Sampling & Analysis Plan for Sediment Characterization at Capitol Lake

Olympia, Washington

Prepared for

Washington State Department of
General Administration

Prepared by

ENTRANCO
10900 NE 8th Street, Suite 300
Bellevue, Washington 98004-4405
(206) 454-5600

August 21, 1995

CONTENTS Page

FIGURES

TABLES

1.0 INTRODUCTION

1.1 Project Description

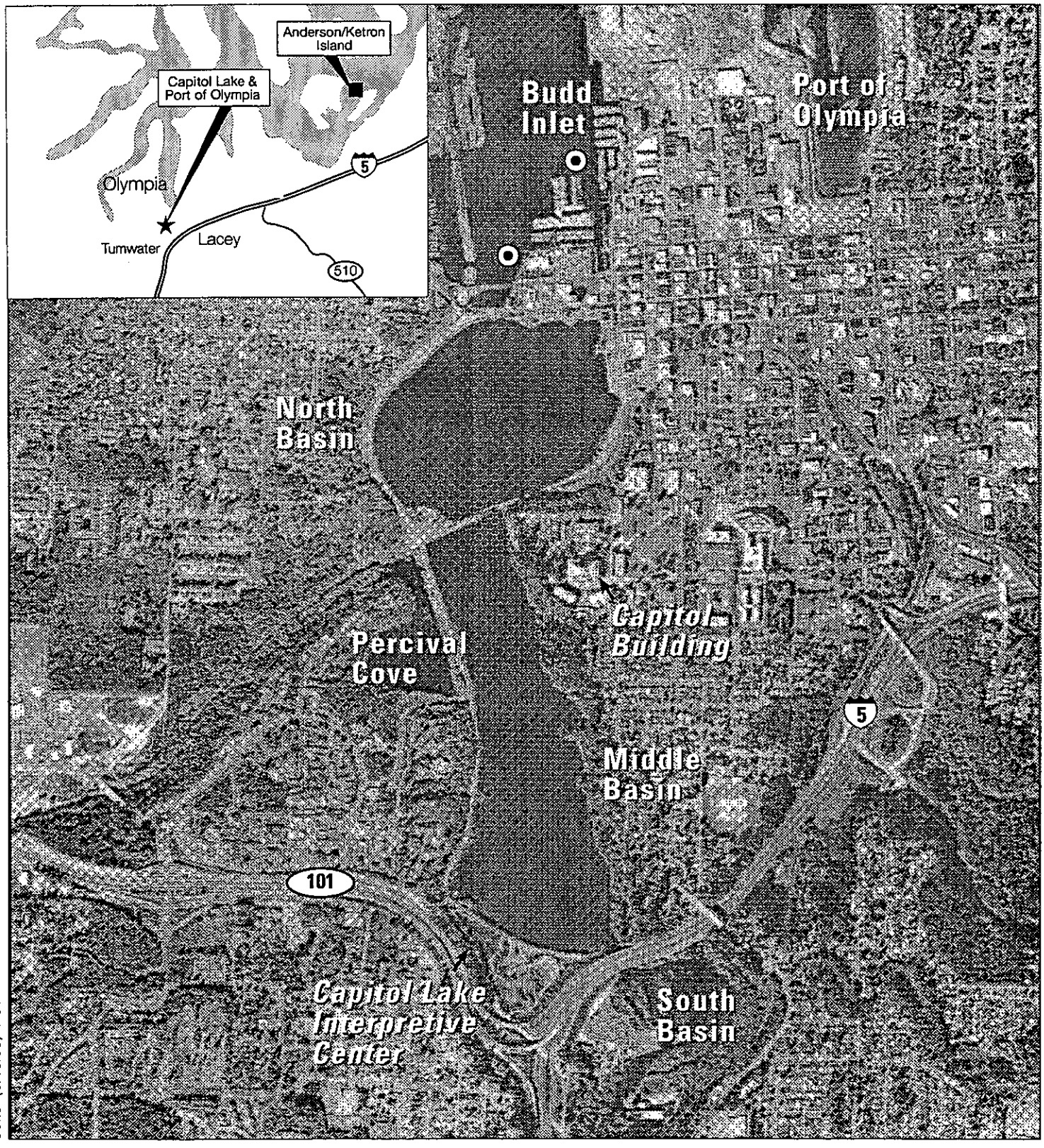
A ten-year sediment removal project is being proposed by the Washington State Department of General Administration (DGA) to maintain the beneficial uses (recreation, aesthetics, fisheries, and flood control) of Capitol Lake, in Olympia Washington (**figure 1**). Sediment removal is needed because recent studies have shown that the middle basin of the lake is filling in gradually despite the presence of a sediment trap in the basin (**Entranco 1984**). Depth of sediment removal would be maximized at the middle basin sediment trap to a depth of 12 feet, while 2 to 3 feet of sediment would be removed from the remaining areas of the lake, where existing water supplies are 5 to 9 feet.

A Supplemental Environmental Impact Statement (SEIS), now being prepared for the DGA, evaluates alternatives for the remote disposal of the dredged sediment. One of the alternatives is to pipe the sediment/water dredge slurry discharge to a barge mooring site at the Port of Olympia, and subsequently transport it and dispose of it to a deep, open-water, marine disposal site at Anderson/Ketron Island in the Puget Sound (**figure 2**). (The other remote disposal options are hauling the dewatered sediment by truck to upland disposal sites at the Thurston County Landfill, a Thurston County Gravel Pit, or the Centralia Coal Mine).

Before sediments can be disposed of at the Anderson/Ketron Island site, sediment testing must be performed and approved by the Washington State Department of Ecology (Ecology), Washington State Department of Natural Resources (DNR), U.S. Environmental Protection Agency (EPA), and U.S. Army Corps of Engineers (Corps) under the Puget Sound Dredged Disposal Analysis (PSDDA) program guidelines. The Corps acts as the lead agency in coordinating the PSDDA program through its Dredged Material Management Office (DMMO). Depending on the results of PSDDA sediment characterization proposed in this sampling plan, disposal will be either inwater to the Anderson/Ketron Island site by bottom dump barge, or by truck to upland sites.

This document outlines sampling and analysis procedures to be followed during sediment characterization at Capitol Lake. The plan has been developed in accordance with the protocols and quality assurance/quality control (QA/QC) objectives set forth in the following documents published by the U.S. Army Corps of Engineers:

- Puget Sound Dredged Disposal Analysis (PSDDA) Evaluation Procedures Technical Appendix (**June 1988**).
- The updated protocols given in the Phase II Management Plan Report (**September 1989**).
- The Puget Sound Estuary Program (PSEP) Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (**1991**).



A689 92007-64 Soils (8/18/95) AGT

ENTRANCO

Figure 1
Capitol Lake Project Area

Although this plan is written in accordance with PSDDA guidelines, this project is unique to PSDDA in the following ways:

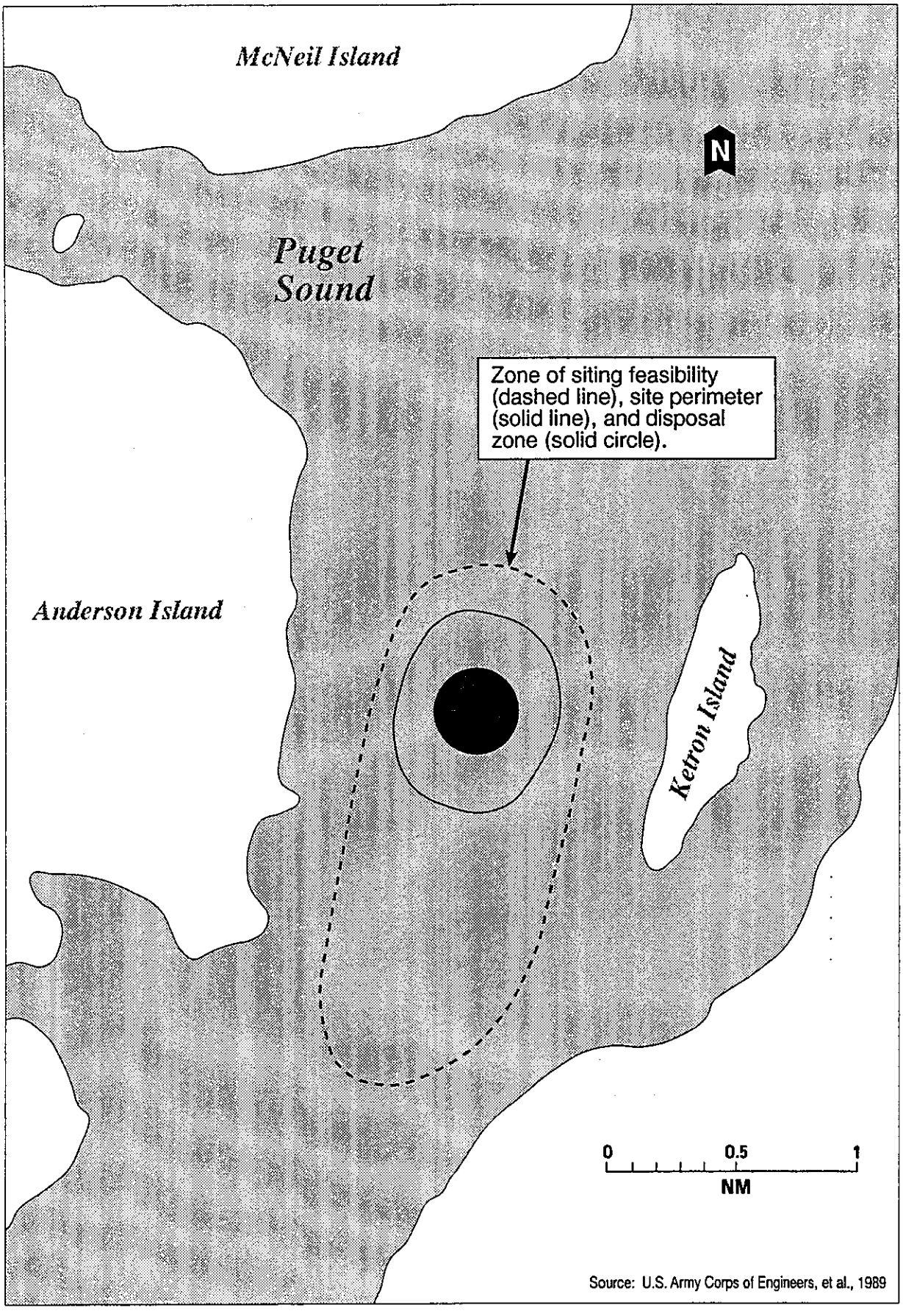
- Biological testing will not performed because a recent sediment characterization study indicated no contamination for the parameters sampled (see Section 1.3 and **Appendix A**). It should be noted that samples were not tested for pesticides). Should results of the PSDDA sampling indicate the need to conduct biological testing, an addendum to this Sampling Analysis Plan (SAP) will be prepared and additional sediment sampling will be performed.

- Subsurface sampling (below 3 feet) will not be performed because the depth of sediment removal will be between 2 and 3 feet through most of the lake. Deeper sediment removal of 4 to 5 feet will only occur in dredged material management unit (DMMU) #1 - the middle basin sediment trap.

Under the marine disposal alternative, lake sediments would be excavated using a hydraulic dredge. The sediment/water slurry from the dredge would be piped north across the surface of Capitol Lake and under Budd Inlet to a marine barge mooring site at the Port of Olympia (**figure 1**). The sediment/water slurry would be discharged directly to a barge (4,000 cubic yard capacity) and transported (one barge per day) to an approved deep, open-water, marine disposal site located between Anderson and Ketron Islands in Puget Sound (**figures 1 and 2**). The distance to the PSDDA open-water disposal site between Anderson and Keatron Island is 21.5 nautical miles (24.7 statute miles).

The intent of the sediment removal project is to remove approximately 300,000 to 350,000 cubic yards of sediment over a ten-year period. The volume of material to be removed from Capitol Lake is 30,000 to 35,000 cubic yards each year (or 60,000 to 70,000 cubic yards every other year). Maintenance sediment removal at this rate would keep pace with sediment delivery to the lake from the Deschutes River watershed. Sediment removal would occur in the middle basin trap and in nine additional DMMUs covering the entire middle basin (**figure 3**). A shoreline buffer zone would be retained to avoid impact to juvenile chinook salmon rearing habitat and shoreline aquatic plant beds (**figure 3**). Periodic sediment removal is also needed in Percival Cove at the mouth of Percival Creek to maintain fish passage from the Cove to Capitol Lake (DMMU #10, **figure 3**). The first sediment removal will occur in stages with DMMUs 1 to 5 being dredged first. The last five DMMUs will be dredged approximately five years later.

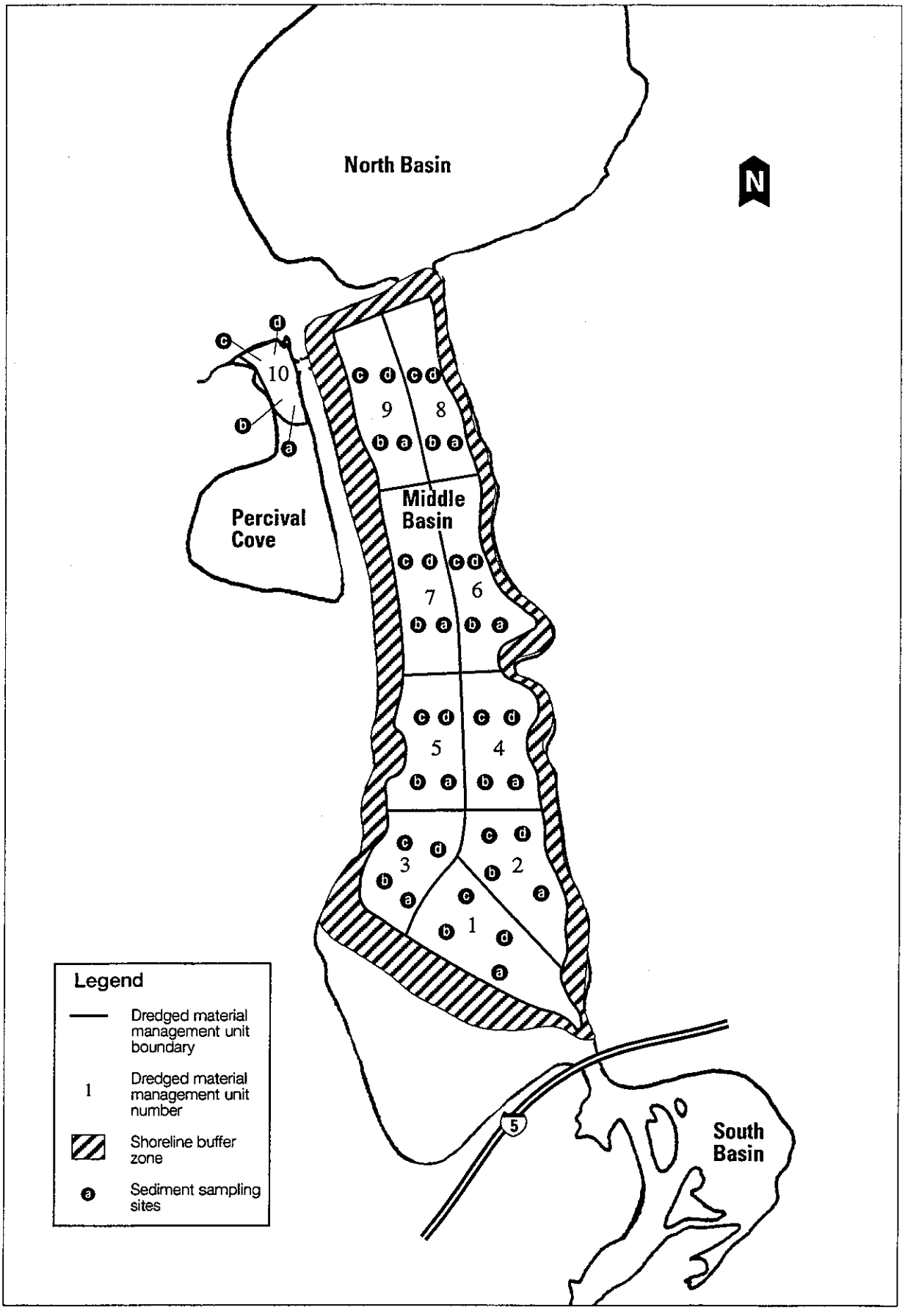
The DGA proposes to conduct a comprehensive sediment characterization program by collecting and analyzing representative core samples in accordance with PSDDA requirements for the DMMUs of Capitol Lake from which sediment will be removed. The cores will be tested for chemical contamination at this time. These results will be provided to the PSDDA agencies as the basis for identifying an acceptable disposal option.



A692 92007-61 Soils (8/15/95) AGT

ENTRANCO

Figure 2
Anderson/Ketron Island Site



A693 92007-61 Soils (8/17/95) AGT

ENTRANCO

Figure 3
Dredged Material Management Units and Sampling Core Locations

The sampling and analysis program was developed by Entranco with consideration of site-specific project and environmental factors. A key requirement is assuring that if an individual DMMU (represented by four core sections) is found unsuitable for unconfined open-water disposal, then that unit could be avoided, or dredged and the material disposed of at an upland site, if upland criteria could be met.

1.2 Site History

Capitol Lake was formed in 1951 by an act of the Washington State Legislature. The Legislature authorized the construction of a dam at the 5th Avenue Bridge to create a reflecting pool for the Capitol Campus as designed by New York architects, Wilder and White, in 1911. The creation of Capitol Lake also provided a freshwater environment which eventually became the central feature of park and recreational facilities for the Capitol Campus and the cities of Olympia and Tumwater.

The formation of Capitol Lake has resulted in accelerated sediment accumulation within the middle basin. An estimated 30,000 to 35,000 cubic yards of sediment accumulates in the lake each year. The DGA completed a long range sediment removal and lake recreation plan in 1977 (**CH2M Hill 1977**). Initial work under this plan was carried out between 1978 and 1982, which included removing 257,000 cubic yards of sediment and constructing sediment traps in the south and middle basins. Additional maintenance dredging, which involved removing 60,000 cubic yards of sediment, was conducted in 1986 (**Ebasco 1986**). Sediment removal to date totals 314,000 cubic yards. This means that a net accumulation of approximately 1.2 million cubic yards (1.5 million minus 300,000) of sediment have been deposited in the lake since 1951 and that the lake has become shallower each year.

The primary land use in the Deschutes River watershed is forest (59 percent), with lesser amounts in rural and agricultural use (35 percent) and urban use (six percent). There are several stormwater outfalls that drain into Capitol Lake, which receive runoff from the adjacent road and I-5 highway.

1.3 Sediment Description

Surface sediments (0 to 3 feet) in the middle basin of Capitol Lake are comprised primarily of silts (59 percent), sands (26 percent), and clays (11 percent), based on the average grain size distribution of 15 sediment cores taken throughout the middle basin (**CH2M Hill 1976 and Hong West 1994**). Some natural sorting of material occurs in the middle basin, with a tendency for sands to drop out in the upper portion of the basin in the vicinity of the sediment trap, and finer silts and clays to accumulate elsewhere throughout the lake.

The PSDDA guidelines identifies Capitol Lake as an area of low to moderate concern for sediment contamination based on the results of a sediment characterization study performed last year for the DGA (**Appendix A**). The data indicated that all samples had concentrations of metals and PCBs that were below the Screening Levels (SLs) of PSDDA **(Appendix A).**

1.4 Permitting

Permitting and approvals required to begin sediment removal include:

- Washington State Department of Natural Resources Open-Water Disposal Site Use permit.
- Washington State Department of Fish and Wildlife - Hydraulic Project Approval
- US Army Corps of Engineers - Section 10 and 404 Permits and Puget Sound Dredged Disposal Analysis (PSDDA) letter of authorization for marine disposal of sediments (PSDDA authorization includes concurrent review by EPA, Ecology, and DNR). A permit application for Capitol Lake sediment removal and disposal will be submitted by the DGA to the Corps, Seattle District, in August 1995.
- Cities of Olympia and Tumwater - Shoreline Substantial Development Permits.
- Washington State Department of Ecology - Coastal Zone Management (Shoreline Substantial Development Permit) review, Water Quality Certification, and Temporary Water Quality Modification Permits.
- Washington State Department of Natural Resources - Aquatic lands use permit and lease for barge mooring site in Budd Inlet.
- Environmentally Sensitive Areas Approvals and Excavation/Grading Permits from the cities of Olympia and Tumwater and from Thurston County.

An SEIS for the proposed Capitol Lake Sediment Removal project, including sediment removal and disposal, is being prepared by Entranco for the DGA (in progress).

2.0 PROGRAM OBJECTIVES AND CONSTRAINTS

The sediment characterization program objectives and constraints are summarized below:

- Characterize sediments to be removed in conformance with Puget Sound Dredged Disposal Analysis (PSDDA) requirements to enable the PSDDA agencies to designate approved disposal option(s).

- Optimize the prospect of identifying all Dredged Material Management Units (DMMUs) acceptable for disposal at the Anderson/Ketron Island PSDDA disposal site, while assuring that unacceptable sediments are disposed of at an approved upland site.

- Collect, handle, and analyze representative sediment core samples in accordance with protocols and quality assurance/quality control (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 Puget Sound Estuary Program (PSEP) Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound.

- Locate representative sampling stations.

- Identify sediment analysis levels above the PSDDA screening levels and maximum levels, after QA/QC review.

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) quality assurance/quality control (QA/QC) management, and 5) final data report. Staffing and responsibilities are outlined below.

3.1 Project Planning and Coordination

David Morency of Entranco (Bellevue) will be the overall project manager responsible for developing and completing the sampling program. As the applicant's principal representative he will also provide the primary contact for Puget Sound Dredged Disposal Analysis (PSDDA) agencies. Following plan approval by the PSDDA agencies, Mr. Morency will be responsible for monitoring and administrative coordination to assure timely and successful completion of the project. Mr. Morency will provide a copy of the approved sampling plan along with the PSDDA agency approval letter to all sampling and testing subcontractors. Any significant deviation from the approved sampling plan will be coordinated with the Dredged Material Management Office.

3.2 Field Sample Collection

Entranco personnel will be responsible for the collection of sediment samples. Mr. Morency will be assisted in the field by Jory Oppenheimer, James Patterson, and members of the Entranco survey crew. Mr. Morency will provide overall direction to the field sampling and laboratory analysis programs in terms of logistics, personnel assignments, and field operations. He will supervise field collection of the sediment core samples and will be responsible for assuring accurate sample positioning; recording sample locations, depths, and identification; assuring conformance to sampling and handling requirements including field decontamination procedures; photographing, physical evaluation, and logging of the samples; and tracking chain-of-custody for the samples until they are delivered to AmTest, Inc. analytical laboratory in Redmond, Washington. Mr. Morency and other Entranco personal will extrude the samples and record the necessary data on those samples. They will composite and homogenize the cores into samples as described in Section 4.0. Appropriate protocols for decontamination, sample preservation and holding times will be observed.

3.3 Laboratory Preparation and Analyses

David Morency will document sample preparation, observations, and chain-of-custody up until the time he delivers the samples for analyses to AmTest, Inc. He will also instruct the analytical laboratory on the need to maintain required handling and analytic protocols including meeting PSDDA minimum detection limits. AmTest, Inc. will ensure that archived sediments are stored under proper conditions.

AmTest will handle and analyze the submitted samples in accordance with PSDDA analytical testing protocols and QA/QC requirements. A written report of analytical results and QA/QC procedures will be prepared by AmTest and included as an appendix in the final report.

3.4 QA/QC Management

Mr. Oppenheimer will serve as Quality Assurance Representative for the sediment characterization project. He will perform assurance oversight for both the field sampling and laboratory programs. He will keep himself fully informed of field program procedures and progress during sample collection and laboratory activities during sample preparation. He will record and correct any activities which vary from the written sampling and analysis plans. He will also review the laboratory analytical and QA/QC data to ensure that data is valid and procedures meet the required analytical quality control limits. Upon completion of the sampling and analytical program he will incorporate all findings into a QA/QC report.

3.5 Final Data Report

Mr. Oppenheimer will prepare the final sediment characterization report describing sample locations and depths; sampling, handling, and analytical methods; QA/QC; and data results. The data will be assembled into table format, and compared to the PSDDA screening levels and maximum levels values. The results of the analysis will be included as an appendix in the final data report. A draft of the final report will be reviewed and edited by Mr. Morency prior to submittal to the PSDDA review agencies.

4.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

4.1 Sampling and Compositing Scheme

The Puget Sound Dredged Disposal Analysis (PSDDA) ranks the middle basin of Capitol Lake, including the sediment removal area, as an area of low to moderate concern for sediment contamination. In accordance with PSDDA requirements, full sediment characterization requirements for a sediment removal area ranked low to moderate concern, are one core section analysis for every 8,000 cubic yards of sediments, with up to four samples being composited for laboratory analysis for each dredged material management unit (DMMU). (Approximately 30,000 to 35,000 cubic yards of sediment will be removed from each DMMU).

The quantity and related sampling requirements are as follows:

Four cores will be collected for DMMUs 1, 2, 3, 4, and 5 shown in **figure 3**. The four cores will be composited into one sample for analysis at AmTest Laboratories. A total of five composited samples will be delivered to the laboratory for analysis. A separate field sampling effort will be conducted in approximately five years for the remaining DMMUs, following the same procedures specified in this sampling and analysis plan.

The 20 sediment coring stations for the five DMMUs, which will be premarked with floating buoys, are shown in **figure 3** and are listed in **table 1**. At each sampling station, the sampling boat will be anchored as close as possible to the buoys and the divers will collect sediment samples within 10 feet of the buoys. Floating buoys will be located in the field using global positioning survey (GPS) methods to locate their position (see Section 4.2). As shown in **figure 3**, samples will not be collected near the shore to protect wildlife habitat and avoid areas with potential outfall contamination.

4.2 Sampling Station Location Methods

On the day preceding sampling, 20 buoys will be placed in the lake to mark the location of each sediment core station shown in **figure 3**. The stations will be located approximately equidistant from boundaries of each DMMU (**figure 3**). The coordinates of each sample site within the DMMUs will be calculated prior to placing the buoys. The buoy location will be directed by using GPS and Real Time Kinematic (RTK) technique to guide the boat to the predetermined position and anchor the buoy. Elevations will be referenced to the City of Olympia datum and corrected to mean lower low water (MLLW) using the tide gauge. Horizontal positions obtained by GPS will be in Latitude and Longitude to the nearest 0.01 second and converted to Washington State Coordinate System South Zone NAD 83 (91) (**North American Datum 1983).** These systems are expected to document sampling locations to +/- 2 meters accuracy to allow the dredge to discretely remove sediment from different DMMUs (**U.S. Army Corps of Engineers 1988**).

Table 1
Capitol Lake Sample Compositing Scheme

Sediment Cores (to a depth of 3 feet)

DMMU and Sample Identification

DMMU (Grid Unit No.)	Core (Core Section)	Sample #
1	1a, 1b, 1c, 1d	1
2	2a, 2b, 2c, 2d	2
3	3a, 3b, 3c, 3d	3
4	4a, 4b, 4c, 4d	4
5	5a, 5b, 5c, 5d	5
6	6a, 6b, 6c, 6d	6
7	7a, 7b, 7c, 7d	7
8	8a, 8b, 8c, 8d	8
9	9a, 9b, 9c, 9d	9
10	10a, 10b, 10c, 10d	10

Note: Sediment cores will only be taken in DMMUs 1 through 5 at this time. All DMMUs have a volume of 30,000 to 35,000 cubic yards.

4.3 Presampling Preparation

Before sampling is conducted, a team meeting will be held to assure procedures outlined in this sampling and analysis plan (SAP) are understood and followed. All participants of the sampling team will review the SAP prior to the meeting. The team members participating in the presampling meeting will include the Entranco sampling team and survey crew, and a representative from AmTest laboratories.

Well in advance of the sampling date, the necessary equipment, such as core tubes, compositing bowls, and appropriate sample containers, will be obtained. The analytical laboratory will be advised to expect the arrival of samples.

All sampling tubes and cutter heads will be thoroughly cleaned prior to use according to the following procedure:

- hot water rinse
- wash with brush and Alconox soap
- double rinse with distilled water
- rinse with nitric acid
- rinse with deionized water
- rinse with methanol

After cleaning, all core tubes will be foil wrapped and capped to limit the risk of contamination. Caps will only be removed as the tubes are loaded into the sampling device. Once the cap has been removed, a final wash as defined above will be performed at the cutter head just prior to deployment. The protective cutter head cap and wrapper will be removed underwater upon inserting the core tube. Sufficient extra sampling tubes will be available on-site to allow for uninterrupted operations should a sampling tube become contaminated. The rule of "potential for contaminants" will be used such that any sampling tube suspected of contamination will be rejected and recycled on shore for use later in the program.

4.4 Sample Collection and Field Processing

The field crew and equipment will be mobilized from Entranco's Bellevue Office. The field crew will make sure all equipment is in good working order prior to collection of cores. Program plans will be developed and final arrangements made for logistics and field operations.

4.4.1 Sample Collection and Compositing

Ten approximately equal-volume DMMUs were laid out in a series in the lake reflecting the sediment removal approach. Each DMMU is identified with a number which designates the proposed sequence of sediment removal (see **figure 3**). Four cores, designated as a, b, c, and d, will be collected and composited from each DMMU, for analysis at AmTest laboratories (**table 1**). (A fifth designation, FD, will be used to label a field duplicate sample which will be provided to the analytical laboratory for quality assurance). The sampling locations for each DMMU were established to cover the entire area of the DMMUs. This will ensure a good spatial representation for these DMMUs. Estimated sediment volume represented by each DMMU is 30,000 to 35,000 cubic yards.

A four-foot stainless steel hand sediment coring device (Wildco #2424-A50) with two-inch diameter liner tubes will be used to collect the core samples. The core liners are made of clear thermoplastic and the endcaps of each tube are made of polyethylene. Scuba divers will drive the core samplers to a depth of three feet (depth of sediment removal), or to the point of resistance. Sediment cores will be taken within a 10-foot radius of each buoy.

After the cores are collected, both ends of the tubes will be capped and taped, until the cores can be extruded on the boat. Entranco personnel will extrude the samples into a sample tray covered with aluminum foil. The sample observations will then be made as described in the next section, 4.4.2. After completion of the observations, the sample will be transferred to a stainless steel mixing bowl and held on ice until all four samples are available for composite. Equal portions from the DMMU's four stations will then be composited and homogenized. After homogenization of the sediments, the sample will be processed for the analyses described below. One homogenized sample, determined to have an adequate volume, will be spilt to provide a blind duplicate. The duplicate will be labeled FD. All sampling devices touching the sample material will have been decontaminated before they are used.

Glassware for conducting the analytical testing will be provided by AmTest laboratories. Jars will be precleaned according to PSEP protocols. A solvent rinse will not be used on the containers used to analyze samples for volatile organics. Additional jars will be available to allow for breakage.

Samples for analysis of sulfides will be taken directly from the representative core prior to any subsampling for other analyses, or immediately after sample collection and prior to composite processing. These subsamples will be removed from one randomly chosen core or scoop of material prior to the composite processing. They will be taken from the representative sampling core section immediately upon extruding the core. These samples will be placed in 125 mL glass jars without mixing of material. Using a pipette, 5 mL of zinc acetate will be placed on top of the sample in the jar.

After compositing, portions of each sample will be placed in appropriate containers (**table 2**) obtained from AmTest laboratories. After placement, each sample will be stored at approximately 4°C (except samples for mercury analysis, which will be held at -18°C) until analyzed.

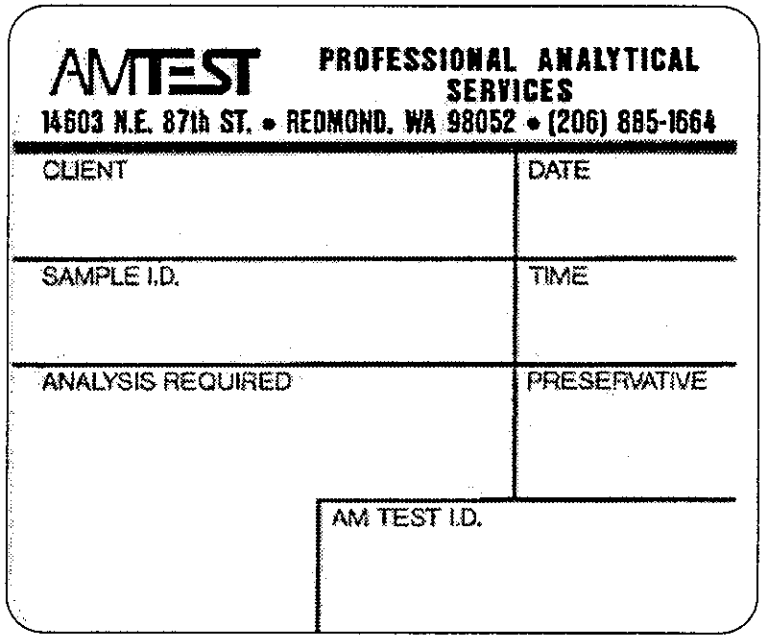
Each sample container, as detailed in **table 2**, will be clearly labeled with the project name, sample/composite identification, date and time, initials of persons preparing the sample, analysis specifications, any pertinent comments such as preservatives present in the sample. Each sample will be referenced by entry onto the field log sheets. A typical sample label is presented in **figure 4**.

Table 2
Sample Storage Criteria

Sample Type	Holding Time	Sample Size[a]	Temperature[c]	Container	Archive[b]
Particle Size	6 Months	100-200g (150 ml)	4–C	1-liter Glass (combined)	
Total Solids	14 Days	125g (100 ml)	4–C		X
Total Volatile Solids	14 Days	125 g (100 ml)	4–C		
Total Organic Carbon	14 Days	125 g (100 ml)	4–C		
Ammonia	7 Days	25 g (20 ml)	4–C		
Metals (except Mercury)	6 Months	50 g (40 ml)	4–C		
Semivolatiles, Pesticides and PCBs	14 Days until extraction,	150 g (120 ml)	4–C		
	1 Year until extraction		-18–C		
	40 Days after extraction		4–C		
Total Sulfides	7 Days	50 g (40 ml)	4–C[d]	125 ml Plastic	
Mercury	28 Days	5 g (4 ml)	-18–C	125 ml Glass	
Volatile Organics	14 Days	100 g (2-40 ml jars)	4–C	2-40 ml Glass	

a. Recommended minimum field sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide for a margin of error and allow for retests.
b. For every DMMU, a 250 ml container is filled and frozen to run any or all of the analyses indicated.
c. During transport to the lab, samples will be stored on blue ice. The mercury and archived samples will be frozen immediately upon receipt at the laboratory.
d. The sulfides sample will be preserved with 5 ml of 2 Normal zinc acetate per 30 g of sediment.

Figure 4
Example of a Sample Container Label



4.4.2 Field Measurements and Miscellaneous Data

In addition to physical collection of the sediment samples, specific field information will be recorded to fulfill PSDDA requirements. A field data log (**figure 5**) will be used to note the date, time, and location of sampling stations, as well as additional auxiliary parameters recorded in the field. The following data will be included in the field log:

- General field observations including, but not limited to, activities in the area which may affect the quality of the data.
- Date and time of collection of each sediment core sample.
- Names of field supervisor and person(s) collecting and logging in the sample.
- The sample station number as derived from **table 1** and **figures 2 and 3**.
- Length and depth intervals of each core section and recovery for each sediment sample from the sediment water interface.
- Qualitative notation of apparent resistance of sediment column to coring.
- Any deviation from the approved sampling plan.

After volatiles and sulfides subsampling, each discrete core section will then be color photographed.

FIELD DATA LOG

GENERAL PROJECT INFORMATION

Project Name: _____ Site Location: _____
Project Number: _____ Date: _____

SAMPLING PERSONNEL

(1) _____
(2) _____
(3) _____

Data Recorder: _____ Time: _____

DESCRIPTION OF SITE/STATION: _____

STATION LOCATION

Latitude (GPS)	Longitude	Loran TD 1	Loran TD 2	Station Depth (ft.)

SEDIMENT SAMPLING PARAMETERS

Sample ID Number _____ Method of Collection _____
Depth of Coring _____ % Sample Recovery _____
Depth to RDP (cm) _____ Odor (sulfide, oils, etc.) _____

Physical Soil Description: _____

Vegetation _____ Debris _____

Presence of Organisms _____

Compositing and Handling Procedure Comments: _____

Figure 5
Draft Example of a
Field Data Log Form

Sediment description of each sample will be recorded on the data log for the following parameters as appropriate:

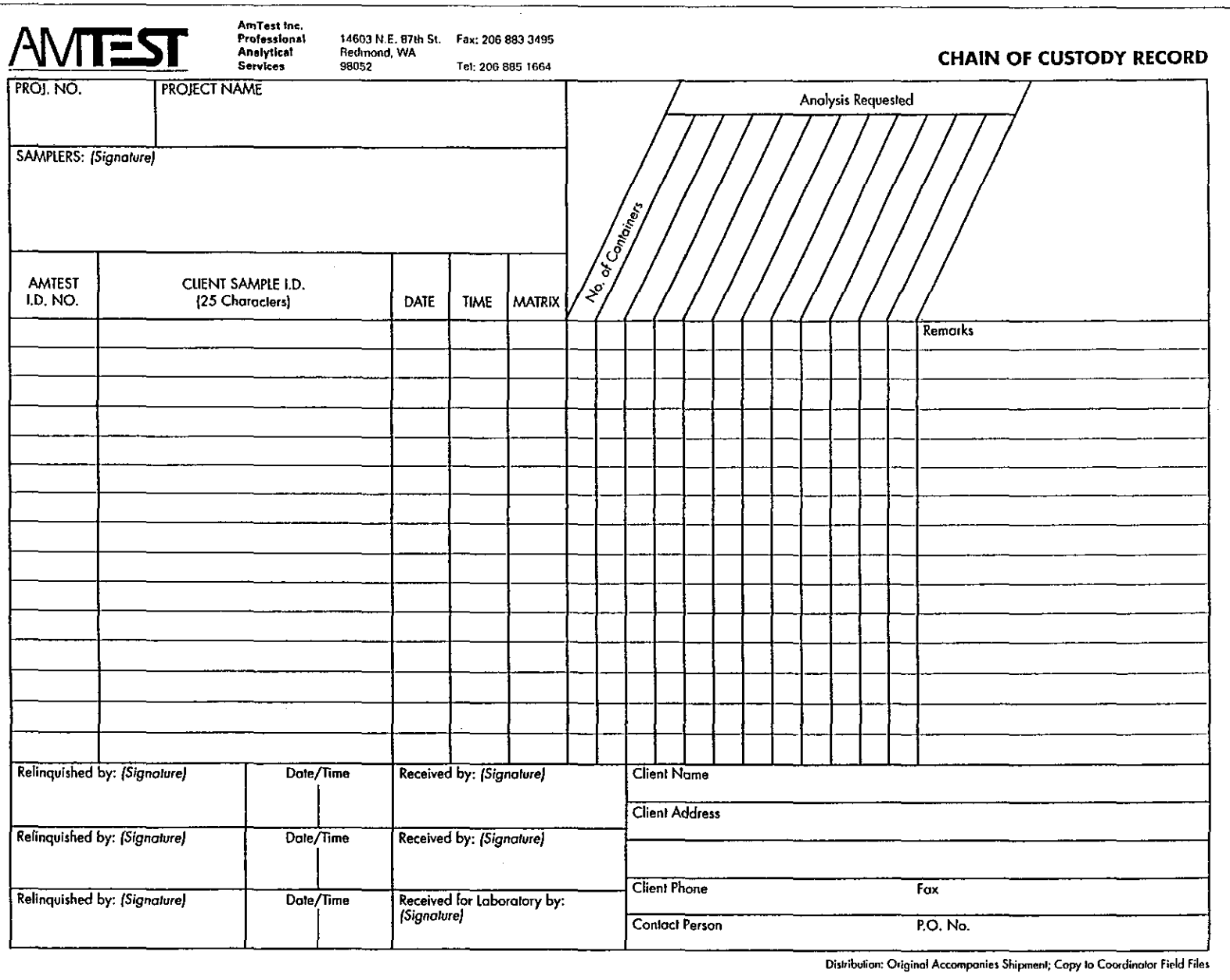
- Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratifications and lenses
- Vegetation
- Debris
- Biological Activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Depth of sediment
- Any other distinguishing characteristics or features

4.4.3 Field Sampling Schedule

The field sampling schedule is constrained by the shortest sample holding time (seven days). To safely meet the holding times for composited samples, the field samples will be composited and delivered for laboratory testing within three days of sampling the first core within each composite. Based on a review of the available sediment data and expected logistic considerations, it is projected that up to ten sediment cores can be completed per sampling day. The entire core-sampling program is expected to be completed within three working days.

4.5 Sample Transport and Chain-of-Custody Procedures

Chain of custody (COC) forms will be completed immediately after sample processing. All sample containers will be carefully packed in shock absorbent containers to prevent breakage and will be transported in an upright position, on ice, to AmTest laboratories at the earliest opportunity. Upon delivery of the samples, representatives of AmTest laboratories and Entranco will verify that sample descriptions on the COC are consistent with the actual delivered samples. The COC will then be signed with the date and time included in the appropriate spaces. Representatives of both companies will retain a copy of the COC. A sample COC form is shown in **figure 6**.



AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA
98052
Fax: 206 883 3495
Tel: 206 885 1664

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
SAMPLERS: *(Signature)*	

Analysis Requested

AMTEST I.D. NO.	CLIENT SAMPLE I.D. (25 Characters)	DATE	TIME	MATRIX	No. of Containers	Remarks

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*

Client Name
Client Address
Client Phone Fax
Contact Person P.O. No.

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

A695 92007-61 Soils (8/17/95) AGT

ENTRANCO

Figure 6
Chain of Custody Record

5.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

5.1 Laboratory Analyses Protocols

As discussed previously, to meet quality assurance/quality control (QA/QC) requirements, a blind duplicate sample must be analyzed for all the conventional and chemicals-of-concern parameters identified by Puget Sound Dredged Disposal Analysis (PSDDA). The composite samples will be identified as discussed in earlier Section 4.4.1.

A chain of custody (COC) record for samples will be maintained throughout all sampling activities and will accompany samples delivered to the laboratory. Information tracked by the COCs in the laboratory will 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.

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 Puget Sound Estuary Program (PSEP) Recommended Protocols. Several details of these procedures are discussed below.

5.1.1 Conventional Parameters

The following conventional parameters must be run on each sample within the holding times specified below:

- Total volatile solids — 14 days at 4°C
- Total organic carbon — 14 days at 4°C
- Percent solids — 14 days at 4°C
- Total sulfides — 14 days at 4°C
- Ammonia — 7 days at 4°C
- Grain size distribution — 6 months at 4°C

Particle grain size distribution for each composite sample will be determined in accordance with U.S. Environmental Protection Agency (EPA) guideline (**1991**). Wet sieve analysis will be used for the sieve sizes U.S. No. 4, 10, 20, 40, 60, 140, 200, and 230. Pipette/hydrometer analysis will be used for particle sizes finer than the 230 mesh. Water content will be determined using ASTM D2216. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-

detection below PSDDA screening levels (SLs). Sediment classification designation will be made in accordance with U.S. Soil Classification System (**ASTM D2487**).

5.1.2 Chemicals of Concern

AmTest laboratories will analyze the samples for the chemicals of concern identified by PSDDA in table A.7 of the 1989 Management Plan Report according to the protocols outlined by PSEP. The preparation and analysis methods, specific analysis reference, the sediment method detection limit, and the PSDDA SLs are provided in **Appendix C.** Detection limits of all measured chemicals 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 to make certain that it complies with the PSDDA detection limit requirements. 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. In addition, an aliquot (8 oz) of each sediment sample for analysis will be archived and preserved at -18°C for additional analysis if necessary. Archived samples will be labeled "Z" followed by the coring number.

5.1.3 Quality Assurance Quality Control Requirements

In addition to running a blind duplicate analysis, the two separate sets of analyses on the composite sediment samples and the minimum laboratory QA/QC requirements will be undertaken (**table 3**).

5.2 Laboratory Written Report

A written report will be prepared by AmTest documenting all the activities associated with laboratory sample analyses. At 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. Further reporting that will be completed by Entranco is detailed in Section 6.0.

Table 3
Minimum Laboratory QA/QC

Analysis Type	Method Blanks	Triplicates[5]	Replicates	CRM[7]	Matrix Spike[5]	Surrogates[1]
Volatile Organics[2,3]	X[5]		X[6,10]		X	X
Semivolatiles[2,3]	X[4]		X[6,10]	X[8]	X	X
Pesticides/PCBs[2,3]	X[4]		X[6,10]	X[8]	X	X
Metals	X[5]		X[5]	X	X	
Ammonia	X[5]	X				
Total Sulfides	X[5]	X				
Total Organic Carbon	X[5]	X		X[9]		
Total Solids		X				
Total Volatile Solids		X				
Particle Size		X				

1. Surrogate spikes required for every sample, including matrix spiked samples, blanks and reference materials
2. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria
3. *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
4. Frequency of Analysis (FOA) = one per extraction batch
5. FOA = 5 percent or one per batch, whichever is more frequent
6. FOA = <20 samples: one per batch; 20+ samples: 1 triplicate and additional duplicates for a minimum of 5 percent total replication
7. Certified Reference Material
8. Sequim Bay Reference (one replicate)
9. FOA = 1 per major survey
10. Matrix spike duplicate will be run

6.0 REPORTING

6.1 QA Report

The project quality assurance representative will prepare a quality assurance report based on 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.*

6.2 Final Report

A written report shall be prepared by Entranco documenting all activities associated with collection, compositing, transportation of samples, and chemical and physical analysis of samples. The chemical and physical analysis reports will be included as appendices. At 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 accompanied by photographs adequate to provide a visual representation of the sediments.
- Methods used to locate the sampling positions within an accuracy of ± 2 meters.
- 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 quality assurance report for Section 6.1 above.
- All raw data required for Dredged Analysis Information System (DAIS) as identified in **Appendix E.** In addition, all field and laboratory analyses results and associated quality assurance data will be submitted on floppy diskettes using the U.S. Army Corps of Engineers' DAIS format.

- Quality assurance data required by the Washington State Department of Ecology for data validation prior to entering data in their Sediment Quality database. These data are listed in **Appendix E.**

- Sampling and analysis cost data will be submitted upon project completion on forms provided by the Dredged Material Management Office.

REFERENCES

ASTM

1986 Standard Test Method for Classification of Soils for Engineering Purposes. U.S. Soil Classification System (ASTM D2487-85).

CH2M Hill

1977 *Capitol Lake Restoration and Recreation Plan.* Final Environmental Impact Statement and Supporting Documents. Prepared for the State of Washington Department of General Administration.

1976 *Capitol Lake Restoration.* Draft Environmental Impact Statement. Prepared for the State of Washington Department of General Administration.

Hong West

1994 Geotechnical Engineering Services, Capitol Lake Sediment Control Project, Olympia, Washington. HWA Project No. 92055-2.

Ebasco

1986 Specifications for Capitol Lake Maintenance Dredging. 85-140D. Prepared for the State of Washington Department of General Administration.

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency (EPA), Washington State Department of Natural Resources, and Washington State Department of Ecology.

1989 *Puget Sound Dredged Disposal Analysis (PSDDA).* Management Plan Report (MPR) for Unconfined, Open-Water Disposal of Dredged Material, Phase II (North and South Puget Sound).

1988 *Puget Sound Dredged Disposal Analysis (PSDDA).* Evaluation Procedures Technical Appendix - Phase I (Central Puget Sound).

U.S. Environmental Protection Agency (EPA)

1991 The Puget Sound Estuary Program (PSEP) Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound.

APPENDIX A

Draft Sediment Characterization Results Capitol Lake (Entranco Unpublished Report, 1994)

SUMMARY AND CONCLUSIONS

As part of the Capitol Lake Sediment Control Project, twenty sediment samples were collected in the middle basin of the lake and six sediment samples were collected in the middle basin sediment dewatering site. The purpose of the sediment characterization study was to determine whether the sediments are contaminated by any toxic substances. The sediment sampling sites were chosen to represent the various sectors of the dredge areas in the middle basin and the dredge spoil dewatering area. Samples were not collected near the shoreline, because this area will not be dredged. The results of the sediment study are:

- Total petroleum hydrocarbon (TPH) levels were below the Thurston County High Risk Waste guidelines for the disposal of lake sediments. There currently are no state standards for TPH in sediments.

- Contamination from PCB was not detected in any sample.

- Selected sediment metals were analyzed using the following three separate procedures:

  1) **The Toxicity Characteristic Leaching Procedure (TCLP)** - The TCLP was used to determine the potential of lake sediments to leach toxic materials. Twenty six samples were analyzed using the TCLP for all parameters. All samples had metal concentrations that were below the Maximum Allowable Concentrations for the State of Washington Dangerous Wastes Regulations and the Thurston County Guidelines for High Risk Wastes.

  2) **Total metals concentrations of the bulk sediments** - Five samples were analyzed for the total metal levels in the sediments. Not all metals adsorbed to sediment particles are available to be leached into the water column. The bulk analysis indicated that the sediment concentrations for metals were generally near average and median background concentrations for Washington State lakes, and were well below the "Severe effect level" criteria - the level at which harm has been demonstrated for most benthic (bottom-dwelling) organisms. There currently are not state standards for freshwater sediments.

  3) **Elutriate testing for metals and nitrate** - The purpose of the elutriate analysis was to determine if State of Washington Water Quality Standards for water quality would be exceeded during the disturbance caused by the sediment removal operations. The analysis conducted for this study indicated that none of the standards for the selected metals measured in this study would be exceeded during dredging operations.

TABLE OF CONTENTS

INTRODUCTION

The purpose of this memorandum is to present results of the sediment characterization study performed as part of the Capitol Lake Sediment Control Project. The methods used to handle and dispose of the dredged material may be affected by the chemical characteristics of the sediments. The objectives of the sediment sampling effort were to determine 1) the physical characteristics of the sediments for geotechnical analysis and 2) whether the sediments are contaminated by any toxic substances. This report presents results of the chemical analysis only, the physical characteristics of the sediments are described elsewhere in the dredging plan.

The sediment sampling sites were chosen to represent the various sectors of the dredge areas in the middle basin and the dredge spoil dewatering area (**Figure 1**). Samples were not collected near the shoreline, because this area will not be dredged. The study methods are described first, followed by the sediment results and conclusions.

METHODS

Ten sediment cores were collected in March 1994 at eight stations in the middle basin (**Figure 1**). A four-foot stainless steel hand sediment coring device (Wildco #2424-A50) with two-inch diameter liner tubes was used to collect the core samples. SCUBA divers collected the core samples. The core liners were made of clear thermoplastic and the endcaps of each tube were made of polyethylene. The cores were processed at the laboratory within 48 hours of collection and holding times were not exceeded (**Attachment A**). Two field duplicate cores were collected to estimate field and laboratory variability. Each core was separated into two approximately four-inch samples representing the top and bottom of the core. The top and bottom samples generally ranged in depth between 1 and 7 inches and 9 to 18 inches, respectively (**Table 1**).

In addition, six samples were collected at two stations in February 1994 from the dredge material dewatering area. The stations were located at opposite ends of the dredge material dewatering area (**Figure 1**) and sampled up to a depth of 6.5 feet (**Table 1**). The sediments were placed directly into pre-cleaned glass jars provided by Amtest, Inc.

The samples were analyzed for selected metals, organic compounds (total petroleum hydrocarbons and polychlorinated biphenyl), and total solids. The parameters and methods are listed in **Table 1**. Three types of analysis were conducted to characterize the sediment metals.

1) **The Toxicity Characteristic Leaching Procedure (TCLP)** - The TCLP is used to estimate the concentrations of metals that would become available (not adsorbed on to sediment particles) and leach into groundwater if the dredge spoils were disposed in a landfill. Therefore, the potential metal toxicity of the lake sediments can be evaluated using the TCLP. This procedure complies with the Washington State Department of Ecology's Dangerous Waste Regulations (WAC 173-303-100) and Thurston County's Environmental Health guidelines for the disposal of dredge spoils. The Thurston County Health Officer must authorize the disposal of high risk wastes as outlined in Article V of the Thurston County Sanitary Code, Section 24. All samples were analyzed using the TCLP as indicated in **Table 1**.

A lower detection limit for lead is required to determine compliance with Thurston County Guidelines for High Risk Wastes as compared with Washington State Department of Ecology's Dangerous Waste Regulations. (Thurston County's guidelines are one hundred times lower - 0.05 mg/L versus 5 mg/L for Washington State's Regulations). Therefore, all samples from the middle basin were also analyzed using the method with a lower detection for lead than normally used for the TCLP. The higher detection limits are appropriate only for determining compliance with the Washington State Department of Ecology's Dangerous Waste Regulations and should not be used to determine compliance with Thurston County's guidelines .

2) **Total metals concentrations of the bulk sediments** - Although there currently are no sediment *standards* based on the total concentration (bulk analysis) of sediment metals, the Washington State Department of Ecology (Ecology) is in the process of developing such standards and comparisons of sediment quality are frequently made on the basis of total sediment concentration. Three samples from the middle basin and two samples (19 percent of the total samples) from the dredge spoil dewatering area were selected for bulk analysis and elutriate testing (see additional discussion below) of selected metals (**Table 1**). The stations with higher metals, as determined from the TCLP analysis, were selected for these additional tests. An acid digestion procedure (EPA 3010) was used to extract the sediment metals for bulk analysis. Results are compared against available *criteria* from Ecology (**Ecology 1991**)

3) **Elutriate testing for metals and nitrate** - The purpose of the elutriate analysis was to determine whether the State of Washington Water Quality Standards for Toxic Substances (WAC 173-201A-040) for metals would be exceeded by the disturbance caused during the dredging operations. Five sediments samples were selected for additional analysis for total and dissolved fractions (**Table 1**). The elutriates were generated by combining three parts of lake water, taken from Capitol Lake, with one part sediment. This mixture was aerated for a period of one hour and allowed to settle overnight. A portion of the elutriate was filtered through a 0.45 micron filter in order to obtain the "Dissolved Metals" fraction. Samples of the "background" lake water were also analyzed for metals (arsenic, cadmium, copper, lead, mercury, and zinc), hardness, and nitrate+nitrite-nitrogen.

Table 1
Sample Depths and Analysis of Sediment Samples Collected in Capitol Lake

Station	Sample Depths (Inches)	TCLP[a]	Bulk Sediment and Elutriate Testing[b]
Middle Basin			
1B (Dup)	2 - 6 and 14 -18	■	■
1B	2 - 6 and 13.5 - 17.5	■	
2-1	2 - 6 and 18 - 23	■	
2-2	0 - 4 and 4 - 8	■	
3-1	1 - 8 and 9 -16	■	
3-2	1 - 7 and 8 -13	■	■
4-1	1 - 7 and 10 - 16	■	
4-1 (Dup)	1 - 6 and 7 -13	■	
5-1	1-7 and 10 - 15	■	■
5-3	1 -7 and 10 - 15	■	
Middle Basin Sediment Dewatering Site			
TP-4-1	1 foot	■	
TP-4-3	3 feet	■	
TP-4-6.5	6.5 feet	■	■
HA-5-1.5	1.5 feet	■	
HA-5-3-	3 feet	■	■
HA-5-6.5	6.5 feet	■	

a. Includes the following metals: As, Cd, Cu, Pb, Hg, Zn, and the following parameters: TPH, percent solids, PCB.

b. Includes the following parameters: hardness, NO2+NO3-N, metals (As, Cd, Cu, Pb, Hg, Zn, both total and dissolved).

Table 2
Analytical Methods and Detection Limits for Metals

	TCLP		Elutriate		Total Sediment	
Parameter	Method	Detection Limit ug/L	Method	Detection Limit ug/L	Method	Detection Limit ug/g
Arsenic	1310 SW-846	30	206.2 EPA	1	6010 SW-846	3.0
Cadmium	1310 SW-846	50	200.7 EPA	2	6010 SW-846	0.20
Lead [a)]	1310 SW-846 239.2 EPA	100 1	239.2 EPA	1	6010 SW-846	2.0
Mercury	1310 SW-846	1	245.1 EPA	0.2	7470 SW-846	0.020
Copper	1310 SW-846	20	200.7 EPA	2	6010 SW-846	0.20
Zinc	1310 SW-846	10	200.7 EPA	2	6010 SW-846	0.20

Remaining Parameters

Parameter	Method	Detection Limit
TPH	418.1 EPA	5 ug/g
PCB	8080 SW-846	
Total Solids	2540B SM	
Nitrate+nitrite-nitrogen	353.2.EPA	10 ug/L
Hardness	130.2 EPA	1 mg/L

EPA: 1983: Methods for Chemical Analysis of Water and Wastes
SM: 1992: Standard Methods for the Examination of Water and Wastewater, 18th ed.
SW-846: Test methods for Evaluating Solid Waste Physical/Chemical Methods

[a] To meet the lower detection limits required for Thurston County Guidelines for High Risk Wastes, Method 239.2 EPA was also used for lead analysis for the TCLP. The higher detection limits are appropriate for determining compliance with the Washington State Department of Ecology's Dangerous Waste Regulations. Thurston County Guidelines for High Risk Wastes, however, require detection limits that are less than 50 ug/L.

SEDIMENT QUALITY RESULTS AND DISCUSSION

The sediment data are evaluated on the basis of comparisons with standards and/or criteria and the likelihood of contamination. Some of the sediment or water quality criteria are not directly applicable, but are used in this study to determine the level of contamination, if any, and to allow comparison with background conditions or other studies. Results for the organic parameters, TPH and PCB, are presented first, followed by the three types of metal analysis - TCLP, total sediment metals, and elutriate analysis. The complete sediment data are presented in **Attachment B**.

Total Petroleum Hydrocarbon

Total petroleum hydrocarbon (TPH) represents a fraction of total oil, and the potential nonpoint sources of TPH contributing to lake sediments include urban runoff, boat motors, and contaminated groundwater caused by leakage from underground storage tanks.

The concentrations of sediment TPH in the dewatering area ranged from less than 5 ug/g (dry weight) at the surface of the southern station to approximately 74 ug/g at the lower depths of the northern station. All of the samples within the dewatering area are well below the Thurston County High Risk Waste guideline of 200 mg/kg (equal to ug/g). There currently are no state standards or criteria for freshwater sediment TPH's.

In general, TPH values were similar throughout the middle basin of the Capitol Lake. The average (and standard deviation) TPH concentration in the middle basin was 49 ± 17 ug/g. The highest level measured in the lake was 91 ug/g at the surface of the southernmost station, 1-B-T (**Figure 1**). Therefore, the sediments of the middle basin of Capitol Lake have acceptable levels of TPH and should not require special precautions for handling or disposal.

Polychlorinated biphenyl (PCB)

Polychlorinated biphenyl (PCB) is particularly persistent in the environment and is almost entirely generated by human activity. Sources of PCB include spills and leakage of products containing PCBs, such as electrical equipment (transformers) used in urban areas.

The sediments of Capitol Lake showed no evidence of PCB contamination as all 26 samples were below the detection limit (**ATTACHMENT B**). The detection limit for the fractions of PCB, which varies as a function of soil moisture and sample size, varied from 52 ug/kg to 310 ug/kg as dry weight.

Metal Analysis

Toxicity Characteristic Leaching Procedure (TCLP)

The intent of the TCLP is to estimate the potential of proposed landfill wastes to leach toxic material. The TCLP reflects the concentrations in an extracted volume and not the total concentrations in the sediment. For this study, the TCLP is used to determine whether the levels of metals in Capitol Lake sediments satisfy the State of Washington's Dangerous Waste Regulations (WAC 173-303-100) and Thurston County's Environmental Health guidelines for the disposal of lake sediments. The high risk waste level for the Thurston County guidelines is found by dividing the Dangerous Waste (DW) TCLP standard by 100. For example, the Dangerous Waste TCLP standard for lead is 5 mg/L and the high risk waste level is 0.05 mg/L. The Thurston County Health Officer must authorize the disposal of high risk waste.

The State of Washington Dangerous Waste Regulations specify that a waste (such as the lake sediments) would exhibit toxicity if it contains contaminants equal to or greater than the DW values (refer to **Table 3**). Any waste which equals or exceeds these levels must comply with applicable requirements of WAC 173-303-100, which establish special precautions for the handling of wastes.

As shown in **Table 3**, all Capitol Lake sediment samples were below the maximum allowable concentration (MAC) for dangerous wastes. All arsenic, cadmium and mercury samples taken from the middle basin of Capitol Lake were below detection limits (**Table 3, Attachment B**). Copper concentrations were also generally below detection limits, with the exception of the surface sample at Station 5-1 and both samples at Station 1-B.

All samples from the middle basin were also below the Thurston County's High Risk guidelines for the disposal of lake sediments (**table 3**). The maximum lead concentration using the TCLP from the middle basin was 19 ug/L, about one-half of Thurston County's High Risk guideline level of 50 ug/L.

On the basis of these results, the sediments would be classified as inert material (likely to retain its physical and chemical structure) and a nondangerous solid wastes for all parameters collected in this study.

Table 3
Results of TCLP Analysis

Parameter	MAC for Dangerous Wastes (mg/L)[1]	High Risk Waste Level (mg/L)[2]	Maximum Concentration from Capitol Lake Sediments (mg/L)	Number of Samples greater or equal to MAC/High Risk Level
Arsenic	5	NA	0.03	0/NA
Cadmium	1	NA	< 0.5	0/NA
Lead	5	0.05	0.019[3]	0/0[3]
Mercury	0.2	NA	0.003	0/NA
Copper	NA	100	0.15	NA/0
Zinc	NA	500	0.12	NA/0

1. MAC: Maximum Contaminant Concentration for dangerous wastes as listed in the Washington State Dangerous Waste Regulations (WAC 173-303-100). Dangerous waste are those wastes designated as dangerous or extremely hazardous under chapter 173-303 WAC, Dangerous Waste Regulations.
2. Thurston County Environmental Health High Risk Waste Evaluation Guidelines: The high risk waste level is found by dividing the Dangerous Waste TCLP standard by 100. For example, the TCLP standard for lead is 5 mg/L, while the high risk waste level is 0.05 mg/L.
3. Comparison of lead levels with Thurston County's High Risk Waste Guidelines apply only to the samples collected in the middle basin.

Total Sediment Metals (Bulk Analysis).

Lake sediments naturally contain concentrations of certain trace metals although the concentration can vary from region to region and lake to lake. Average background concentrations for soil and freshwater sediments in Washington State are shown in **Table 4**. The criteria and guidelines chosen for comparison in this study are based on either the background levels shown in **Table 4** or effects on aquatic organisms.

Ecology has developed and adopted marine sediment *standards*, but has not yet completed development of freshwater sediment *standards*. Ecology has compiled freshwater sediment *criteria* developed from various sources in Canada and the United States (**Ecology 1991**). **Table 4** compares the Capitol Lake sediment results with the available freshwater sediment criteria from the Ontario Ministry of the Environment, which developed guidelines for contaminated sediments based on the chronic and long-term effects on benthic organisms (**Ecology 1991**). The guideline for the "Severe-effect level" is a, "Pronounced disturbance of sediment-dwelling organisms can be expected. Contaminant concentration would be detrimental to the majority of benthic species."

Most sediment metal concentrations in Capitol Lake were near the background levels for lake sediments reported for Washington State. The one exception was copper levels, which were approximately twice background concentrations. As shown in **Table 5**, the lowest effect threshold was equaled or exceeded for arsenic (3 samples), cadmium (2 samples), copper (5 samples), and mercury (2 samples). The severe effect level was not approached by any of the samples. Copper had levels which fell closest to the severe effect level, which were generally one-half this concentration.

Elutriate Test Results

The elutriate test was conducted to evaluate whether sediment removal operations would pollute the water column as a result of sediment resuspension. The elutriate test results for both dissolved and total metal concentrations are shown in **Table 6**. The results of this analysis indicate that none of the freshwater criteria for toxic substances would be exceeded for the metals measured in this study. Note that these criteria are based on the protection of freshwater aquatic life.

Table 4
Comparison between Freshwater Sediment Metals Criteria with Concentrations Measured in Capitol Lake

SAMPLE NUMBERS	As (ug/g)	Cd (ug/g)	Cu (ug/g)	Hg (ug/g)	Pb (ug/g)	Zn (ug/g)	Percent Solids
1-B-B-1	< 2.6	0.6	51	0.2	18.2	63.6	55
3-2-B	6.1	0.8	63	0.1	18.5	72.2	54
5-1-T	13.4	< 0.17	68	0.1	23.4	81.6	38
TP-4-6.5	12.7	0.5	43	0.1	16.5	51.7	60
HA-5-3	< 2.7	< 0.18	63	0.2	26.1	71.7	46
Severe Effect *	33	10	110	2	250	820	
Background Concentrations **							
Mean	6.4	2.6	34	ND	94	220	
Median	3.4	0.5	24	ND	33	84	

All values are reported in dry weight

* Source: Ecology 1991.
** Source: PTI 1989.

Table 5
Elutriate Metals Test Results

SAMPLE NUMBERS		Hardness (mg/L)	NO2+NO3 (ug/l)	As (ug/l)	Cd (ug/l)	Cu (ug/l)	Hg (ug/l)	Pb (ug/l)	Zn (ug/l)
1-B-B-1	Total metals	92	300	< 1	< 2	< 2	< 0.4	1	25
1-B-B-1	Dissolved			< 1	< 2	< 2	< 0.4	< 1	38
3-2-B	Total metals	73	160	2	< 2	3	< 0.4	5	16
3-2-B	Dissolved			1	< 2	< 2	< 0.4	< 1	27
5-1-T	Total metals	65	720	3	< 2	< 2	< 0.4	10	9
5-1-T	Dissolved			1	< 2	< 2	< 0.4	< 1	10
TP-4-6.5	Total metals	940	350	2	16	4	< 0.4	1	54
TP-4-6.5	Dissolved			< 1	< 2	< 2	< 0.4	< 1	65
HA-5-3	Total metals	170	95	1	< 2	12	< 0.4	2	46
HA-5-3	Dissolved			< 1	< 2	3	< 0.4	< 1	44
Lake water	Total metals	30	720	< 1	< 2	< 2	< 0.4	1	3
Lake water	Dissolved			1	< 2	< 2	< 0.4	< 1	2

QUALITY CONTROL RESULTS

As part of routine procedures, the laboratory performed a series of quality control checks. The quality control data were evaluated to determine the precision and accuracy of the sample data. The documentation of the quality assurance and quality control analyses is provided in **Attachment A.**

For the metals analysis, quality control analyses included laboratory duplicates, blanks, standard reference material analysis, and sample spikes at a frequency of ten percent of the samples.

Laboratory Duplicates - Laboratory duplicates for the TCLP analysis of a dewatered sediment sample ranged between 3 percent for arsenic to 75 percent for zinc. The remaining TCLP metals (lead, copper, and mercury) duplicates were approximately 30 to 40 percent. Similarly, the laboratory duplicates for the TCLP analysis of two middle basin sediment sample ranged between 0 percent for lead to 29 percent for zinc. Therefore, the relative percent difference between duplicate samples analyzed occasionally exceeded the control limit of 20 percent on 6 of 12 samples, but this was attributed by the laboratory to the low metals concentrations and the greater relative variability that occurs at these lower levels. The laboratory duplicates for the Capitol Lake elutriate metal samples could not be calculated because one or both samples were below detection limits, with the exception of zinc.

The laboratory duplicates for TPH was less than 20 percent for both of the samples in which this analysis was conducted. Laboratory duplicates for PCB analysis was not conducted as all samples were below detection limits.

Blanks - All blanks for TCLP metals analyses and elutriate metals were below detection limits. The blank values for the total sediment metal for cadmium and copper were 0.4 ug/g and 2.3 ug/g, approximately two and eleven times the detection limit, respectively. This blank for sediment copper is relatively high and concentrations presented in the results section should be viewed as approximate values. The remaining blank values for sediment metals, PCB, and TPH were below the detection limits.

Matrix Spikes - The spike recoveries for PCB, using hexabromobenzene as a surrogate, ranged between 72 and 121 percent, with an average recovery of 92 percent. One value exceeded the acceptable range of 75 to 125 percent. Percent recoveries for the metals (TCLP and elutriate analyses) and TPH were within the control limits. The percent recoveries for the laboratory reference materials were also within the acceptable range.

Standard Reference materials - Standard reference materials for all metals analysis and TPH were within the laboratory control limits **(Attachment A).**

REFERENCES

Brown and Caldwell. 1984. Operations and Maintenance Manual for Capitol Lake Dredge Spoils Treatment Site.

Davis, S, S. Berg, and J. Michaud. 1993. Budd Inlet/Deshutes River Watershed Characterization. Part II. Water Quality Study. Thurston County Public Health and Social Services Department. Olympia, WA.

Ecology. 1991. Summary of Criteria and Guidelines for Contaminated Freshwater Sediments. Produced for Ecology's Sediment Management Unit. Compiled by Jon Bennett and Jim Cubbage. Washington State Department of Ecology.

PTI Environmental Services. 1989. Draft Report Sections 1-7, Background Concentrations of Selected Chemicals in Water, Soil, Sediments, and Air of Washington State. Washington Department of Ecology. Olympia, WA.

Tetra Tech, Inc. 1986. Puget Sound Protocols. U.S. EPA document

Thurston County Department of Environmental Health Division, Public Health and Social Services Department 1991. High Risk Waste Evaluation Guidelines. Olympia Washington.

US Environmental Protection Agency 1983. Methods for Chemical Analysis of Water and Wastes

ATTACHMENT A

Quality Assurance/Quality Control Data

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

March 16, 1994

Adolphson and Associates Inc.
attn. Lisa Adolphson
5309 Shilshole Ave. NW
Seattle, WA 98107

Dear Lisa,

Enclosed you will find the analytical results for the first set of sediment samples collected from the Capital Lake Dredging project (# 92055-2). On the 24th of February, Am Test received a total of six (6) samples (sampled 2/23/94) from Hong West and Associates.

The samples were received in good condition. At the time of receipt, the samples were logged in and properly maintained prior to their subsequent analyses. Below you will find a listing of the laboratory sample numbers and the corresponding identifications provided on the chain of custody forms.

94-A004330	TP-4-1
94-A004331	TP-4-3
94-A004332	TP-4-6.5
94-A004333	HA-5-1.5
94-A004334	HA-5-3
94-A004335	HA-5-6.5

The samples were analyzed for the following parameters using the analytical methods that are detailed below:

Nitrate & Nitrite Nitrogen*	353.2	EPA
Total Petroleum Hydrocarbon	418.1	EPA
PCB's	8080	SW-846
TCLP Metals (As, Cd, Cu, Pb, Hg, Zn)	1310	SW-846
Total Solids	2540B	SM

* Soluble

AMTEST

The analyses were performed within their respective holding times. The results of the Conventional analyses are expressed on an "as received" basis. The total solids content for each of the samples is reported for you convenience. The apparent disparity between the Total Solids content (sample dried at 103 degrees C) and the Moisture content of the TCLP analysis (filtration) is a function of the differences between the two methods.

*Please note that the detection limits, with the exception of the TCLP Metals, are expressed in terms of minimum method detection limits (i.e. IDL*final extract volume/sample weight) as opposed to quantitation limits.*

Following the analytical data, you will find the Quality Control (QC) summary. Information in this section includes the dates of analyses, and the results of the blanks, duplicates and matrix spikes. All of the QC data was within the control limits of the laboratory, as well as those of the analytical methods.

The data has been reviewed for completeness, accuracy and release. If you have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Mark A. Fugiel
Technical Director
Am Test Inc.

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

March 24, 1994

Adolphson and Associates Inc.
attn. Lisa Adolphson
5309 Shilshole Ave. NW
Seattle, WA 98107

Dear Lisa,

Enclosed you will find the analytical results for the second set of sediment samples collected from the Capital Lake Dredging project (# 92055-2). On the 10th of March, Am Test received a total of twenty (20) samples from Entranco Engineers.

At the time of receipt, the sample cores were split, homogenized, and transfered into proper containers. They were subsequently logged in and properly maintained prior to their analyses.

Below you will find a listing of the laboratory sample numbers, the corresponding client identifications, and the sample depths (inches) that were provided on the chain of custody forms.

94-A005105	1-B-T-1	2-6"
94-A005106	1-B-B-1	14-18"
94-A005107	1-B-T-2	2-6"
94-A005108	1-B-B-2	13-17"
94-A005109	2-1-T	2-6"
94-A005110	2-1-B	18-23"
94-A005111	2-2-T	0-4"
94-A005112	2-2-B	4-8"
94-A005113	3-2-T	1-7"
94-A005114	3-2-B	8-13"
94-A005115	4-1-T-1	1-7"
94-A005116	4-1-B-1	10-16"
94-A005117	4-1-T-2	1-6"
94-A005118	4-1-B-2	7-13"
94-A005119	5-1-T	1-7"
94-A005120	5-1-B	10-15"

94-A005121	*5-3-T*	*1-7"*
94-A005122	*5-3-B*	*10-15"*
94-A005123	*3-1-B*	*9-16"*
94-A005124	*3-1-T*	*1-8"*

The samples were analyzed for the following parameters using the analytical methods that are detailed below:

*Nitrate & Nitrite Nitrogen**	*353.2*	*EPA*
Total Petroleum Hydrocarbon	*418.1*	*EPA*
PCB's	*8080*	*SW-846*
TCLP Metals		
(As, Cd, Cu, Pb, Hg, Zn)	*1310*	*SW-846*
Total Solids	*2540B*	*Std Methods*

** Soluble*

The analyses were performed within their respective holding times. The results of the Conventional analyses are expressed on an "as received" basis. The total solids content for each of the samples is reported for you convenience.

The apparent disparity between the Total Solids content (sample dried at 103 degrees C) and the Moisture content of the TCLP analysis (filtration) is a function of the differences between the two methods.

*Please note that the detection limits, with the exception of the TCLP Metals, are expressed in terms of minimum method detection limits (IDL*final extract volume/sample weight) as opposed to quantitation limits.*

Following the analytical data, you will find the Quality Control (QC) summary. Information in this section includes the dates of analyses, and the results of the blanks, duplicates and matrix spikes. All of the QC data was within the control limits of the laboratory, as well as those of the analytical methods.

The data has been reviewed for completeness, accuracy and

AMTEST

release. If you have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Mark A. Fugiel
Technical Director
Am Test Inc.

AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

June 8, 1994

ENTRANCO
JUN 15 1994
RECEIVED

Adolphson and Associates Inc.
attn. Lisa Adolphson
5309 Shilshole Ave. NW
Seattle, WA 98107

Dear Lisa,

Enclosed you will find the analytical results for the metals analyses that were performed on five selected sediments and their corresponding elutriate fractions (Total and Dissolved) from the Capital Lake Dredging project (# 92055-2). The analyses were performed on the same samples that were received from Entranco Engineers in March of this year.

The results of the total metals analyses in the sediments are expressed on an "as received" basis. The method references and the analyses dates are detailed in the Quality Control section of this report.

The elutriates were generated by combining three parts of lake water, taken from Capital Lake, with one part of sediment. This mixture was aerated for a period of one hour and allowed to settle. However, since the particle size of these sediment were extremely small, the elutriates were allowed to settle overnight, as opposed to the typical one hour period that is referenced in the Army Corp procedures. This was necessary in order to obtain a fairly clear resulting solution (Total Metals). A portion of the elutriate was then filtered through a 0.45 micron filter in order to generate the "Dissolved Metals" fraction. Samples of the "background" lake water were also analyzed.

For the elutriates, Arsenic and Lead were analyzed using Graphite Furnace Atomic Absorption (GFAA). The remaining metals (Cadmium, Copper and Zinc), with the exception of Mercury (Cold Vapor), were analyzed by Inductively Coupled Plasma Arc Spectroscopy (ICAP).

AMTEST

Following the analytical data, you will find the Quality Control (QC) summary. Information in this section includes the dates of analyses, and the results of the blanks, duplicates, matrix spikes and Standard Reference Materials (SRM). All of the QC data was within the control limits of the laboratory, as well as those of the analytical methods.

If you have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Mark A. Fugiel

Mark A. Fugiel
Technical Director
Am Test Inc.

ANALYSIS REPORT AMTEST

Adolfson and Associates, Inc.
Lisa Adolfson

Date Received: 02/25/94
Date Reported: 03/16/94
Project: Capitol Lk Sed Cntl

QUALITY CONTROL - EXTRACTION & ANALYSIS DATES

AM TEST Sample Numbers: 94-A004330 through 94-A004335.

PARAMETERS	DATES
PCB's:	
Extraction	02/28/94
Analysis	03/07/94
Total Petroleum Hydrocarbon	03/04/94
TCLP Metals Extraction	03/10/94
TCLP Metals Analysis:	
Arsenic	03/16/94
Cadmium	03/14/94
Copper	03/14/94
Lead	03/14/94
Mercury	03/11/94
Zinc	03/14/94
Nitrate + Nitrite Nitrogen:	
Extraction	02/25/94
Nitrate	03/08/94
Nitrite	02/25/94
Total Solids	03/04/94

ANALYSIS REPORT AMTEST

Adolfson and Associates, Inc.
Lisa Adolfson

Date Received: 03/10/94
Date Reported: 03/24/94
Project: Capitol Lk Sed

QUALITY CONTROL - EXTRACTION & ANALYSIS DATES

AM TEST Sample Numbers: 94-A005105 through 94-A005124.

PARAMETERS	DATES
PCB's:	
Extraction	03/14/94 - 03/15/94
Analysis	03/16/94
Total Petroleum Hydrocarbon	03/23/94
TCLP Metals Extraction	03/15/94
TCLP Metals Analysis:	
Arsenic	03/16/94
Cadmium	03/16/94
Copper	03/16/94
Lead	03/16/94
Mercury	03/17/94
Zinc	03/16/94
Nitrate + Nitrite Nitrogen:	
Extraction	03/15/94
Nitrate	03/18/94
Nitrite	03/15/94

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

METHODOLOGY REPORT

AM TEST ID 94-A008701 MATRIX : Water
CLIENT ID HA-5-3 Elutriate T.M. SAMPLED:

ANALYTE	UNITS	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Hardness (as CaCO3)	mg/l	130.2	EPA	1.0	5/25/94
Nitrate + Nitrite	mg/l	353.2	EPA	0.010	5/18/94
Arsenic	mg/l	206.2	EPA	0.001	6/ 6/94
Cadmium	mg/l	200.7	EPA	0.002	5/25/94
Copper	mg/l	200.7	EPA	0.002	5/25/94
Mercury	mg/l	245.1	EPA	0.0002	5/19/94
Lead	mg/l	239.2	EPA	0.001	6/ 6/94
Zinc	mg/l	200.7	EPA	0.002	5/25/94
Acid Dig.(Tot Metals)		3010	EPA		5/24/94

SM = Standards Methods for the Examination of Water and Wastewater 18th ed.
SW-846 = Test Methods for Evaluating Solid Waste Physical/Chemical Methods
EPA = Methods for Chemical Analysis of Water and Wastes 1983

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

METHODOLOGY REPORT

AM TEST ID 94-A008695
CLIENT ID HA-5-3

MATRIX : Sediment
SAMPLED:

ANALYTE	UNITS	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Acid Digestion for Soils		3050	SW-846		5/18/94
Arsenic	ug/g	6010	SW-846	3.0	5/23/94
Cadmium	ug/g	6010	SW-846	0.20	5/23/94
Copper	ug/g	6010	SW-846	0.20	5/23/94
Mercury	ug/g	7470	SW-846	0.020	5/19/94
Lead	ug/g	6010	SW-846	2.0	5/23/94
Zinc	ug/g	6010	SW-846	0.20	5/23/94

SM = Standards Methods for the Examination of Water and Wastewater 18th ed.
SW-846 = Test Methods for Evaluating Solid Waste Physical/Chemical Methods
EPA = Methods for Chemical Analysis of Water and Wastes 1983

ANALYSIS REPORT AMTEST

Adolfson Associates, Inc.
Lisa Adolfson

Date Received: 05/10/94
Date Reported: 06/08/94
Project: Capitol Lake Sed.
Project No.: 92007-61

QUALITY CONTROL
NBS 2704 - BUFFALO RIVER SEDIMENT
PLASMA SPECTROGRAPHIC ANALYSIS BY EPA METHOD 6010

ELEMENTS		MEASURED VALUE (ug/g)	TRUE VALUE (ug/g)	RECOVERY (%)	DETECTION LIMIT* (ug/g) dry wt.	LABORATORY CONTROL LIMIT** (ug/g)
Arsenic	As	23.6	23.4	100.	3.0	33 - 9.9
Cadmium	Cd	3.92	3.45	114.	0.2	4.77 - 2.03
Copper	Cu	102.	98.6	103.	0.2	125 - 76.7
Lead	Pb	168.	161.	104.	2.0	200 - 125
Zinc	Zn	432.	438.	99.	0.2	538 - 384

*Based on a sample size of 2.0 grams dry weight.
**Based on two standard deviations of the mean (revised 2/93).

Blanks

Dewatering sample			Middle Basin		Elutriate		Sediments	
TPH	< 5	mg/L	16	mg/L				
TCLP								
Arsenic	< 0.03	mg/L	< 0.03	mg/L	< 0.001	mg/L	< 0.10	(ug/g)
Cadmium	< 0.05	mg/L	< 0.05	mg/L	< 0.002	mg/L	0.4	(ug/g)
Copper	< 0.02	mg/L	< 0.02	mg/L	< 0.002	mg/L	2.3	(ug/g)
Lead	< 0.10	mg/L	< 0.10	mg/L	< 0.004	mg/L	< 0.10	(ug/g)
Mercury	< 0.001	mg/L	< 0.00	mg/L	< 0.001	mg/L	< 0.01	(ug/g)
Zinc	< 0.01	mg/L	< 0.02	mg/L	< 0.004	mg/L	< 0.20	(ug/g)

Laboratory Duplicates
HA-5-6.5

	Sample Value (ug/L)	Duplicate Value (ug/L)	Relative Percent Difference
TCLP			
Arsenic	34	35	3
Cadmium	< 5	< 5	NC
Copper	140	180	29
Lead	280	170	39
Mercury	3	2	33
Zinc	40	70	75
TPH (ug/g)			
1-B-T-1	29	34	17
4-1-T-1	18	19	6
1-B-T-1			
TCLP			
Arsenic	< 20	< 20	NC
Cadmium	< 50	< 50	NC
Copper	40	30	25
Lead	140	140	0
Mercury	< 1	< 1	NC
Zinc	120	110	8
1-B-B-1			
TCLP			
Arsenic	< 20	< 20	NC
Cadmium	< 50	< 50	NC
Copper	< 20	30	NC
Lead	< 100	< 100	NC
Mercury	< 1	< 1	NC
Zinc	160	120	25
Capitol Lake Water	Total Metals	(ug/L)	
Arsenic	< 1	1	NC
Cadmium	< 2	< 2	NC
Copper	< 2	< 2	NC
Lead	< 0.4	< 0.4	NC
Mercury	1	< 1	NC
Zinc	3	3	0

Capitol Lake
QA/QC
Percent Recovery

Sample	PCB	TPH	As	Cd	Cu	Hg	Pb	Zn
1-B-T-1	99							
1-B-B-1	72	93						
1-B-T-2	80							
1-B-B-2	100							
2-1-T	93							
2-1-B	103							
2-2-T	112							
2-2-B	110							
3-2-T	101							
3-2-B	75							
4-1-T-1	94		100	100	95	100	90	105
4-1-B-1	87	93	104	96	97	100	93	106
4-1-T-2	97							
4-1-B-2	100							
5-1-T	99							
5-1-B	81							
5-3-T	113							
5-3-B	95							
3-1-B	106							
3-1-T								
TP-4-1	120							
TP-4-3	99	92						
TP-4-6.5	115							
HA-5-1.5	121							
HA-5-3	116							
HA-5-6.5	118		104	86	107	93	95	110
Capitol Lake Water			108	98	100	98	84	103
Standard Reference		95	96	102	100	104	90	100

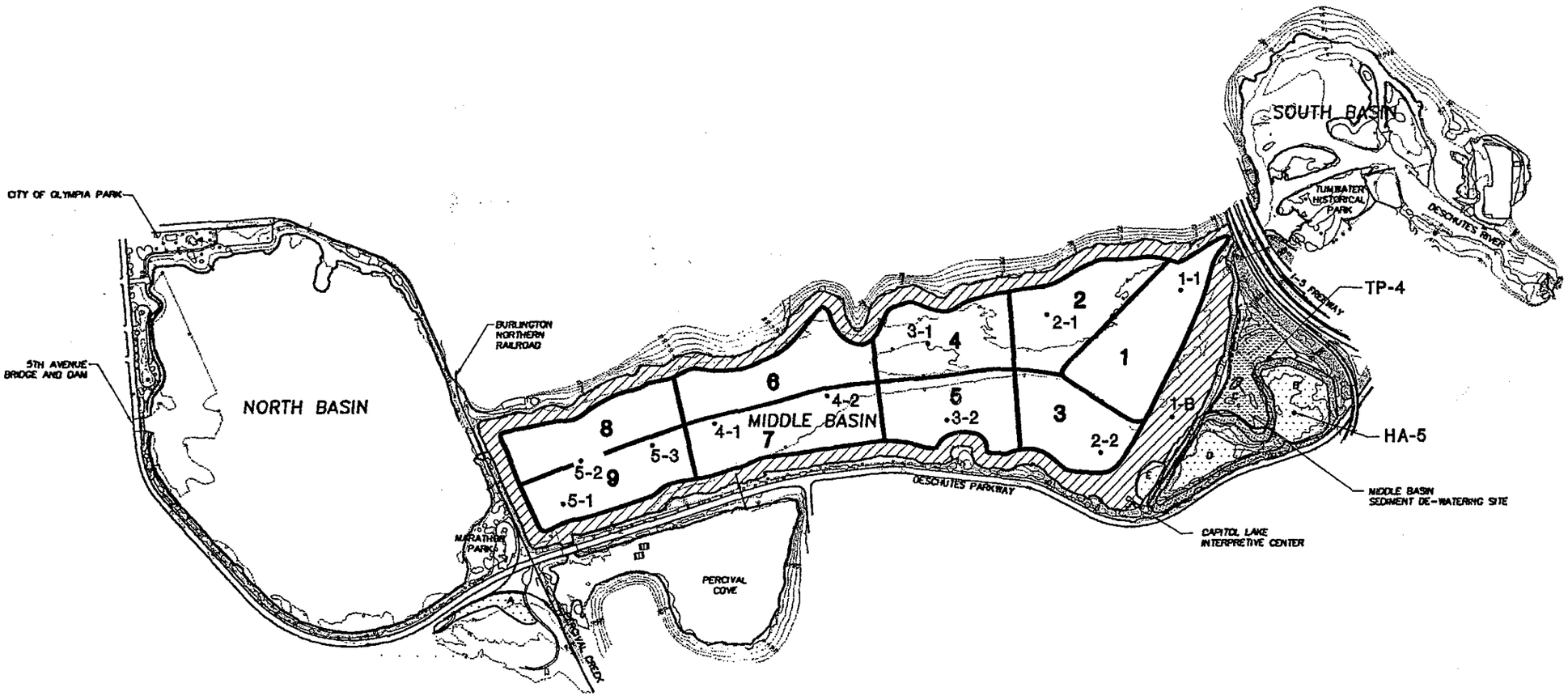
ATTACHMENT B

TCLP, TPH, and PCB Sediment Data

SEDIMENT DATA
CAPITOL LAKE SEDIMENT REMOVAL PROJECT

Sediment Dewatering Area

SAMPLED ON 02/23/94		TCLP METALS				AA			
SAMPLE NUMBERS	TPH (ug/g)	As (mg/l)	Cd (mg/l)	Cu (mg/l)	Pb (mg/l)	Pb (mg/l)	Hg (mg/l)	Zn (mg/l)	SOLIDS (%)
TP-4-1	<5	<0.03	<0.05	0.04	0.17		<0.001	0.08	60
TP-4-3	<5	<0.03	<0.05	0.04	0.12		<0.001	0.08	60
TP-4-6.5	37	<0.03	<0.05	0.04	0.28		<0.001	0.07	60
HA-5-1.5	22	<0.03	<0.05	<0.02	<0.1		<0.001	0.10	42
HA-5-3	74	0.03	<0.05	0.10	0.43		0.002	0.06	46
HA-5-6.5	53	0.03	<0.05	0.14	0.28		0.003	0.04	51
Middle Basin SAMPLED ON 03/10/94									
1-B-T-1	91	<0.03	<0.05	0.04	0.14	<0.001	<0.001	0.12	32
1-B-B-1	38	<0.03	<0.05	0.03	<0.1	0.004	<0.001	0.16	55
1-B-T-2	67	<0.03	<0.05	<0.02	<0.1	0.003	<0.001	0.09	39
1-B-B-2	24	<0.03	<0.05	<0.02	<0.1	0.005	<0.001	0.04	72
2-1-T	56	<0.03	<0.05	<0.02	<0.1	0.005	<0.001	0.10	52
2-1-B	29	<0.03	<0.05	<0.02	<0.1	<0.001	<0.001	0.07	59
2-2-T	40	<0.03	<0.05	<0.02	<0.1	0.019	<0.001	0.06	58
2-2-B	30	<0.03	<0.05	<0.02	<0.1	0.002	<0.001	0.07	63
3-2-T	35	<0.03	<0.05	<0.02	0.14	0.001	<0.001	0.07	48
3-2-B	41	<0.03	<0.05	<0.02	<0.1	0.003	<0.001	0.04	54
4-1-T-1	38	<0.03	<0.05	<0.02	<0.1	0.004	<0.001	0.06	48
4-1-B-1	53	<0.03	<0.05	<0.02	0.11	0.002	<0.001	0.04	51
4-1-T-2	54	<0.03	<0.05	<0.02	<0.1	0.004	<0.001	0.05	46
4-1-B-2	62	<0.03	<0.05	<0.02	<0.1	0.003	<0.001	0.04	47
5-1-T	34	<0.03	<0.05	0.15	0.11	0.005	<0.001	0.08	38
5-1-B	70	<0.03	<0.05	<0.02	<0.1	0.005	<0.001	0.07	44
5-3-T	64	<0.03	<0.05	<0.02	0.11	<0.001	<0.001	0.06	42
5-3-B	47	<0.03	<0.05	<0.02	0.14	<0.001	<0.001	0.06	45
3-1-B	37	<0.03	<0.05	<0.02	<0.1	0.003	<0.001	0.04	54
3-1-T	71	<0.03	<0.05	<0.02	<0.1	<0.001	<0.001	0.07	41



NOTES

1. WETLAND BOUNDARIES SHOWN ARE APPROXIMATE.
2. UPLAND CONTOURS ARE AT APPROXIMATE 5 FOOT INTERVALS, AND SHALL BE VERIFIED BEFORE DREDGING.

LEGEND

- DE-WATERING SITE BOUNDARY
- EXISTING LAKE SHORELINE
- SEDIMENT REMOVAL SECTOR BOUNDARY
- 1 — SEDIMENT REMOVAL SECTOR NUMBER
- • 2-1 — SAMPLING STATION CODE
- SHORELINE BUFFER ZONE
- WETLAND
- WETLAND BUFFER
- DE-WATERING SITE

N

400 200 0 400 800

DATUM

CITY OF OLYMPIA

No.	Date	By	Ckd.	Appr.	Revision

Approved By:

Drawn By: BLT Date: 6-2-94
Designed By: DAM 6-2-94
Checked By:
Approved By:

ENTRANCO
ENGINEERS • SCIENTISTS • PLANNERS • SURVEYORS
WASHINGTON ARIZONA CALIFORNIA

Scale:
Horiz. 1"=800'
Vert. –
Job No. 92007-61

WASHINGTON STATE
DEPARTMENT OF GENERAL ADMINISTRATION
CAPITOL LAKE
10-YEAR SEDIMENT REMOVAL PLAN: 1995-2005
1994 Sampling Locations

Sheet 1 of 2

APPENDIX B

PSDDA Parameters and Methods

APPENDIX B
PSDDA PARAMETERS

[Testing Parameter, Preparation Method, Analytical Method,
Sediment Method Detection Limit (MDL), PSDDA Screening Levels (SL),
Maximum Levels (ML) and Bioaccumulation Levels (BT)]

Parameter	Preparation Method	Analysis Method	Sediment MDL (1)	PSDDA SL	PSDDA (1) BT	PSDDA ML
Conventionals						
Total Solids (%)	---	Pg. 17 (2)	0.1	---	---	---
Total Volatile Solids (%)	---	Pg. 20 (2)	0.1	---	---	---
Total Organic Carbon (%)	---	Pg. 23 (2, 3)	0.1	---	---	---
Total Sulfides (mg/kg)	---	Pg. 32 (2)	1	---	---	---
Ammonia (mg/kg)	---	Plumb 1981 (4)	1	---	---	---
Grain Size	---	Modified ASTM with Hydrometer	---	---	---	---
Metals (ppm)						
Antimony	APNDX D (5)	GFAA (6)	2.5	20	146	200
Arsenic	APNDX D (5)	GFAA (6)	2.5	57	507.1	700
Cadmium	APNDX D (5)	GFAA (6)	0.3	0.96	---	9.6
Copper	APNDX D (5)	ICP (7)	15.0	81	---	810
Lead	APNDX D (5)	ICP (7)	0.5	66	---	660
Mercury	MER (8)	7471 (8)	0.02	0.21	1.5	2.1
Nickel	APNDX D (5)	ICP (7)	2.5	140	1,022	---
Silver	APNDX D (5)	GFAA (6)	0.2	1.2	4.6	6.1
Zinc	APNDX D (5)	ICP (7)	15.0	160	---	1,600
Organics (ppb)						
LPAH						
Naphthalene	3550 (9)	8270 (10)	20	210	---	2,100
Acenaphthylene	3550 (9)	8270 (10)	20	64	---	640
Acenaphthene	3550 (9)	8270 (10)	20	63	---	630
Fluorene	3550 (9)	8270 (10)	20	64	---	640
Phenanthrene	3550 (9)	8270 (10)	20	320	---	3,200
Anthracene	3550 (9)	8270 (10)	20	130	---	1,300
2-Methylnaphthalene	3550 (9)	8270 (10)	20	67	---	670
Total LPAH				610	---	6,100

Parameter	Preparation Method	Analysis Method	Sediment MDL (1)	SL	PSDDA (1) BT	ML
Organics (ppb) (Continued)						
HPAH						
Fluoranthene	3550 (9)	8270 (10)	20	630	4,600	6,300
Pyrene	3550 (9)	8270 (10)	20	430	---	7,300
Benzo(a)anthracene	3550 (9)	8270 (10)	20	450	---	4,500
Chrysene	3550 (9)	8270 (10)	20	670	---	6,700
Benzofluoranthenes	3550 (9)	8270 (10)	20	800	---	8,000
Benzo(a)pyrene	3550 (9)	8270 (10)	20	680	4,964	6,800
Indeno(1,2,3-c,d)pyrene	3550 (9)	8270 (10)	20	69	---	5,200
Dibenzo(a,h)anthracene	3550 (9)	8270 (10)	20	120	---	1,200
Benzo(g,h,i)perylene	3550 (9)	8270 (10)	20	540	---	5,400
Total HPAH				1,800	---	51,000
CHLORINATED HYDROCARBONS						
1,3-Dichlorobenzene	P&T (12)	8240 (11)	3.2	170	1,241	---
1,4-Dichlorobenzene	P&T (12)	8240 (11)	3.2	26	190	260
1,2-Dichlorobenzene	P&T (12)	8240 (11)	3.2	19	37	350
1,2,4-Trichlorobenzene	3550 (9)	8270 (10)	6	13	---	64
Hexachlorobenzene (HCB)	3550 (9)	8270 (10)	12	23	168	230
PHTHALATES						
Dimethyl phthalate	3550 (9)	8270 (10)	20	160	1,168	---
Diethyl phthalate	3550 (9)	8270 (10)	20	97	---	---
Di-n-butyl phthalate	3550 (9)	8270 (10)	20	1,400	10,220	---
Butyl benzyl phthalate	3550 (9)	8270 (10)	20	470	---	---
Bis(2-ethylhexyl)phthalate	3550 (9)	8270 (10)	20	3,100	13,870	---
Di-n-octyl phthalate	3550 (9)	8270 (10)	20	6,200	---	---
PHENOLS						
Phenol	3550 (9)	8270 (10)	20	120	876	1,200
2 Methylphenol	3550 (9)	8270 (10)	6	20	---	72
4 Methylphenol	3550 (9)	8270 (10)	20	120	---	1,200
2,4-Dimethylphenol	3550 (9)	8270 (10)	6	29	---	50
Pentachlorophenol	3550 (9)	8270 (10)	61	100	504	690

Parameter	Preparation Method	Analysis Method	Sediment MDL (1)	SL	PSDDA (1) BT	ML
MISCELLANEOUS EXTRACTABLES						
Benzyl alcohol	3550 (9)	8270 (10)	6	25	---	73
Benzoic acid	3550 (9)	8270 (10)	100	400	---	690
Dibenzofuran	3550 (9)	8270 (10)	20	54	---	540
Hexachloroethane	3550 (9)	8270 (10)	20	1,400	10,220	14,000
Hexachlorobutadiene	3550 (9)	8270 (10)	20	29	212	290
N-Nitrosodiphenylamine	3550 (9)	8270 (10)	12	28	161	220
VOLATILE ORGANICS						
Trichloroethene	P&T (12)	8240 (11)	3.2	160	1,168	1,600
Tetrachloroethene	P&T (12)	8240 (11)	3.2	14	102	210
Ethylbenzene	P&T (12)	8240 (11)	3.2	10	27	50
Total Xylene	P&T (12)	8240 (11)	3.2	12	---	160
PESTICIDES						
Total DDT	---	---	---	6.9	50	69
p,p'-DDE	3540 (13)	8080 (13)	2.3	---	---	---
p,p'-DDD	3540 (13)	8080 (13)	3.3	---	---	---
p,p'-DDT	3540 (13)	8080 (13)	6.7	---	---	---
Aldrin	3540 (13)	8080 (13)	1.7	10	37	---
Chlordane	3540 (13)	8080 (13)	1.7	10	37	---
Dieldrin	3540 (13)	8080 (13)	2.3	10	37	---
Heptachlor	3540 (13)	8080 (13)	1.7	10	37	---
Lindane	3540 (13)	8080 (13)	1.7	10	---	---
TOTAL PCBs	3540 (13)	8080 (13)	67	130	38*	2,500

* Total PCBs BT value in ppm carbon-normalized.

1. Dry Weight Basis.
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. Procedures For Handling and Chemical Analysis of Sediment and Water Samples, Russell H. Plumb, Jr., EPA/Corps of Engineers, May, 1981.
5. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment and Tissue Samples, Puget Sound Estuary Program, March, 1986.
6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
8. Mercury Digestion and Cold Vapor Atomic Absorption (CVAA) Spectrometry - Method 7471, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.
10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
11. GCMS Analysis - Method 8240, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
12. Purge and Trap Extraction and GCMS Analysis - Method 8240, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
13. Soxhlet Extraction and Method 8080, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

APPENDIX C

Quality Assurance Data Requirements Chemical Variables

APPENDIX C
QUALITY ASSURANCE DATA REQUIREMENTS
CHEMICAL VARIABLES

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
- Analysis concentrations with reporting units identified (to two significant figures unless otherwise justified)
- Quantification of all analyses 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.

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

APPENDIX D

Raw Data Requirements For Dredged Analysis Information System DAIS Data Checklist

APPENDIX D
RAW DATA REQUIREMENTS
FOR DREDGED ANALYSIS INFORMATION SYSTEM

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)				
Chemicals of Concern Analysis Data				

DAIS Data Checklist (Continued)

Grain/Size Analysis (Continued)	Metals	Semivol.	Pest./ PCBs	Volatiles
Extraction/digestion method	■	■	■	
Extraction/digestion dates (test sediment, blanks, matrix spike, reference material)	■	■	■	
Analysis method	■	■	■	■
Data and QA qualifier included for:				
test sediments	■	■	■	■
reference materials including 95% confidence interval (each batch)	■	■	■	
method blanks (each batch)	■	■	■	■
matrix spikes (each batch)	■	■	■	■
matrix spike added (dry weight basis)	■	■	■	■
replicates (each batch)	■	■	■	■
Units (dry weight)				
Method blank units (dry weight)				
QA/QC qualifier definitions	■	■	■	■
Surrogate recovery for test sediment, blank, matrix spike, ref. material		■	■	■
Analysis dates (test sediment, blanks, matrix spike, reference material)	■	■	■	■

■ Shaded areas indicate required data