmental Laboratory Services*

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

## Organochlorine Pesticides and PCBs by EPA Method 8081/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0770854** | **Date Prepared: 7/29/97** | | | | | **Extraction Method: EPA 3520/600 Series** | | | | |
| **Blank** | **0770854-BLK1** | | | | | | | | | |
| Aldrin | 8/2/97 | | | ND | ug/l | 0.0400 | | | | |
| alpha-BHC | " | | | ND | " | 0.0200 | | | | |
| beta-BHC | " | | | ND | " | 0.0300 | | | | |
| delta-BHC | " | | | ND | " | 0.0200 | | | | |
| gamma-BHC (Lindane) | " | | | ND | " | 0.0300 | | | | |
| Chlordane (tech) | " | | | ND | " | 0.150 | | | | |
| alpha-Chlordane | " | | | ND | " | 0.0200 | | | | |
| gamma-Chlordane | " | | | ND | " | 0.0200 | | | | |
| 4,4'-DDD | " | | | ND | " | 0.0400 | | | | |
| 4,4'-DDE | " | | | ND | " | 0.0300 | | | | |
| 4,4'-DDT | " | | | ND | " | 0.0900 | | | | |
| Dieldrin | " | | | ND | " | 0.0700 | | | | |
| Endosulfan I | " | | | ND | " | 0.0300 | | | | |
| Endosulfan II | " | | | ND | " | 0.0500 | | | | |
| Endosulfan sulfate | " | | | ND | " | 0.0700 | | | | |
| Endrin | " | | | ND | " | 0.0800 | | | | |
| Endrin aldehyde | " | | | ND | " | 0.0800 | | | | |
| Heptachlor | " | | | ND | " | 0.0300 | | | | |
| Heptachlor epoxide | " | | | ND | " | 0.0300 | | | | |
| Methoxychlor | " | | | ND | " | 0.500 | | | | |
| Toxaphene | " | | | ND | " | 1.50 | | | | |
| Aroclor 1016 | 8/3/97 | | | ND | " | 0.100 | | | | |
| Aroclor 1221 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1232 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1242 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1248 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1254 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1260 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1262 | " | | | ND | " | 0.100 | | | | |
| Aroclor 1268 | " | | | ND | " | 0.100 | | | | |
| *Surrogate: TCX* | " | *0.200* | | *0.163* | " | *40.0-130* | *81.5* | | | |
| **LCS** | **0770854-BS1** | | | | | | | | | |
| Aldrin | 8/2/97 | 0.250 | | 0.218 | ug/l | 45.0-143 | 87.2 | | | |
| gamma-BHC (Lindane) | " | 0.250 | | 0.194 | " | 45.0-147 | 77.6 | | | |
| Heptachlor | " | 0.250 | | 0.122 | " | 37.0-156 | 48.8 | | | |
| Aroclor 1260 | 8/3/97 | 10.0 | | 7.65 | " | 33.0-122 | 76.5 | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitio*

Kirk Gendron, Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Parametrix Inc
5808 Lake Washington Blvd
Kirkland, WA 98033

Project: Lab Water Analysis
Project Number: 124C7541 BI
Project Manager: Dayle Ormerod

Sampled: 7/25/97
Received: 7/25/97
Reported: 8/25/97 13:43

**Organochlorine Pesticides and PCBs by EPA Method 8081/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **LCS (continued)** | **0770854-BS1** | | | | | | | | | |
| *Surrogate: TCX* | *8/3/97* | *0.200* | | *0.166* | *ug/l* | *40.0-130* | *83.0* | | | |
| **LCS Dup** | **0770854-BSD1** | | | | | | | | | |
| Aldrin | 8/2/97 | 0.250 | | 0.220 | ug/l | 45.0-143 | 88.0 | 36.0 | 0.913 | |
| gamma-BHC (Lindane) | " | 0.250 | | 0.197 | " | 45.0-147 | 78.8 | 25.0 | 1.53 | |
| Heptachlor | " | 0.250 | | 0.124 | " | 37.0-156 | 49.6 | 37.0 | 1.63 | |
| Aroclor 1260 | 8/3/97 | 10.0 | | 7.77 | " | 33.0-122 | 77.7 | 21.0 | 1.56 | |
| *Surrogate: TCX* | " | *0.200* | | *0.177* | " | *40.0-130* | *88.5* | | | |

North Creek Analytical, Inc.

Kirk Gendron, Project Manager

**Refer to end of report for text of notes and definiti*

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

**Volatile Organic Compounds by EPA Method 8260A/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | No |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0870126** | **Date Prepared: 8/5/97** | | | | **Extraction Method: EPA 5030** | | | | | |
| **Blank** | **0870126-BLK1** | | | | | | | | | |
| Acetone | 8/5/97 | | | ND | ug/l | 10.0 | | | | |
| Benzene | " | | | ND | " | 1.00 | | | | |
| Bromobenzene | " | | | ND | " | 1.00 | | | | |
| Bromochloromethane | " | | | ND | " | 1.00 | | | | |
| Bromodichloromethane | " | | | ND | " | 1.00 | | | | |
| Bromoform | " | | | ND | " | 1.00 | | | | |
| Bromomethane | " | | | ND | " | 1.00 | | | | |
| 2-Butanone | " | | | ND | " | 10.0 | | | | |
| n-Butylbenzene | " | | | ND | " | 1.00 | | | | |
| sec-Butylbenzene | " | | | ND | " | 1.00 | | | | |
| tert-Butylbenzene | " | | | ND | " | 1.00 | | | | |
| Carbon disulfide | " | | | ND | " | 1.00 | | | | |
| Carbon tetrachloride | " | | | ND | " | 1.00 | | | | |
| Chlorobenzene | " | | | ND | " | 1.00 | | | | |
| Chloroethane | " | | | ND | " | 1.00 | | | | |
| Chloroform | " | | | ND | " | 1.00 | | | | |
| Chloromethane | " | | | ND | " | 1.00 | | | | |
| 2-Chlorotoluene | " | | | ND | " | 1.00 | | | | |
| 4-Chlorotoluene | " | | | ND | " | 1.00 | | | | |
| Dibromochloromethane | " | | | ND | " | 1.00 | | | | |
| 1,2-Dibromo-3-chloropropane | " | | | ND | " | 5.00 | | | | |
| 1,2-Dibromoethane | " | | | ND | " | 1.00 | | | | |
| Dibromomethane | " | | | ND | " | 1.00 | | | | |
| 1,2-Dichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,3-Dichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,4-Dichlorobenzene | " | | | ND | " | 1.00 | | | | |
| Dichlorodifluoromethane | " | | | ND | " | 1.00 | | | | |
| 1,1-Dichloroethane | " | | | ND | " | 1.00 | | | | |
| 1,2-Dichloroethane | " | | | ND | " | 1.00 | | | | |
| 1,1-Dichloroethene | " | | | ND | " | 1.00 | | | | |
| cis-1,2-Dichloroethene | " | | | ND | " | 1.00 | | | | |
| trans-1,2-Dichloroethene | " | | | ND | " | 1.00 | | | | |
| 1,2-Dichloropropane | " | | | ND | " | 1.00 | | | | |
| 1,3-Dichloropropane | " | | | ND | " | 1.00 | | | | |
| 2,2-Dichloropropane | " | | | ND | " | 1.00 | | | | |
| 1,1-Dichloropropene | " | | | ND | " | 1.00 | | | | |
| cis-1,3-Dichloropropene | " | | | ND | " | 1.00 | | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitio*

Kirk Gendron, Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

## Volatile Organic Compounds by EPA Method 8260A/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Blank (continued)** | **0870126-BLK1** | | | | | | | | | |
| trans-1,3-Dichloropropene | 8/5/97 | | | ND | ug/l | 1.00 | | | | |
| Ethylbenzene | " | | | ND | " | 1.00 | | | | |
| Hexachlorobutadiene | " | | | ND | " | 1.00 | | | | |
| 2-Hexanone | " | | | ND | " | 10.0 | | | | |
| Isopropylbenzene | " | | | ND | " | 1.00 | | | | |
| p-Isopropyltoluene | " | | | ND | " | 1.00 | | | | |
| Methylene chloride | " | | | ND | " | 5.00 | | | | |
| 4-Methyl-2-pentanone | " | | | ND | " | 10.0 | | | | |
| Naphthalene | " | | | ND | " | 1.00 | | | | |
| n-Propylbenzene | " | | | ND | " | 1.00 | | | | |
| Styrene | " | | | ND | " | 1.00 | | | | |
| 1,1,1,2-Tetrachloroethane | " | | | ND | " | 1.00 | | | | |
| 1,1,2,2-Tetrachloroethane | " | | | ND | " | 1.00 | | | | |
| Tetrachloroethene | " | | | ND | " | 1.00 | | | | |
| Toluene | " | | | ND | " | 1.00 | | | | |
| 1,2,3-Trichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,2,4-Trichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,1,1-Trichloroethane | " | | | ND | " | 1.00 | | | | |
| 1,1,2-Trichloroethane | " | | | ND | " | 1.00 | | | | |
| Trichloroethene | " | | | ND | " | 1.00 | | | | |
| Trichlorofluoromethane | " | | | ND | " | 1.00 | | | | |
| 1,2,3-Trichloropropane | " | | | ND | " | 1.00 | | | | |
| 1,2,4-Trimethylbenzene | " | | | ND | " | 1.00 | | | | |
| 1,3,5-Trimethylbenzene | " | | | ND | " | 1.00 | | | | |
| Vinyl chloride | " | | | ND | " | 1.00 | | | | |
| o-Xylene | " | | | ND | " | 1.00 | | | | |
| m,p-Xylene | " | | | ND | " | 1.00 | | | | |
| *Surrogate: 2-Bromopropene* | " | *20.0* | | *19.4* | " | *80.0-120* | *97.0* | | | |
| *Surrogate: 1,2-DCA-d4* | " | *20.0* | | *21.2* | " | *80.0-120* | *106* | | | |
| *Surrogate: Toluene-d8* | " | *20.0* | | *20.6* | " | *80.0-120* | *103* | | | |
| *Surrogate: 4-BFB* | " | *20.0* | | *21.5* | " | *80.0-120* | *108* | | | |
| **LCS** | **0870126-BS1** | | | | | | | | | |
| Benzene | 8/5/97 | 10.0 | | 10.8 | ug/l | 80.0-120 | 108 | | | |
| Chlorobenzene | " | 10.0 | | 10.4 | " | 80.0-120 | 104 | | | |
| 1,1-Dichloroethene | " | 10.0 | | 10.6 | " | 80.0-120 | 106 | | | |
| Toluene | " | 10.0 | | 10.5 | " | 80.0-120 | 105 | | | |
| Trichloroethene | " | 10.0 | | 10.6 | " | 80.0-120 | 106 | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definiti*

Kirk Gendron, Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ■ (425) 481-9200 ■ FAX 485-2992
SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc | Project: Lab Water Analysis | Sampled: 7/25/97 |
| 5808 Lake Washington Blvd | Project Number: 124C7541 BI | Received: 7/25/97 |
| Kirkland, WA 98033 | Project Manager: Dayle Ormerod | Reported: 8/25/97 13:43 |

**Volatile Organic Compounds by EPA Method 8260A/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **LCS (continued)** | **0870126-BS1** | | | | | | | | | |
| *Surrogate: 2-Bromopropene* | *8/5/97* | *20.0* | | *19.3* | *ug/l* | *80.0-120* | *96.5* | | | |
| *Surrogate: 1,2-DCA-d4* | " | *20.0* | | *21.3* | " | *80.0-120* | *106* | | | |
| *Surrogate: Toluene-d8* | " | *20.0* | | *20.3* | " | *80.0-120* | *101* | | | |
| *Surrogate: 4-BFB* | " | *20.0* | | *23.6* | " | *80.0-120* | *118* | | | |
| **Matrix Spike** | **0870126-MS1** | | **B707501-01** | | | | | | | |
| Benzene | 8/5/97 | 10.0 | ND | 11.1 | ug/l | 80.0-120 | 111 | | | |
| Chlorobenzene | " | 10.0 | ND | 10.7 | " | 80.0-120 | 107 | | | |
| 1,1-Dichloroethene | " | 10.0 | ND | 11.2 | " | 80.0-120 | 112 | | | |
| Toluene | " | 10.0 | ND | 10.8 | " | 80.0-120 | 108 | | | |
| Trichloroethene | " | 10.0 | ND | 10.8 | " | 80.0-120 | 108 | | | |
| *Surrogate: 2-Bromopropene* | " | *20.0* | | *19.4* | " | *80.0-120* | *97.0* | | | |
| *Surrogate: 1,2-DCA-d4* | " | *20.0* | | *22.7* | " | *80.0-120* | *114* | | | |
| *Surrogate: Toluene-d8* | " | *20.0* | | *20.1* | " | *80.0-120* | *101* | | | |
| *Surrogate: 4-BFB* | " | *20.0* | | *23.9* | " | *80.0-120* | *119* | | | |
| **Matrix Spike Dup** | **0870126-MSD1** | | **B707501-01** | | | | | | | |
| Benzene | 8/5/97 | 10.0 | ND | 11.2 | ug/l | 80.0-120 | 112 | 15.0 | 0.897 | |
| Chlorobenzene | " | 10.0 | ND | 10.7 | " | 80.0-120 | 107 | 15.0 | 0 | |
| 1,1-Dichloroethene | " | 10.0 | ND | 10.9 | " | 80.0-120 | 109 | 15.0 | 2.71 | |
| Toluene | " | 10.0 | ND | 10.7 | " | 80.0-120 | 107 | 15.0 | 0.930 | |
| Trichloroethene | " | 10.0 | ND | 10.9 | " | 80.0-120 | 109 | 15.0 | 0.922 | |
| *Surrogate: 2-Bromopropene* | " | *20.0* | | *18.9* | " | *80.0-120* | *94.5* | | | |
| *Surrogate: 1,2-DCA-d4* | " | *20.0* | | *22.9* | " | *80.0-120* | *114* | | | |
| *Surrogate: Toluene-d8* | " | *20.0* | | *20.1* | " | *80.0-120* | *101* | | | |
| *Surrogate: 4-BFB* | " | *20.0* | | *23.4* | " | *80.0-120* | *117* | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitio*

Kirk Gendron, Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

**Semivolatile Organic Compounds by EPA Method 8270B/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 9708193** | **Date Prepared: 7/31/97** | | | | **Extraction Method: EPA 3510/600 Series** | | | | | |
| **Blank** | **9708193-BLK1** | | | | | | | | | |
| Acenaphthene | 8/6/97 | | | ND | ug/l | 5.00 | | | | |
| Acenaphthylene | " | | | ND | " | 5.00 | | | | |
| Aniline | " | | | ND | " | 5.00 | | | | |
| Anthracene | " | | | ND | " | 10.0 | | | | |
| Benzoic Acid | " | | | ND | " | 5.00 | | | | |
| Benzo (a) anthracene | " | | | ND | " | 5.00 | | | | |
| Benzo (b) fluoranthene | " | | | ND | " | 5.00 | | | | |
| Benzo (k) fluoranthene | " | | | ND | " | 5.00 | | | | |
| Benzo (ghi) perylene | " | | | ND | " | 5.00 | | | | |
| Benzo (a) pyrene | " | | | ND | " | 5.00 | | | | |
| Benzyl alcohol | " | | | ND | " | 10.0 | | | | |
| Bis(2-chloroethoxy)methane | " | | | ND | " | 10.0 | | | | |
| Bis(2-chloroethyl)ether | " | | | ND | " | 10.0 | | | | |
| Bis(2-chloroisopropyl)ether | " | | | ND | " | 10.0 | | | | |
| Bis(2-ethylhexyl)phthalate | " | | | ND | " | 20.0 | | | | |
| 4-Bromophenyl phenyl ether | " | | | 83 | " | 10.0 | | | | |
| Butyl benzyl phthalate | " | | | ND | " | 5.00 | | | | |
| Carbazole | " | | | ND | " | 10.0 | | | | |
| 4-Chloroaniline | " | | | ND | " | 5.00 | | | | |
| 2-Chloronaphthalene | " | | | ND | " | 10.0 | | | | |
| 4-Chloro-3-methylphenol | " | | | ND | " | 10.0 | | | | |
| 2-Chlorophenol | " | | | ND | " | 10.0 | | | | |
| 4-Chlorophenyl phenyl ether | " | | | ND | " | 10.0 | | | | |
| Chrysene | " | | | ND | " | 5.00 | | | | |
| Dibenzo (a,h) anthracene | " | | | ND | " | 5.00 | | | | |
| Dibenzofuran | " | | | ND | " | 10.0 | | | | |
| Di-n-butyl phthalate | " | | | ND | " | 5.00 | | | | |
| 1,3-Dichlorobenzene | " | | | ND | " | 5.00 | | | | |
| 1,4-Dichlorobenzene | " | | | ND | " | 5.00 | | | | |
| 1,2-Dichlorobenzene | " | | | ND | " | 5.00 | | | | |
| 3,3'-Dichlorobenzidine | " | | | ND | " | 20.0 | | | | |
| 2,4-Dichlorophenol | " | | | ND | " | 10.0 | | | | |
| Diethyl phthalate | " | | | ND | " | 10.0 | | | | |
| 2,4-Dimethylphenol | " | | | ND | " | 10.0 | | | | |
| Dimethyl phthalate | " | | | ND | " | 10.0 | | | | |
| 4,6-Dinitro-2-methylphenol | " | | | ND | " | 10.0 | | | | |
| 2,4-Dinitrophenol | " | | | ND | " | 10.0 | | | | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definiti

Laura L Dutton, Director, Analytical Services

18939 120th Avenue N.E., Suite 101, Bothell, WA 98011-9508
East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Parametrix Inc
5808 Lake Washington Blvd
Kirkland, WA 98033

Project: Lab Water Analysis
Project Number: 124C7541 BI
Project Manager: Dayle Ormerod

Sampled: 7/25/97
Received: 7/25/97
Reported: 8/25/97 13:43

## Semivolatile Organic Compounds by EPA Method 8270B/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | N |
|---|---|---|---|---|---|---|---|---|---|---|
| **Blank (continued)** | **9708193-BLK1** | | | | | | | | | |
| 2,4-Dinitrotoluene | 8/6/97 | | | ND | ug/l | 10.0 | | | | |
| 2,6-Dinitrotoluene | " | | | ND | " | 10.0 | | | | |
| Di-n-octyl phthalate | " | | | ND | " | 5.00 | | | | |
| Fluoranthene | " | | | ND | " | 5.00 | | | | |
| Fluorene | " | | | ND | " | 10.0 | | | | |
| Hexachlorobenzene | " | | | ND | " | 10.0 | | | | |
| Hexachlorobutadiene | " | | | ND | " | 5.00 | | | | |
| Hexachlorocyclopentadiene | " | | | ND | " | 5.00 | | | | |
| Hexachloroethane | " | | | ND | " | 10.0 | | | | |
| Indeno (1,2,3-cd) pyrene | " | | | ND | " | 5.00 | | | | |
| Isophorone | " | | | ND | " | 10.0 | | | | |
| 2-Methylnaphthalene | " | | | ND | " | 10.0 | | | | |
| 2-Methylphenol | " | | | ND | " | 10.0 | | | | |
| 3 & 4-Methylphenol | " | | | ND | " | 10.0 | | | | |
| Naphthalene | " | | | ND | " | 10.0 | | | | |
| 2-Nitroaniline | " | | | ND | " | 20.0 | | | | |
| 3-Nitroaniline | " | | | ND | " | 10.0 | | | | |
| 4-Nitroaniline | " | | | ND | " | 10.0 | | | | |
| Nitrobenzene | " | | | ND | " | 10.0 | | | | |
| 2-Nitrophenol | " | | | ND | " | 5.00 | | | | |
| 4-Nitrophenol | " | | | ND | " | 10.0 | | | | |
| N-Nitrosodiphenylamine | " | | | ND | " | 10.0 | | | | |
| N-Nitrosodi-n-propylamine | " | | | ND | " | 10.0 | | | | |
| Pentachlorophenol | " | | | ND | " | 10.0 | | | | |
| Phenanthrene | " | | | ND | " | 10.0 | | | | |
| Phenol | " | | | ND | " | 10.0 | | | | |
| Pyrene | " | | | ND | " | 5.00 | | | | |
| 1,2,4-Trichlorobenzene | " | | | ND | " | 5.00 | | | | |
| 2,4,5-Trichlorophenol | " | | | ND | " | 10.0 | | | | |
| 2,4,6-Trichlorophenol | " | | | ND | " | 10.0 | | | | |
| *Surrogate: 2-FP* | " | 50.0 | | 44 | " | 21-110 | | | | |
| *Surrogate: Phenol-d6* | " | 50.0 | | 77 | " | 10-110 | | | | |
| *Surrogate: 2,4,6-TBP* | " | 50.0 | | 83 | " | 35-114 | | | | |
| *Surrogate: Nitrobenzene-d5* | " | 50.0 | | 90 | " | 43-116 | | | | |
| *Surrogate: 2-FBP* | " | 50.0 | | 27 | " | 10-123 | | | | |
| *Surrogate: p-Terphenyl-d14* | " | 50.0 | | 67 | " | 33-141 | | | | |

North Creek Analytical, Inc.

*Refer to end of report for text of notes and definitic

Laura B Dutton, Director, Analytical Services

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ▪ (425) 481-9200 ▪ FAX 485-2992
SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

**Semivolatile Organic Compounds by EPA Method 8270B/Quality Control**
**North Creek Analytical - Bothell**

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit Recov. Limits | Recov. % | RPD Limit | RPD % | 
|---|---|---|---|---|---|---|---|---|---|
| LCS | 9708193-BS1 | | | | | | | | |
| Acenaphthene | 8/6/97 | 100 | | 95 | ug/l | 42.0-110 | 95.0 | | |
| 4-Chloro-3-methylphenol | " | 200 | | 170 | " | 35.0-110 | 85.0 | | |
| 2-Chlorophenol | " | 200 | | 160 | " | 45.0-110 | 80.0 | | |
| 1,4-Dichlorobenzene | " | 100 | | 85 | " | 23.0-110 | 85.0 | | |
| 2,4-Dinitrotoluene | " | 100 | | 86 | " | 51.0-110 | 86.0 | | |
| 4-Nitrophenol | " | 200 | | 180 | " | 16.0-110 | 90.0 | | |
| N-Nitrosodi-n-propylamine | " | 100 | | 98 | " | 34.0-115 | 98.0 | | |
| Pentachlorophenol | " | 200 | | 200 | " | 30.0-124 | 100 | | |
| Phenol | " | 200 | | 170 | " | 39.0-110 | 85.0 | | |
| Pyrene | " | 100 | | 83 | " | 49.0-113 | 83.0 | | |
| 1,2,4-Trichlorobenzene | " | 100 | | 100 | " | 17.0-110 | 100 | | |
| *Surrogate: 2-FP* | " | | | | " | *21-110* | *69* | | |
| *Surrogate: Phenol-d6* | " | | | | " | *10-110* | *89* | | |
| *Surrogate: 2,4,6-TBP* | " | | | | " | *35-114* | *91* | | |
| *Surrogate: Nitrobenzene-d5* | " | | | | " | *43-116* | *97* | | |
| *Surrogate: 2-FBP* | " | | | | " | *10-123* | *69* | | |
| *Surrogate: p-Terphenyl-d14* | " | | | | " | *33-141* | *66* | | |
| LCS Dup | 9708193-BSD1 | | | | | | | | |
| Acenaphthene | 8/6/97 | 100 | | 90 | ug/l | 42.0-110 | 90.0 | 23.0 | 5.41 |
| 4-Chloro-3-methylphenol | " | 200 | | 150 | " | 35.0-110 | 75.0 | 25.0 | 12.5 |
| 2-Chlorophenol | " | 200 | | 150 | " | 45.0-110 | 75.0 | 26.0 | 6.45 |
| 1,4-Dichlorobenzene | " | 100 | | 80 | " | 23.0-110 | 80.0 | 35.0 | 6.06 |
| 2,4-Dinitrotoluene | " | 100 | | 83 | " | 51.0-110 | 83.0 | 17.0 | 3.55 |
| 4-Nitrophenol | " | 200 | | 170 | " | 16.0-110 | 85.0 | 20.0 | 5.71 |
| N-Nitrosodi-n-propylamine | " | 100 | | 89 | " | 34.0-115 | 89.0 | 26.0 | 9.63 |
| Pentachlorophenol | " | 200 | | 190 | " | 30.0-124 | 95.0 | 31.0 | 5.13 |
| Phenol | " | 200 | | 160 | " | 39.0-110 | 80.0 | 27.0 | 6.06 |
| Pyrene | " | 100 | | 76 | " | 49.0-113 | 76.0 | 21.0 | 8.81 |
| 1,2,4-Trichlorobenzene | " | 100 | | 100 | " | 17.0-110 | 100 | 36.0 | 0 |
| *Surrogate: 2-FP* | " | | | | " | *21-110* | *66* | | |
| *Surrogate: Phenol-d6* | " | | | | " | *10-110* | *82* | | |
| *Surrogate: 2,4,6-TBP* | " | | | | " | *35-114* | *86* | | |
| *Surrogate: Nitrobenzene-d5* | " | | | | " | *43-116* | *90* | | |
| *Surrogate: 2-FBP* | " | | | | " | *10-123* | *61* | | |
| *Surrogate: p-Terphenyl-d14* | " | | | | " | *33-141* | *61* | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definit.*

Laura L Dutton, Director, Analytical Services

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ■ (425) 481-9200 ■ FAX 485-2992
SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

| | | |
|---|---|---|
| Parametrix Inc<br>5808 Lake Washington Blvd<br>Kirkland, WA 98033 | Project: Lab Water Analysis<br>Project Number: 124C7541 BI<br>Project Manager: Dayle Ormerod | Sampled: 7/25/97<br>Received: 7/25/97<br>Reported: 8/25/97 13:43 |

## Notes and Definitions

| # | Note |
|---|---|
| 1 | The spike recovery for this QC sample is outside of established control limits. Review of associated batch QC indicates the recovery for this analyte does not represent an out-of-control condition for the batch. |
| DET | Analyte DETECTED |
| ND | Analyte NOT DETECTED at or above the reporting limit |
| NR | Not Reported |
| dry | Sample results reported on a dry weight basis |
| Recov. | Recovery |
| RPD | Relative Percent Difference |

North Creek Analytical, Inc.

Kirk Gendron, Project Manager

Due to a clerical error this number has been omitted.

APPENDIX G

HEALTH AND SAFETY PLAN

# APPENDIX A

# HEALTH AND SAFETY PLAN
# HAMM CREEK AND KENCO MARINE SEDIMENT/SOIL CHARACTERIZATIONS

June 13, 1996

Submitted to:

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, WA 98124

Submitted by:

Science Applications International Corporation
Environmental Sciences Division
18706 North Creek Parkway, Suite 110
Bothell, WA 98011

TABLE OF CONTENTS

**THIS HEALTH AND SAFETY PLAN APPLIES TO THE EMPLOYEES OF SAIC AT THE INVESTIGATION SITES. THE SAIC SITE SAFETY OFFICER, SAIC PROJECT TEAM LEADER, AND EVERY MEMBER OF THE FIELD INVESTIGATION TEAM ARE RESPONSIBLE FOR THE IMPLEMENTATION OF THIS HEALTH AND SAFETY PLAN. SAIC WILL PROVIDE A COPY OF THE HEALTH AND SAFETY PLAN TO ALL SAIC PERSONNEL AND REQUIRES ALL PERSONNEL TO FOLLOW THESE PROTOCOLS.**

# INTRODUCTION

## SCOPE AND APPLICABILITY

The information provided in this plan was developed for use by Science Applications International Corporation (SAIC) in support of the Hamm Creek and Kenco Marine sediment/soil characterization studies for the purpose of assigning responsibilities, establishing personal protection standards and mandatory safety procedures, and to provide for contingencies that may arise while SAIC operations are conducted at the Hamm Creek and Kenco sites. SAIC disclaims responsibility for any other use of this information other than the express purpose for which it is intended and assumes no liability for the use of this information for any other purpose. The evaluation of potential hazards and their controls reflect professional judgments subject to the accuracy and completeness of information available when this plan was prepared.

Hazards are associated with the equipment and supplies used in this program, as well as the general rigors of work at sea. The purpose of a health and safety plan (HSP) is to identify the potential hazards, institute procedures for minimizing them, and make this information known to all personnel.

## SITE HISTORY AND DESCRIPTION

As part of the Hamm Creek restoration project, Hamm Creek will be realigned and 7 acres of a 22-acre piece of land adjacent to the Seattle City Light substation will be converted into a combined saltwater/freshwater wetland. Approximately 80,000 cubic yards will be dredged in providing a new outlet for Hamm Creek to the Duwamish River, creating a saltwater marsh in the riverside area and excavating upland for a freshwater wetland. This material is proposed for open-water disposal at the Elliott Bay site or for beneficial use, and will therefore be characterized under Puget Sound Dredged Disposal Analysis (PSDDA) and Sediment Management Standards (SMS) guidelines.

The study area along the Duwamish estuary was originally a mudflat, and was subsequently filled and developed. A portion of the Seattle City Light property was filled and developed for use as a substation location. The remaining portion, upon which the proposed habitat restoration project will be located, was never developed for industrial or commercial purposes, although it was used a dredged material stockpiling area. A detailed description of the site is included as part of the Quality Assurance Sampling and Analysis Plan (QASAP).

The Kenco Marine, Inc. property is located within a quarter mile of the Hamm Creek project along the Duwamish waterway, at the third turning basin (about river mile 6.1). The Kenco Marine site has the potential of being purchased and developed as a habitat restoration site. The project at this site is a preliminary level two site assessment and requires sediment chemistry analyses of surficial sediments.

## PROJECT WORK SCOPE OVERVIEW

| | |
|---|---|
| **PROJECT NAME:** | Hamm Creek Restoration Project. and Phase II Site Assessment Sampling at Kenco Marine. Inc.. Duwamish Turning Basin No. 3. Tukwila. King County. Washington |
| **SAIC CONTRACT NUMBER:** | DACW67-95-D-1020 |
| **PROJECT MANAGER:** | John Lunz |
| **CLIENT:** | U.S. Army Corps of Engineers. Seattle District |
| **CLIENT CONTACT:** | Patrick Cagney |
| **CLIENT PHONE NUMBER:** | (206) 764-6577 |
| **SITE LOCATION:** | Duwamish Waterway. Tukwila. Washington (see Figure 1 of the QASAP) |
| **SITE PHONE NUMBER:** | 915-5267 (SAIC Cellular) |

**OBJECTIVES:**

Sediment and soil sampling at the Hamm Creek and Kenco Marine, Inc. sites for the purpose of determining if material is suitable for open water disposal (Hamm Creek) and assessing the sediment chemistry as part of a Level 2 site assessment (Kenco Marine). For the Hamm Creek project. the USACE and its drilling subcontractors will collect the samples by auger drill/split-spoon, and SAIC will process the samples in the field. Sampling for the Kenco Marine project will occur on the University of Washington's Boston whaler. Full description of the activities of this program may be found in the QASAP.

| | |
|---|---|
| **PROPOSED DATES OF OPERATION:** | June 16. 1997 Hamm Creek<br>June 12. 1997 |
| **WORK TIME LIMITATIONS:** | Daylight Hours |
| **SOURCE OF SITE INFORMATION:** | Weston, 1990 |

## PROJECT ORGANIZATION AND RESPONSIBILITIES

### SAIC ORGANIZATION AND RESPONSIBILITIES

**Project Manager:** John Lunz

Has overall responsibility for the safe performance of the project and is the central point of contact with the client.

**Site Health and Safety Officer:** John Nakayama, Lisa Roach

Responsibilities include that the requirements of the HSP are followed by all SAIC and subcontractors personnel. They are to ensure that all necessary personal protective equipment and supplies are available to the field team. They are also responsible for ensuring that subcontractors are informed and applicable provisions of the HSP and that they have an adequate health and safety program that will protect their employees. If he determines that site conditions are unsafe, he has the authority to suspend field operations until the problem is corrected.

**Field Team Leader:** See field team members.

**Field Team Members:**

| | | |
|---|---|---|
| | Lisa Roach | Hamm Creek |
| | John Nakayama | Kenco Marine |

**SAIC Subcontractors on site:** None

**Government Agency Representatives on site:** USACE scientists and representatives

## TASK DESCRIPTION

A complete description of the tasks undertaken for this program is given in the QASAP.

## HAZARD ANALYSIS AND CONTROLS

Hazards encountered during sampling are generally classified as either chemical or physical. Chemical hazards are twofold: (1) chemicals used to decontaminate sampling gear and preserve samples, and (2) contaminants or hazardous materials potentially present within the sediments sampled. Physical hazards are associated with sampling gear, vessel, and work conditions at sea.

### CHEMICAL HAZARDS

A 1990 site assessment conducted by Boeing or the dredge fill at the Hamm Creek site indicated cadmium and mercury concentrations above the PSDDA SL, with maximum concentrations of 1.3 and 0.51 mg/kg, respectively. No organics were detected above the PSDDA SL, although some of the detection limits (e.g., PCB for PCB Aroclor 1254) were above the PSDDA SL. Some of the sampling locations at Kenco Marine may be contaminated with petroleum products. For the most part, stations to be sampled at both locations are not expected to contain hazardous materials or require extraordinary precautions. During field operations, if evidence of contaminated sediments is observed by odor, color, presence of debris, petroleum products, or excessive organic enrichment, suitable protective measures for the crew will be instituted immediately.

Precautions employed in the handling of chemicals include restricting their use to the deck when sampling on the boat, storing and dispensing them from narrow-mouth bottles, and exercising care in their use. Solvent rinsing of sampling equipment is conducted over a stainless steel basin or plastic bucket, so that the excess solvent is not spilled and vapors escape freely. All waste chemicals will be stored in clearly labeled buckets, and securely stored until properly disposed. Gloves and safety glasses are worn when handling the acid and solvents. For the Kenco Marine project, all crew members should remain aware of the sea state and the presence of wakes or other disturbances that could cause spills.

**Zinc acetate:** a 2 Normal (2N) solution of zinc acetate is used to preserve sediment samples for sulfide analysis. Zinc acetate is dispensed from a narrow-mouth bottle with a plastic eyedropper. This procedure is conducted on deck to ensure adequate ventilation and reduce the severity of any spills.

**Nitric acid (1 Normal) and methanol:** These chemicals are used to decontaminate sampling equipment. Both are clear, colorless liquids with strong odors; methanol is a volatile solvent. Nitric acid will burn exposed skin on contact. Personnel are required to wear protective gloves and eyewear whenever handling the decontaminating agents. These liquids are used in the open air or under a hood. Respirators are optional, if desired by crew members.

## PHYSICAL HAZARDS

Gear deployment and retrieval present hazards because of the heavy weight of the sampling gear and the risk of accidental and premature closure. During field operations, van Veen grab sampler (0.025 or 0.1 $m^2$) will be used for the Kenco Marine project, and auger drill with split-spoon sampler will be used for the Hamm Creek project. SAIC personnel will not be involved with drilling operations.

A small boat will be used during sampling events. Some small boats can be unstable in the water; therefore, field personnel will wear Coast Guard-approved life vests or life jackets. Prior to coming on site, all persons will be trained on the operation of the vessel including boat safety, how to start/stop the motor, forward/reverse, fuel requirements, etc. Personnel should be aware of, and not exceed the limits for weight capacity and number of persons on the boat. A hand-held radio or cellular phone will be onboard to allow for direct communication to shore. Under circumstances of potentially dangerous waves or winds, the field team leader will employ best professional judgment to ensure safe field operations.

The physical hazards associated with the deployment and retrieval of sampling equipment are due to their weight, the method of deployment, and the risk of accidental and premature closure. During deployment and retrieval in rough waters or strong winds, this equipment may shift on deck or swing (if at the end of the winch wire). During gear deployment and retrieval, personnel should pay close attention to the position of the gear, the motion of the boat, mobility depending on obstructions on deck, and actual or potential fouling of the gear. Hands and feet must never be placed underneath sampling gear.

To avoid injuries from deck gear and equipment, sample handling equipment, containers, and deck lines not in immediate use will be kept clear of work areas until needed. To the extent possible, the crew will attempt to minimize the amount of sediment accumulating on deck in order to prevent slipping.

While working over water on the research vessel, using heavy equipment or during stormy weather, there is a potential for a man-overboard situation. If this situation occurs, the vessel will be stopped immediately. Flotation devices will be thrown to the victim from the vessel. The victim will then be brought aboard the vessel or towed to shore, whichever is quicker; wet clothes will be removed and replaced with dry clothing. The victim may need to be treated for cold stress. No other person(s) shall enter the water except if the victim is unconscious or seriously injured. Rescuers must wear life preservers and be tethered to the research vessel or shore.

# HAZARD MONITORING AND CONTROL

## TRAINING

While not specifically required, all personnel involved in the conduct of this program have completed the 40-hour hazardous waste site training, annual 8-hour refresher course, and appropriate medical monitoring in accordance with CFR 1910.120.

## PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

All crew members are required to wear hard hats when working near the drill rig. Latex or nitrile gloves are required when sampling and when using nitric acid, methanol, or zinc acetate. All crew members will have access to respirators, but are not required to use them during operations, unless otherwise instructed by the site health and safety officer. Flotation vests are required on the small boat.

Each crew member is expected to bring clothing appropriate to the weather and task to minimize the hazards of exposure and heat stress. Boots and rain gear or other waterproof clothing are recommended, particularly when processing sediment samples on deck.

## MEDICAL SURVEILLANCE

All on-site personnel have had the appropriate medical monitoring in accordance with CFR 1910.120 for this program. No site-specific medical monitoring is required.

## MONITORING AND SAMPLING PLAN

No specific direct reading air monitoring equipment is planned for this operation.

## SITE CONTROL MEASURES

As sampling operations for the Kenco Marine project are to be conducted on-board the Boston whaler, access to the work site is controlled and only authorized personnel are on board. As this is not a hazardous waste sampling operation, there are not designated exclusion zones. However, the back deck of the whaler is designated as the work zone. A processing table and decontamination area (for processing gear and split-spoons) will be set up for the Hamm Creek sampling. Work operations will incorporate the use of the buddy system on deck at all times. No operations will be undertaken without line-of-sight or direct communication for all work.

## DECONTAMINATION PLAN

Formal sampling personnel decontamination procedures are not necessary under this program.

## INVESTIGATION DERIVED WASTE MANAGEMENT PLAN

All sediments, wash water, or other site-derived materials (e.g., wood debris) will be discarded overboard. Waste solvents from decontamination procedures will be captured, placed in appropriate sealed containers, and properly disposed of through a private waste management firm.

## OTHER HAZARD CONTROL MEASURES

Site- and situation-specific hazard control measures shall be identified and incorporated as revisions or addenda to this HSP as required.

## ENFORCEMENT OF THE HSP

To protect all personnel visiting SAIC site activities from any adverse health effects that may result from those site activities, all employees, contractors, and visitors to the SAIC work site are required to follow the requirements of this plan. All personnel involved with the investigation will check in with the Field Team Leader prior to site entry. All personnel must provide their own necessary PPE as specified in this HSP or by the Site Health and Safety Coordinator. All personnel visiting the investigation area will be briefed on this HSP, and all SAIC field personnel are required to sign their acknowledgment of the requirements herein.

## SPILL CONTAINMENT PLAN

Site- and situation-specific spill containment measures shall be identified and incorporated as revisions or addenda to this HSP as required.

## RECORDKEEPING

All revisions or addendums to this HSP will be documented in the project file and copies of all modifications will be maintained on the job site at all times.

EMERGENCY RESPONSE PLAN

<u>**For all Health and Medical Emergencies, Notify the On-site SAIC Health and Safety Officer or Site Supervisor**</u>

| | |
|---|---|
| **SAIC PROJECT MANAGER:** | John Lunz, (206) 485-5800 |
| **SAIC SITE HEALTH AND SAFETY OFFICER:** | John Nakayama, Lisa Roach |
| **CLIENT CONTACT:** | Patrick Cagney |
| **CLIENT PHONE NUMBER:** | (206) 764-6577 |
| **SITE PHONE NUMBER:** | 915-5267 (SAIC Cellular) |
| **Personal Injury or Illness:** | Administer First Aid; Call Ambulance; If necessary, transport to hospital. See Emergency Medical Care. |

**Fire or Explosion:** Turn off all motorized equipment; evacuate the work area; meet at designated upwind assembly area.

**Hazardous Material Spill or Release:** Turn off all motorized equipment; evacuate the work area in a direction upwind of the spill or release; meet at designated upwind assembly area; contact appropriate response personnel as necessary.

**Person Overboard:** Turn off all motorized equipment, and cease all non-rescue activities. Flotation devices attached to lines will be thrown to the victim from the vessel. No other person(s) shall enter the water except if the victim is unconscious or seriously injured. Rescuers must wear life preservers and be tethered to the research vessel. The victim will then be brought aboard the vessel; wet clothes will be removed and replaced with dry clothing. In the event the victim is injured or unconscious, activate the emergency medical alert system (911) and/or notify the U.S. Coast Guard.

**Equipment Failure:** If any other equipment on-site fails to operate properly, the project team leader and site safety officer shall be notified and they shall determine the effect of this failure on continuing operations on site. If the failure affects the safety of personnel or prevents the proper completion of the tasks described in the work plan, all operations will be secured and all personnel shall cease activities until the situation has been evaluated and appropriate actions taken.

# EMERGENCY MEDICAL CARE AND PROCEDURES

**For all Health and Medical Emergencies, Notify the On-site SAIC Health and Safety Officer or Site Supervisor**

| | |
|---|---|
| **SAIC PROJECT MANAGER:** | John Lunz, (206) 485-5800 |
| **SAIC SITE HEALTH AND SAFETY OFFICER:** | John Nakayama, Lisa Roach |
| **CLIENT CONTACT:** | Patrick Cagney |
| **CLIENT PHONE NUMBER:** | (206) 764-6577 |
| **SITE PHONE NUMBER:** | 915-5267 (SAIC Cellular) |

Nearest Emergency Medical Facility:

Harborview Medical Center
325 Ninth Avenue
Seattle, Washington 98104
(206) 731-3074 (emergency)
(206) 731-3000 (information)

Group Health Cooperative
201 16th Ave East 98112
(206) 326-3000 (ambulatory and urgent care)

Highline Riverton Community Hospital
12844 Military Road, South
Tukwila, Washington
(206) 244-0180

Emergency Phone Numbers:

| | |
|---|---|
| Police Department, Emergency | 911 |
| Fire Department, Medical Emergency | 911 |
| U.S. Coast Guard | 1-800-592-9911 |
| Shephard Lifefleet Ambulance Service | (206) 322-0330 |

**Emergency First Aid Procedures for Substances Present:**

See attached data sheets for specific symptoms and treatments.

First Aid Equipment On-Site: (Placed in accessible area outside of the Work Zone)

| | |
|---|---|
| First Aid Kit | Cellular Telephone |
| Fire Extinguisher | Cool water/fluids (2 gallons/person/day) |

SIGNATURE PAGE

Prepared by:

| Name (Print) | Signature | Title | Date |
|---|---|---|---|

Approved by:

| Name (Print) | Signature | Title | Date |
|---|---|---|---|

We, the undersigned, have read this Site Health and Safety Plan and will institute the provisions and abide by the regulations contained herein for the duration of this program.

| Name (Print) | Signature | Title | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## REFERENCES

Weston. 1990. *Baseline Soil and Groundwater Quality Assessment. Seattle City Light Long-Term Lease Option, Seattle, Washington.* Prepared for Boeing Environmental Affairs, Seattle, Washington by Roy F. Weston, Inc., Seattle, Washington.

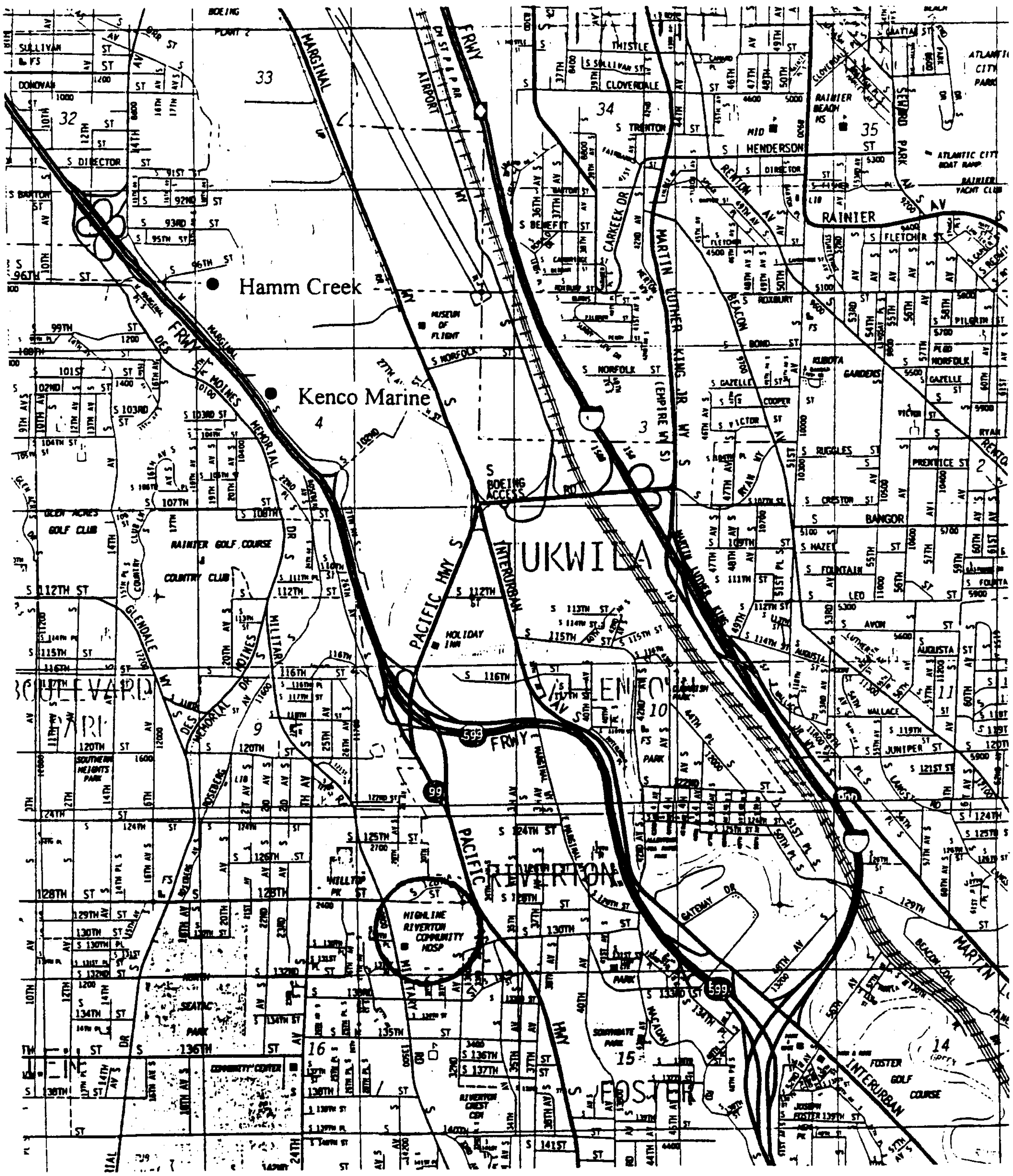



**Figure A-1.** Nearest emergency medical facility.