8.2.9

DRAFT REMEDIAL ACTION REPORT

PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS UNIT
SEATTLE, WASHINGTON

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September 9, 2005

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ABBREVIATIONS AND ACRONYMS

ACC/Hurlen	American Civil Constructors/Hurlen Construction
ARARs	applicable or relevant and appropriate requirements
AET	apparent effects threshold
ARI	Analytical Resources, Inc.
bgs	below ground surface
CAS	Columbia Analytical Services
CDFR	chemical data final report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cm	centimeter
CO	Contracting Officer
COC	chemical of concern
COR	Contracting Officer's Representative
CQAP	construction quality assurance plan
CSL	cleanup screening level
cy	cubic yard
DCQCR	daily construction quality control report
DGPS	differential global positioning system
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
DQO	data quality objective
ECD	electron capture detector
Ecology	(Washington State Department of) Ecology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute
FS	feasibility study
GC	gas chromatograph
GPS	global positioning system
HPA	hydraulic project approval
HPAH	high molecular weight polynuclear aromatic hydrocarbons
HYPAK	hydrographic package
LAET	lowest apparent effects threshold
LNAPL	light nonaqueous-phase liquid
LPAH	low molecular weight polynuclear aromatic hydrocarbons
MCUL	minimum cleanup level

ABBREVIATIONS AND ACRONYMS (Continued)

MDL	method detection limit
MLLW	mean lower low water
mm	millimeter
MRL	method reporting limit
MSU	Marine Sediments Unit
NAD	North American Datum
NAPL	nonaqueous-phase liquid
NELAP	National Environmental Laboratory Accreditation Program
ng	nanogram
NMFS	National Marine Fisheries Service
NTP	Notice to Proceed
NTU	Nephelometric turbidity unit
NWS	USACE Northwestern Division, Seattle District
OC	organic carbon
O&M	operation and maintenance
OMMP	operation and maintenance monitoring plan
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCDD/F	dioxins and furans
PID	photoionization detector
PM	project manager
Port	Port of Seattle
PPE	personal protective equipment
PSDDA	Puget Sound Dredge Disposal Analysis
PSEP	Puget Sound Estuary Program
PSR	Pacific Sound Resources
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QAR	Quality Assurance Representative
QCS	quality control system
RA	remediation area
RAMP	remedial action management plan
RAO	remedial area objective
RAR	remedial action report
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
RDC	Regional Disposal Company

ABBREVIATIONS AND ACRONYMS (Continued)

RFI	Request for Information
RFP	Request for Proposal
RMS	Resident Management System
ROD	Record of Decision
RTK	real-time kinematic
SAS	sampling and analysis plan
SMS	Sediment Management Standard
SQS	Sediment Quality Standard
STFATE	Short-Term Fate [of dredged material disposal in open water]
SVOC	semivolatile organic compound
SVPS	sediment vertical profiling system
TCLP	toxicity characteristic leaching procedure
TEQ	toxic equivalent
TOC	total organic carbon
TVS	total volatile solids
URS	URS Group, Inc.
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VECP	value engineering change proposal
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WINOPS	Windows Offshore Positioning Software® (Lyman Burk & Associates)
WQC	water quality criteria
2LAET	second lowest apparent effects threshold

1.0 INTRODUCTION

The purpose of this Draft Remedial Action Report (RAR) is to document completion of all remedial actions at the Pacific Sound Resources (PSR) Superfund Site. The Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) identification number for this site is WAD009248287. This Draft RAR has been prepared consistent with U.S. Environmental Protection Agency (EPA) guidance entitled *Close Out Procedures for National Priorities List Sites* (USEPA 2000).

1.1 SITE LOCATION AND DESCRIPTION

The PSR site, formerly known as the Wyckoff West Wood Treating Facility, is located on the south shore of Elliott Bay in Puget Sound, in Seattle, Washington (Figure 1-1). The site is divided into two operable units: the Upland Unit and the Marine Sediments Unit (MSU). The Upland Unit consists of the former wood treating facility and occupied an area of approximately 25 acres; the MSU encompasses approximately 200 acres of Elliott Bay and approximately 2,000 feet of shoreline. Tidal elevations in the MSU range from extreme low water at -4 feet mean lower low water (MLLW) to extreme high water at +14.8 MLLW (USACE 2002, Nelson 1978).

Groundwater and soils contamination by creosote and other wood-treating waste products was present in the Upland Unit; an area of the MSU encompassing approximately 50 acres was reported to contain sediments with elevated levels of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) that present unacceptable risks to aquatic resources. During design, the size of the Record of Decision (ROD) defined area of concern was determined to be 55 acres. (The cap design area encompasses approximately 58 acres.)

1.2 ENVIRONMENTAL SETTING

The upland area of the site lies in an estuary that was filled to create usable land for industrial development (USEPA 1998). The upland fill is variable in nature and underlain by, in lithological sequence, native estuarine deposits, deltaic deposits, and glacial deposits. The fill in the upland area is typically 20 to 45 feet thick and consists of dredged sand and silt, construction debris and predominantly granular sediment, riprap, and wooden bulkhead debris. Estuarine deposits consist of silty sand and sandy silt with interbedded silt, clay and sand, and minor peat, wood, organic fragments and shells. The lower deltaic unit is medium dense to dense sand, and silty sand with some silt interbeds. Silt and clay lenses up to 10 feet thick have been observed and indicate a seaward dip of about 5 to 10 degrees. Dense glacial deposits were not encountered in the upland borings installed as part of the remedial investigation (RI), which penetrated approximately 100 feet below ground surface (bgs), nor were they encountered in sediment explorations installed during the RI/feasibility study (FS) and predesign investigations through depths of 80 feet below the mudline.

The sea-bottom slopes in the MSU are generally steeper nearshore and become flatter further offshore. The bottom slopes are variable, with nominal slopes up to about 20 to 25 percent (5H:1V to 4H:1V) from the shore to water depths of about -120 feet MLLW, 15 percent (7H:1V) in the 120- to 150-foot MLLW depth, and about 6 to 15 percent (16H:1V to 7H:1V) below −150 feet MLLW. A flat embayment area is present at the Crowley Marine Services pier in a water depth of about 40 feet.

Surface deposits of anthropogenic contaminated fill material overlie native sediments throughout the MSU. For consistency with the ROD, this contaminated fill material in the MSU is referred to as the Marine Sediments Unit fill, or simply "fill." Side-scan sonar (USGS 1996) and core samples (USEPA 1998a) indicate as much as 20 feet of fill consisting of contaminated sand and silty sand with organics and occasional wood debris.

The presence of thin layers of contaminated sediments in water depths up to 200 feet suggest that some fill material may have flowed down the submarine slopes due to uncontrolled placement (USGS 1996). Bathymetric data indicate that landslides have also historically occurred as subaqueous landslide features. Settling of turbidity plumes may also have contributed to the thin deposits of contaminated sediments. Ongoing sediment resuspension and transport during storm events could also explain the occurrence of contaminated sediments in deeper offshore areas.

Seattle is located in a seismically active area. In addition to documented earthquakes throughout the Northwest region, the project site is located adjacent to the Seattle fault. Current research by the U.S. Geological Survey (USGS) indicates that the Seattle fault may have produced a Magnitude 7 earthquake about 1,100 years ago.

1.3 SITE HISTORY AND NATURE OF CONTAMINATION

From 1909 to 1994, wood-treating operations were performed at the site. The wood-treating facility was originally a pile-supported facility over the Duwamish River estuary. The shoreline and intertidal area were filled in at various times throughout the last 100 years and the facility was eventually entirely located on approximately 25 acres of fill material that created an upland. This in-filling resulted in a steep riprap bank on the shoreline between the upland and off-shore area.

The southern portion of the facility (10 acres) was used primarily for treated wood storage and the northern part of the facility (15 acres) was used for processing. All retorts, product storage tanks, and piping were located on the northern portion of the facility. Wood-treating chemicals used at the site included creosote, pentachlorophenol and various metals-based wood preservation solutions.

The MSU has been contaminated by discharge of used and waste creosote and wood-treating chemicals from the former wood-treating operations on the upland portion of the site. Chemicals of concern in the MSU include PAHs, phenolic compounds, dibenzofuran, polychlorinated dibenzo-p-dioxins and -furans, PCBs, and mercury (USEPA 1998a). PAHs have been detected in excess of screening levels to depths of 20 feet below the mudline at the site. Downward and lateral migration of nonaqueous-phase liquids (NAPL), transport of contaminated groundwater, and erosion of contaminated soils by stormwater runoff from the Upland Unit represent historical sources and transport pathways to the MSU. In addition, the former Longfellow Creek outfall historically contributed PCB contamination to the MSU, and mercury contamination appears to have migrated from a source to the east of the site.[1]

A conceptual site model is provided as Figure 1-2. As a result of cleanup actions in the Upland Unit, there are only three likely contaminant migration pathways to Elliott Bay remaining: (1) transport of dissolved contaminants via groundwater with subsequent partitioning to sediment; (2) dissolution of sediment-bound contaminants to the waters of Elliott Bay; and (3) longshore or downslope migration of contaminated surface sediment in the MSU. The transport of free- and dissolved-phase NAPL in shallow groundwater to Elliott Bay has been inhibited by the slurry wall and light NAPL (LNAPL) recovery trench that were constructed as part of the upland source control activities. However, some dense NAPL (DNAPL) is present seaward of and deeper than the slurry wall. The DNAPL constitutes an ongoing, however minor, source to the bay via dissolved phase groundwater transport (USEPA 1999).

1.4 REGULATORY AND ENFORCEMENT HISTORY

The PSR site was added to the National Priorities List in May 1994. A settlement with the Wyckoff Company was embodied in a Consent Decree entered into Federal District Court in August 1994. The Decree creates the PSR Environmental Trust into which the heirs of the Wyckoff Company founders, owners, and operators placed all ownership rights and shares in the Company to allow the Trust to maximize liquidation of all company assets, including non-wood-treating holdings, for the benefit of the environment. The beneficiaries of the Trust are the United States Department of Interior, National Oceanic and Atmospheric Administration of the Department of Commerce, and the Suquamish and Muckleshoot Tribes, as Natural Resource

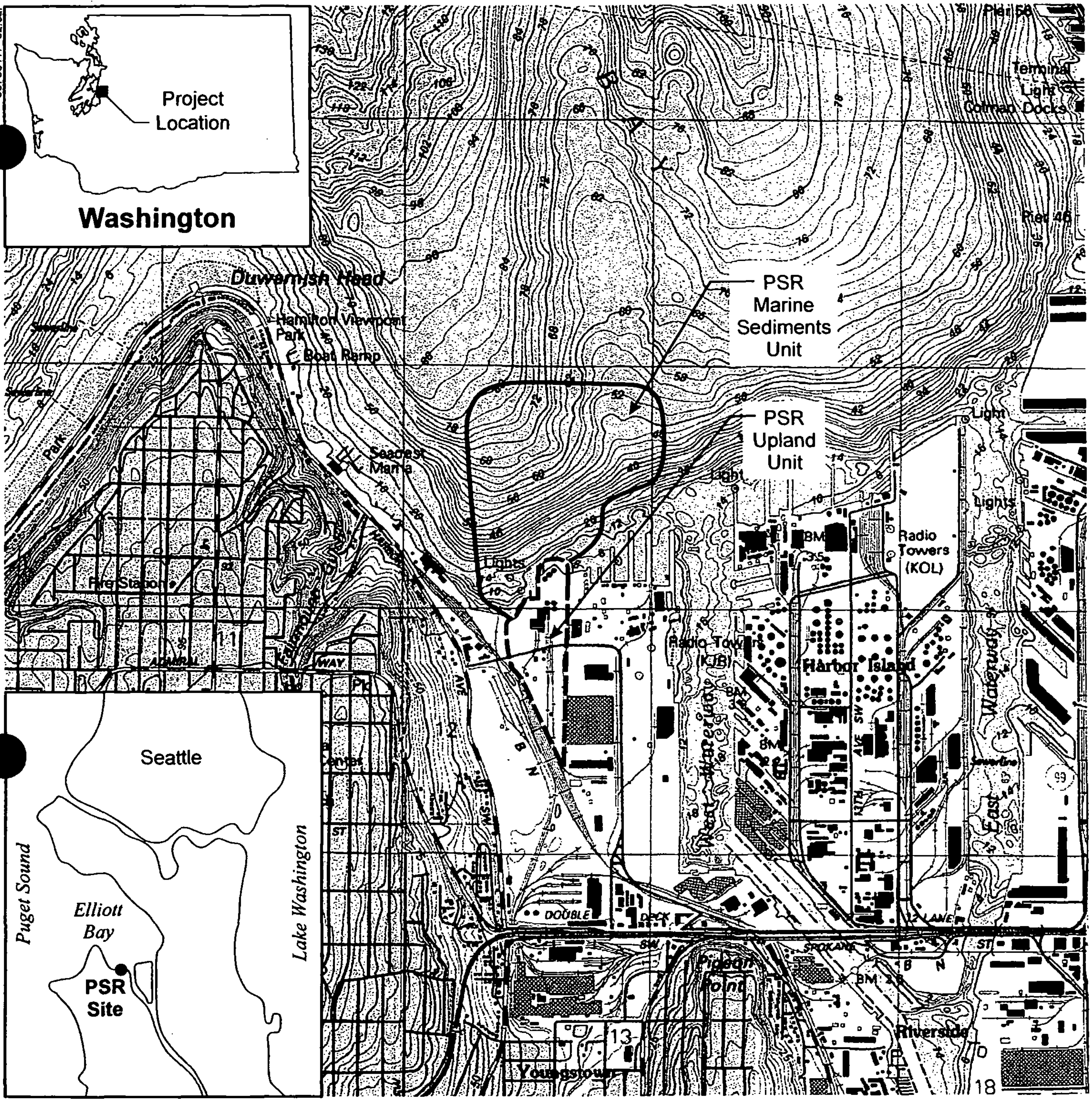
[1] Flow from Longfellow Creek has since been rerouted to the West Waterway of the Duwamish River. The outfall remains functional and receives local storm drainage as well as overflow of peak flows from Longfellow Creek.

Trustees, as well as EPA for reimbursement of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial costs.

1.5 ACTIONS TO DATE

EPA conducted two phases of early cleanup actions on the upland portion of the site. The first phase focused on site stabilization and demolition of on-site structures. The second phase focused on controlling ongoing sources to Elliott Bay, addressing contaminated soil, and preparing the site for reuse by the Port of Seattle (Port). During the first phase, in 1994, the entire wood treatment facility was demolished and approximately 4,000 cubic yards of highly contaminated soil and process sludge were removed from the site. During the second phase, which began in 1996, a subsurface physical containment barrier (slurry wall) was installed to prevent migration of LNAPL to Elliott Bay and reduce the influence of tidal fluctuation at the site. The slurry wall is 1,200 feet in length and extends from the ground surface to an average depth of 40 feet. An LNAPL recovery trench was installed in conjunction with the barrier wall to intercept any LNAPL. In addition, a low-permeability asphalt cap was constructed over a layer of clean fill placed at the site. This cap was designed to prevent direct exposure of on-site workers to contaminated soil, prevent runoff of contaminated soil into Elliott Bay, and minimize infiltration of storm water to groundwater. The cap was completed in 1998.

Other early actions taken at the site include clean-out of the Longfellow Creek overflow channel and marine outfall (along the western border of the site) and collection and disposal of the DNAPL that accumulates in on-site monitoring wells. Twenty-five cubic yards of PCB-contaminated sediments were removed from the Longfellow Creek outfall area by the Port as part of their terminal development work, and approximately 1,500 gallons of DNAPL were recovered from on-site wells and treated through incineration through September 1999.



Map created with TOPO!™ © 1997 Wildflower Productions, www.topo.com, based on USGS topographic map

Note: Contours shown in meters

0 0.5 1.0
Approximate Scale in Miles

Figure 1-1

PSR Upland and Marine Sediments Unit Location Map

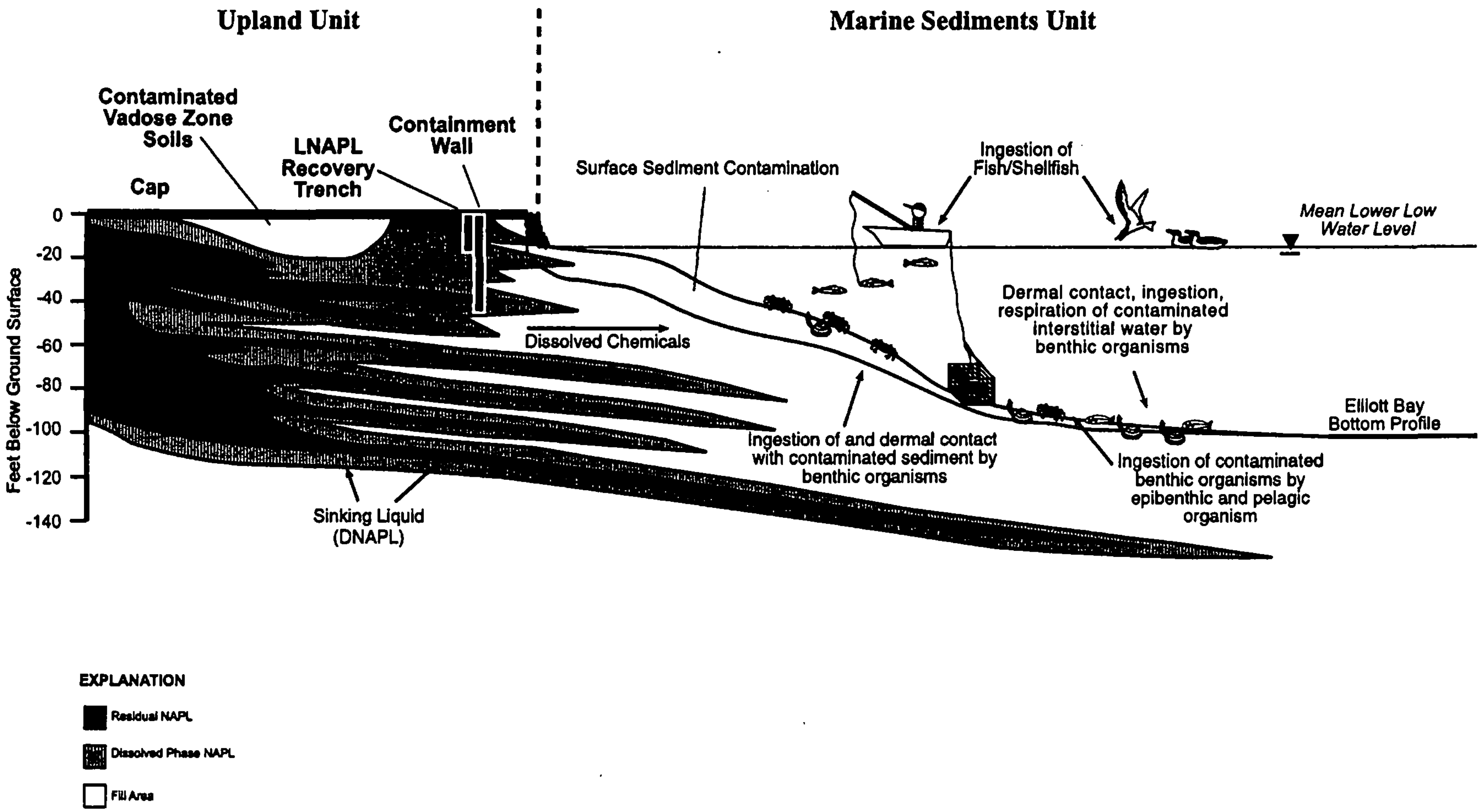


Figure 1-2

PSR Conceptual Site Model of Receptors and Exposure Pathways in the Marine Sediments Unit Post-upland Cleanup

2.0 OPERABLE UNIT BACKGROUND

2.1 SUMMARY OF ROD REQUIREMENTS

2.1.1 Remedial Action Objectives and Remediation Goals

The ROD (USEPA 1999) identified the following remedial action objectives for cleanup in the MSU:

- Minimize human exposure through seafood consumption
- Minimize benthic community exposure to site contaminants

Attainment of these overall objectives, as specified in the ROD, was measured by compliance with the Washington State Sediment Management Standards (SMS) (WAC 173-204). The SMS establish a narrative standard with specific biological effects criteria and numerical chemical concentrations for Puget Sound sediment. Under the SMS, the cleanup of a site should result in the elimination of adverse effects on biological resources and any health threats to humans. The Sediment Quality Standards (SQS) correspond to this narrative for ecological effects. Under the SMS, site-specific cleanup standards are established from a range of concentrations based on environmental effects, feasibility, and cost; they are to be as close as practicable to the SQS and no greater than the minimum cleanup levels (MCULs). The MCULs are equivalent to the cleanup screening levels (CSLs).

The CSL for PAHs served as the trigger for remediation of the MSU; the SQS for PCBs was the trigger for active remediation of sediments in the nearshore environment (shallower than –10 feet MLLW). The marine sediment cap is the primary component to achieve CSLs and SQS in the MSU. The ROD identified the cap boundaries based on these triggers, as shown in Figure 2-1. The capping material was required to meet the SQS, resulting in SQS or lower concentrations throughout the capped area.

2.1.2 Selected Remedy

The selected remedy for the MSU is described in the ROD (USEPA 1999) and generally consists of the following elements:

- Confinement of contaminated marine sediments by placement of a sediment cap that covers approximately 50 acres. The acreage estimate from the ROD was refined to 55 acres of required capping area. The cap as designed covers approximately 58 acres.

- Dredging approximately 3,500 cubic yards of contaminated sediment from the area north of Crowley Marine Services, to allow capping while maintaining current navigational depths (dredge quantity estimate from ROD)
- Removal of unused piling prior to capping
- Implementation of institutional controls to restrict use of boat anchors
- Development and implementation of both a short- and long-term monitoring and management plan to ensure that the cap is placed as intended and is performing the basic confinement functions

The capping and dredging activities are described in detail in Section 3. Piling removal was accomplished by the Port and is not discussed further in this document. The institutional control for anchoring is further discussed in Section 2.1.2.1. The monitoring and management plans are discussed in Section 2.1.2.2.

2.1.2.1 Institutional Controls

The ROD requires that the entire capped area be designated as a "no-anchor" zone. The no-anchor designation will apply to commercial vessels using the large "whale-tail" type anchors that have the capacity to break through the cap and expose contaminated sediment. Figure 2-2 illustrates the area to be covered by the "no-anchor" designation.

This institutional control will be implemented through the promulgation of a regulatory amendment that designates the entire sediment cap as a "no-anchor" zone. In consultation with the Washington State Department of Natural Resources (WDNR), EPA, and the USACE, the USCG will develop an additional section to USCG regulation 33 CFR Part 165, Regulated Navigation Areas and Limited Access Areas. This new section will prohibit commercial vessels from using large "whale-tail" anchors in the no-anchor zone. The rule-making will be subject to public comment. The institutional control described above will remain in place as long as the cap is needed to contain subsurface contaminated sediments. For the USCG to modify or terminate the regulation, it would have to publish the proposed regulatory change in the *Federal Register* for public (and agency) comment and then take any comments into account before finalizing a change.

Other regulatory programs will address the capped contaminated sediment that may be potentially exposed by future dredging projects that might be proposed within the capped area. Such projects may be associated with currently unplanned future development scenarios. Permitting requirements under Section 404 of the federal Clean Water Act and the Washington State Shoreline Management Act will address such scenarios and will require appropriate design elements, such as requirements for handling and disposal of contaminated sediments, restoration of the cap following dredging, or dredging to remove all sediments above the SQS.

2.1.2.2 Monitoring Requirements

The ROD requires that both a short- and long-term monitoring or management plan be developed to ensure that the cap is placed as intended and performs its basic confinement functions. Specific monitoring requirements are included to address the intermediate groundwater discharge zone. The durations of the specific monitoring requirements are to be addressed in the monitoring plan. In addition, this plan must address the monitoring approach to be implemented following any unusually significant seismic or storm event in the Elliott Bay area. The monitoring/management plan must also address data management, and contingency plans in the event the cap is not meeting the remedial action objectives (RAOs).

An operations and maintenance monitoring plan (OMMP) was developed to meet the ROD requirements. The OMMP is described in Section 6.

2.1.3 Future Site Use

The ROD (USEPA 1999) describes future uses of land, groundwater, and surface water at the site.

2.1.3.1 Land Use

The current and future land use associated with the upland portion of the site is use as part of the Port's intermodal terminal. As such, the site will primarily be used as an industrial property. The Port has leased the property to a container transport company (a 30-year lease), and it is anticipated this property will continue to be used for container storage and transfer into the foreseeable future. The property located to the south and east of the site is also part of the intermodal yard. The property to the west of the PSR site is utilized as a barge transport facility for bulk materials, and the site is bordered to the north by Elliott Bay. A small portion of the upland area of the site immediately adjacent to the shoreline has been developed for public use, and includes an observation tower and a scenic public walkway. Access to the shoreline itself has been prohibited, and the shoreline has been made physically inaccessible from the Upland Unit through the use of fencing.

2.1.3.2 Groundwater Use

The groundwater associated with the site is not currently being utilized, nor should it be utilized for any purpose in the future. The Washington State Department of Ecology (Ecology) has made a determination that groundwater beneath the PSR site is not suitable for use as a potable water supply, and no wells will be permitted. EPA's groundwater classification evaluation concurred with this determination. Further, EPA has determined that the groundwater associated with PSR meets the criteria necessary to set alternate concentration limits for the site-related contaminants of concern.

2.1.3.3 Surface Water Use

The PSR site is located in the southwestern portion of Elliott Bay, a deep, cold-water embayment located in east-central Puget Sound. Elliott Bay has been extensively developed for urban, port, and industrial land uses. While the intertidal/shoreline area is not accessible from the PSR site, there are a couple of beach areas exposed during low tides that include mudflats and sandflats, as well as pilings and riprap. The MSU is located in a transition zone between the estuarine environment of the Duwamish River and marine environment of Elliott Bay; the substrates and waters adjacent to the site contain habitat characteristics common to both environments. Currently, the usual and accustomed fishing grounds of the Suquamish Tribe and the Muckleshoot Indian Tribe include the site and adjacent areas, and impacts to potential tribal shellfish collection from the beach areas must be minimized to the greatest extent practicable.

2.2 SUMMARY OF REMEDIAL DESIGN

2.2.1 Regulatory Considerations

The remedy was designed to comply with applicable or relevant and appropriate requirements (ARARs). A summary of these requirements and the manner in which the remedy is designed to comply with these requirements is presented in the final design submittal (USEPA 2003). A summary of the major regulatory considerations that affected the design is presented in this section.

Attainment of the overall cleanup objectives, as specified in the ROD, was measured by compliance with the Washington State SMS (Ch. 173-204 WAC). The CSL for PAHs served as the trigger for active remediation of the MSU; the SQS for PCBs was the trigger for active remediation of sediments in the nearshore environment (shallower than –10 feet MLLW). The marine sediment cap is the primary component to achieve CSL and SQS in the MSU. All imported capping materials (with the exception of coarse-grained rock such as riprap) were sampled to establish that import material chemical concentrations were below the SQS.

Section 401 of the Clean Water Act requires that a certification of water quality be issued by the responsible government authority to state that remedial actions will not violate applicable water quality standards. EPA and Ecology examined the remedial design and determined that the project could meet water quality criteria (WQC). EPA issued the water quality certification for this remedial action, which established the boundaries of the temporary mixing zone and criteria that must be met outside of the temporary mixing zone.

Section 404 of the Clean Water Act establishes requirements for dredging and placing fill materials. A Section 404(b)(1) evaluation was completed for the project, and it determined that the in-water remediation work complied with the requirements of Clean Water Act Section 404. Specifically, the work complied with the substantive requirements of Nationwide Permit No. 38, Cleanup of Hazardous and Toxic Wastes.

The Endangered Species Act (ESA), the Fish and Wildlife Coordination Act, and the State of Washington Hydraulic Project Approval (HPA) regulations contain requirements to protect fish and wildlife from the potential effects of project actions. Several federal threatened or endangered species occur in the site area. A biological assessment was prepared for the project by USACE. Coordination and consultation with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and Washington State Department of Fish and Wildlife (WDFW) under the ESA, the Fish and Wildlife Coordination Act, and the HPA regulations were conducted to ensure that design elements met the requirements for all these programs. Based on this consultation, periods when in-water work was restricted were identified and specific habitat enhancement measures were included in the design. The natural resource agencies identified the following restrictions on in-water work:

- Dredging – prohibited from February 14 through August 16
- Capping – prohibited from February 14 through July 16

2.2.2 Technical Considerations

The primary component of the selected remedy, a marine sediment cap, was designed in accordance with the ROD and USACE guidance (Palermo et al. 1998a and b), to accomplish the following:

- Reduce the chemical flux from contaminated sediments and groundwater, and chemically isolate these sources from benthic organisms

- Physically isolate the contaminated sediments and provide a clean habitat for benthic organisms

- Maintain stability under static loads and have an acceptable reliability under design seismic loads

- Resist erosion, suspension, and transport of cap materials and underlying contaminated sediments by waves, tidal and wind-induced currents, and propeller wash

The cap was not designed to ensure stability under extreme seismic loads, such as earthquakes that are projected to occur at return periods of greater than 100 years. Construction of engineered features to improve long-term seismic stability throughout the MSU was not considered practicable and would represent a very large capital expenditure. Rather, long-term seismic damage to the cap was addressed by establishing future maintenance requirements, which are described in the OMMP.

The ROD also specifies the following design parameters for the cap:

- The minimum cap thickness shall be 5 feet in the intertidal area

- Capping material shall be at least as clean or cleaner than the SQS and, according to the ROD, will originate from routine maintenance dredge projects in local rivers. (Note: It was necessary, however, to use upland materials for capping certain areas of the site to enhance cap stability and allow for construction activities to be completed within specific time periods so that impacts to aquatic resources were minimized.)

- Capping material shall be selected and placed in such a way as to provide appropriate habitat for the marine organisms natural to this area

For engineering purposes, individual RAs were developed according to specific site conditions and operational considerations that require different cap designs, cap materials specifications, or construction methods. The RAs are shown in Figure 2-3. The MSU is divided into the following RAs:

- **RA1: Intertidal/Shallow Subtidal Area.** The RA1 boundaries extend from the top of the bank offshore a sufficient distance to construct the required grade transitions to the adjacent offshore RAs. RA1 includes intertidal areas. The design included a minimum of 5 feet of clean sediment to physically isolate and reduce the chemical flux from contaminated sediments. Erosive forces due to surface waves, propeller wash, and cross-shore sediment transport processes determine the particle size of capping material in RA1. Design elements include intertidal habitat enhancement and establishment of beach areas. The potential for erosion was addressed in the design by including a 12-inch thick layer of coarse-grained material as the surficial layer of the cap.

- **RA2: Shallow Nearshore Areas.** RA2 consists of two discrete nearshore areas, RA2a and RA2b, which extend from approximately -15 to -50 feet MLLW. RA2a and RA2b are characterized by relatively flat areas or shallow slopes, with localized steepened areas. The design included a minimum of 2 feet of clean sediment to physically isolate and reduce the chemical flux from contaminated sediments. Erosive forces due to propeller wash determine the particle size of capping material in RA2a. The potential for erosion in RA2a was addressed in the design by including a 12-inch thick layer of coarse-grained material as the surficial layer of the cap. Erosive forces are not anticipated to be significant in RA2b.

- **RA3: Crowley Marine Services Area.** It is necessary to maintain navigational depths in this area for barges, tugs, and other vessels. Because sediment contamination in this area extends to depths of 8 to 10 feet below the mudline and because of the need to maintain navigational access, a cap cannot be constructed in the area of Crowley Marine Services without first removing materials through dredging. The design included a minimum of 2 feet of clean sediment to physically isolate and reduce the chemical flux from contaminated sediments. The capping material in this area must also resist erosive forces from propeller wash. The potential for erosion was addressed in the design by including a 12-inch thick layer of coarse-grained material as the surficial layer of the cap.

- **RA4: Sloping Offshore Area.** This area extends from approximately -50 to -140 feet MLLW and includes relatively steep slopes with approximately 15 percent to 25 percent grades. The stability of these soft/loose sediment slopes and the potential for failure during cap placement require specific controlled cap placement methods. The potential for slope failure was addressed in the design in two ways. First, the design specified that the cap material be placed beginning at the toe of the slope and proceeding upslope to buttress the slope. Second, the design limited material placement rates to limit the driving forces and allow time for consolidation of the native sediment. The design included a minimum of 2 feet of clean sediment to physically isolate and reduce the chemical flux from contaminated sediments.

- **RA5: Deep Offshore Areas.** RA5 consists of sub-areas RA5a and RA5b. These areas extend from approximately -140 to -240 feet MLLW and include slopes of approximately 4 percent to 15 percent. The design included a minimum of 1.5 feet of clean sediment to physically isolate and reduce the chemical flux from contaminated sediments. Placement of cap material in RA5 can be accomplished in the most cost-effective manner by instantaneous bottom-dump placement of clean dredged material from other dredging projects.

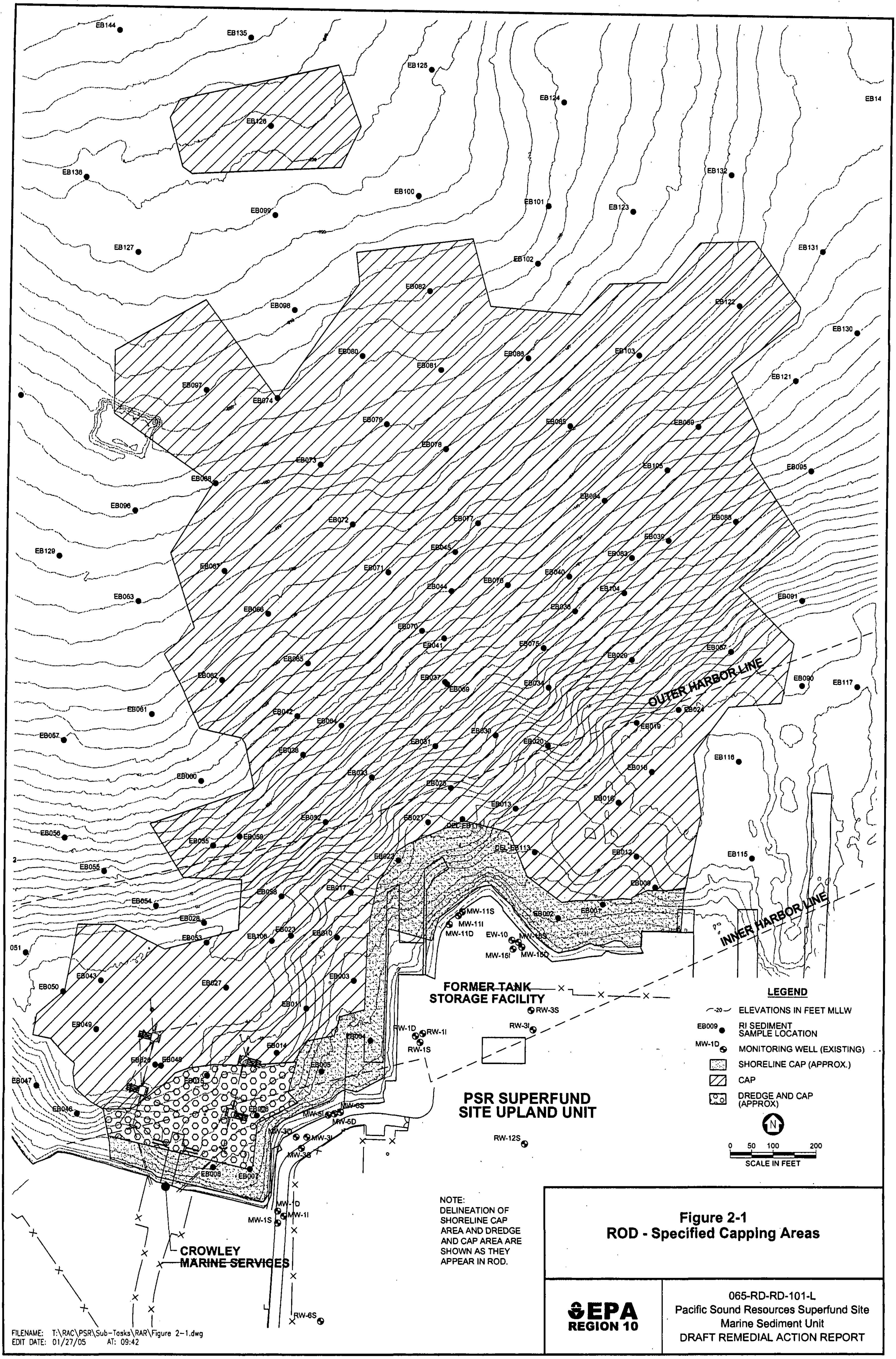


Figure 2-1
ROD - Specified Capping Areas

EPA REGION 10

065-RD-RD-101-L
Pacific Sound Resources Superfund Site
Marine Sediment Unit
DRAFT REMEDIAL ACTION REPORT

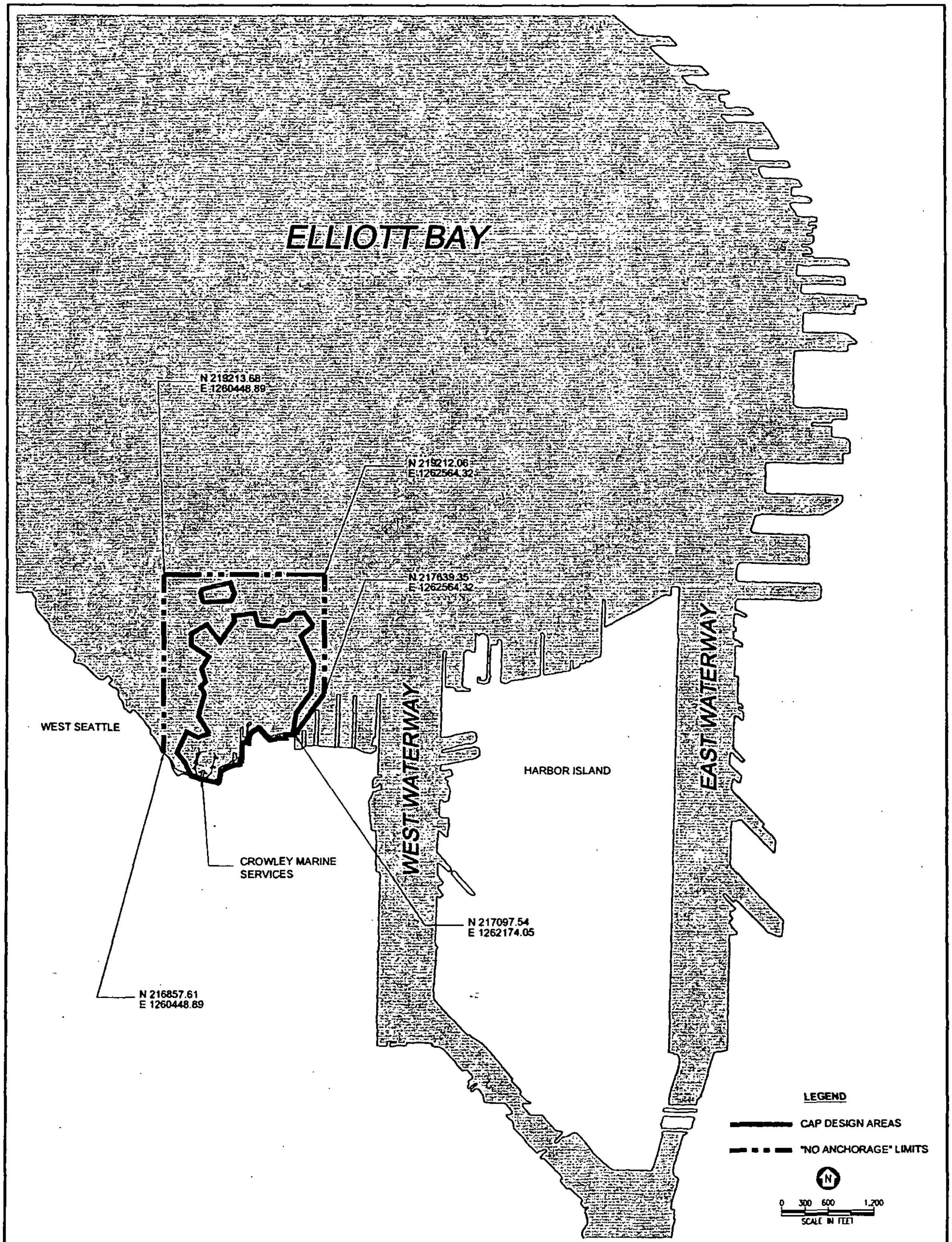


Figure 2-2
Area of "No Anchor Zone"
Institutional Control

EPA REGION 10

065-RD-RD-101-L
Pacific Sound Resources Superfund Site
Marine Sediment Unit
DRAFT REMEDIAL ACTION REPORT

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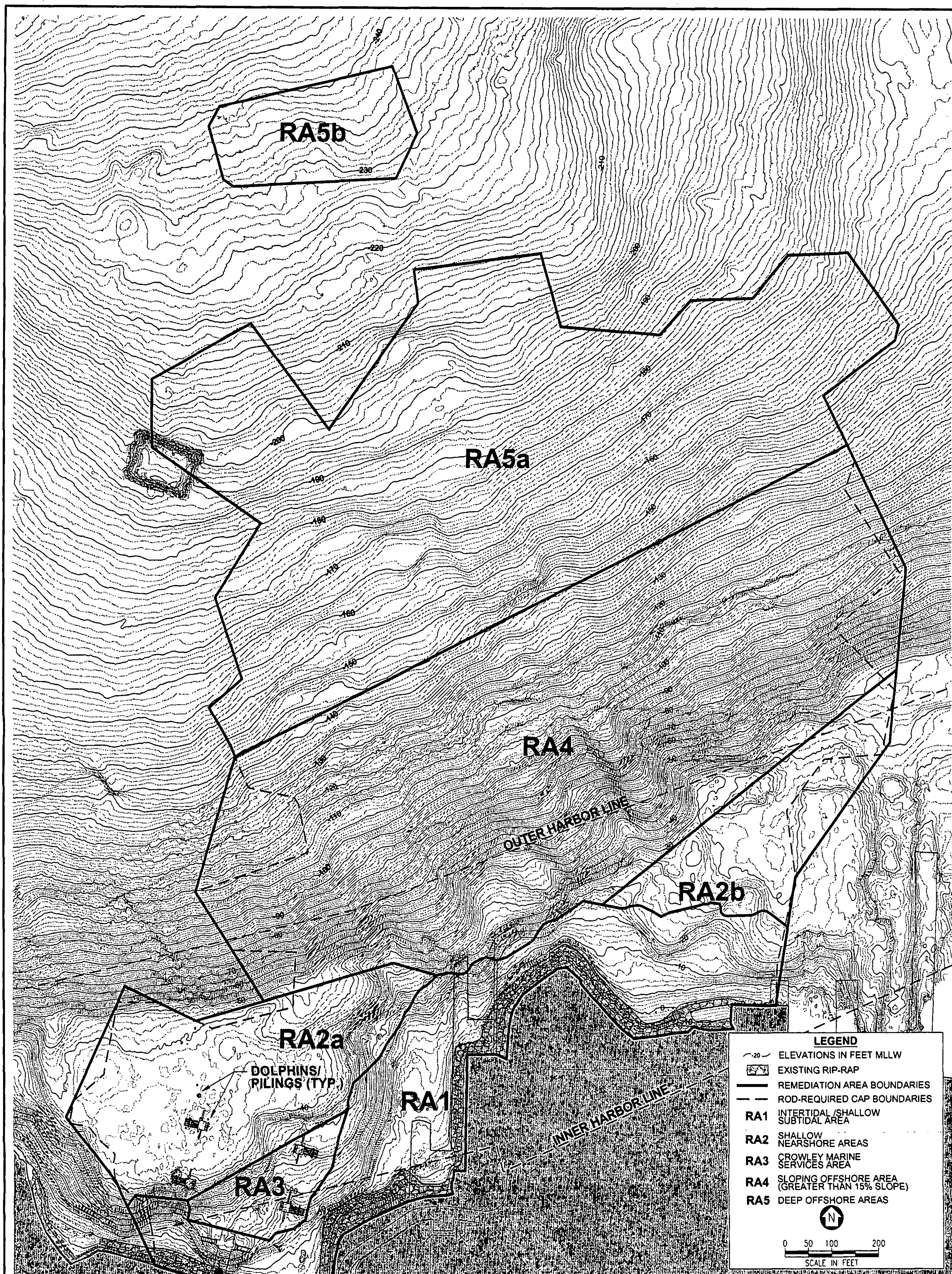

Figure 2-3
PSR Remediation Areas

EPA REGION 10

065-RD-RD-101-L
Pacific Sound Resources Superfund Site
Marine Sediment Unit
DRAFT REMEDIAL ACTION REPORT

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3.0 CONSTRUCTION ACTIVITY

3.1 SUMMARY OF CONSTRUCTION ACTIVITY

URS Corporation prepared the engineering plans and specifications for construction of RAs 1-4. The USACE Northwestern Division, Seattle District (NWS) reviewed these plans in support to EPA. The request for proposal (RFP) was issued by NWS and awarded through a competitive bid process to American Civil Constructors (ACC)/Hurlen Construction.

The NWS Project Manager, Project Engineer, and Quality Assurance Officer met weekly with the contractor Project Manager and on-site personnel during all phases of work. To assure design integrity, URS was included in discussions that were relevant to design. Change orders and Requests for Information (RFIs) were minimal compared to what would be expected for a construction project of this magnitude.

Construction activities conducted to implement the remedial action in RAs 1-4 include the following elements:

- Confinement of contaminated marine sediments in RAs 1-4 by placement of a sediment cap that covers approximately 58 acres
- Dredging of contaminated sediment from RA3, to allow capping while maintaining current navigational depths
- Extension of the Longfellow Creek outfall, located in RA1 and RA3, to facilitate completion of the intertidal cap
- Installation of native plants in three intertidal beach locations

URS prepared the design for RA 5, and the plans and specifications were prepared by NWS. Construction activities conducted to implement the remedy in RA 5 included the following:

- USACE dredging of accepted material from the Duwamish River in 2004 and the Snohomish River in 2005
- Dredging of accepted material from privately funded projects Tyee Yacht Club in 2004 and Lehigh in 2005
- Placement of dredged material at PSR by bottom dump barge

3.1.1 Contract and Project Organization

Initially, project progression for RAs 1-4 was identified as one contract with a base award and several options; the base award included capping in RA1 and dredging in RA3, and the options included all other activities. The contract was structured to accommodate funding availability. Construction in RAs 1-4 was to take place over two construction seasons as follows: first award season, RA 1 cap and RA 3 dredge; and second season RAs 2a, 2b, 3, and RA 4 cap. If funds were not available to award RAs 2-4 simultaneously, it would have been possible to further phase the work so that RAs 2a and 3 took place separately from RAs 2b and 4, adding a third construction season. An excellent working relationship with the contractor and designers allowed for rapid field changes to the design when necessary, resulting in completion of RAs 1-3 in the first construction season and RA4 in the second season. Specific field design changes are discussed in Section 3.9 below.

USACE Seattle District prepared the engineering plans and specifications for dredging, and URS did the actual design for RA5. The plan was reviewed and approved by EPA. In RA5, navigational dredge material from the Snohomish River was used for construction of the cap. Therefore, two USACE project managers were involved: the Environmental Management Branch project manager (PM) responsible for construction at PSR and the Navigation Section PM responsible for the navigation dredging. The request for proposal was issued by NWS Navigation Section for navigational dredging and awarded through a competitive bid process to Dutra Corporation. The Navigation Section was responsible for quality assurance of the dredging portion of the project, and the Environmental Management Branch was responsible for quality assurance of the capping portion of the project.

The PM for the Navigation Dredging Project met weekly with the contractor PM and on-site personnel during all phases of dredging. The PM and Quality Assurance Officer for the PSR site met weekly with the Navigation Dredging PM and other team members to track capping progress and discuss changes needed for placement operations to assure a complete and functional remedy. Construction activities conducted to implement the remedial action in RA5 included dredging of suitable material from the Snohomish River and placement of that material from bottom-dump barges into RA5. No RFIs or change orders were issued on this contract. Design changes are discussed in Section 3.9 below.

A separate performance based contract for installation and care of plant materials on beach areas was prepared and issued by USACE. The contract duration for plant installation was approximately 1 month. However, the maintenance period began at the end of installation and will continue for 1 year. No RFIs or change orders were issued on this contract to date.

3.1.2 Construction Materials

Planned and actual volumes of material placed into or dredged from each RA are shown in Table 3-1.

3.2 DESCRIPTION OF QA/QC SYSTEMS

3.2.1 RAs 1-4

The quality assurance/quality control (QA/QC) program used throughout the project was outlined in the Remedial Action Management Plan (RAMP) prepared by the Contractor and approved by the Contracting Officer (CO) and EPA. The Government used the Resident Management System (RMS) for Windows to assist in monitoring and administration of this contract. The Contractor used the Government-furnished Construction Contractor Module of RMS, referred to as Quality Control System (QCS), to record, maintain, and submit information throughout the contract period. This joint Government-Contractor use of RMS facilitated the electronic exchange of information and overall management of the contract.

3.2.1.1 Sediment Cap QA/QC

ACC/Hurlen and USACE utilized the USACE Three-Phase Inspection System. This system includes: (1) a preparatory phase performed prior to each definable feature of work, (2) an initial phase performed at the start of each definable feature of work, and (3) a follow-up phase performed during and after each definable feature of work. The QC officer maintained a three-ring binder at the job office that contained a Phase checklist identifying each piece of work with appropriate dates on which each inspection occurred. In addition, inspection information was included on the contractor daily quality control reports.

Upon completion of a pre-construction hydrographic survey of the entire site, survey data was entered into the Windows Offshore Positioning Software (WINOPS) Marine Positioning and Mapping Software Package© **(Lyman Burk & Associates)**. Used in conjunction with a state of the art real-time kinematic (RTK) system, global positioning system (GPS), and electronic tide gauge, WINOPS computes the X,Y,Z coordinates of both the vessel and the bucket in real time for accurate dredging and cap placement. WINOPS allowed the operator to track and record the location of material dredged or placed in real time. Frequent calibration and lead line surveys were made to verify the accuracy of the system.

Single beam hydrographic surveys were used to monitor capping progress on a daily basis. The survey vessel operated with the same state-of-the-art RTK GPS equipment and software as the derrick barge with the addition of a depth sounder. The HYPACK© (hydrographic package, Hypack, Inc.) software allowed for cross section display/print and volume computations provided to the USACE QA officer daily. Daily and weekly tracking of material volumes in conjunction with daily cross sections allowed the QA officer to determine whether materials were placed according to design specifications and to measure progress of the contract.

Water quality monitoring by a subcontractor occurred over the duration of the project. Details are provided in the EPA-issued water quality certification and the RAMP. Verification information and results are provided in Section 3.10 below.

3.2.1.2 Vegetation QA/QC

During installation of plant materials, a USACE biologist was on site daily to inspect plant materials prior to installation and to monitor installation procedures and upkeep.

Linear exterior planting
The specification called for willow cuttings to be placed randomly on a triangle. However, due to the limited quantity of willows specified and the size of the area to be covered, a modification was necessary. Willows were planted in a linear alignment 8 feet apart at an appropriate elevation determined in the field.

Storage of bare-root material
The bare-root plant material for gumweed (*Grindelia integrifolia*) was submersed in water buckets for storage prior to installation. Long-term storage of bare-root plants in water can be lethal. Plants were removed from the water and appeared stressed prior to installation. The plants will be monitored to determine if the 60% survival rate is met.

Spacing of goose exclosures
The Work Plan (Cherokee, September 2003) called for goose exclosure lines to be placed 10 feet apart. The spacing was changed to 24 inches, since a 10-foot span would permit goose access. The 24-inch spacing was based on our reference site goose exclosure at Codiga Farms 1135. The specification for wood posts for the exclosure lines was changed to metal posts for stability. The change was made at no additional cost to the government.

Monitoring reports
A record of inspection for each site visit will be submitted to the contracting officer's representative (COR) describing the maintenance work performed, photographic documentation of planted areas, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit. One maintenance record shall be submitted that incorporates maintenance for sprigging and exterior planting. The last record of inspection was received 27 December 2004. Record of inspections will be submitted regularly throughout the 1-year plant establishment period.

Throughout the 1-year plant establishment period, plants are to be irrigated once a week. A record of each site visit shall be submitted describing the maintenance work performed, photographic documentation of planted areas, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit.

3.2.2 RA 5

The QA/QC program used throughout the project was outlined in the Construction Quality Assurance Plan (CQAP) (USACE 2003).

To track the formation of the cap in RA5 as placement events occurred, a combination of data from the Short Term Fate of Dredged Material Disposal in Open Water (STFATE) Model and geospatial analysis software was used. Based on contractor-reported locations and volumes of discrete placement events, modeled results of material dispersal were located on a map of the target sites. The map was generated and stored in ArcMap, a component of the Environmental Systems Research Institute (ESRI) ArcGIS software suite. Material dispersal behavior was modeled at 500 cubic yard increments. Various analytical tools were applied to the data in order to keep track of the cap thickness as it increased. A map generated from the modeling results was distributed to team members and the placement contractors, in order to provide an approximate picture of which portions of the RA5 area should be concentrated on in order to complete cap construction and ensure that the final product met design criteria for thickness. Placement data was received from the contractor daily and the maps generated at least weekly to assure that each placement event would contribute appropriately to cap formation.

The contractor submitted Daily Construction Quality Control Reports (DCQCRs) to the USACE Navigation Section Quality Assurance Representative (QAR) including volume dredged to date, survey results, and current location.

Water quality monitoring at the PSR site occurred over the duration of material placement by a separate USACE issued contract. Details are provided in the EPA-issued water quality certification and the RAMP. Verification information and results are provided in Section 3.10 below.

Water quality monitoring at the dredge location occurred through a contract overseen by the Navigation Section. Results of this monitoring will not be discussed in this report except as necessary to describe changes to activities at PSR.

3.3 DESCRIPTION OF DREDGING OPERATION IN RA3

3.3.1 Summary of Design

The removal of sediments from the Port of Seattle, Pier 2 (Crowley Marine Services Area in RA 3 and adjacent portions of RA 1) occurred to maintain navigational access depths while still allowing placement of an environmentally protective sediment cap, to provide cutback slopes for cap construction in this area, and to allow for the extension of the Longfellow Creek outfall. To maintain existing mudline elevations, the design called for dredging of a minimum of 5 feet of sediment in the area shown in Figure 3-1. The estimated neatline dredge volume was 8,040 cubic yards; including a 1-foot overdepth allowance, the total estimated dredge volume was 9,850 cubic yards. The contract volume was rounded up to 10,000 cubic yards.

The design specified use of mechanical dredging equipment and on-site dewatering by gravity drainage on flat-deck barges for a minimum of 8 hours. Overflow from the barges after leaving the site was not permitted. Disposal at an approved upland Resource Conservation and Recovery Act (RCRA) Subtitle D landfill was required in order to comply with the CERCLA Off-Site Policy (40 CFR 300.440).

3.3.2 Sequence of Dredging Operations

The sequence of dredging operations was as follows: (1) pre-dredge multi-beam hydrographic survey, (2) pre-dredge physical characterization of material to determine best management practices, (3) material dredging with environmental bucket, and (4) concurrent removal of material from the site by barge to a nearby upland facility for transfer to the landfill.

Material characterization from composite core samples indicated silty sand consisting of sand 71 percent, silts 23 percent and traces of clay 5 percent. This material was considered granular and non-plastic, with a moisture content of 27 percent. The material was very free-flowing, with little or no cohesive binding, causing no resistance when dumping the material into the dredge barge. In addition, minimal residue that could increase turbidity was retained in the bucket, so no pre-washing of the bucket was required before it re-entered the water after dumping material on the barge. The free- draining nature of the material allowed the material to meet the 8-hour minimum decanting time on the barge. Over-depth dredging of up to 1 foot occurred mainly due to the softness of the sediment, since no hard layer of material appeared to exist. Dredge control and tracking occurred through the use of the WINOPS dredging system mounted on the crane.

Dredged material was placed directly into ACC-Hurlen barges set up to handle the wet material. Dredged material was loaded into lined shipping containers on-site and transported via flat-topped barge to the transfer facility in accordance with the contractor's Waste Management Plan. Barges used for hauling dredged material are closed-hull with side walls. Overflow was not permitted from barges transporting dredged material out of the MSU. Barges were tightly sealed to prevent leakage of materials.

The barges were then moved to the ACC-Hurlen dock facility located at 700 South Riverside Drive in Seattle. The material was transferred from ACC-Hurlen barges via conveyor to trucks and trailers lined with a 6-mil sheet of visqueen on the dock. The unloading area was covered with thick plastic to contain dropped liquids. Large volumes of spillage from the unloading conveyor or barge did not occur. Truck wheels were washed before the truck left the unloading area, and rinse water was absorbed by "oil socks" surrounding the wheel wash area. The socks were then disposed of with the heavy plastic as waste. Following the route detailed in the traffic control plan, the trucks proceeded to the Rabanco transfer station at 2733 3rd Avenue South in Seattle.

Trucks were weighed on a Washington State certified scale and computerized weight tickets were generated for each load. The Regional Disposal Company (RDC) provided a weekly Certificate of Disposal upon placement of the dredged material in the Roosevelt Regional Landfill (Subtitle D).

3.3.3 Summary of Contract Changes and Quantities Dredged

The Record of Decision (USEPA 1999) assumed that approximately 3500 cubic yards (cy) of material would be dredged based on the assumption that exactly 3 feet of material would be dredged and replaced. Factors included in the design but not in the ROD were (a) a minimum 5 feet required dredging, to allow room for minimum 3.5-feet cap, with a 1-foot cap overplacement allowance and a 0.5-ft buffer to ensure meeting navigational depths (a standard 1-ft dredge overdepth is acceptable based on equipment accuracy), (b) standard slope cutbacks around the dredge prism were required for stability, and (c) additional dredging to install the outfall was required. Therefore, the estimated volume provided in contract documentation was 10,000 cy. The actual volume of material dredged from RA3 was 9,790 cy.

Dredging in RA3 and RA1 was expected based upon the above information and assumptions that the area under the outfall pipe would also require dredging. Dredging did not actually occur within RA1 for the Longfellow Creek outfall due to minor alignment changes from design. Two sections of pipe totaling 16 feet were removed from design and the alignment adjusted in order to avoid interference from pilings.

3.4 DESCRIPTION OF CAPPING OPERATIONS IN RA1

3.4.1 Summary of Design

RA1 includes both intertidal and subtidal areas. The RA1 cap design is composed of two parts:

- A gravel cap constructed to moderate slopes at finished elevations in the intertidal zone. The gravel cap provides a stable cap of a thickness necessary to provide for nearshore habitat. The gravel cap is used to the maximum extent practical; however, in many locations the grades of the gravel cap could not match the steeply sloping existing mudlines.

- A thick slope cap constructed to slopes of up to 2H:1V. This cap generally is used at subtidal elevations, to allow grade transition between RA1 and the offshore caps in the other RAs. In some locations, the existing nearshore mudlines are sufficiently steep that the thick slope cap must extend upward into intertidal elevations.

In intertidal areas, the design called for a minimum cap thickness of 72 inches, plus a 12-inch overplacement allowance. In subtidal areas, the design called for a minimum cap thickness of 42 inches, plus a 12-inch overplacement allowance.

The gravel cap in RA1 consists of:

- A 2-feet layer of gravel mix foundation (in locations shown on the drawings).

- A chemical isolation layer of a well-graded, medium to coarse sand with trace gravel and fines, with average 0.5 percent or greater total organic carbon (TOC) ("sand cap mix"). The base layer is a minimum of 2 feet thick.

- An intermediate layer of a well-graded, sandy gravel with a D_{50} of approximately 18 mm and a maximum particle size of approximately 64 mm (2.5 inches) ("gravel mix").

- A top course of 6 inches of well-graded sandy gravel ("habitat mix").

The thick slope cap in RA1 is a typical armored slope design for the region, and consists of:

- A filter layer of a well-graded, sandy gravel ("filter material"). Where the thick slope cap sits directly on a dredge cut, the filter material is a minimum of 2 feet thick and has an average 0.5 percent or greater TOC.

- An armor layer of a graded, angular broken stone ("riprap"). The armor layer is a minimum 24 inches thick.
- A riprap "key" or toe berm constructed at the base of the slope to provide support to the overlying riprap.
- Habitat mix (a well-graded sandy gravel) placed over the armor layer, filling the voids in the riprap between the elevations of -10 feet MLLW and +13 feet MLLW.

The design called for mechanical placement of the cap in RA1, or by other method(s) proposed by the contractor and approved by USACE. Estimated volumes of capping materials in the design are shown in Table 3-1.

Changes during construction eliminated the use of one material (filter material 1) as noted in Section 3.9 below.

3.4.2 Sequence of Material Placement

All material was placed from barges using a clamshell bucket or skip box. Material above +10 elevation was conveyored onto the beach and contoured with a bulldozer. Cap material placement was accomplished so that material deposits formed a uniform layer of the required thickness as measured by daily hydrographic surveys. The methods used minimized the re-suspension of bottom sediment to prevent contamination of cap materials by native sediments.

Actual placement methods and productivities differed for each type of material and location, depending on the required layer thickness and the layer's position within the matrix. A skip box was used for placement of gravel to ensure appropriate thickness was achieved. Within the skip box, a volume of material corresponding to the required layer thickness was placed. The box was lowered to the placement depth and tripped to allow an even discharge of material.

Riprap toe-berm and key materials were placed using a combination of a rock skip box for the larger toe-berm sections and a clamshell for the key sections.

The toe berm and keyway were placed first in any remedial area, based on availability of materials and transportation schedule. In some cases, material placement occurred differently than described in the design. In all cases, however, the intent of the design was met as agreed among the designers, contractor, and USACE personnel. In general, the toe berm and keyway were constructed first in any given area, riprap was placed as per design, the isolation layer sand cap mix was placed, and finally the erosion protection layer was placed. The project progressed in a general west-to-east manner.

The initial design provided for a 24-inch thick layer of gravel mix, covered with a 24-inch thick layer of sand cap mix. The 24-inch layer of sand is covered by a variable thickness layer of gravel and then topped with riprap or habitat mix. The contractor requested that modification of the initial thickness of the gravel base be established at not less than 24 inches and not greater than 36 inches, to allow for placement of a smooth, even gravel layer not impacted by irregularities in the slope. This also improved placement of the 24-inch sand cap mix and the subsequent layers. The USACE and URS agreed that placement of the initial gravel layer between 24 and 36 inches would meet the maximum lift thicknesses described in Section 02483 of the specifications. The contractor was approved to vary the thickness of the initial gravel layer to improve the placement of subsequent cap layers.

A single beam hydrographic survey vessel was used to monitor capping progress on a daily basis.

3.5 DESCRIPTION OF CAPPING OPERATIONS IN RA2 AND RA3

3.5.1 Summary of Design

The cap designs in RA2a, RA2b, and RA3 varied based on the potential for erosion. The designs for RA2a and RA3 included a top layer of coarse material to resist erosion due to propeller wash. This layer was not included in the cap design for RA2b because there was little potential for erosion in that area.

The RA2a and RA3 cap designs differ only in the gradation of the erosion-resistant top layer of cap material. The RA2a and RA3 designs called for a minimum cap thickness of 42 inches, plus a 12-inch overplacement allowance, for a maximum cap thickness of 54 inches. To satisfy the above requirements, the cap material in RA2a and RA3 consisted of:

- A base layer of sand cap mix at a minimum of 24 inches thick
- In RA2a, a top layer of a well-graded, gravelly sand with a D_{50} of approximately 5 mm ("coarse sand") at a minimum of 18 inches thick
- In RA3, a top layer of gravel mix at a minimum of 18 inches thick

The RA2b design called for a minimum cap thickness of 30 inches, plus a 12-inch overplacement allowance, for a maximum cap thickness of 42 inches. The RA2b cap design consisted of a single layer of sand cap mix.

The design called for placement of the sand cap mix layers mechanically or by hydraulic washing from a barge and placement of the top layers of coarse sand and gravel mix mechanically. Other method(s) proposed by the contractor and approved by USACE could have been used. The estimated quantities of material required to construct the cap included:

- 43,600 cy in RA2a
- 18,200 cy sand cap mix in RA2b
- 7,700 cy in RA3

3.5.2 Use of Dredged Material in RAs 2a, 2b, and 3

The contractor became aware that the Duwamish River would be dredged by the USACE for navigation channel maintenance. The contractor submitted a Value Engineering Cost Proposal (VECP) to the USACE to use dredged material in place of the sand cap mix in RA2 and RA3. The contractor, USACE, and designers agreed that the beneficial use of this material for chemical isolation was acceptable based on its physical properties, total organic carbon content, and close proximity. Decreased costs were realized for both the Navigation Section, which would normally pay for open water disposal, and for the PSR Superfund project, which would normally pay for transportation of upland material.

A total of 17,565 tons of Duwamish River dredged material was used to cap RA2 and RA3. However, insufficient dredge material was available to complete the sediment cap as designed in RA2b. In addition, some areas on the east side of RA2a required more sand cap mix than initially designed in order to assure erosional stability. Accordingly, an additional 11,904 tons of sand cap mix was used in RA2a in order to meet design elevations.

Due to the increased quantity of sand cap mix necessary in RA2a, the design for this area was re-evaluated and conservative assumptions eased. The re-evaluation determined that cap thickness within 50 feet of the boundary with RA1 would remain the same for erosion stability, but that the thickness of dredged material in the remaining areas of RA2b and RA3 could be decreased from 24 inches to 18 inches. This change provided the cost savings necessary to purchase the extra sand cap mix needed in RA2a.

3.5.3 Sequence of Material Placement

The sequence of material placement in RA2 and RA3 occurred in the manner described in Section 3.4.2.

3.6 DESCRIPTION OF CAPPING OPERATIONS IN RA4

3.6.1 Summary of Design

The RA4 cap design called for a minimum cap thickness of 30 inches, plus a 12-inch overplacement allowance for a maximum cap thickness of 42 inches consisting of a single layer of sand cap mix. The design called for placement by hydraulic washing from a barge, or by other method(s) proposed by the contractor and approved by USACE. To limit the potential for landsliding, the design called for the RA4 cap to be placed in lifts beginning at the toe of the slope and proceeding upslope. It was estimated in design that a total of 159,000 cy of material would be required to construct the cap in RA4.

3.6.2 Sequence of Material Placement

The RA4 cap was constructed using a bottom dump pocket barge that released material in a controlled manner while its operator monitored and adjusted the barge speed to achieve the desired cap thickness.

RA4 had the most restrictive lift thickness requirements to avoid bearing capacity failures and potential landslides on the steep slopes. Capping depths were up to –140 feet below MLLW. The entire area was segregated into three sections to facilitate material placement planning. Each section was completed from deepest to shallowest depth as follows: east section, west section, and middle section, in order to assure that slope failures would not occur. Planned lines running parallel to the slope and of an equal width of the oval formed by material being spread from the pocket barge were set up as targets for the barge.

Using mooring anchors and a deck winch system (see attached drawings), the barge was guided along the section as the material was released from the bottom of the pocket barge. The barge was equipped with a computer receiving real time position and speed from an on-board GPS to allow documentation of the actual path and to aid the operator in keeping the barge aligned. After the initial layer was placed, the rate of barge movement was decreased in accordance with increased allowable cap thickness in subsequent layers. By adjusting the width of the bottom door openings and the speed of the pocket barge, the operator was able to control cap thickness.

3.7 DESCRIPTION OF CAPPING OPERATIONS IN RA5

3.7.1 Summary of Design

The RA5 design called for a minimum cap thickness of 27 inches, plus a 13-inch overplacement allowance for a maximum (short-term) cap thickness of approximately 40 inches. Following consolidation, it was anticipated that the cap would have a minimum 24-inch thickness and that the average cap thickness would be approximately 30 inches.

The design called for the RA5 cap to consist of a single layer of sandy dredged material placed at regularly spaced target locations using the instantaneous bottom-dump placement method. It was estimated that a total of 217,000 cubic yards of material would be required to construct the cap in RA5. The models indicated that a percentage of the fine material would migrate outside the specified RA5 boundaries during placement due to water depth. This was considered "incidental" capping for those areas adjacent to the RA5 boundary.

Incidental capping was considered advantageous because although the Record of Decision had not included those areas in the cap boundary, sediments in these adjacent areas exceeded certain regulatory criteria. During the Remedial Investigation, sediment chemical data were compared with effects-based SMS, which provide two sets of chemical criteria: SQS, established as long-term cleanup goals, and CSL, which are less stringent and typically used to determine if remediation is required. The RA5 boundary was set based on those sediments whose chemical concentrations exceeded the SQS. However, areas outside of that boundary exceeded the CSL. These areas were considered to benefit from incidental capping.

The design was modeled with STFATE using barges with a 1,000 cy capacity. With this model, 39 target areas were assigned over the entire RA5 area. Each target area was to have a specified quantity of material placed within its 200 ft radius (refer to Figure 5 in the CQAP RA5) in at least two lifts to assure slope stability in some areas and complete coverage in all areas.

3.7.2 Sequence of Material Placement

Upon the start of construction, the contractor was only able to utilize 3,000 and 5,000 cy bottom dump barges. Therefore, each barge was required to place material onto multiple target areas rather than one target. Upon review by the designers, it was agreed that areas critical for slope stability would maintain the initial target capacity limits for the first lift, even though more than one target was used for each barge. Therefore, approximately 3,000 to 5,000 cy per barge were dumped within and between multiple targets.

Material was placed at the rate of approximately 2 to 3 barges (5,000 to 13,500 tons) per 24 hours. The barges placed limited amounts of material corresponding to a 1-foot cap thickness along the southern edge of the cap as per the specification to minimize risk of slope failure.

A total of 300,000 cy of material were to be dredged from the Snohomish River. Monitoring during placement indicated that additional dredged material could be placed at the site to maximize contaminant containment and increase the potential for incidental capping outside the RA boundaries.

3.8 DESCRIPTION OF OUTFALL EXTENSION IN RA1 AND RA3

3.8.1 Summary of Design

The Longfellow Creek Overflow outfall is located approximately 140 feet east of the Crowley pier. The outfall consists of an 84-inch (7-ft) inside diameter, 8-inch thick, reinforced concrete pipe (RCP), with the invert of the pipe at approximately -7.6 feet MLLW. The design was driven by the need to avoid erosion of the sediment cap from outflow and to minimize the volume of riprap placed in intertidal area. Therefore, the design called for the outfall to be extended by approximately 90 feet. To accommodate this extension, the design called for dredging to remove existing sediments along the alignment of the extension. This dredging was anticipated to remove all highly compressible sediments from the pipeline alignment and thereby limit the potential for unacceptable deflections in the pipeline.

3.9 SIGNIFICANT CHANGES FROM DESIGN

3.9.1 Sand Cap Mix/TOC Alteration

The specified sand cap mix material was to contain 0.5 percent of total organic carbon (TOC) by amendment with no floatable material. The intent of the TOC was to adsorb dissolved phase contaminants that may occur in cap material during pore-water movement immediately following cap placement. Design estimates were very conservative based on a one-dimensional chemical transport model. The design cost estimate assumed that the TOC would be easily included in the material from the quarry and did not uniquely identify the type of TOC necessary to meet the characteristics specified. Upon further investigation during construction, it was determined that the only TOC material available to meet the specification would be significantly more costly than identified during design, would need to be transported from the East Coast and mixed into the sand cap material at a separate location, and could potentially not behave in a manner intended in the design. Upon reevaluation of the design, the more conservative assumptions were relaxed, and it was determined that the sand cap material without amendment would meet design objectives for chemical isolation. Therefore, the initial specification for TOC was removed from the sand cap mix specifications. A memorandum documenting the evaluation of cap material TOC requirements is presented in Appendix A.

No contractor-initiated change orders were associated with the changed action described above. The action described was initiated by the government.

3.9.2 Material Placement Under Piers

The initial design to achieve placement of material between pilings under the viewing pier was to "cast" material with a small capacity bucket. Upon closer inspection by the contractor, it was determined that the pilings were closer together than anticipated. Due to the limited accessibility, the riprap toe berm could not be placed beneath the viewing pier without disturbing the pier. Access limitations were defined as close spacing of piles, limited overhead clearance, a cyclone fence skirt on the west side of the pier, a timber frame on the east side of the pier, steep onshore ground, and a retaining wall on east side of pier.

The proposed solution was to place an initial 2 feet of gravel mix around the pier, then to bring the toe berm as close as possible to the pier from the east and west sides. The berm was turned southward a short distance (25 to 35 feet) along both sides of the pier. The top of the berm elevation rises somewhat along these southward extensions. The low area beneath the pier was capped by first placing a layer of sand cap mix, followed by gravel mix, then habitat mix.

The sand was placed by backhoe or dredge bucket onto the face of the berm extensions, as close to the pier as possible. Over several days the sand migrated downhill toward the center of the pier by gravity and tidal forces. After the sand migrated beneath the pier, the same placement technique was used for the gravel cap mix. The gravel also migrated both towards the center of the pier and northward down the axis of the pier due to the absence of a rip rap berm at the north end of the pier.

The long-term configuration of the cap at this location will likely be a depressed corridor down the axis of the pier, with the gravel toe of the cap protruding downhill of the planned toe berm location. The southward extensions of the riprap toe berm along both sides of the pier will limit the possibility that gravel mix will migrate further to the east and west of the pier. The presence of the riprap along edges of the pier corridor will provide greater resistance to northward gravel migration within the corridor. The initial higher levels of gravel mix on one side of the timber piles are not expected to create a problem for the piles as long as this condition is present on both the east and the west side of the pier.

No change orders were associated with the changed action described above.

3.9.3 Alignment of Outfall Pipe

The outfall pipe was installed as designed; however, the alignment was adjusted and the length was shortened by 16 feet to accommodate pilings that were shown on the drawings in improper alignment. In addition, during dredging of the outfall extension cut, the contractor encountered a series of tightly spaced, untreated wood pilings beneath the mudline. The pilings within the dredge cut were removed during dredging; however, stability concerns remained regarding the possibility that there were additional pilings along the pipe alignment and/or that the removal of the pilings during dredging may have impacted the stability of the sediments needed to support the mass of the installed pipe. Therefore, for stability purposes, pipe anchors were left in place that had not been anticipated in the design.

Each pipe was checked visually by divers for deficiencies, including uneven joints. The area was surveyed after pipe installation and again after backfilling and capping occurred in adjacent areas.

A memorandum documenting the change in the outfall alignment is presented in Appendix B.

3.9.4 Thickness of Material in RA2a

The minimum thickness of the erosion resistance layer was reduced from 18 inches to 12 inches over the majority of the RA2a area. The full 18-inch thickness specified was retained in the northeast corner of RA2a (within 50 feet of the western boundary of RA 1) because the water is shallower there and it was likely that larger tugboats would operate in that vicinity. The allowed changes were based on the following considerations.

The RI indicated that some of the chemicals of concern (COCs) were still at a reasonably high level in Area 2a. Construction verification appeared to indicate that the thickness of the chemical isolation layer already placed in RA 1 was typically at or not more than a few inches greater than specified. Therefore, an assumption that the chemical isolation ability was equal to but not more than the minimum designed. Measurements indicated that the although the average particle size of material comprising the coarse sand erosion protection layer was within the range provided in the specifications, the actual value was on the coarse end of the possible range of values provided.

Accordingly, the erosion resistance layer thickness was reduced to 12 inches because it provided adequate erosion protection. Therefore, the actual total thickness of chemical isolation and erosion resistance materials will be approximately 36 inches, which is still considered an effective overall cap thickness for preserving the long-term chemical isolation function at this location.

In areas where riprap was within the tidal zone and potentially exposed to wave action, concern existed regarding whether the sand cap mix would be eroded out from underneath the riprap. The filter materials were designed to be fine enough to prevent the underlying sand cap mix from being washed through the riprap and coarse enough to prevent the filter layer itself from being washed through the riprap. Two filter materials were specified depending on whether the riprap was within or below the tidal zone. Both materials were designed to meet minimum gradation requirements based on tidal influence. Filter material 1 was to be placed in those areas within the tidal zone to provide a buffer between the riprap and sand cap mix. Filter material 2 was to provide the same protection for areas below tidal influence but did not contain the larger materials specified for filter material 1. During construction planning, the contractor suggested that it was very difficult to transport and place the small volume of filter material 1 with the equipment mobilized without significantly decreasing production times. In addition, the riprap gradation contained some material that met the larger size requirements of filter material 1. Accordingly, the designers re-evaluated the design and determined that filter material 2 would provide adequate protection in areas both within and below tidal influence.

3.9.5 Material Change in RA4

The material used to construct the cap in RA4 differed from the original design based upon concern that sand cap mix would not remain in place as designed due to steep slopes. It had been noted in RA2b that the sand cap material migrated further than anticipated during placement on areas with a shallower slope than that found in RA4. Therefore, the contractor proposed the use of a more angular and larger sized material for capping in RA4. The designers agreed that the proposed material would provide equal or better long-term slope stability, erosion resistance, and chemical isolation in RA4 than the originally specified sand cap mix.

In general, the designers acknowledged that the material change was fundamentally sound and represented an innovative approach. Specific construction oversight recommendations included closely monitoring bathymetric survey results, closely monitoring barge draft and positioning records to evaluate how evenly the material is being placed, observing specified consolidation periods, and carefully interpreting the hydrographic surveys to account for consolidation of underlying sediments and survey accuracy.

The material placed in RA4 required a placement method that differed from that used in RAs 1-3. The granular nature and size of the material and water depth in RA4 required that the material be placed from a bottom dump barge. To assure slope stability and that cap lift thickness requirements were met, the material was placed from a pocket barge. The barge had seven pockets that allowed the operator to dump varying amounts of material over a varying time as described in Section 3.6.2 above. Additionally, monitoring was adjusted to delete the use of through-cap coring, which probably would not have been successful in this type of material, and utilize a Van Veen sampler for surface grab samples in its place. Appropriate chemical analysis was achieved with this collection method. Cap thickness monitoring was achieved using daily and final bathymetric surveys with daily review of volume and location placement data.

The change in material was made through VECP 003. A memorandum that evaluates VECP003 is presented in Appendix C.

3.9.6 Use of Dredged Material from Duwamish River in RAs 2 and 3

The contract initially required the use of upland sources of material for cap construction to provide a predictable source of sand for use in the chemical isolation layer of the cap. After award of the contract, an approved source of dredge material from a nearby federal navigation project became available for use, and the cap designers concurred with its use. To obtain this material, a contract modification was made to the original construction contract to allow ACC/Hurlen to dredge approximately 60,000 cy of sediment from the federally authorized maintenance dredging of the Duwamish Waterway. The dredge material was placed onto flat deck barges and transported to the PSR site and placed in RAs 2a, 2b and 3 according to the specifications of the existing contract described above.

Use of the existing construction contract to accomplish the dredging of the Duwamish River represented a significant savings to the government. Dredging costs were reduced due to the shorter transportation distance to the PSR site rather than the open water disposal site normally used for dredging projects in Elliott Bay. In addition, replacement of the specified sand cap mix with dredged material allowed the government to save approximately $1.3 million in material costs. Use of the dredge material also allowed completion of a substantially greater area of the total site in one construction season, thereby reducing the potential exposure of both human and ecological receptors to unacceptable levels of chemical contamination.

3.10 FINAL INSPECTION DOCUMENTATION

This section documents the pre-final and final inspections conducted by the contracting party and contractor at the completion of construction of the operable unit, including a brief description of the deficient construction items (punch list) reported and resolved during the pre-final and final inspections and a list of attendees at the inspection(s).

The USACE and the Contractor developed a draft and final punch list in January 2004. The Corps of Engineers reviewed final inspection of all work, supported by documentation on April 6, 2004 at the PSR site. Travis Shaw, Project Engineer, and Brenda Bachman, QAR, represented the Government for all items on the final punch list during the inspection.

The USACE considered areas RA1, RA2a, RA2b, RA3 and the Longfellow Creek Extension complete as of the final inspection on April 6, 2004.

Remedial areas RA4 and RA5 were considered construction complete as of the final inspections which occurred on November 2004 and February 2005, respectively.

Snohomish River dredging and placement at PSR RA5 was completed on February 10, 2005. Construction verification was completed as described below. Performance standards for this project include state cleanup levels for chemicals of concern at this site and cap thickness specifications. The performance standards and construction and final monitoring results are described below. Results indicate that all performance standards as outlined in the ROD and technical specifications were met.

3.10.1 Summary of Construction Monitoring and Verification Requirements

The design for RAs 1-4 required the contractor to 1) monitor water quality for compliance with the Clean Water Act Section 401 water quality certification; 2) verify that cap thickness is within specified limits; and 3) verify that the chemical quality of the cap met project requirements. In RAs 1-4, the construction contractor was required to provide all monitoring and verification requirements.

For the Snohomish River dredging and placement in RA5, however, the contractor was required to a) monitor water quality at the dredge site, b) meet dredge cut and quantity specifications for the dredging, and c) place a specified quantity of material within specific targets areas at the PSR site. Water quality monitoring for placement of material at RA5 and cap verification monitoring were under a separate USACE contract.

Water Quality
The PSR remediation area is situated in Class A waters of the state, per Washington State water quality standards (WAC 173-201A).

WAC 173-201A and the water quality certification for all RAs at the PSR site required the contractor to monitor dissolved oxygen (DO), turbidity, temperature, and total suspended solids within the water column and sheens on the water surface. Monitoring was required at the edge of the 300-feet-long mixing zone (the "compliance boundary"). Additional DO monitoring was required at the midpoint between the active operations and the compliance boundary (the "early warning location"). For RAs 1-4, Tables 3-2 and 3-3 summarize the compliance criteria and points of compliance and the required monitoring frequency, respectively. For RA 5, the water quality certification was included in the scope of work.

Cap Thickness
Through-cap coring, differential bathymetry, sub-bottom profiling, and material placement records were all used to verify cap thickness where applicable. In RA4 and in areas with riprap, through-cap coring was not used due to material size.

The design required the contractor to verify that the individual lift thickness and final cap thickness in each RA were within acceptable limits using core sampling, controlled material placement rates, and hydrographic surveys. Maximum allowable lift thicknesses and material placement rates for RAs 1-4 are summarized in Table 3-4. Core sampling requirements for RAs 1-4 are summarized in Table 3-5. Final cap thickness tolerances for RAs 1-4 are shown in Table 3-6. The design called for verification of compliance with final cap thickness tolerances using single-beam hydrographic surveys. The required precision of these surveys was ±0.3 feet for water depths of 0 to 30 feet and ±1% of the water depth for water depths greater than 30 feet.

Due to the granular nature of the material actually used in RA4, through-cap cores could not be used in this area. The verification procedure was modified to use only surface grabs to measure chemical concentrations and WINOPS/HYPACK information along with bathymetric surveys to verify thickness.

Cap Surface Chemical Concentrations

The contractor was required to obtain samples of the top 4 inches of the cap sediment and verify compliance with the chemical quality requirements summarized for RAs 1-4 in Table 3-7.

Import Material Testing

All cap materials were tested for gradation and chemistry parameters to determine suitability for compliance with the specifications including WAC 173-204 (State sediment regulations). The following borrow materials used in RAs 1-4 were tested for grain size, metals, pesticides, PCBs, and SVOCs as specified: beach sand, sand cap mix, filter material 2, and habitat mix. In addition, sand cap mix and filter material 2 were tested for total organic carbon. Riprap, gravel mix, and filter material 1 were not tested due to their size. All dredged material placed at PSR was tested using the Puget Sound Dredge Disposal Analysis (PSDDA) parameters as directed in the specifications.

Waste Characterization Testing

All waste samples were analyzed prior to disposal for total solids, leachable chemicals using the toxicity characteristic leaching procedure (TCLP), pesticides, PCBs and semivolatile organic compounds (SVOCs).

3.10.2 Water Quality Monitoring Results

All water quality monitoring results for all RAs were reviewed by USACE quality assurance personnel within 24 hours of collection. All data that exceeded criteria were reported to the USACE immediately upon verification in the field. Any changes to data collection were coordinated and carried out on the same day when possible given weather and daylight limitations. Monthly water quality reports were also submitted by the contractor for RAs 1-4. Final water quality monitoring reports are included in Appendix D.

3.10.2.1 RAs 1-4

Water quality monitoring occurred from August 26, 2003, through February 26, 2004, and from September through November 2004. Monthly reports were provided to the USACE QAR and were used to summarize results below.

One modification was made to the monitoring requirements as outlined in the technical specifications and WQC during the 2003-2004 construction season. During the first week of monitoring, reference station 3 was moved because the original location was in the shipping channel (Chemical Data Final Report, May 2004). The new location was near the east mooring buoy unless it was being used, in which case the location would be at the west mooring buoy. The alternative reference location did not impact data quality or representativeness of background water quality data.

Although several minor concerns regarding data quality were identified during monitoring, corrective actions taken by the contractor resulted in representative and usable data. Results indicate that water quality parameters were met during the 2003-2004 construction season with minor exceptions. Minor WAC 173-201A and water quality certification exceedances for the DO and turbidity parameters at various sampling locations, depths, and times were identified as localized occurrences or equipment malfunctions and were not indicative of general water quality around construction operations.

3.10.2.2 RA5

Water quality monitoring occurred in RA5 from December 2004 through February 2005. Daily reports were provided to the USACE QAR for review. Results indicate that water quality parameters were met during the 2005 construction season with minor exceptions. Minor WAC 173-201A and water quality certification exceedances for the DO and turbidity parameters at various sampling locations, depths, and times were identified as localized occurrences not indicative of general water quality around construction operations. No corrective actions were required or taken by the placement contractor during operations.

3.10.3 Physical Cap Placement Verification Results

Placement of the sand cap mix and initial layers of the gravel mix and filter material #2, as shown in Table 3-4, required that the initial layer placed be no thicker than 1 foot based on bearing capacity analysis. In the dredged areas, USACE allowed ACC-Hurlen to place the gravel mix and the filter material #2 in 2-foot thicknesses. When this was successful, this practice was also allowed with the gravel mix and sand cap mix in all areas west of grid line 18+00. In the area east of grid line 18+00, sand cap mix was still placed in 1-foot layers, with physical verification samples taken between lifts.

During placement operations, ACC-Hurlen used two methods to track placement of each type of material. First, material that was placed with a bucket was tracked with WINOPS and a bucket placement map was generated weekly. Second, a daily single beam hydrographic survey verified placement depths of the various materials in the different cap design areas. The survey crew set up contract parameters in the computers on board the dredging and placement equipment, and WINOPS tracked material placement as described above. Grids were set up on 10-feet spacing and the survey vessel conducted daily surveys as material was placed using cross-sections developed from the pre-construction hydrographic multi-beam and topographic surveys. Bucket placement and survey reports were reviewed at least weekly by the QA/QC staff of ACC-Hurlen and the USACE to assure that placement was occurring according to the specifications. In addition, the contractor provided a visual interpretation map that showed areas of cap thickness within and outside of the specified thickness in a given remedial area. The weekly meeting included discussion about precisely where additional material was to be placed and allowed the QA/QC personnel to accurately identify if material was placed in those areas. All material placed in RAs 1-3 was tracked in this way throughout the construction period. All physical data utilized to track placement in RAs 1-3 indicate that the cap was successfully constructed as designed. Bathymetric cross-sections and through-cap cores taken between lifts during the capping process and upon completed capping indicate that all material was placed at specified thicknesses.

In RA1, design thickness was specified as 0 to 60 inches depending upon location and material type as per drawings. A total of 15 through-cap cores were taken in RA1 at 10 locations. Duplicate cores were taken for chemistry and cap thickness verification at 5 of the 10 locations. Through-cap cores show that 16 to 50 inches were placed in all core locations, which is well within the specified thickness range. The extent of mixing of native material with cap material was found to be 0 to 4 inches in 5 of the 10 locations sampled. The other five locations were sampled only for chemistry.

In RA2a, design thickness was specified as minimum of 24 inches with a 12-inch over-placement allowance. However, during construction, the minimum thickness of the erosion resistance layer was reduced from 18 inches to 12 inches over the majority of the RA2a area, with the full 18-inch thickness retained only in the northeast corner of RA2a, within 50 feet of the western boundary of RA1. This reduced the total thickness from 24 inches to 18 inches over the majority of the area. A total of 17 cores were taken in RA2a. The through-cap cores indicate that 12 to 36 inches of material were placed across the area. The extent of mixing of native material with cap material was found to be 0 inches in 13 of the 17 locations sampled. The other four locations were sampled only for chemistry.

In RA2b, design thickness was specified as a minimum of 18 inches with a 12-inch over-placement allowance as described in Section 3.5.2 above. A total of seven through-cap cores were taken at four locations. Duplicate cores were taken for chemistry and cap thickness verification at three of the four locations. Through-cap cores show that 18 to 25 inches of material were placed across the area, which is well within the revised specified range. The extent of mixing of native material with cap material was found to be 0 inches in four of the seven locations sampled. The other three locations were sampled only for chemistry.

In RA3, through-cap cores were not utilized due to the nature of the capping material as described in Section 3.10.1 above.

In RA4, design thickness was specified as a minimum of 24 inches with a 12-inch over-placement allowance. As noted above, in RA4, barge volumes and paths, bathymetric cross-sections, and the interpretive map were reviewed weekly as the material was placed by bottom-dump barge. In addition, the contractor surveyed the completed construction area and provided those cross-sections in a final report. Review of these cross-sections indicates that the cap was successfully constructed as designed. Due to large scale placement with the bottom dump barge, cap thickness varies mildly throughout the RA; however, overall cap thickness is acceptable. In areas where the interpretive map and direct bathymetric results indicated "thin" areas, the contractor deliberately placed additional material with a bucket. Regardless of this additional placement, the final bathymetry indicates that approximately 0.5 percent of the area in RA4 is not at the specified thickness. These areas should be targeted for biased sampling during the next monitoring event to assure that surface sediment chemistry meets criteria.

In RA5, cap thickness was specified as a minimum of 27 inches plus 12-inch over-placement allowance. Through-cap cores were collected at 21 on- and off-cap locations shown in Appendix E using a vibracorer. The vibracorer was allowed to penetrate to refusal or to a depth of 7 feet, which was the limit imposed by the length of the core barrels. When that depth was reached, the vibracorer was turned off and returned to the surface for removal and temporary storage of the core barrel. Immediately upon recovery, cores were inspected for native material at the bottom of the cores. Cores were then cut to length, capped, labeled, and stored upright for subsequent transport to the processing facility. Details of the collection activities were recorded in the field log notes and entered on core collection field forms. Processing occurred onshore at the Analytical Resources, Inc. (ARI) laboratory. Cores were cut open down the length of the barrel using a circular saw. The core was then stabilized on a table and split open for visual characterization. All cores were photographed after being split open and then logged by a qualified geotechnical engineer. Details of the characterization were recorded on core logging forms.

In general, the capping material and original sediment could be distinguished by their color (dark gray versus olive gray to black), and the presence or absence of product or sheen. However, identification was ambiguous at some locations because the original sediment also contained gray to dark gray sand and silt zones, and both sediment and cap material contained wood, shell, and vegetation debris. In this report, material that could not be conclusively identified as either sediment or cap material has been identified as sediment, which yields conservative estimates of cap thickness.

To assist in the identification and thickness determination of the RA5 cap, pre-dredge characterization logs and daily dredge reports from the Lower Snohomish River Settling Basin were reviewed. This material can be characterized as dark gray, very silty sand based on a volume-weighted average of the entire dredge prism. On average, 58 percent of all sediment was finer than a 0.125 mm sieve (the upper limit of the very fine sand classification). Cap material observed in cores consisted of layers of dark gray (medium to fine) sand to sandy silt with occasional occurrences of minor constituents (e.g., shell fragments, vegetation, and wood debris). The underlying native material ranged from soft, dark olive gray, plastic silt to very dark gray to black, fine sand. Some of this material was observed to possess visible sheen and petroleum odor and was considered to be contaminated sediment. Several of the cores also contained a thin layer of light gray, fine sand. This material is assumed to be the fine fraction fallout from the RA4 cap material. In many cases, this layer served as the defining interface between the RA5 cap material and the existing underlying sediments. Cores at locations RA5-02 and RA5-06 contained 34 and 14 inches, respectively, of RA4 cap material, as opposed to fallout from RA4. Analysis of only the through-cap cores inside the boundaries of RA5a and RA5b indicates average cap thicknesses of 9 inches and 42 inches, respectively. These estimates include the contribution from any RA4 material identified in the cores. A breakdown, by core, of the estimated thickness of RA5 material, contribution of RA4 material, and total estimated cap thickness is provided in Appendix E.

The entire core (28 inches) at location RA5-01 consisted of RA5 cap material. Apparently, underlying RA4 cap material was encountered during core collection and caused refusal, although none of the RA4 material was recovered. In 9 of the 21 cores, a layer of RA4 cap fallout identified the interface between RA5 cap material and the underlying native sediment. In 2 of the 21 cores, RA5 cap material lay over RA4 cap material whose thickness could not be determined. In these cores, the thickness of RA5 cap material ranged from 3 to 12 inches. In 7 of the 21 cores, RA5 cap material was considered to lie directly in contact with the underlying native sediment, so any estimates of cap thickness rely on the ability to clearly distinguish between the two types of material. In any cases where there was uncertainty, the estimated cap thickness was limited to only that material that could clearly be identified as capping material. This constitutes a conservative approach, and the result is that these are minimum estimates of the thickness of RA5 material at these seven locations. Estimates of the minimum thickness of RA5 cap material ranged from 5 to 28 inches within and in the vicinity of RA5a, with the exception of 2 samples discussed below and from 13 to 45 inches within and in the vicinity of RA5b.

In 2 of the 21 cores (RA5-05 and RA5-11), RA5 cap material could not be unambiguously identified. In one, the upper 1 foot of the core appeared contaminated. In the other, the surface material was RA4 cap fallout. The thickness of RA5 cap material was assigned a value of zero for these two locations. The cap thickness at the adjacent RA5-05 and RA5-11 locations is about 9 inches.

There appear to be three distinct spatial distributions of total cap thickness. One is along the boundary between RA5 and RA4, where there is a contribution from RA4 material, and the total thickness is approximately 2 feet or more. The second is the remainder of RA5a and adjacent core locations, where total cap thickness is approximately 1 foot or less with little contribution from RA4 material. The third is within RA5b, where thicknesses are approximately 3 to 4 feet and show no contribution from RA4 material, and to the north of RA5b, where the thickness is 13 inches. Initial modeling to estimate the amount of sediment necessary to achieve cap construction thickness design criteria took into account that approximately 54 percent of the discharged material would be deposited outside the boundaries of RA5. The modeling effort thus anticipated the effects of advective transport of cap material beyond the boundaries of RA5.

Based on chemical and physical results for the as-constructed RA5 cap, Integral Consulting, Inc. and URS conducted a re-evaluation of chemical isolation performance. The memorandum in Appendix F describes the approach, results, and recommendations of the evaluation. This re-evaluation considered the as-placed characteristics of the cap (e.g., higher OC content of the as-placed cap compared to the original design assumption) and used less conservative estimates of biodegradation rates. In addition, the potential for future deposition of clean sediment was considered in evaluating the necessary cap thickness. In summary, the re-evaluation indicated that a cap thickness of 8 inches would be sufficient to provide chemical isolation for 100 years.

3.10.4 Chemical Compliance Verification Results

3.10.4.1 RAs 1-4

Sampling and testing of cap material from RAs 1-4 were performed following the methods outlined in the project-specific sampling and analysis plan (SAP) and quality assurance project plan (QAPP). Samples were collected using either a boat-mounted electric vibracore capable of collecting continuous cores at all applicable water depths or a grab sampler. Sampling stations were located using a GPS capable of locating final station locations to within 1 meter. Upon locating a target sampling location, the coring unit was deployed. Continuous cores were collected in clean, non-contaminating liners and returned to the boat deck for visual inspection. Following visual inspection and data logging, a sub-sample of each core was collected for analysis at a National Environmental Laboratory Accreditation Program (NELAP) and USACE validated laboratory. A sub-sample of each core was retained as an archive for the purpose of re-analysis if necessary.

Following chemical analysis as specified in the Work Plan, analytical data were delivered to ACC/Hurlen's subcontractor for validation and completion of a chemical data final report (CDFR). Complete data validation was performed following guidelines published in ER 1110-1-263, which integrates USACE guidance on data quality control objectives. This was supplemented by ER 200-1-6, which provides additional guidance on chemical data quality objectives (DQOs). All data were validated in accordance with the USACE "Analytical Shell" as outlined in SW846 and associated regulatory documents, and include evaluations of the precision, accuracy, representativeness, comparability, completeness, and sensitivity. The CDFR includes a summary of the field sampling efforts, including final sampling locations and maps, a summary of the chemical parameters and analytical results, and a discussion of the data and QA/QC summary.

Following placement of the first lift of cap in RA1, RA2a, RA2b, and RA3 and after placement of the final lift in RA1, RA2a, RA2b, and RA3, through-cap samples of the cap material were collected using a vibracore. Samples of cap material were also collected using a vibracore, after placement of the coarse sand lift in RA2a. In RA4, all samples were collected with a grab sampler. Although only fine material from this RA was chemically analyzed, results are considered representative and acceptable. All coring and sample collection was conducted in accordance with Puget Sound Estuary Program (PSEP) guidelines (PSEP 1997) and in consultation with the USACE project team. Sediment samples were analyzed for a suite of chemical parameters including metals, SVOCs, PCBs, and TOC.

In RA1, the sand cap mix was placed on a 2-foot-thick layer over gravel mix. Since a through cap core was not applicable to this material, five grab samples were collected west of grid line 18+00. East of grid line 18+00, sampling occurred on a steep slope and several attempts were required to successfully collect the required samples.

In RAs 1-3, all cap verification chemical results were within criteria. Two samples exceeded the organic carbon (OC) normalized criteria as follows: In RA1, the fluorene result in one sample was 38 mg/kg, which exceeds the TOC normalized criteria of 23 mg/kg; in RA 2a, the acenaphthene result in one sample was 19 mg/kg, which exceeds the TOC normalized criteria of 16 mg/kg. Because the TOC in these samples were below the 0.5 percent value used for OC normalization (see WAC 173-204), dry weight values were used for comparison (Table 3-7). Both samples were well within the dry weight criteria. Therefore, no criteria were exceeded in samples taken from RAs 1-3.

In RA4, all cap verification chemical results were within criteria, with the exception of two compounds in one sample (VS-35). Concentrations of acenaphthene (518 μg/kg dry weight) and pyrene (3,672 μg/kg dry weight) exceeded the dry weight values of 500 μg/kg (dry weight) and 2600 μg/kg (dry weight), respectively. In addition, three samples exhibited a sheen in the grab sample: VS-31, 33, and 35. These areas should be targeted for biased sampling during the next monitoring event to identify whether surface sediments meet or exceed sediment criteria.

3.10.4.2 RA5

In RA5, grab samples were collected for surface chemistry analysis following PSEP (1997) protocols and as specified in the QAPP. Horizontal positioning was determined using an onboard differential global positioning system (DGPS) based on coordinates chosen in advance of field work. Actual station positions were converted to latitude and longitude (North American Datum [NAD] 83) to the nearest 0.01 second. The accuracy of measured and recorded horizontal coordinates was within 3 meters. The complete data report in Appendix E presents surface sample coordinates and shows the actual sampling locations. The water depth at each grab station was measured using an onboard fathometer, and the seafloor elevation was calculated by subtracting the water depth from the tidal elevation. Tidal elevations were based on data from the tide prediction program Tides and Currents for Windows™ by Nobeltec Corporation. Once at the station, samples were collected from the vessel using a Van Veen-type grab sampler. Location and water depths were recorded by field staff while the sampler was at depth.

The sampler was then retrieved on board the vessel, and sample quality was evaluated against PSEP criteria. If a sample met criteria, the 0 to 10 centimeter (cm) interval was collected. Sampling sediment in contact with the walls of the sampler was avoided. Collected sediment was homogenized in a decontaminated stainless steel mixing container and placed in pre-labeled, certified pre-cleaned glass jars. All samples were kept at 4°±2°C until delivery to the laboratory Columbia Analytical Services (CAS) for analysis. Details of the collection activities were recorded in the field log book and entered on surface sediment field sample collection forms.

Surface chemistry results from RA5 are presented in Tables 3 and 4 of Appendix E, which provide analytical results in the appropriate format for comparison with SMS or Puget Sound Apparent Effects Threshold (AET) evaluation criteria, respectively.

Organic Compounds
TOC content ranged from 0.30 percent to 2.57 percent. TOC content in samples RA5-16-GS and RA5-19A-GS were 0.49 percent and 0.30 percent, respectively. In accordance with the USACE Statement of Work (USACE 2005), AET dry weight criteria were used for evaluation of organic compounds in these two samples. All other samples fell within the standard range of 0.50 percent to 4.00 percent TOC for comparison to SMS criteria.

Comparison with SMS Organic Carbon Normalized Criteria
Table 3 in Appendix E presents the SMS OC-normalized SQS and Cleanup Screening Level (CSL) criteria and the OC-normalized chemical analytical results for all samples within the range

of 0.50 percent to 4.00 percent. None of the detected analyte concentrations of SVOCs exceeded their respective SMS OC-normalized criteria. PAHs were detected at low concentrations relative to screening criteria. Phenols were undetected in most samples, and the detected concentrations were low relative to screening criteria. For non-detected analyte concentrations, the method reporting limits (MRLs) for 2,4-dimethylphenol exceeded SQS criteria for some samples; therefore, the method detection limits (MDLs) for 2,4-dimethylphenol were entered for all samples in the table for comparison to the evaluation criterion. None of the MDLs exceeded the criterion.

Concentrations of PCBs were either very low or not detected in 20 of the 21 samples. The exception was sample RA5-05-GS, which had a total PCB concentration of 18.91 mg/kg OC. This exceeded the SMS SQS criterion of 12 mg/kg OC by only a factor of 1.5. Evaluation of the core collected at Station RA5- 05 indicated that no cap material was present, so the corresponding grab sample from that location likely represents native sediment.

Comparison with Puget Sound AET Dry Weight Criteria
Table 4 in Appendix E presents the lowest apparent effects threshold (LAET) and second lowest apparent effects threshold (2LAET) sediment quality criteria and the dry weight chemical analytical results for samples RA5-16-GS and RA5-19A-GS. Percent TOC in these samples, 0.49 percent and 0.30 percent respectively, was outside the range of 0.50 percent to 4.00 percent, so it is appropriate to compare the measured chemical concentrations to the AET criteria. None of the detected analyte concentrations in either of the sediment samples exceeded their respective AET criteria.

Inorganic Compounds
Evaluation criteria for metals are not presented on an OC-normalized basis, and the same values are used for comparison with the SMS and AET criteria. In general, metals were detected in all samples; however, the concentrations were not atypically elevated, and there were no exceedances of evaluation criteria. Metals results are presented in Tables 3 and 4 in Appendix E.

3.10.5 Import Material Testing Results in RAs 1-4

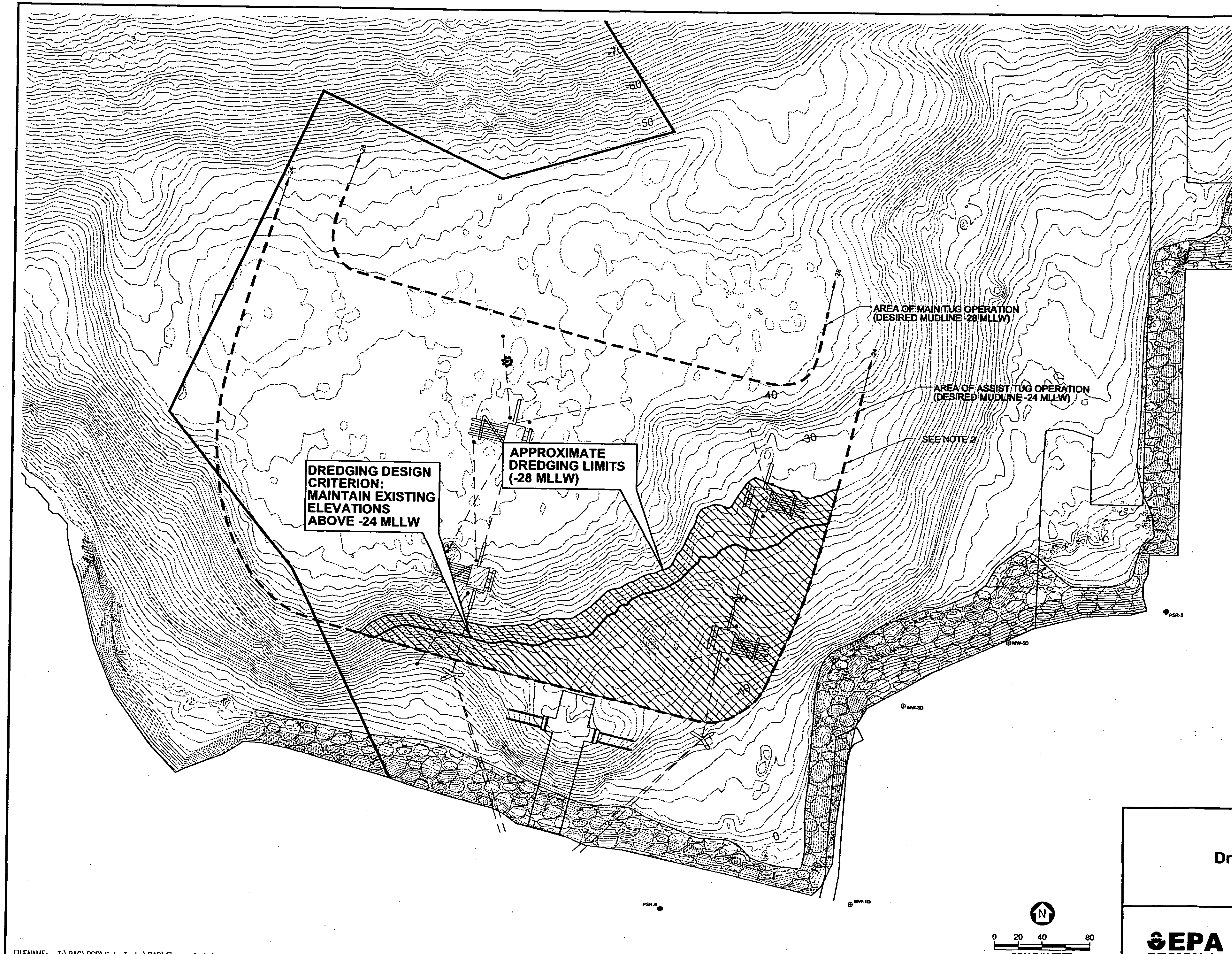
Chemical compliance criteria for all borrow materials were met. Both filter materials and habitat mix did not meet all or part of the physical grain size criteria and were either remixed until they met criteria or were accepted based on inherent flexibility in the specifications.

3.10.6 Health and Safety Documentation

No health and safety problems were encountered during construction activities on this project. Modified Level D personal protective equipment (PPE) was required for all personnel who came into direct contact with the dredged material. The equipment included hard hats, safety glasses, life vests, steel-toed safety boots and Nitrile gloves. All personnel working on the dredge barges and the survey vessel also used these safety items.

All health and safety performance standards were followed during work activities and requirements of the Accident Prevention Plan were met. No accidents or incidents involving worker injuries were reported during the 187 days of construction in RAs 1-4. All instruments used in the collection of air samples were calibrated before each use in accordance with manufacturers' specifications. Daily Health and Safety / Tailgate meetings and Weekly Safety Meetings covering specific topics were conducted. The absence of worker injuries was largely a result of the active participation of all personnel, who provided timely and relevant topics for discussion during these meetings.

Air monitoring with a PID (photoionization detector) was conducted initially and periodically to determine potential personnel exposure to airborne hazardous contaminants and was performed as needed by the On-Site Safety Officer. Upon review of project air monitoring data, worker exposure assessments, observations and discussions of procedures used regarding work methodology, and cleaning and decontamination procedures (in accordance with the contractor's accident prevention plan), no incidents of employee exposure to hazardous constituents were associated with this project.



NOTES

1. THIS FIGURE PRESENTS DREDGING DESIGN CRITERIA ONLY. REFER TO DESIGN DRAWINGS FOR SPECIFIC DREDGE DESIGN ELEMENTS.
2. SLOPED DREDGE CUTBACKS ARE REQUIRED AT THE SHOREWARD LIMITS OF THE DREDGE AREA. REFER TO DESIGN DRAWINGS.

LEGEND

- CAP DESIGN AREAS
- -20 ELEVATIONS IN MLLW
- MW-15D HISTORICAL DEEP WELLS
- PSR-1 SURVEY MONUMENT
- DOLPHIN/PILING
- EXISTING STEEL CABLES
- REQUIRED DREDGING AREA

Figure 3-1
Dredging Design Criteria

EPA REGION 10

065-RD-RD-101-L
Pacific Sound Resources Superfund Site
Marine Sediment Unit
DRAFT REMEDIAL ACTION REPORT

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Table 3-1
Planned and Actual Material Volumes by RA and Material Type

Material Type	Planned Tonnage	Actual Tonnage
RA 1		
Beach Sand	1,000 tons	712 tons
Sand Cap Mix (with TOC)	27,300 tons	16,380 tons
Sand Cap Mix (w/o TOC)		16,012 tons
Gravel Mix	85,300 tons	91,558 tons
Filter Material #2 (with TOC)	2,900 tons	2,740 tons
Habitat Mix	6,900 tons	6,092 tons
Riprap	12,200 tons	10,797 tons
Filter Material #1	700 tons	0 tons
RA 2a		
Duwamish River Dredge Material	38,947 tons	43,260 tons
Coarse Sand	32,800 tons	10,478 tons
RA 2b		
Duwamish River Dredge Material	23,222 tons	17,565 tons
Sand Cap Mix (w/o TOC)		11,904 tons
RA 3		
Duwamish River Dredge Material	6,810 tons	7,153 tons
Gravel Mix	5,500 tons	4,515 tons
RA 4		
Sand Cap Mix	239,940 tons	0
Alternate Material	0	249,940 tons
RA 5		
Dredge Material	**Planned Volume**	**Actual Volume**
Various Sources	217,000 cy	
Duwamish River Upper Turning Basin		18,037 cy
Snohomish River		315,000 cy
Tyee Yacht Club		2,300 cy
Lehigh Northwest Inc.		3,900 cy

Notes:
cy - cubic yard
TOC - total organic carbon
w/o - without

Table 3-2
Water Quality Parameters and Compliance Criteria for RAs 1-4

Parameter	Compliance Criteria	Basis	Point of Compliance
Dissolved Oxygen	No less than 6 mg/L; if the DO is already below 6 mg/L, then the project shall not cause DO to decrease by 0.2 mg/L	WAC 173-201A	Compliance boundary
	No less than 4 mg/L	Acute effects	"Early warning" location
Turbidity	No greater than 5 NTU over background when background is 50 NTUs or less; no greater than 10% increase when background is < 50 NTUs	WAC 173-201A	Compliance boundary
Temperature	<16°C; and no incremental increase >0.3°C allowed when background temperature naturally exceeds 16°C	WAC 173-201A	Compliance boundary
Total Suspended Solids	For informational purposes (no criteria available)	-	-
Sheens	No visible sheens allowed outside the work area. Sheens shall be contained with booms or other appropriate controls.	WAC 173-201A	All surface water outside of containment booms

Notes:
°C - degrees Celsius
DO - dissolved oxygen
mg/L - milligram per liter
NTU - Nephelometric turbidity unit
WAC - Washington Administrative Code

Table 3-3
Water Quality Monitoring Schedule

Monitoring	Schedule	Initiation Conditions for Schedule
Ambient	• Background collected 24 to 48 hours prior to initiation of construction • Reference (outside of the influence of activity) collected with all other water quality monitoring events	• Background: on-site measurements prior to any in-water construction activity • Reference: in conjunction with all other water quality monitoring events (intensive, routine, or limited)
Intensive	• Minimum twice daily for 2 days following any initiation condition for intensive monitoring	• Startup of any in-water construction activity • In response to any major modification to construction procedures • In response to an exceedance of any water quality performance criteria at the compliance boundary
Routine	• Once daily	• No performance criteria are exceeded at the compliance boundary during intensive monitoring for 2 days; requires CO approval
Limited	• Once daily	• No performance criteria are exceeded at the compliance boundary during routine monitoring for 1 week; requires CO approval

Note:
CO - contracting officer

Table 3-4
Allowable Lift Thicknesses and Consolidation Periods for Cap Placement

Remediation Area	Lift Number	Maximum Allowable Thickness of Cap Lift (ft)[a]	Maximum Allowable Placement Rate (ton/acre)[b]	Required Consolidation Period
1	1	1	--	Allow 48 hours consolidation between lifts[c]
	2	2	--	
	3,4,5	3	--	
2a, 2b, 3	1	1	2100	Allow 48 hours consolidation between lifts[c]
	2	2	4200	
	3,4	2	4200	
4	1	0.5	1200	Allow 48 hours consolidation between lifts[c]
	2	0.75	1800	
	3,4	1.75	4000	
5	Multiple lifts to complete volume in target areas	Minimum cap thickness of 27 inches.	First placement event at each target not to exceed 1 barge of material.	Allow 2 weeks consolidation prior to verification sampling

[a] Maximum allowable thicknesses are based on bearing capacity analyses. In RA1, Contractor shall not place individual lifts in greater thicknesses than those shown in this column.
[b] In RA2a, RA2b, RA3, and RA4, Contractor shall place cap material at rates not to exceed those shown in this column.
[c] Consolidation period does not apply to placement of riprap and filter material on armored slopes.

Notes:
-- Not applicable
ft - feet

Table 3-5
Cap Verification Sampling Requirements

RA	Event	Sample Type[a]	Analysis[b]	No. of Cores[c]	No. of Samples Analyzed
1 (gravel cap areas only)	First sand cap mix lift	Core	Visual inspection for intermixing with native sediments	10	0
	Final sand cap mix lift	Core	Chemical analysis (0 to 4 inches)	10	10
2a	First lift	Core	Visual inspection for intermixing with native sediments	5	0
	Final sand cap mix lift	Core	Chemical analysis (0 to 4 inches)	5	5
	Final cap surface and profile	Core	Chemical analysis at surface (0 to 4 inches)	5	5
2b	First lift	Core	Visual inspection for intermixing with native sediments	4	0
	Final cap surface and profile	Segmented core	Chemical analysis at surface (0 to 4 inches) and a 4-inch interval at the mid-point of the cap	4	8
3	First lift	Core	Visual inspection for intermixing with native sediments	2	0
	Final sand cap mix lift	Core	Chemical analysis (0 to 4 inches)	2	2
4	Final cap surface and profile	Segmented core	Chemical analysis at surface (0 to 4 inches) and a 4-inch interval at the mid-point of the cap	15	30

[a] All cores shall penetrate a minimum of 12 inches into native material. All cores shall be relatively undisturbed samples. All cores shall be logged and evaluated for thickness of cap and individual layers.
[b] Chemical analysis includes COCs and TOC, reported in mg/kg dry weight. Reporting limit for TOC = 0.1%.
[c] See Drawings for sampling locations. Re-occupy first lift stations for collection of final cap samples.

Notes:
COC - chemical of concern
TOC - total organic carbon

Table 3-6
Cap Thickness Requirements

Remediation Area	Minimum Cap Thickness (inches)	Overplacement Allowance (inches)	Underplacement Tolerance (inches)
RA1	[a]	12	12[b]
RA2a	42	12	0
RA2b	30	12	0
RA3	42	12	0
RA4	30	12	0

[a] Grade final surface of RA1 to lines and grades shown on Drawings. Outer flank of toe berm may deviate from the lines and grades shown on the Drawings.
[b] Underplacement tolerance in RA1 is 12 inches at elevations below 0 ft MLLW. There is no underplacement tolerance above 0 ft MLLW.

Notes:
ft - feet
MLLW - mean lower low water

Table 3-7
Sediment Management Standards and Required Method Reporting Limits

Chemical Parameter	Required for Imported Materials	Required for Cap Verification	Sediment Management Standards SQS[f]	Dry Weight Analogs of SMS Criteria Dry Weight Equivalent[g]	Analytical Method	Method Reporting Limit
Metals			**mg/kg dry wt**	**mg/kg dry wt**		**mg/kg dry wt**
Arsenic	X		57	57	EPA Method 6000/7000	20
Cadmium	X		5.1	5.1	EPA Method 6000/7000	2
Chromium	X		260	260	EPA Method 6000/7000	20
Copper	X	X	390	390	EPA Method 6000/7000	20
Lead	X		450	450	EPA Method 6000/7000	20
Mercury	X	X	0.41	0.41	EPA Method 6000/7000	0.1
Silver	X		6.1	6.1	EPA Method 6000/7000	2
Zinc	X	X	410	410	EPA Method 6000/7000	20
Nonionizable Organic Compounds						
Polynuclear Aromatic Hydrocarbons			**mg/kg organic carbon[a,e]**	**µg/kg dry wt[a]**		**µg/kg dry wt[a]**
Total LPAH[b]	X	X	370	5200	EPA Method 8270	10
Naphthalene	X	X	99	4100	EPA Method 8270	10
Acenaphthlyene	X	X	66	1300	EPA Method 8270	10
Acenaphthene	X	X	16	500	EPA Method 8270	10
Fluorene	X	X	23	540	EPA Method 8270	10
Phenanthrene	X	X	100	1500	EPA Method 8270	10
Anthracene	X	X	220	960	EPA Method 8270	10
2-Methylnaphthalene	X	X	38	670	EPA Method 8270	10
Total HPAH[c]	X	X	960	12000	EPA Method 8270	10
Fluoranthene	X	X	160	1700	EPA Method 8270	10
Pyrene	X	X	1000	2600	EPA Method 8270	10

Table 3-7 (Continued)
Sediment Management Standards and Required Method Reporting Limits

Chemical Parameter	Required for Imported Materials	Required for Cap Verification	Sediment Management Standards SQS[f]	Dry Weight Analogs of SMS Criteria Dry Weight Equivalent[g]	Analytical Method	Method Reporting Limit
Benz(a)anthracene	X	X	110	1300	EPA Method 8270	10
Chrysene	X	X	110	1400	EPA Method 8270	10
Total benzofluoranthenes[d]	X	X	230	3200	EPA Method 8270	10
Benzo(a)pyrene	X	X	99	1600	EPA Method 8270	10
Indeno(1,2,3-c,d)pyrene	X	X	34	600	EPA Method 8270	10
Debenz(a,h)anthracene	X	X	12	230	EPA Method 8270	10
Benzo(g,h,i)perylene	X	X	31	670	EPA Method 8270	10
Cholorinated Benzenes			**mg/kg organic carbon[a,e]**	**µg/kg dry wt[a]**		**µg/kg dry wt[a]**
1,2-Dichlorobenzene	X		2.3	35	EPA Method 8270	10
1,3-Dichlorobenzene	X		--	--	EPA Method 8270	10
1,4-Dichlorobenzene	X		3.1	110	EPA Method 8270	10
1,2,4-Trichlorobenzene	X		0.81	31	EPA Method 8270	10
Hexachlorobenzene	X		0.38	22	EPA Method 8270	10
Phthalate Esters						
Dimenthyl phthalate	X		53	71	EPA Method 8270	10
Diethyl phthalate	X		61	20	EPA Method 8270	10
Di-n-butyl phthalate	X		220	1400	EPA Method 8270	10
Butyl benzyl phthalate	X		4.9	63	EPA Method 8270	10
Bis(2-ethylhexyl)phthalate	X		47	1300	EPA Method 8270	10
Di-n-octyl phthalate	X		58	6200	EPA Method 8270	10
Miscellaneous						
Dibenzofuran	X	X	15	540	EPA Method 8270	10

Table 3-7 (Continued)
Sediment Management Standards and Required Method Reporting Limits

Chemical Parameter	Required for Imported Materials	Required for Cap Verification	Sediment Management Standards	Dry Weight Analogs of SMS Criteria	Analytical Method	Method Reporting Limit
			SQS[f]	Dry Weight Equivalent[g]		
Hexachlorobutadiene	X		3.9	11	EPA Method 8270	10
N-nitrosodiphenylamine	X		11	28	EPA Method 8270	10
Pesticides/PCBs						
PCBs	X	X	12	130	EPA Method 8082	10
Ionizable Organic Compounds			**µg/kg dry wt**	**µg/kg dry wt**		**µg/kg dry wt[a]**
Phenol	X	X	420	420	EPA Method 8270	10
2-Methylphenol	X	X	63	63	EPA Method 8270	10
4-Methylphenol	X	X	670	670	EPA Method 8270	10
2,4-Dimethylphenol	X	X	29	29	EPA Method 8270	10
Pentachlorophenol	X	X	360	360	EPA Method 8270	10
Benzyl alcohol	X		57	57	EPA Method 8270	10
Benzoic acid	X		650	650	EPA Method 8270	10
Conventional Parameters						**Percent dry wt**
Total Organic Carbon	X	X			EPA Method 9060/PSEP	10 %

[a] Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied: (i) Where chemical analyses identify an undetected value for every individual compound/isomer, then the single highest detection limit shall represent the sum of the respective compounds/isomers; and (ii) Where chemical analyses detect one or more individual compounds/isomers, only the detected concentrations will be added to represent the group sum.

[b] The total LPAH criterion represents the sum of the following low molecular weight polynuclear aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorine, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH definition. The LPAH criterion is not the sum of criteria values for the individual LPAH compounds listed.

Table 3-7 (Continued)
Sediment Management Standards and Required Method Reporting Limits

[c] The total HPAH criterion represents the sum of the following high molecular weight polynuclear aromatic compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, debenz(a,h)anthracene, and benzo(g,h,i)perylene. The HPAH criterion is not the sum of criteria values for the individual HPAH compounds listed.
[d] The total benzofluoranthenes criteria are compared to the sums of the concentrations of the b, j, and k isomers of benzofluoranthene.
[e] The listed values represent concentrations in parts per million "normalized" on a total organic carbon (TOC) basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.
[f] Use values in this column when sample TOC ≥0.5% and ≤4%.
[g] Use values in this column when sample TOC < 0.5% and > 4%.

Notes:.
HPAHs - high molecular weight polynuclear aromatic hydrocarbons
LPAHs - low molecular weight polynuclear aromatic hydrocarbons
PCB - polychlorinated biphenyl
SMS - sediment management system
SQS - sediment quality standard
TOC - total organic carbon
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

4.0 CHRONOLOGY OF EVENTS

A chronology of PSR site events is listed in the table below.

Date	Event
September 30, 1999	PSR ROD signed
February 3, 2003	PSR Remedial Design completed
March 3, 2003	RFP Issued
June 2, 2003	Contract Award/Notice to Proceed (NTP)
9/2003 - 2/2004	Construction Underway RAs 1-3
9/2004 - 2/2005	Construction Underway RAs 4-5
February 2005	Construction Complete for entire site
RA-1 Remediation	
9/2003 - 2/2004	Construction Underway
August 27, 2003	Thick slope cap modification requested [RFI-007C]
September 17, 2003	Alternate cap placement requested [RFI-010C]
October 3, 2003	Dredging and disposal complete
	Shoreline restoration complete
	Longfellow Creek Overflow outfall extension complete
	Cap verification sampling and analysis complete
RA-2a Remediation	
November 17, 2003	Value Engineering Change Proposal [VECP-002] Accepted
9/2003 - 2/2004	Construction Underway
	Cap verification sampling and analysis complete
	Hydrographic survey complete
RA-2b Remediation	
November 17, 2003	Value Engineering Change Proposal [VECP-002] Accepted
9/2003 - 2/2004	Construction Underway
	Cap verification sampling and analysis complete
	Hydrographic survey complete
RA-3 Remediation	
November 17, 2003	Value Engineering Change Proposal [VECP-002] Accepted
9/2003 - 2/2004	Construction Underway
	Cap verification sampling and analysis completed
	Hydrographic survey completed
RA-4 Remediation	
September 22, 2004	Value Engineering Change Proposal [VECP-003] Accepted
9/2004 - 11/2004	Construction Underway
January 26, 2004	Duwamish Dredging NTP
	Cap verification sampling and analysis completed
	Hydrographic survey complete

Date	Event
RA-5 Remediation	
	Snohomish River Dredging NTP
1/2005 - 2/2005	Construction Underway
February 14, 2005	Cap material placement complete
	Cap verification sampling and analysis complete
	Hydrographic survey complete
Post Construction Events	
	No anchor zone on record with USCG

Notes:
NTP - notice to proceed
PSR - Pacific Sound Resources
RFI - request for information
ROD - record of decision
USCG - U.S. Coast Guard
VECP - value engineering change proposal

5.0 SUMMARY OF CONSTRUCTION AND MONITORING RESULTS

5.1 RAs 1-4

The sediment cap in RAs 1-4 is considered to have achieved construction completion. The cap was placed in accordance with the design, as modified during construction, in RAs 1-4. Design modifications included reduced cap thickness in RA2a (see Section 3.9.4) and changes in cap material specifications (see Sections 3.9.1, 3.9.5, and 3.9.6). The as-placed cap thickness was within the target thickness range in each RA, except for approximately 0.5 percent of the area in RA4. These areas should be targeted for biased sampling during the next monitoring event to assure that surface sediment chemistry meets criteria. In RAs 1-3, all cap verification chemical results were within criteria. In RA4, all cap verification chemical results were within criteria with the exception of two compounds in one sample (VS-35). In addition, three samples exhibited a sheen in the grab sample: VS-31, 33, and 35. These areas should be targeted for biased sampling during the next monitoring event to identify whether surface sediments meet or exceed sediment criteria.

5.2 RA5

The ROD (USEPA 1999) identified the following remedial action objectives for cleanup in the MSU:

- Minimize human exposure through seafood consumption
- Minimize benthic community exposure to site contaminants

Attainment of these overall objectives, as specified in the ROD, was measured by compliance with the Washington State Sediment Management Standards (SMS) (WAC 173-204). Although the as-designed cap thickness was not achieved throughout RA5, sediment surface chemical concentrations meet the SMS criteria with significantly reduced human health and environmental exposure. Therefore, this site is considered to have achieved construction completion. A comparison of concentrations of PAHs and PCBs in surface (0 to 10 cm) sediment in RA5a before and after capping is presented in Table 5-1. These data indicate that average concentrations of PCBs in surface sediment were reduced by about 2 orders of magnitude (99 percent) as a result of cap construction, and average concentrations of PCBs were reduced by about 70 percent as a result of cap construction.

The OMMP, which is summarized in Section 6, describes future physical, chemical, and biological monitoring required under CERCLA. Based on as-constructed monitoring results, the OMMP schedule may require revision to more frequent monitoring or to begin the long-term monitoring sooner than initially scheduled. The first standard (5-year) monitoring event was initially set to be performed early in the 2007-2008 season to make data available for the first 5-year review in 2009. To assure that human health and environmental risk remains low (i.e., chemical isolation is intact) during the first 5 years, an initial round of monitoring may be initiated earlier than 2007-2008.

Table 5-1
Comparison of Contaminant Concentrations in Surface Sediment in RA5a Before and After Capping

Contaminant	SQS	Before Capping[1]				After Capping[2]			
		Number of Samples	Minimum	Maximum	Average	Number of Samples	Minimum	Maximum	Average[3]
Total LPAHs	370	13	298	2,004	981	11	0.9	19.2	6.6
Total HPAHs	960	13	417	8,489	1,639	11	3.9	59.0	20.4
Total PCBs	12	6	6.4	10.3	7.7	11	0.2	18.9	2.2

All contaminant concentartions are in units of milligram per kilogram of organic carbon
[1]Source: Roy F. Weston, Inc. 1998. Remedial Investigation Report. Pacific Sound Resources, Marine Sediments Unit.
[2]Source: Anchor Environmental. 2005. Data Report. Construction Monitoring of RA5 Marine Sediments Unit. Pacific Sound Resources Superfund Site.
[3]For non-detects, a value of one-half the detection limit was used to calculate the average.

6.0 OPERATION AND MAINTENANCE

The PSR OMMP covers long-term monitoring for a 10-year period (or longer) beginning with the 2003-2004 construction season (USACE 2003). The purpose of long-term monitoring is to assess and document the efficacy of the remedial actions. Information from long term monitoring will be used in development of statutory (CERCLA) 5-year reviews and as a basis for transition of long term O&M to Ecology. Whenever contamination exceeding acceptable risk levels remains on site, CERCLA requires that a review for ongoing protectiveness be completed at least every 5 years. The ROD indicates that initiation of the remedy (which started in 2003) is the start of the clock for the 5-year review.

Monitoring covered in the OMMP evaluates:

- Physical stability of the completed sediment cap
- Physical and chemical isolation of contaminants from the biologically active zone (0 to 10 cm)

6.1 MONITORING SCHEDULE

The initial monitoring schedule is presented in Table 6-1. EPA and/or Ecology will refine the monitoring program after 10 years. This schedule is based on completion of RA1 in the first construction season (2003-2004), completion of RA2, RA3, RA4, and RA5 in the second construction season (2004-2005). Construction was initiated in 2003-2004; therefore, the first standard (5-year) monitoring event will be performed early in the 2007-2008 season to make data available for the first 5-year review in 2009.

The as-built cap multi-beam bathymetric surveys performed by the contractor after completion of RAs 1-4 are being used as the as-built baseline for physical monitoring in the subtidal areas. Chemical monitoring performed at the completion of the construction of RAs 1-4 is being used as the chemical as-built baseline. Bathymetric surveys cannot be reliably used in RA5 due to error related to water depth.

The second round of sampling to test for chemicals of concern in RA5 will occur at the first standard monitoring event in 2008 (described below). These data will be compared to the post-construction monitoring data to determine whether chemical concentrations that affect human health and environmental risk have changed during that time. Selected sampling of incidental off-site capping from dredged material placement in RA5 will be performed at the 2007-2008 monitoring event. The next standard monitoring event is scheduled in 2012-2013. The 2012-13 event will provide data for the second 5-year review.

6.1.1 Physical Monitoring

The principal measure of cap stability will be sequential measurements of cap elevation or thickness, including a baseline measurement that will be made following completion of material placement in each RA. Cap thickness will be determined by three methods for the subtidal area: precision multibeam bathymetry, through-cap coring (cap thicknesses greater than 8 inches), and sediment vertical profiling system (SVPS) (cap thicknesses less than 8 inches during construction in RA5 and off site following completion of the entire cap). An additional method (sub-bottom sonar profiling) has been included in the program as a possible cost-effective contingency. Visual inspection and photography at set points on the beach combined with topography will be used to identify significant changes in cap thickness in the intertidal zone.

Due to limitations on precision at depths, bathymetry will be most useful in RAs where the sediment surfaces are generally less than -100 feet MLLW. This includes RA1, RA2, RA3, and the shallower portion of RA4. For the portions of RA4 and RA5 with water depths greater than –100 feet MLLW, through-cap coring is planned as the primary means for verifying cap thickness, with SVPS primarily used for determining the extent of the spread of the deposited dredge material. However, bathymetry will be performed throughout the RA4 area. The results for water depths between –100 feet and –140 feet MLLW will be used to distinguish large features, such as slope failures. Also, if the precision errors of bathymetry at the time of the survey allow reliable depth calculations for water depths greater than –100 ft MLLW, bathymetry may be substituted for through-cap coring throughout the RA4 area. Sub-bottom profiling may also be attempted if coring and/or SPVS prove unsatisfactory; but this method is considered secondary because of difficulties in its use at a similar creosote contaminated site.

Through-cap cores will be the primary method to determine cap thickness in RAs 4 and 5 where the water depths are deeper than -100 feet MLLW. Conventional boring techniques, vibracore samplers, and a variety of gravity coring devices may be suitable. However, site-specific factors such as the layering of the deposit (e.g., sand cap over relatively soft material), cap material properties, and the capability of a coring technique to collect samples from such deposits should be considered when selecting a coring technique. Cores will be inspected to determine the thickness of cap. All cores will be photographed, measured, and logged. Samples may be archived for future chemical sampling.

Beach walks will be performed annually at tides of –1.5 feet MLLW for the entire length of the accessible beach to provide the following information:

- Logged visual observations of material accretions or erosion, and notes of any debris that might over time cause excessive erosion in specific areas

- Photographs taken from fixed points of reference at least every 200 linear feet, and of any additional features that would indicate significant changes to the beach. In the event of major cap thickness changes, the photographs will be used with the topographic surveys to help ascertain the cause of the cap changes.

- Record of distressed or dead biota

- Special beach inspections if seismic events occur

An initial post-construction beach inspection will occur along with the baseline topographic survey and annually thereafter. Beach inspections may also be scheduled following any major physical events such as large or unusual storms.

6.1.2 Chemical Monitoring

Most surface sediment samples will be taken with grab samplers. Sediment grab samples will be collected from the biologically active zone (0 to 10 cm). For the samples collected on RA5 in the first construction season, only TOC will be determined. If the TOC values are greater than 1 percent, no further determination of the RA5 cap TOC will be performed. If TOC values are below 1 percent, a management decision will be made to conduct further sampling or to alter the dredge selection and/or placement procedures. For the samples collected during the standard monitoring events and any expanded sampling, surface sediments will be chemically analyzed and compared to SQS values. At the first 5-year review, it may be possible to reduce the list of chemical parameters shown in Table 6-2. If the concentrations are above SQS but below CSL, biological tests may be performed to determine whether biological SQS requirements are satisfied. This evaluation will determine whether the cap has provided physical and chemical isolation of contaminants.

"Conventional" parameters are required to provide information to aid in interpreting chemical and biological tests. Sediment conventional parameters measured to support biological analysis include:

- Total volatile solids (TVS)
- Grain size
- TOC
- Percent solids (total solids)
- Total sulfides
- Ammonia.

As stated above, the list of analytes for full characterization of the capped area is subject to reduction in several parameters based on results of the construction and OMMP monitoring.

- EPA SW-846 Method 8082 (PCBs). Method 8082 will be used to measure total PCBs, with Method 3510C used to prepare extracts, followed by analysis by a gas chromatograph (GC) equipped with a dual electron capture detector (ECD).

- Method 8270c (SVOCs). Method 8270c will be used to analyze all the organics other than PCBs, with Method 3550b used to prepare extracts.

- Method 6010C/7470A (Metals). Method 6010C (inductively coupled plasma) will be used to measure arsenic, cadmium, chromium, copper, lead, and zinc. Method 7470A (cold vapor atomic absorption) will be used to analyze mercury.

- Ammonia analysis should be conducted according to standard EPA/USACE procedures (Plumb 1981).

- Analysis of total solids, TVS and total sulfides will follow the *Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound* (PSEP 1986).

- SW-846 Method 9060 shall be used provides for more sensitive measurement of TOC concentrations in sediment than the PSEP method. In running the analysis, the corresponding total solids analysis should be run twice, once at 70 degrees C and once at 104 degrees C, and the TOC calculation based on dry weight at 104 degrees C.

- Grain size will be determined using PSEP (1987). The following sieve series will be used: numbers 4, 10, 18, 35, 60, 120, and 230. The fine-grained fraction must be classified by phi size (+5, +6, +7, +8, and >8).

- At a minimum, the laboratory should meet the requirements specified by Ecology for both chemical and biological testing. These requirements can be found on Ecology's web-site at http://www.ecy.wa.gov/programs/tcp/smu/sapa/ch7.doc.

6.1.3 Biological Monitoring

Bioassay tests are a contingent test; that is, EPA and Ecology coordination will occur before applying it. Should chemistry levels fall between SQS and CSL in the grab samples, biological testing is recommended to confirm whether a biological effect is realized. Above the CSL, bioassays will not be performed. Bioassay testing references the *Puget Sound Protocols and*

Guidelines (PSEP 1995) and the Dredged Material Management Office homepage: http://www.nws.usace.army.mil under "Dredged Material Management" for bioassay testing references.

The standard suite of bioassays may be triggered by meeting or exceeding one or more SQS in surface sediments during monitoring. Bioassays need to be performed within Maximum Holding Times (40 days from collection). The list of standard bioassays and benthic community measures are detailed in the OMMP.

6.2 RA1 INTERTIDAL

6.2.1 Physical Monitoring

The topographic survey was taken on transects located 100 feet apart. The transects originate at the shoreline and extend into Elliott Bay through the intertidal zone to approximately –1.5 feet MLLW, or deeper if possible by wading. Photographs will be taken from the waterline at a known elevation while looking up the beach. Multibeam bathymetry may be accomplished in water to about –1.5 feet MLLW when accomplished on a high tide. The baseline shoreline topography is shown in Figure 6-1.

6.2.2 Chemical/Biological Monitoring

No chemical/biological monitoring is planned for the intertidal area because the gravel layer of the intertidal cap is too coarse for chemical and biological testing. However, if fine material is present on the intertidal cap, sample(s) may be collected.

6.3 RAs 1-5 SUBTIDAL AREAS

6.3.1 Physical Monitoring

Multibeam bathymetry from the construction of RA1 through RA5 will be used as a baseline for bottom elevations; subsequent multibeam surveys taken during the O&M monitoring will compare to the baseline to determine cap thickness changes. The results will be used to map the post-construction cap changes. Multibeam surveys will be conducted using a small research vessel capable of operating in water depths of 5 feet or shallower. The following activities are included:

- Survey planning, delivery and mobilization of equipment
- Conduct acoustic surveys on cap as required
- Installation of recording tide gage if not already established

- Post-processing and QC of collected acoustic data

Through-cap cores will be used for cap thickness determination for depths below 100 feet, and multibeam bathymetry will confirm area trends to 140 feet below MLLW. The objectives for coring are a) penetration through the cap into the sediment below, and b) the ability to visually distinguish the old sediment from the cap.

Figure 6-1 provides the baseline bathymetry for RAs 1-4.

6.3.2 Chemical/Biological Monitoring

No baseline chemical monitoring will occur in RA5. Chemical monitoring of RA 5 will occur at the 5-year standard monitoring event. Per Table 6-1, the baseline monitoring event performed after the completion of the RAs will sample and analyze for the compounds listed as compounds of concern in Table 6-2, with the exception of dioxins and furans (PCDD/F). PCDD/F are not included in the SQS for ecological effects. The ROD indicated that both PCB and PCDD/F are compounds of concern for human health but did not develop a specific human-health protection cleanup goal for PCDD/F. Instead, the ROD references the area mean background concentration of 1.052 nanograms per kilogram (ng/kg) Toxic Equivalent (TEQ) (dry weight) for PCDD/F. Existing information on concentrations in the Duwamish River suggests that the river sediments are in the low ng/kg TEQ. Accordingly, PCDD/F should not be much different from area background, and is not proposed for analysis.

Reduction of analytes may be considered based on the contaminant detection frequencies and concentration levels during construction and post-construction monitoring. The baseline chemical monitoring data for RAs 1-4 and RA5 are presented in Appendix D and Appendix E, respectively.

6.4 LONGFELLOW CREEK OUTFALL RELOCATION

6.4.1 Physical Monitoring

Multibeam bathymetry will be accomplished. Figure 6-1 provides the baseline survey for the RA areas.

6.4.2 Chemical/Biological Monitoring

This area will be tested as detailed for all RA areas (refer to Section 6.3.2). This information, along with comparison of the results from each location to SQS, will be used to determine whether the outfall may be contributing contamination to the sediment. The baseline chemical monitoring data are presented in Appendix D.

6.5 OFFSITE INCIDENTAL CAPPING AREA

It is expected that some of the RA5 dredged material that is placed will form an incidental cap outside the actual site boundaries.

6.5.1 Physical Monitoring

After completion and verification of the laying of the desired dredge cap thickness throughout RA5, physical monitoring of the adjacent areas will be conducted through a sediment vertical profiling system (SVPS) centered on a distance of 300 feet to the east and west and 800 feet to the north from the boundary of the capped area (these distances may be altered depending on SVPS measurement of the actual lateral spread of the off-site cap). There is no associated performance standard for this monitoring, but it will demonstrate the spread of cap material to these adjacent areas. The area within the designed cap boundaries will not be sampled by SVPS, which does not have enough penetration to provide useful information there. Figure 6-1 provides the baseline survey for the RA areas.

6.5.2 Chemical Monitoring

The objective of the off-site chemical sampling is to determine whether the incidental capping has resulted in surface concentrations below the SQS. After completion of the RA5 cap, seven surface grab samples in grids approximately 300 feet outside of the site boundary were collected and analyzed to determine the sediment chemistry outside the design cap area. There is no associated performance standard, but this monitoring will demonstrate whether incidental capping succeeded in reducing values of PAHs above the SQS to below SQS. The baseline chemical monitoring data are presented in Appendix E.

6.6 REPORTING

A Field Report and a Monitoring Report will be prepared for each year in which monitoring is conducted.

6.6.1 Field Sampling Report

A Field Sampling Report will be submitted by the contractor to the Monitoring Task Manager for review after each year's monitoring cruise. This report will be reviewed by the Monitoring Task Manager, the EPA Remedial Program Manager, and other interested agencies, as determined by the EPA. The contractor will revise the Field Sampling Report to incorporate comments from this review. The Field Sampling Report will describe actual field logistics and schedule, procedures and methods, sampling locations, and deviations from the SAP. It will include the field log, notes, and sample logs. The Field Sampling Report will include the following sections:

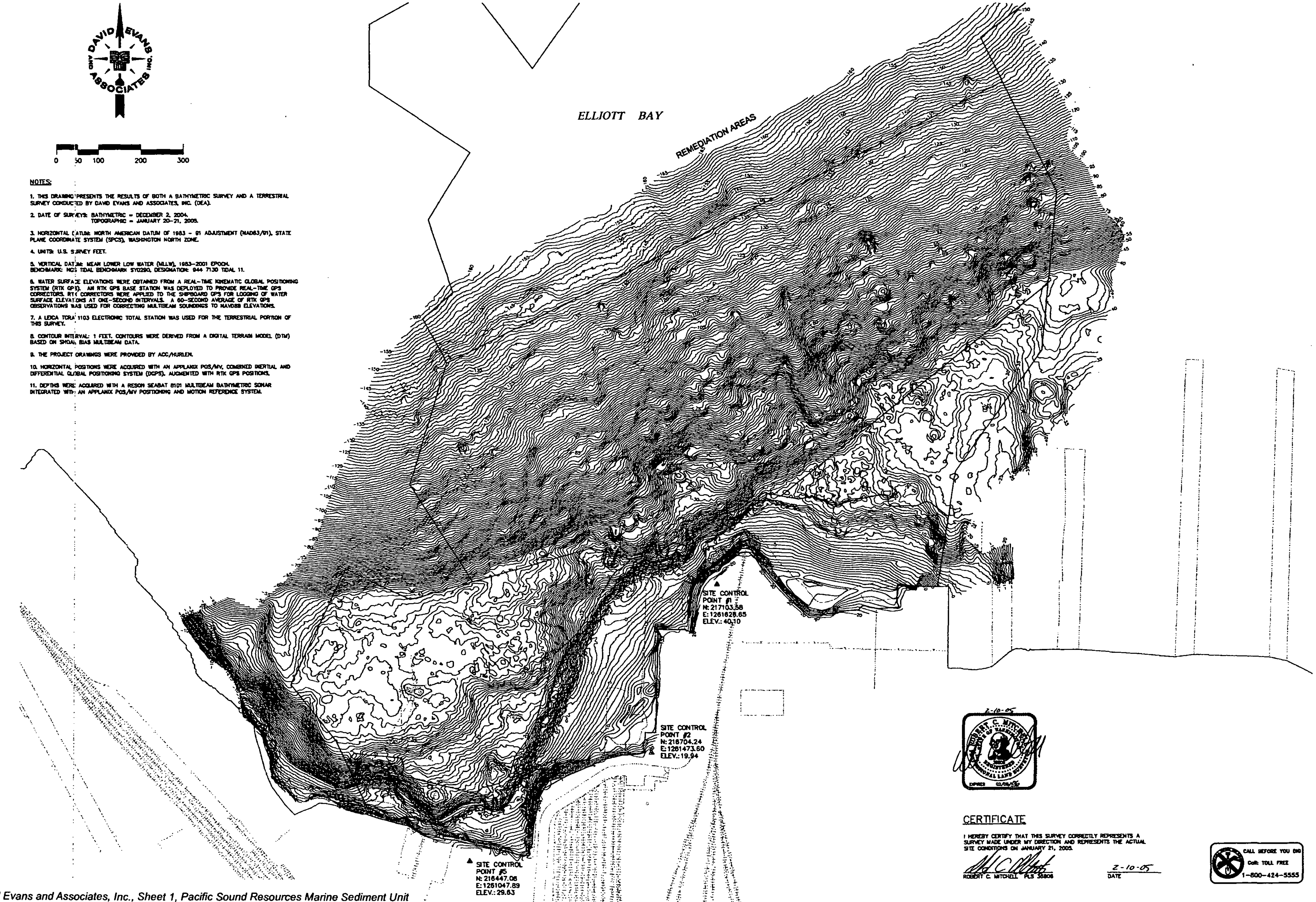
- Cruise Objectives
- Chronology of Field Operations
- Field Sampling Methods
- Deviations from the SAP
- Summary of Data Collected
- Schedule of Analyses and Reporting
- Appendices
  - Sampling Coordinates
  - Field Log Notes
  - Sample Logs
  - Station Logs

6.6.2 Monitoring Report

Each Monitoring Report will address monitoring conducted during the year of the report. The Monitoring Report will be submitted by the contractor to the Monitoring Task Manager after receipt of validated analytical results. This report will be reviewed by the Monitoring Task Manager, the Remedial Program Manager (EPA), and other interested agencies. The contractor will revise the Monitoring Report to incorporate the comments from this review. The Monitoring Report will describe the site; monitoring objectives; field, laboratory, and data analysis methods; present analytical results in organized data table and figures (as appropriate); describe trends if any are apparent; present conclusions about environmental conditions in the MSU as determined by monitoring; and make any appropriate recommendations for revisions to the monitoring program. The Monitoring Report will include the following sections:

- Site Description and Background
- Monitoring Objectives
- Methods and Results (for each monitoring type)
  - Sampling Locations and Methods
  - Analytical Methods
  - QA/QC Summary
  - Results
- Summary of Conditions in the MSU

- Comparison of Results to Expectations
- Recommended Revisions to Monitoring
- References
- Appendices.



SOURCE: David Evans and Associates, Inc., Sheet 1, Pacific Sound Resources Marine Sediment Unit

Figure 6-1
Baseline Survey for RAs 1-4

Table 6-1
Monitoring Schedule

RA Area	Construction Monitoring[a]	Intertidal Inspection	Standard Monitoring[b]
1	Baseline[c]	Annually [d]	2007/8[c] and 2012/13 [c]
2	Baseline	NA	2007/8 and 2012/13
Longfellow Creek Outfall	Baseline	NA	2007/8 and 2012/13
3	Baseline	NA	2007/8 and 2012/13
4	Baseline	NA	2007/8 and 2012/13
5	Baseline[e]	NA	2007/8[f] and 2012/13
Off-site Capping Area	NA	NA	2007/8

[a] Baseline monitoring includes physical (multibeam survey) and chemical events performed at the completion of each of the caps
[b] Standard monitoring includes physical (multibeam survey) and chemical events
[c] Monitoring of RA1 will not include chemical analyses [until fine sediments cover the gravel cap]
[d] Beach inspection to include topographic survey, visual observation, fixed location photographs - Beach inspections will also be performed after seismic and storm events
[e] Dredge material deposited in RA5 is below SQS, no baseline chemical event is scheduled
[f] RA5 monitoring to include off-cap vicinity at 5 year event (2007)

Table 6-2
SMS Chemical Guidelines

Chemical Group	Required for Cap Confirmation?	SQS	CSL	Lowest Apparent Effects Threshold[b]
Metals		(mg/kg dry weight)[a]		
Arsenic	No	57	93	57
Cadmium	No	5.1	6.7	5.1
Chromium	No	260	270	260
Copper	Yes	390	390	390
Lead	No	450	530	450
Mercury	Yes	0.41	0.59	0.41
Silver	No	6.1	6.1	
Zinc	Yes	410	960	410
Organic Compounds		(mg/kg organic carbon normalized)		mg/kg dry weight[a]
Total Low MW PAH	Yes	370	780	5.2
Naphthalene	Yes	99	170	2.1
Acenaphthylene	Yes	66	66	1.3
Acenaphthene	Yes	16	57	0.5
Fluorene	Yes	23	79	0.54
Phenanthrene	Yes	100	480	1.5
Anthracene	Yes	220	1,200	0.96
2-Methylnaphthalene	Yes	38	64	0.87
Total High MW PAH	Yes	960	5,300	12
Fluoranthene	Yes	160	1,200	1.7
Pyrene	Yes	1,000	1,400	2.6
Benz(a)anthracene	Yes	110	270	1.3
Chrysene	Yes	110	460	1.4
Total benzofluoranthenes	Yes	230	450	3.2
Benzo(a)pyrene	Yes	99	210	1.6
Indeno (1,2,3,-c,d) pyrene	Yes	34	88	0.6
Dibenzo (a,h) anthracene	Yes	12	33	0.23
Benzo(g,h,i)perylene	Yes	31	78	0.67
1,2-Dichlorobenzene	No	2.3	2.3	
1,4-Dichlorobenzene	No	3.1	9	
1,2,4-Trichlorobenzene	No	0.81	1.8	
Hexachlorobenzene	No	0.38	2.3	
Dimethyl phthalate	No	53	53	
Diethyl phthalate	No	61	110	
Di-n-butyl phthalate	No	220	1700	

Table 6-2 (Continued)
SMS Chemical Guidelines

Chemical Group	Required for Cap Confirmation?	SQS	CSL	Lowest Apparent Effects Threshold[b]
Butyl benzyl phthalate	No	4.9	64	
Bis (2-ethylhexyl) phthalate	No	47	78	
di-n-octyl phthalate	No	58	4500	
Dibenzofuran	**Yes**	15	58	0.54
Hexachlorobutadiene	No	3.9	6.2	
N-Nitrosodiphenylamine	No	11	11	
Total PCBs	**Yes**	12	65	0.13
Phenol	**Yes**	420	1200	0.42
2-Methylphenol	**Yes**	63	63	0.063
4-Methylphenol	**Yes**	670	670	0.67
2,4-Dimethyl phenol	**Yes**	29	29	0.029
Pentachlorophenol	**Yes**	360	690	0.36
Benzyl alcohol	No	57	73	
Benzoic acid	No	650	650	
Chlorinated dioxins, furans	**b**	NS	NS	NS

[a] Washington Department of Ecology typically uses dry-weight basis concentrations to determine compliance with Sediment Quality Standards outside of the range of 0.5-4% Total Organic Carbon.

[b] In the ROD, the risk assessment considered PCDD/F variations from an Elliott Bay-wide background for 2,3,7,8-tetrachloro-dibenzodioxin toxicity equivalents. The values are: 1.052 ng/kg dry weight and 122.34 ng/kg TOC normalized. It is not clear from the ROD if this is a remedial action objective.

7.0 SUMMARY OF PROJECT COST

The final cost for the Marine Sediments Unit was $17,150,000.

Design	**$2,000,000**
Construction	**$15,150,000**
RAs 1-4	$14,750,000
RA5	$400,000

The original cost estimate in the ROD was approximately $7,000,000 for the Marine Sediments Unit. Costs increased mainly because upland material was used to construct the cap in RAs 1-4. The cost estimate in the ROD was based on the use of dredged material, which is less expensive than upland material, for construction of the entire cap. The lack of availability of dredge material and the complex nature of RAs1-4, which comprise approximately 60 percent of the site, led to the choice of more expensive upland material for the cap construction for this highly engineered portion of the site (see previous sections of this report for a comprehensive description of RAs 1-4). The final cost of upland material was approximately $26 per cubic yard. Dredged material was used whenever possible, including small portions of RAs 2a and 2b and all of RA5. Dredged material had an average cost of $4 per cubic yard.

8.0 CONTACT INFORMATION

The following individuals and organizations may be contacted for further information:

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American Civil Constructors, West Co.
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Cherokee General Corporation
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Fairview, OR 97024
253-333-7393
Contract No. DACW67-03-D-1009

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Appendix A

Memorandum: Discussion of Modeling Results for TOC Requirements

Memorandum

To: Miriam Gilmer/Travis Shaw, USACE

From: David Schuchardt, URS

Date: May 6, 2004

Subject: PSR EDC, Seattle, WA
Contract No. DACA67-02-D-2003, Delivery Order No. 0017
URS Job No. 33756117.02010

Re: **Discussion of Modeling Results for TOC Requirements**

Summary

This memorandum documents chemical isolation modeling the we have conducted to re-examine the TOC requirements for sand cap mix (SCM) and Filter Material #2 (FM2) per Specification 02483. This effort is in response to the Memorandum for Record dated 15 October 2003. USACE previously indicated that a decision was required by 10/31/03 to direct the Contractor whether to order additional TOC amendment. Our preliminary results were transmitted to USACE on 10/31/03. The preliminary results have subsequently been subject to URS internal quality assurance and independent peer review by USACE. This memorandum finalizes the analysis, and the substantive conclusions remain unchanged.

The modeling indicates that the native TOC content of Glacier's SCM can provide adequate chemical isolation to meet the project objectives. Based on this modeling we recommend that no additional TOC amendment be purchased.

Background

The Final Design and specifications for TOC content were based on the chemical isolation modeling documented in Appendix B of the Final Design. A minimum TOC content of 0.5% was specified based on conservative modeling assumptions and conversations with potential materials suppliers including Glacier Northwest.

As noted on page B-15 of the Final Design, the model results were considered conservative primarily with regard to assumed biodegradation rates. Biological degradation of semivolatile organic contaminants in the cap is expected to occur, however the rates of biodegradation are considered uncertain and are site-specific. Absent site-specific information, the uncertainty was dealt with by assuming zero biodegradation. This led to the reliance (in the model) on sorption/retardation processes to achieve chemical isolation.

Based on our conversations with Glacier we anticipated that providing the 0.5% TOC content was feasible and the incremental cost was relatively small. Thus, the conservatism in the modeling did not lead to unacceptable costs.

For reasons documented in the 15 October 2003 Memorandum For Record, the product that was actually bid is an expensive, anthracite-amended product. While the amended product may provide adequate chemical isolation performance, the amendment approach and associated costs are not consistent with our communications with Glacier during the design. Our design intention was to specify products that can be sourced or blended locally, using readily-available, naturally-occurring materials. Therefore, it is necessary to re-evaluate TOC requirements using less conservative, yet defensible chemical isolation modeling.

Approach

The revised modeling uses the same, peer-reviewed model used in the Final Design. The goal is to evaluate whether the naturally-occurring TOC content of the un-amended products will be protective. The following modifications were made to the modeling assumptions:

1. Cap TOC content is assumed to be 0.033%, based on Glacier's TOC analysis (EPA method 9060) of the existing, un-amended SCM product (Mason 2003)

2. Biodegradation rates within the cap are taken from the literature (Mackay, et al. 1992, Howard et al. 1991). The lowest literature values for anaerobic groundwater are used.

3. Modeled sediment concentrations within the cap are compared to dry-weight SMS equivalents, which are based on LAET values. This is because carbon-normalization is not an appropriate predictor of adverse biological effects in the low-TOC regime within the cap.

4. Indicator chemicals selected in the Design are modeled (naphthalene, acenaphthene, dibenz(a,h)anthracene, fluoranthene, and dibenzofuran). Mercury was not modeled because the new TOC values would not change the previously modeled (and acceptable) results. PCB has been added as an indicator chemical because biodegradation cannot be assumed to be significant for PCBs.

5. Surface sediment concentrations are evaluated at the top of the cap, rather than at the top of the chemical isolation layer. In this evaluation, the short-term cap losses from consolidation are subtracted from the total cap thickness.

6. Organic-rich surface deposits that will build up on the cap surface are evaluated. Future chemical concentrations in these deposits are appropriately compared to the carbon-normalized

SQS values. Due to model limitations it is assumed that the chemical concentrations in these deposits are simply in equilibrium with underlying cap porewater concentrations. In reality, the concentrations in this biologically active zone should be less than this evaluation would indicate, due to surface water interactions (simple diffusion, enhanced biodiffusion, and mechanical mixing) and sediment deposition/resuspension/burial processes. More complex modeling would be required to account for these processes, and such modeling does not appear necessary.

Results

The modeling indicates that the native TOC content of the SCM can provide adequate chemical isolation to meet the project objectives. Within a several-hundred year timeframe, cap surface sediment concentrations are predicted to be below SQS/LAET values, and near-surface porewater concentrations are predicted to be below WQC. The earliest predicted exceedance of any chemical criterion occurs after 350 years, for Aroclor 1254 in porewater.

Table 1 summarizes key input parameters, and Table 2 summarizes the model results. Detailed model inputs and outputs are shown on the attached spreadsheets.

Based on this modeling, we recommend that no additional TOC amendment be purchased.

References:

Mason, Tom 2003: Personal Communication with David Schuchardt, URS, 10/27/2003

Howard, et al 1991. Handbook of Environmental Degradation Rates.

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Appendix B

Memorandum: Longfellow Creek Extension Issues

CENWS-EC-TB-ET 30 October 2003

MEMORANDUM FOR RECORD

SUBJECT: Pacific Sound Resources, Marine Sediment Unit, Remedial Action (Contract # DACW67-03-0012), Longfellow Creek Extension Issues

The constructability and design of the Longfellow Creek outfall extension work has been the focus of discussion between ACC/Hurlen, URS design engineers, Corps project and contract managers and EPA. This discussion began during an initial meeting held on Tuesday (9/30) and continued during the progress meetings in early October. Three primary issues have been raised by ACC/Hurlen regarding the outfall extension work. These three issues include:

1) ACC/Hurlen is concerned that the description of the work in the specifications will lead to an undermining of the foundation underlying the existing outfall section. Undermining of the foundation material would lead to the potential failure of the existing outfall section.

2) ACC/Hurlen is concerned that placement of the pipe sections as described in the specifications without anchors or fasteners will lead to the eventual separation of the joints. Separation of the joints could lead to infiltration of sand or other material and the creation of obstructions within the outfall pipe and increase future O&M costs.

3) ACC/Hurlen's initial survey indicates that one of the pilings on the dolphin closest to the end of the designed outfall extension intrudes into the alignment of the outfall dredge cut and may be only several feet from the actual pipe extension alignment.

At the conclusion of the 30 September meeting the following interim decisions were made:

1) URS will review the design assumptions and calculations used in developing the specifications. In addition, URS will contact the manufacturer and revisit the initial decision to not use anchors or fasteners. Originally, these features were left out of the design to allow the joints to deflect slightly when material is placed over the pipe during completion of the cap.

2) ACC/Hurlen will confirm the initial survey results to determine the extent of intrusion of the piling into the outfall alignment.

3) To avoid potential undermining of the existing outfall section, ACC/Hurlen will complete the dredge cut as designed to within 20 feet of the existing outfall section. The 20-foot section immediately adjacent to the end of the existing outfall pipe will be dredged to the bed elevation to avoid undermining the pipe until a final decision is made on how to proceed.

Alternatives Discussed:

Possible alternatives were presented to resolve these issues:

1) Install the outfall as designed. This alternative assumes that the piling does not intrude into the alignment in a way that constitutes an obstruction.

2) Install the outfall as designed with the addition of anchors or fasteners. This alternative assumes that the URS review results in some uncertainty about the long-term integrity of the pipe joints.

3) Install the outfall as designed but remove the last section of the existing outfall. This alternative would reduce the risk of a failure of the existing outfall section. In addition, if the piling does create an obstruction, the piling could be avoided. This alternative would also require some field changes to ensure that the splash apron at the end of the outfall could be placed to protect the intruding piling during periods when the outfall is conveying high flows.

4) Eliminate the pipe extension entirely and replace the structure with an armored trench. This alternative may be more favorable if the pipe sections could be returned to the supplier for a credit. This may result in a substantial savings to the project in terms of material cost and installation time. The costs may be offset by some additional design cost to produce CADD drawings of the trench by URS.

Designer's Evaluation

After the initial round of discussions, the URS design team re-examined many of the original design assumptions for the outfall extension work and addressed the issues raised by ACC/Hurlen in a memo dated 6 October 2003. The contents of the URS designer's memo is provided below:

1. Existing Outfall Design – Pipe Joint Restraints: The design consists of extending the existing 84-inch outfall pipe with several additional segments of the same pipe type. URS was in contact with Hanson (the pipe supplier) during the development of the design and determined that pipe joint restraints were not required for this installation. This issue was re-evaluated again to address the Contractor's concerns, and the design team believes that joint restraints are not needed for this installation. URS contacted Clint Hall at Hanson during this re-evaluation and he concurred that joint pipe restraints are not requited for this installation.

2. Existing Outfall Design – Long-term Integrity: The design includes provisions to accommodate the anticipated settlement that may occur after installation. The design team considered the settlement that is likely to occur and believes that this settlement would remain within the allowable deflection at the pipe joints. To increase the pipe's ability to withstand these deflections, URS specified relatively short pipe segments shown on the plans. URS does not anticipate any long-term concerns with the integrity of the outfall extension, provided installation is in accordance with the plans and specs.

3. Existing Outfall Design – Dolphin Interference: Based on information provided by ACC/Hurlen, it appears that the northeast piling of the dolphin is driven (at a batter of 1H:2V) to within several feet of the pipe alignment, roughly at station 1+40 on transect 6+33.79. This dolphin presents difficulties in excavating the trench for pipe bedding. At the 10/2/03 project meeting we discussed that an acceptable way to deal with the interference would be to eliminate the last two pipe segments with appropriate minor adjustments to the revetment face and splash pad locations. URS recommends ACC/Hurlen confirm the station at which the piling crosses the pipe alignment. This could be handled as a field change – URS has not been directed to revise the drawings.

4. Evaluation of the "Trench" alternative. The outfall extension design was developed consistent with the following requirements and habitat goals:

- Provide a minimum 5-ft thick cap (ROD requirement)
- Maximize areas with critical habitat elevations (-4 to +4 feet MLLW)
- Avoid the use of riprap in intertidal elevations
- Provide a suitable substrate for salmonids (habitat mix, which requires a slope less than about 7:1 to stand by itself)

In general, the minimum 5-foot cap thickness can be met with the trench concept, using the existing dredge cut, with minor potential "thin areas" than could be resolved with limited additional dredging or other measures. The trench concept is not entirely consistent with the habitat objectives, and an area of roughly 0.1 acre would be converted to a steep (2H:1V) riprap trench with less favorable elevations (compared against the existing design). URS also has some concern that the trench may increase the potential for erosion of cap material in the adjacent "perched" areas, as the sediment transport dynamics could be affected by this discontinuity in the beach. As a result, the trench may increase the potential need for future corrective actions in this area (such as adding armoring or re-nourishing with habitat mix). Potential cost savings associated with concept should be discussed directly with ACC/Hurlen, to reflect a decreased effort by the Contractor and should be balanced against some additional design effort by URS.

Revised Alternatives:

Based on re-evaluation of the design assumptions in light of ACC/Hurlen's concerns, the original list of alternatives can be restated as follows:

Alternative #1: Build the outfall extension as specified. This is basically a no action (or more properly, no change) alternative. However, this alternative does not address ACC/Hurlen's concerns regarding complications that may arise during installation including difficulty maintaining joint integrity during installation without the use of fasteners. In addition, the piling from the dolphin near the end of the outfall extension does in fact intrude into the alignment of the dredge cut and appears to be very close to the designed pipe alignment. This intrusion may further complicate the installation of the pipe and would complicate any future maintenance of either the dolphin or the outfall pipe. Lastly, during dredging of the outfall extension cut, the contractor encountered a series of tightly spaced un-treated wood pilings. The pilings within the dredge cut were removed during the dredging, however, it is possible that addition pilings are present along the pipe alignment or that the removal of the pilings during dredging may have impacted the stability of the sediments that will need to support the mass of the installed pipe.

Cost and Schedule Impacts: Directing ACC/Hurlen to install the outfall extension as specified is covered under the existing award for a cost of $140,000 as a lump sum. However, the existence of the untreated wood pilings constitutes a Differing Site Condition that may result in a claim from the contractor if the presence of the pilings does impact the installation of the pipe. In addition, there is some risk of a claim if the foundation of the existing outfall pipe section is undermined or fails during installation of the outfall extension.

Alternative #2: Build the outfall extension largely as designed but remove the last section of the existing outfall and connect the new outfall section further shoreward. This alternative would reduce ACC/Hurlen's concerns about the potential failure of the existing outfall pipe section and would reduce the overall length of the outfall extension. Shortening the length of the extension would also allow ACC/Hurlen to avoid placing the new pipe section too close to the intruding dolphin piling.

Cost and Schedule Impacts: Similar to Alternative #1, the cost of this option is largely already covered under to lump sum bid for the outfall extension. There may be some minor additional cost for removal of the existing pipe section. However, the removal of this section up-front does eliminate some of the risk associated with possible undermining of the foundation at the connection of the existing pipe and the new pipe sections. This alternative does not reduce the risk of a claim associated with the potential problems of foundation integrity caused by the newly discovered pilings.

Alternative #3: Elimination of the pipe extension entirely and installation of an armored trench. As noted above, this approach is not completely consistent with the design objectives of the project. While this alternative does allow for the placement of a 5 foot thick cap, it does increase the use of rip-rap in the intertidal zone and may create a discontinuity in the designed beach that may cause migration of habitat mix or gravel from adjacent areas of the cap. However, there may be design features that could be utilized to bring this alternative more in line with project objectives. Further evaluation with a hydraulic engineer may necessary to fully evaluate this alternative.

Cost and Schedule Impacts: Since this portion of the project is carried on the contractor schedule as a critical path item, there is little impact to overall schedule regardless of the decision on the final implementation of this alternative. Since the pipe has already been ordered and manufactured, there is a cost to the project of approximately $45,000 regardless of whether the pipe is installed or not. Since the dredging of the outfall alignment has already occurred and is covered under a separate bid item, the remainder of the bid item could potentially be credited to the government. There may be some additional cost to cover material needed to construct the trench and perhaps a larger splash apron. URS has estimated the level of effort required to design the trench and alter CADD drawing at approximately 40 hours. Consequently, the cost savings to the government for eliminating the installation of the pipe would be on the order of $85,000. This assumes that EPA and project stakeholders are not opposed to some change in project objectives that would allow the placement of the armored trench within the intertidal zone of the restored shoreline.

Appendix C

Memorandum: Response to VECP 003

Memorandum

To: Miriam Gilmer/Travis Shaw, USACE

From: David Schuchardt, URS

cc: Marty McCabe, URS

Date: September 9, 2004

Subject: PSR EDC, Seattle, WA
Contract No. DACA67-02-D-2003, Delivery Order No. 0017
URS Job No. 33756117.02060

Re: **Response to VECP 003**

URS has reviewed ACC Hurlen's Value Engineering Change Proposal #3, including revised specifications 01270 and 02483, and the Contractor Capping Plan dated 09/09/04. We have considered the technical merits and the USACE evaluation criteria, which is stated as follows:

> The objective of value engineering is good value. To achieve this objective, each component or item in a project must perform its basic function at minimum cost. Value Engineering Change Proposals (VECPs) must provide equivalent or superior project quality, reliability and life expectancy without increasing maintenance or operation costs.

TECHNICAL EVALUATION

Specific technical issues were evaluated as follows:

1. Long-term Slope Stability: The proposed material will provide equal or better long-term slope stability in RA4.

2. Slope Stability During Placement: VECP 003 proposes nominal lift thicknesses of 1 foot and 2 feet, which are thicker than originally designed for RA4. Placing thicker lifts may induce landsliding due to bearing capacity failures. However, this risk is mitigated by the placement method and sequencing, the coarser material being used in RA4, and the relative conservatism in the original design. We believe the proposed lift thicknesses are acceptable provided the placement is monitored intensively with bathymetric surveys. Should any evidence of sloughing be detected by the surveys, the lift thicknesses should be reduced. Also, large or sudden dumps of the barge pockets should be prohibited, to minimize the potential for triggering submarine landslides. USACE should closely monitor barge draft and positioning records to evaluate how evenly the material is being placed. If the Contractor has difficulty in achieving an even spread of material, USACE

should reduce the allowable lift thicknesses to the original design thicknesses. Finally, the consolidation periods specified in Table 02483-9 need to be observed, to allow strength gain in underlying sediments. This is not specifically addressed in the Contractor Capping Plan, and the sequencing shown on Figure 2 suggests the Contractor could have downtime to allow this consolidation.

3. Erosion Resistance: The material is expected to provide equal or better erosion resistance in RA4.

4. Chemical Isolation: The material is expected to provide equal or better long-term chemical isolation in RA4.

5. Habitat: The material proposed is considerably coarser than the specified Sand Cap Mix, and appears to be a crushed rock/soil mixture. The material will segregate as it descends through the water column. The degree of segregation is a function of the water depth (which varies from about 30 to 140 ft), the material type, and the specifics of the placement method. The material will be placed in at least 3 lifts, so the cap will have interbedded layers of coarser and finer materials. The final lift will have a surface layer of the finer material fractions, and it is this surficial material that may affect habitat quality.

   Examining the gradation range proposed in VECP 003 SECTION 02483, Table 02483-6a, and the two actual grain size analyses of Hurlen's proposed material, the fall velocities and settling times for the various fractions were estimated. It appears that approximately 8-20 percent of the material is sufficiently small (i.e., pasing a #40 sieve) that it can be expected to settle out after the coarser sands and gravels have deposited. If the final lift of capping material is 1-ft thick, then we can expect this material to deposit as a thick layer of sand, gravel, and cobbles, overlain by a 3-6 cm thick surface layer of medium sand, fine sand, and silt. This is an idealized analysis, and depends primarily on the material being well pluviated (i.e., individual particle settling). Hurlen's proposal indicates that they intend to create a consistent, even flow from partially-opened pocket doors, which should facilitate the pluviation. However, if the material descends in cohesive clumps then the segregation will not be as significant.

   Resource agencies should be consulted to determine if this material provides acceptable habitat.

6. Cap Thickness Verification Methods. SPI imaging will not work with this material and the SPI contract item should not be awarded. Grab samples will be substituted for coring.

Hydrographic surveys, along with placement quantity records, are the proposed thickness verification methods. This is acceptable if accuracy is accounted for (see below).

7. Cap Thickness Verification Accuracy: A minimum 30-inch-thick cap is required in RA4. Surveying/Bathymetry may not be accurate for two reasons 1) the increasing depth results in decreased accuracy of the method, 2) because the underlying sediments may consolidate by approximately 6-12 inches, a thicker cap may be required in order to show an apparent 30" cap thickness based on surveys alone. Using hydrographic surveys as the sole thickness verification method could therefore lead to an incorrect decision to apply more cap material at greater cost to the Government, unless an acceptable means of accounting for consolidation is agreed upon. USACE should consider the consolidation and survey accuracy in interpreting the survey results.

8. If anchoring of the hopper barge within the cap area is to occur, the potential for cap damage and appropriate QC measures should be addressed.

9. Quantities and sequencing shown on Figure 2 were checked. Quantities are appropriate and correspond to a nominal 36-inch thick cap. Considering the geometry of the arc placement, the central portion of RA4 should be capped last. This is appropriately indicated by the lift sequence numbers.

SUMMARY

With regard to the USACE evaluation criteria, VECP 003 as currently proposed should be accepted, with consideration of the recommendations below.

RECOMMENDATIONS

VECP 003 is fundamentally sound and represents an innovative approach. Specific construction oversight recommendations are presented below:

1. Confirm habitat acceptability with resource agencies

2. Closely monitor bathymetric survey results. Should any evidence of sloughing be detected by the surveys, the lift thicknesses should be reduced to the original design thicknesses.

3. Closely monitor barge draft and positioning records to evaluate how evenly the material is being placed. If the Contractor has difficulty in achieving an even spread of material,

USACE should reduce the allowable lift thicknesses to the original design thicknesses.

4. The consolidation periods specified in Table 02483-9 need to be observed, to allow strength gain in underlying sediments.

5. Interpretation of the hydrographic surveys should account for consolidation of underlying sediments and survey accuracy. Simply requiring a minimum 30-inch increase in bathymetric elevations could lead to an incorrect decision to apply more cap material at greater cost to the Government.

6. Modify the RAMP to address issues related to anchoring of the hopper barge.

Please contact me at 206.438.2303 with any questions or concerns.

Appendix D

Chemical Data Final Report for RAs 1-4

CORPS OF ENGINEERS
NORTHWEST AREA OFFICE

MAY 19 2005

APPROVAL DETAILS ON 4025
FORM 4025 ACTION CODE A

CONTRACTOR: ACC WEST COAST, INC.
NUMBER: CONTRACT DACW67-03-C-0012
TRANSMITTAL NUMBER 01450-22
ITEM NUMBER 2
SPECIFICATION SECTION 01450
PARAGRAPH NUMBER 3.7
✓ **APPROVED AS SUBMITTED**
____ **APPROVED WITH CORRECTIONS AS NOTED**

SIGNATURE: [signature]
TITLE: CQC System Manager
DATE: 02-14-2005

Chemical Data Final Report

Pacific Sound Resources Superfund Site

Marine Sediments Operable Unit Remedial Action

ACC-Hurlen
Seattle, Washington

February 2005

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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TABLES

FIGURES

APPENDICES

Acronyms and Abbreviations

ACC	American Civil Constructors-West Coast
BBL	Blasland, Bouck, & Lee, Inc.
CAS	Columbia Analytical Services
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CWA	Clean Water Act
DO	dissolved oxygen
DQO	data quality objective
GPS	global positioning system
L	liter
mg/L	milligrams per liter
MSU	Marine Sediments Operable Unit
NAPL	nonaqueous-phase liquid
NTU	nephelometric turbidity unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PSEP	Puget Sound Estuary Program
PSR	Pacific Sound Resources
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RA	remediation area
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RPD	relative percent difference
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SMS	Sediment Management Standards
SQS	Sediment Quality Standards
SVOC	semivolatile organic compound
TOC	total organic carbon
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
WQC	Water Quality Certification

1. Introduction

1.1 Site History and Contaminants

The Pacific Sound Resources (PSR) Superfund Site Marine Sediments Operable Unit (MSU) encompasses approximately 58 acres of the south shore of Elliott Bay in Seattle, Washington along approximately 2,000 feet of shoreline (Figure 1). The site was formerly known as the Wyckoff West Wood Treating Facility; from 1909 to 1994, wood-treating operations were performed there. The wood-treating facility was originally a pile-supported facility over the Duwamish River estuary. During the last century, the shoreline and intertidal areas were filled, until ultimately the entire facility was located on created uplands. A remedial investigation/feasibility study (RI/FS) was completed for the site, including both the Upland Unit and the MSU, in April 1998. Active cleanup in the Upland Unit has been completed, and the selected MSU cleanup alternative specified in the Record of Decision (ROD) dated September 30, 1999 is being implemented. The remediation is being conducted under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The MSU was contaminated by used and waste creosote and wood-treating chemicals from historical wood-treating operations on the upland portion of the site. Primary chemicals of concern in the MSU are polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). PAHs were detected in excess of the screening level in sediments collected from up to 20 feet below the mudline. Lateral and downgradient migration of nonaqueous-phase liquids (NAPLs), transport of contaminated groundwater, and erosion of impacted soils by stormwater runoff from the Upland Unit represent additional sources and transport mechanisms to the MSU. In addition, the former Longfellow Creek Outfall contributed PCB contamination to the MSU, and mercury contamination appears to have migrated from a source east of the site.

1.2 Work Scope

The MSU was subdivided into remediation areas (RAs) according to specific site conditions, including operational conditions that affect remedy implementation (Figures 2a and 2b). As part of the remediation effort, work was performed in one of these areas (RA 4 Segments 1, 2, and 3) during the 2004/2005 in-water construction season. Between September 16, 2004 and November 30, 2004, American Civil Constructors-West Coast (ACC), under contract to the United States Army Corps of Engineers (USACE), placed a sediment cap in RA 4. Work at the MSU was performed in accordance with the *Pacific Sound Resources Superfund Site Technical Specifications* (USACE, 2003), referred to in this report as the Technical Specifications.

Blasland, Bouck, & Lee, Inc. (BBL) performed water-quality monitoring during the 2004/2005 in-water activities, which included placement of the engineered sediment cap. The objective of the water-quality monitoring was to assess potential short-term water-quality impacts from capping and associated in-water construction activities and to invoke corrective actions or modify capping procedures if necessary to bring construction activities into compliance with water-quality criteria.

Following cap placement, cap verification grab samples were collected to verify that chemical concentrations in the cap material were at or below the concentrations specified in the Technical Specifications.

1.3 Work Summary

Water-quality monitoring was performed from September through November 2004. No violations of the Water Quality Certification (WQC) that could be directly attributed to capping activities occurred during the 2004/2005 construction season.

Cap verification sampling was performed in December 2004. Chemistry results for the cap verification samples were below the criteria specified in the Technical Specifications with the exception of one sample that contained concentrations of acenaphthene and pyrene above the criteria.

1.4 Report Organization

This Chemical Data Final Report was prepared in accordance with Section 01450 of the Technical Specifications (USACE, 2003). The report summarizes the chemical parameter measurement activities conducted by BBL to support the 2004/2005 in-water construction activities performed by ACC, as well as the quality control practices employed. The report is organized as follows:

- Section 1 – Introduction
- Section 2 – Water-Quality Monitoring
- Section 3 – Cap Verification Monitoring
- Section 4 – Conclusions and Recommendations
- Section 5 – References

2. Water-Quality Monitoring

2.1 Task Description

Water-quality monitoring was performed by BBL during capping and other in-water activities conducted by ACC at the MSU between September 2004 and November 2004. During this period, construction and associated water-quality monitoring were performed within RA 4 Segments 1, 2, and 3 (Figures 3a and 3b). The objective of the monitoring program was to assess potential short-term water-quality impacts from capping and associated in-water construction activities and to invoke corrective actions or modify capping procedures if necessary to bring construction activities into compliance with water-quality criteria.

The water-quality monitoring was performed in general accordance with the *Water Quality Monitoring Sampling and Analysis Plan* (Water Quality SAP) (BBL, 2003a), the *Water Quality Monitoring Plan, Field Sampling Plan/Quality Assurance Project Plan* (Water Quality QAPP) (BBL, 2003b), the Technical Specifications (USACE, 2003), and the WQC (United Stated Environmental Protection AgencyUSEPA, 2003a and 2003b).

Specific objectives of the water-quality monitoring program included the following:

- Document ambient conditions prior to construction activities and water-quality conditions during construction activities.
- Assess water-quality parameters (dissolved oxygen [DO], turbidity, and temperature) in the vicinity of in-water activities for comparison to the limits prescribed in the WQC.
- Guide ACC to modify construction operations as necessary to protect the receiving water environment.
- Provide continuous visual monitoring during construction for the presence of oily sediment, sheen, and any distressed or dying fish or wildlife.

No WQC violations that could be directly attributed to capping activities occurred during the 2004/2005 construction season.

2.1.1 Overview of Monitoring Activities

Water-quality monitoring and sampling activities were performed between September 14, 2004 and November 22, 2004. Remediation areas and a conceptual diagram indicating approximate monitoring locations are shown on Figures 3a and 3b. Compliance boundaries were established during construction on a mixing zone radius of 300 feet for dredging activities and 600 feet for capping activities. The mixing zones were oriented radially around each construction activity and migrated with the activity. Monitoring was performed at the water-quality compliance boundary at the edge of the mixing zone. In addition, DO was monitored at an "early warning" location at the midpoint of the radius of the mixing zone. Three down-current locations (Early Warning, Downgradient 1, and Downgradient 2) and one up-current location (Upgradient) were monitored. The Early Warning station was monitored for compliance with DO criteria; however, as discussed below, this location was not a point of compliance for any other water-quality criteria.

Water-quality monitoring was performed according to three schedules: intensive, routine, and limited. The types of water-quality monitoring and associated schedules are summarized in Table 1. Intensive monitoring was conducted during the startup of in-water construction activities and in response to any major modifications to construction procedures or exceedances of water-quality criteria. Routine water-quality monitoring was conducted when no exceedances of water-quality criteria were recorded for a minimum of two days. Limited water-quality monitoring was initiated when no exceedances of water-quality criteria were observed for a minimum of one week. Continuous visual monitoring was also conducted during all work activities. Ambient monitoring was performed at reference stations in conjunction with the compliance monitoring under all three schedules and before construction activities commenced. Monitoring and sampling locations were recorded in the field with a Garmin global positioning system (GPS).

The WQC specifies that when sampling twice a day during intensive water-quality monitoring, sampling is to occur during (1) slack and (2) strong ebb and/or flood tidal conditions. The Technical Specifications state that the first monitoring round is to be performed during strong ebb or flood tidal conditions, and the second monitoring round is to be performed at any time at least three hours later. The Technical Specifications also state that during routine monitoring (once per day) and limited monitoring (once per week), water-quality measurements must be conducted during strong ebb or flood tidal conditions. The sampling events conducted during the 2004/2005 season were generally scheduled in accordance with the requirements outlined in the WQC and Technical Specifications. However, unexpected site conditions occasionally resulted in temporary adjustments to the sampling schedules. These occasional procedural adjustments are discussed for each monitoring period in Sections 2.3 through 2.5.

The following water-quality parameters were monitored in the vicinity of each in-water activity:

- DO;
- turbidity;
- temperature; and
- total suspended solids (TSS), which was measured only for informational purposes.

DO, turbidity, and temperature were measured at three water depths: shallow, intermediate, and deep portions of the water column. Sampling depth descriptions are provided in Table 2. DO, turbidity, and temperature were measured in situ with a YSI 6920 multi-meter probe at the following stations: Reference 1, Reference 2, Reference 3, Early Warning, Downgradient 1, Downgradient 2, and Upgradient.

Samples for TSS analysis were collected only from the intermediate portion of the water column using a van Dorn water sampler. In accordance with the Technical Specifications, TSS samples were submitted to Columbia Analytical Services (CAS) of Kelso, Washington, a USACE-approved analytical laboratory, for analysis within five days. Per the approved Water Quality SAP and Water Quality QAPP (BBL, 2003a and 2003b), TSS samples were collected at the following stations: Reference 1, Reference 2, Reference 3, Downgradient 1, Downgradient 2, and Upgradient. No TSS samples were required or collected at the Early Warning station.

In addition to the water-quality monitoring described above, the water surface was continually monitored during all work activities for sheens and distressed fish or wildlife, except when nightfall made these observations impossible, as noted in Sections 2.3 through 2.5. When BBL was not on the water performing water-quality monitoring, ACC performed the continual monitoring for sheens and distressed fish or wildlife.

Table 3 summarizes water-quality monitoring activities and corresponding in-water construction activities. Sampling locations are summarized in Table 4 and approximate locations are shown on Figure 4 for the

September to December 2004 period and on Figures 5 through 27 for each sampling date. A month-by-month description of water-quality monitoring and sampling is provided in Sections 2.3 through 2.5.

2.1.2 Summary of Water-Quality Performance Criteria

The WQC states that dredging and other in-water activities must meet Water Quality Standards for Surface Waters of the State of Washington (Washington Administrative Code [WAC] 173-201A), a delegated state authority for the Clean Water Act (CWA) regulation. In addition, dredging and other in-water activities must meet the conditions of the WQC.

The MSU and RAs are situated in Class A waters of the state, per WAC 173-201A. Water-quality compliance criteria specified in WAC 173-201A for Class A waters and criteria specified in the WQC are summarized in Table 5. In accordance with the WQC, compliance was determined at the boundary of the dilution zone (referred to as a "mixing zone" in this report) by comparing water-quality measurements to the performance criteria (Table 5).

Initially, compliance measurements were made against a 30-day running average of reference station data, as determined from all depth strata across all reference stations. When it appeared that a given water-quality measurement was outside the bounds of the 30-day running average (i.e., higher or lower, depending on the criterion), then that data point was compared to the daily reference average for the particular depth strata in question. For example, if the turbidity measurement in the deep sample from the Downgradient 1 station on any particular day was greater than the 30-day running average, that deep turbidity reading was compared to the average of the three deep turbidity readings from the reference stations for that day.

In addition, DO monitoring at the midpoint of the mixing zone (Early Warning station) was evaluated for compliance with the acute effects DO criteria listed in the WQC. This midpoint location was not used to determine compliance with any other parameters.

2.1.3 Modifications to the Technical Specifications, Sampling and Analysis Plan, and Water Quality Certification

Because of unexpected changes in site conditions, construction activities, and/or regulatory requirements, several modifications were made to the water-quality monitoring requirements specified in the Technical Specifications, Water Quality SAP, and/or WQC during the 2004/2005 in-water construction season. Modifications to the water-quality monitoring requirements are described in the following sections.

2.1.3.1 Modifications to Reference Stations

Relocation of Reference 3 Station. On August 27, 2003, during the first week of monitoring for the 2003/2004 in-water construction season, the USACE moved the location of Reference 3 to Northing 219,000 and Easting 1,262,000 (Washington State Plane Coordinates North Zone North America Datum 83). The original location for Reference 3 (Northing 219,630 and Easting 1,261,381) was in the Elliott Bay shipping channel and was therefore determined to be unsafe for sampling because of ship traffic and ship wake. The new Reference 3 location is at the east mooring buoy in Elliott Bay; it was agreed that if a vessel were moored at the east buoy, the west buoy would be used for Reference 3. Implementation of an alternative reference location is not expected to adversely affect the quality or representativeness of background data collected during the 2004/2005 in-water season.

Additional Reference Station Monitoring. For the 2004/2005 in-water construction season, background water-quality monitoring was performed weekly at three reference locations (Reference 1 through Reference 3). Only one reference location was required by the Technical Specifications for each water-quality monitoring event. However, consistent with the revised WQC dated September 15, 2003 (USEPA, 2003b), additional background monitoring was performed to better evaluate seasonal changes in background water quality.

Number of Reference Stations Monitored. Three reference stations, instead of the four required in the initial WQC (USEPA, 2003a), were sampled during the 2004/2005 in-water construction season. The approved Water Quality SAP and Technical Specifications required three reference stations, and the revised WQC (USEPA, 2003b) also required only three reference stations.

2.1.3.2 Modifications to Calculation of Compliance Criteria

On November 2, 2004, the USACE requested that BBL modify the calculation of water-quality compliance criteria. During the 2003/2004 in-water construction season, a monthly running average was used to calculate compliance criteria at the USACE's request. This approach was appropriate given the continuous nature of construction at that time. During the 2004/2005 in-water construction season, the USACE requested that BBL use the method described below because of the episodic nature of construction this year.

The new method consists of averaging the results from all three reference stations for each depth on any given day to derive that day's criteria. For example, the turbidity results from the shallow depths at Reference 1, Reference 2, and Reference 3 on a given date are averaged to calculate the shallow depth turbidity criterion for that date. Similarly, the turbidity results from the intermediate depths are averaged to determine the intermediate depth turbidity criterion for that date, and the same is done for the deep depths to determine the deep depth turbidity criterion for that date. The same process is then applied to derive daily average criteria for temperature and DO as well.

Beginning in November, each day that water-quality monitoring was performed, field staff calculated the criteria after monitoring was completed at the reference stations and before monitoring was conducted at the compliance stations. Field staff then compared the compliance station monitoring results to the daily average compliance criteria. If monitoring results were outside of the compliance criteria, field staff were to contact Shannon Dunn of BBL or, if Ms. Dunn was not available, Paul Krause of BBL. Compliance criteria were calculated and recorded on the daily compliance calculation sheet. Although this method was not introduced into the field until November, October data were evaluated using the new method by back-calculating the daily monitoring criteria using data collected daily at the reference stations during October.

2.1.3.3 Short-Term Deviations

Short-term deviations from the Technical Specifications, Water Quality SAP, and/or WQC that occurred as the result of unexpected site conditions, equipment malfunctions, or changes in the construction schedule are summarized in the following subsections for each reporting period.

2.2 Data Quality Evaluation of Water-Quality Monitoring Data

This section summarizes the data quality objectives and the results of the data quality evaluation performed for the water-quality monitoring data. The water-quality field quality control (QC) documentation is provided in Appendix A; the water-quality data quality evaluation is included as Appendix B; and the water-quality analytical data packages are provided in Appendix C.

2.2.1 Data Quality Objectives

Data quality objectives (DQOs) provide a qualitative and quantitative framework and series of planning steps based on the scientific method around which data collection programs can be designed (USEPA, 2000). The use of DQOs provides that:

- the objectives of the investigation are clearly defined;
- the type, quantity, and quality of environmental data used in decision making are appropriate for their intended application; and
- acceptable levels of decision error and performance goals are specified such that the quantity and quality of data needed to support management decisions are provided.

2.2.1.1 Data Use/Type

The analytical data were used by the USACE to determine compliance with the WQC and Technical Specifications. Water-quality monitoring samples were submitted for chemical analyses as described in the Water Quality SAP (BBL, 2003a).

2.2.1.2 Measurement Quality Objectives for Chemical Data

Reporting limit goals are presented in the Water Quality SAP (BBL, 2003a). Precision and accuracy QC limits for chemical constituents are also presented in the Water Quality SAP (BBL, 2003a). Data representativeness was addressed by the sample quantities and locations identified in the Water Quality SAP (BBL, 2003a). Data comparability was achieved through the use of standard USEPA-approved methods. The data completeness goal was 90%.

2.2.2 Water-Quality Monitoring and Analytical Methods

This section discusses the field sampling and measurement procedures and laboratory analytical methods.

2.2.2.1 Field Sampling and Measurement Procedures

Water-quality sampling was performed in the following manner:

- The sampling vessel was positioned over the sampling location.

- Sampling locations were determined either by coordinates provided in the Technical Specifications (for the reference stations) or by the location of the construction barge.

- Water depths were measured by a lead line.

Field sampling procedures and field equipment calibration were performed as outlined in the Water Quality SAP (BBL, 2003a). A van Dorn bottle (2.2-liter [L] capacity) was used to collect water samples for TSS analysis. The van Dorn bottle was lowered to the midpoint of the water column and the weighted messenger was sent down to close the bottle. The van Dorn bottle was retrieved to the surface and the water sample was placed in an appropriate container. Until delivery to the laboratory, sample containers were stored in coolers at 4 ± 2°C. The TSS samples were shipped, under chain of custody, to CAS for analysis.

At the beginning of each sampling event and before moving to the next sampling station, the van Dorn bottle was cleaned with biodegradable, non-phosphate detergent, rinsed with site water, and then rinsed with distilled water.

Water quality was also monitored in situ using a YSI 6920 multi-meter probe to measure turbidity, DO, and temperature. The probe was calibrated daily prior to sampling or more frequently as needed. Calibration logs are provided in Appendix A.

The YSI 6920 probe was lowered through the water column and turbidity, DO, and temperature were recorded at three points (shallow, intermediate, and deep). In-situ water-quality measurements were collected one-way through the water column (i.e., water surface to sediment surface).

2.2.2.2 Laboratory Analytical Methods

Water samples were submitted to CAS for laboratory analysis of TSS by USEPA Method 160.2 with a five-day turnaround time for laboratory results. The reporting limit for TSS was 5 milligrams per liter (mg/L).

2.2.3 Quality Control Procedures

This section presents the field and laboratory QC procedures implemented during the water-quality monitoring program.

2.2.3.1 Field Quality Control Procedures

Field QC procedures performed during sampling included daily calibration of the YSI 6920 probe, collection and analysis of DO samples, and collection of TSS field duplicate samples.

The YSI 6920 probe was calibrated daily prior to sampling, or more frequently as needed, in accordance with the manufacturer's recommendations. The probe was calibrated for DO, turbidity, and conductivity prior to the start of each day's sampling. (The probe was calibrated for conductivity because the conductivity value is used in the measurement of DO on the probe.) There is no field calibration process for temperature, which is calibrated during periodic maintenance by the manufacturer. The calibration logs are presented in Appendix A.

In accord with a corrective action taken after inaccurate DO measurements were collected on September 29 and 30, 2004, a water sample was collected at least once during each sampling event using the van Dorn bottle and was analyzed for DO using a LaMotte DO titration test kit to confirm the DO measurements of the YSI 6920 probe. In addition, a DO titration was also performed whenever DO measurements were below 3.5 mg/L or when the calibration or YSI probe was in question. Results of the DO titration tests are presented in Table 6.

TSS field duplicate samples were collected at a frequency of 10% per the Technical Specifications (Section 01450, Paragraph 1.4.2). Duplicate samples were collected from the van Dorn bottle and submitted blind to the laboratory for analysis. Field duplicate samples were evaluated in the water-quality data quality evaluation, which is presented in Appendix B.

2.2.3.2 Laboratory Quality Control Procedures

CAS performed laboratory QC procedures in accordance with the requirements of the Water Quality QAPP (BBL, 2003b). Quality assurance (QA) indicators were generally defined in terms of five parameters:

- precision;
- accuracy;
- representativeness;
- comparability; and
- completeness.

These parameters are defined and specific objectives for the site actions are set forth in the Water Quality QAPP (BBL, 2003b). An evaluation of the data in terms of these five parameters is presented in the water-quality data quality evaluation (Appendix B). The outcome for each of the five parameters is summarized in Section 2.2.4.

2.2.4 Data Assessment

This section summarizes field and laboratory QC deviations and the results of the data quality assessment.

2.2.4.1 Summary of Quality Control Deviations

During sampling, the YSI 6920 probe was calibrated daily. There were no deviations in the calibration frequency.

Water samples for DO titration tests were not required by the Technical Specifications. However, as described above (Section 2.2.3.1), DO titration tests were performed daily after the September 29 and 30, 2004 sampling events to provide additional QC confirmation of the accuracy of the DO measurements made using the YSI 6920 probe.

Field duplicate TSS samples were collected at a frequency of 10%, as specified in the Technical Specifications (Section 01450, Paragraph 1.4.2). Exceedances of the field duplicate control limits for relative percent difference (RPD) are discussed in the data quality evaluation (Appendix B). As a result of field duplicate RPDs that fell outside the control limits, four of the 187 TSS samples were qualified as estimated (J).

Laboratory QC procedures were generally within the requirements of the Water Quality QAPP (BBL, 2003b). No water-quality data were qualified as a result of laboratory control-limit deviations. The results of the data quality evaluation are summarized in Appendix B.

2.2.4.2 *Overall Assessment of Data Quality*

For TSS, precision was evaluated through laboratory and field duplicates, with a duplicate RPD control limit of 20%. Accuracy was assessed through laboratory control samples. Data representativeness was addressed by the sample quantities and locations identified in the Water Quality SAP (BBL, 2003a). Data comparability was achieved by using standard USEPA-approved methods. The data completeness goal was 90%.

Data precision and accuracy were acceptable. Data representativeness was acceptable. Data comparability was acceptable. The completeness for this set of data is 100%, which exceeds the project-specified goal of 90%. Sampling and analytical methodologies set forth in the Water Quality QAPP (BBL, 2003b) were followed. The prescribed field and laboratory methods were followed. Based on the data quality evaluation, all of the data were determined to be acceptable as qualified.

2.3 September 2004 Water-Quality Monitoring

This section summarizes the water-quality monitoring and sampling performed in September 2004, including procedural deviations from the Technical Specifications, Water Quality SAP, or WQC; field observations; water-quality monitoring results; and WQC deviations and corrective actions.

2.3.1 Field Activities Completed – September 2004

Capping activities began during the afternoon of September 16. Water-quality monitoring was performed at the MSU between September 14 and September 30, 2004. Background monitoring was performed for two days on September 14 and 15 and two half-days on the mornings of September 16 and 17, 2004. These data were used to evaluate background water quality in the vicinity of the site and to set compliance requirements, per the WQC and WAC 173-201A, for water-quality monitoring.

On the afternoons of September 16 and 17, 2004, intensive water-quality monitoring was performed during capping in RA 4. Additionally, intensive water-quality monitoring was performed on September 30, 2004 during capping in RA 4. During the intensive monitoring periods, water-quality monitoring was performed during strong ebb or flood tidal conditions. The two sampling events were separated by at least three hours, in accordance with the Technical Specifications. Routine water-quality monitoring was performed in RA 4 on September 21, 22, 23, 24, and 25, 2004. Limited water-quality monitoring was performed in RA 4 on September 29, 2004. Approximate water-quality monitoring locations for September 2004 are shown on Figures 5 through 15.

2.3.2 Procedural Deviations from the Technical Specifications, Sampling and Analysis Plan, or Water Quality Certification – September 2004

Background water-quality monitoring data were collected over four days (September 14–17) to provide sufficient data for evaluating background water quality and assessing WQC compliance. This represented more background monitoring than was required by the Technical Specifications.

Because of an operator error coupled with a malfunction of the YSI probe on September 29 and 30, 2004, the DO readings for those dates are not considered accurate. The qualified probe readings for these dates are included in Table 6; however, these data are not considered indicative of the DO conditions at the site on those dates. Corrective actions taken as a result of the operator error and probe malfunction are discussed in Section 2.3.5.4.

On September 14, 2004, the west buoy was used as the Reference 3 station because a sea lion was resting on the east buoy. On September 15, 2004, the Reference 3 station was located near the east buoy because barges were tied up to the east and west buoys.

On September 14 and 16, 2004, Native American fishing nets were deployed in the vicinity of the Reference 2 station. To avoid the nets, water-quality monitoring was performed near, but not at, the Reference 2 station on these dates.

Water depths at each location were measured by lead line. Throughout September, it was difficult to obtain accurate water depth measurements by lead line at the Reference 3 station and other deep sample locations because of the water depth, currents, and wave conditions. Consequently, the water depths for some locations are approximate measurements. Actual probe depth (i.e., sample depth) was indicated by a depth transducer on the YSI probe and was recorded.

2.3.3 Field Observations – September 2004

In September, water conditions were dominated by weather conditions. Wind, waves, and stormy conditions combined to produce surface chop and surface foaming throughout the site.

A single dead crab was observed at the Early Warning and Reference 2 stations on September 17 and 25, 2004, respectively. On September 25, 2004, the dead crab was observed before capping activities had begun for the day and was not associated with those activities. It was not clear whether the dead crab observed on September 17, 2004 was associated with capping activities. No other distressed fish or wildlife were observed.

Because of the capping schedule, several of the monitoring events were carried out after dark; detailed field observations were not possible in those cases.

2.3.4 Water-Quality Monitoring Results – September 2004

Water-quality monitoring results for the 2004/2005 in-water construction season are summarized in Table 7. Average background water-quality values are summarized in Table 8.

Complete laboratory analytical data packages for water-quality monitoring, including laboratory QA/QC sample results, are provided in Appendix C. The September 2004 water-quality monitoring results for DO, turbidity, temperature, and TSS were previously reported in the Monthly Water Quality Monitoring Report for September 2004 (BBL, 2004a). As stated in that report, BBL considered the results acceptable for informational purposes. The September 2004 water-quality monitoring results are summarized in the following subsections.

2.3.4.1 Dissolved Oxygen

DO ranged from 3.16 mg/L to 10.98 mg/L at all locations monitored during the September 2004 reporting period. Low DO measurements (less than 6 mg/L) made on September 29 and 30, 2004 were the result of a malfunctioning DO probe and are considered inaccurate measurements. Following this period of questionable data, the corrective action, which consisted of collecting a water sample for DO titrations during each day of sampling, was implemented. All subsequent DO readings were deemed acceptable. Section 2.3.5.1 discusses DO WQC deviations.

The average DO for samples collected from the shallow portion of the water column at all monitoring stations was 7.25 mg/L during this reporting period. The average DO for samples collected from the intermediate portion of the water column was 6.55 mg/L. The average DO for samples collected from the deep portion of the water column was 6.11 mg/L.

2.3.4.2 Turbidity

Turbidity ranged from 0 nephelometric turbidity units (NTUs) to 15.5 NTUs at all locations monitored during the September 2004 reporting period. The average turbidity measurements for all monitoring stations were 0.69 NTU for shallow samples, 0.27 NTU for intermediate samples, and 2.44 NTUs for deep samples. The highest turbidity measurement, 15.5 NTU, occurred at the Downgradient 1 station on September 29, 2004 at the bottom of the water column. The second-highest turbidity measurement, 15.3 NTU, occurred at the Reference 3 station on September 17, 2004. Section 2.3.5.2 discusses turbidity WQC deviations.

2.3.4.3 Temperature

Temperature ranged from 12.23°C to 14.68°C at all locations monitored during the September 2004 reporting period. The average temperatures recorded at all monitoring stations were 13.35°C for shallow samples, 13.21°C for intermediate samples, and 13.01°C for deep samples.

2.3.4.4 Total Suspended Solids

TSS concentrations ranged from non-detect with a method reporting limit of 5 mg/L to 39 mg/L at all the locations sampled during the September reporting period. The average TSS value in September 2004 was 6 mg/L.

2.3.5 Water Quality Certification Deviations and Corrective Actions – September 2004

Potential WQC deviations for DO, turbidity, and temperature for the September 2004 reporting period and corrective actions taken during this period are discussed below. No WQC violations occurred during September 2004 that could be directly attributed to capping activities.

2.3.5.1 Dissolved Oxygen WQC Deviations

The DO criteria for the project are twofold. First, no measurement shall be below 3.5 mg/L at any time during the activities. Second, if a DO measurement is between 6 mg/L and 3.5 mg/L, then the DO shall not be more than 0.2 mg/L below the background average. All DO readings are evaluated at both levels.

Eleven of the DO measurements collected at compliance stations during the September 2004 reporting period were below the WQC acute effects criterion of 3.5 mg/L. All of these measurements were recorded on September 29 or 30, 2004, when the DO probe was found to be malfunctioning; all are therefore of questionable accuracy and are attributed to instrument error, not project impacts. Three measurements below 3.5 mg/L were also recorded at reference stations during September. Corrective measures taken to address these low measurements are discussed below in Section 2.3.5.4.

Thirty-three DO measurements between 6 mg/L and 3.5 mg/L were recorded at compliance stations during the September 2004 reporting period. Thirteen of these measurements were made on September 29 and 30, 2004 and are attributed to instrument error, as discussed above. The remaining 20 measurements ranged from 4.4 mg/L to 5.9 mg/L and were slightly below the average deep background concentration (6.13 mg/L) and similar to reference station measurements; therefore, they are considered indicative of background conditions in the water as opposed to WQC deviations as a result of project activities.

2.3.5.2 Turbidity WQC Deviations

The WQC states that turbidity shall not exceed 5 NTUs over background when background turbidity is 50 NTUs or less. The Early Warning station is not subject to the turbidity criteria. Background turbidity did not exceed 50 NTUs during the September 2004 monitoring.

During the September 2004 reporting period, eight turbidity results were greater than 5 NTUs over background. All eight results were in deep samples, and five of the eight were below the daily average turbidity at deep depths at the reference stations.

- The turbidity at Downgradient 2 on September 17 was measured at 6.2 NTUs in the deep sample. No other station had an elevated turbidity reading on this date.

- Downgradient 1 had measured turbidity of 7.6 NTUs on September 21, 2004 in the deep sample, which was below the deep daily reference average.

- The turbidity at Downgradient 2 on September 23, 2004 was measured at 15.2 NTUs in the deep sample. No other station had elevated turbidity on this date.

- The turbidity reading at the Upgradient location on September 25, 2004 was 6.5 NTUs, which was below the deep daily reference average.

- Downgradient 1 had measured turbidity of 15.5 NTUs on September 29, 2004 in the deep sample.

- Downgradient 2 had a reading of 10.6 NTUs on September 29, 2004, which was below the deep daily reference average.

- The turbidity reading at the Upgradient location on September 30, 2004 was 9.5 NTUs. No other station had elevated turbidity on this date.

During the 2004/2005 in-water construction period, elevated turbidity measurements were periodically observed in the deep samples. Based on the spatial and temporal trends in the data, the data do not appear to indicate that project activities were responsible for the observed WQC deviations in the turbidity data. The data are considered localized occurrences and are not indicative of general water quality in the vicinity of the capping activities. No observation of lasting turbidity was made. Consequently, it was determined that the elevated turbidity measurements were not indicative of longer-term deviations or chronic effects of the construction activities but may be indicative of site-specific conditions (e.g., wave action, tidal surge).

2.3.5.3 Temperature WQC Deviations

The WQC states that temperature shall not exceed 16°C. All temperature measurements were below 16°C.

2.3.5.4 September 2004 Corrective Actions

The turbidity probe calibrated correctly during the daily calibration on September 15, 2004. However, during monitoring at the first location, which was the Reference 1 station during the slack tide, negative turbidity measurements of approximately 1 NTU were observed. The sampling crew returned to shore and recalibrated the turbidity probe. The turbidity probe gave reasonable measurements, based on past data, after recalibration, and the turbidity measurements performed after recalibration are therefore considered accurate.

The turbidity probe appeared to malfunction during the deep sample measurement at Reference 3 on September 21, 2004. A negative number of -4 NTUs was obtained. While negative turbidity measurements near zero (-0.1 to about -0.3 NTU) indicate clear water with zero turbidity, a larger negative number indicates that the turbidity probe malfunctioned. The YSI was retrieved on the boat and the optics wiper was replaced. The YSI was lowered back into the water and the shallow sample was remeasured. The remeasured turbidity was 0.3 NTU, which is consistent with the earlier shallow measurement on September 21, 2004 and also with previous measurements in the shallow samples at Reference 3.

As described in Section 2.3.5.1, the DO measurements made on September 29 and 30, 2004 were all below 6 mg/L. Discussions with field staff indicated that the probe may have malfunctioned. These observations suggest that the reported results are inaccurate on those dates. Furthermore, the DO measurements were consistently low at the reference and compliance locations, and the reference stations were measured before cap placement. The consistently low DO at all locations and lack of correlation with capping activities further suggest that the DO measurements are inaccurate. As a result of sampler error, the procedure for confirming or refuting low DO measurements was not followed in a timely manner.

Based on conversations with George Gardner of ACC and Brenda Bachman, Travis Shaw, and Miriam Gilmer-Bogh of USACE on October 1, 2004, a plan was developed to monitor on October 1, 2004 by making side-by-side DO measurements at the site using BBL's YSI probe and ACC's Troll probe. However, ACC's Troll probe was not functioning and water-quality monitoring was therefore performed using only BBL's YSI probe.

No construction activity occurred on October 1, 2004. Measurements were taken approximately 100 feet to the east of the barge. Using the YSI probe, the DO at the shallow depth was 3.63 mg/L. A water sample was collected and a DO titration was performed; the result was 7.2 mg/L. This titration result indicated that the DO probe was not working properly. Water samples were also collected from the intermediate and deep depths and DO titrations were performed on those samples as well. The titration DO results were 6 mg/L for the intermediate sample and 5.7 mg/L for the deep sample. These results again suggest that DO measurements on September 29 and 30, 2004 were inaccurately low when, based on the subsequent titration tests of October 1, the DO levels were actually within acceptable range. These data further indicate that no WQC deviations occurred during the September 29 to 30, 2004 time period.

To ensure that these problems can be prevented in the future, a number of actions were taken to resolve the DO probe malfunction and the failure to follow corrective action procedures.

- The DO membrane was replaced on the evening of October 1, 2004.

- The sampler who performed the monitoring on September 30, 2004 and failed to follow field procedures is no longer working on the project.

- All field staff were provided again with the Water Quality Monitoring Field Responses Forms (initially provided to them at the beginning of the 2004/2005 in-water construction season). Field staff were also verbally advised of the range of acceptable readings and what actions to take if readings fall outside of that range. The importance of following the Water Quality Monitoring Field Responses Form was stressed to the field staff.

2.4 October 2004 Water-Quality Monitoring

This section summarizes the water-quality monitoring and sampling performed in October 2004, including procedural deviations from the Technical Specifications, Water Quality SAP, or WQC; field observations; water-quality monitoring results; and WQC deviations and corrective actions.

2.4.1 Field Activities Completed – October 2004

Water-quality monitoring was performed between October 1 and October 28, 2004. Limited monitoring was performed in conjunction with corrective action on October 1, 2004. Limited water-quality monitoring was performed during capping in RA 4 on October 5 and 19, 2004. Intensive water-quality monitoring was performed on October 12, 14, 15, 23, 26, and 28 during capping activities in RA 4. The intensive monitoring was performed during slack tidal conditions and strong ebb or flood tidal conditions in accordance with the WQC. Approximate water-quality monitoring locations for October 2004 are shown on Figures 16 through 23.

2.4.2 Procedural Deviations from the Technical Specifications, Sampling and Analysis Plan, or Water Quality Certification – October 2004

On October 26, 2004, severe weather conditions that caused rapid drifting of the boat in high winds may have affected the accuracy of the position and depth of the YSI probe. In addition, data for DO and turbidity were not collected from the Upgradient deep location on October 26, 2004 because of unsafe conditions caused by the weather.

2.4.3 Field Observations – October 2004

In October, water conditions were dominated by weather conditions. Wind, waves, and stormy conditions combined to produce surface chop and surface foaming throughout the site.

Because of the capping schedule, several of the monitoring events were carried out after dark; detailed field observations were not possible in those cases.

2.4.4 Water-Quality Monitoring Results – October 2004

Water-quality monitoring results for the 2004/2005 in-water construction season are summarized in Table 7. Average background water-quality values are summarized in Table 8.

Complete laboratory analytical data packages for water-quality monitoring, including laboratory QA/QC sample results, are provided in Appendix C. The October 2004 water-quality monitoring results for DO, turbidity, temperature, and TSS were previously reported in the Monthly Water Quality Monitoring Report for October 2004 (BBL, 2004b). As stated in that report, BBL considered the results acceptable for informational purposes. The October 2004 water-quality monitoring results are summarized in the following subsections.

2.4.4.1 Dissolved Oxygen

DO ranged from 4.81 mg/L to 8.54 mg/L at all locations monitored during the October 2004 reporting period. The average DO measured at all monitoring stations for samples collected from the shallow portion of the water column was 7.14 mg/L during this reporting period. The average DO for samples collected from the intermediate portion of the water column was 6.11 mg/L. The average DO for samples collected from the deep portion of the water column was 5.74 mg/L. Section 2.4.5.1 discusses DO WQC deviations.

2.4.4.2 Turbidity

Turbidity ranged from 0 NTU to 22 NTUs at all the locations monitored during the October 2004 reporting period. The average turbidity measurements for all monitoring stations were 0.2 NTU for shallow samples, 0.5 NTU for intermediate samples, and 2.6 NTUs for deep samples. The highest turbidity, 22 NTUs, occurred at the Reference 1 station on October 26, 2004 at the bottom of the water column. The second-highest turbidity, 14.9 NTUs, occurred at the Downgradient 1 station on October 5, 2004 at the middle of the water column. Section 2.4.5.2 discusses turbidity WQC deviations.

2.4.4.3 Temperature

Temperature ranged from 11.10°C to 14.35°C at all the locations monitored during the October 2004 reporting period. The average temperatures recorded at all monitoring stations were 12.76°C for shallow samples, 12.52°C for intermediate samples, and 12.40°C for deep samples.

2.4.4.4 Total Suspended Solids

TSS concentrations ranged from non-detect with a method reporting limit of 5 mg/L to 11 mg/L at all the locations sampled during the October 2004 reporting period. The average TSS value in October 2004 was 7.1 mg/L.

2.4.5 Water Quality Certification Deviations and Corrective Actions – October 2004

Potential WQC deviations for DO, turbidity, and temperature for the October 2004 reporting period are discussed below. No WQC violations occurred during October 2004 that could be directly attributed to capping activities at the site.

2.4.5.1 Dissolved Oxygen WQC Deviations

The DO criteria for the project are twofold. First, no measurement shall be below 3.5 mg/L at any time during the activities. Second, if a DO measurement is between 6 mg/L and 3.5 mg/L, then the DO shall not be more than 0.2 mg/L below the background average. All DO readings are evaluated at both levels.

All DO measurements recorded in October 2004 were above 3.5 mg/L.

Fifty-six DO measurements between 6 mg/L and 3.5 mg/L were recorded at the compliance stations. Of these, 22 were within 0.2 mg/L of the average daily background DO for a given depth. Twenty-nine DO measurements between 6 mg/L and 3.5 mg/L were also observed at reference stations. The low DO measurements at both the compliance and reference stations tended to be in the intermediate or deep samples, although there were a limited number of low measurements in the shallow samples. All of the low DO measurements at compliance stations were consistent with corresponding reference station measurements. As a result, these values are considered indicative of background conditions in the water as opposed to WQC deviations resulting from project activities.

2.4.5.2 Turbidity WQC Deviations

The WQC states that turbidity shall not exceed 5 NTUs over background when background turbidity is 50 NTUs or less. The Early Warning station is not subject to the turbidity criteria. Background turbidity did not exceed 50 NTUs during the October 2004 monitoring.

During the October 2004 reporting period, 12 turbidity results were greater than 5 NTUs over background at a compliance location. All 12 results were recorded in deep samples. One of the 12 results was greater than 5 NTUs over background but less than the 30-day running average turbidity at the deep depths at the reference stations.

- At Downgradient 1, a turbidity reading of 14.9 NTUs was recorded on October 5, 2004. No other station had an elevated turbidity reading on this date.
- At Downgradient 2, a turbidity reading of 6.51 NTUs was recorded on October 12, 2004. No other station had an elevated turbidity reading on this date.
- At Downgradient 1, a turbidity reading of 6.2 NTUs was recorded on October 14, 2004. No other station had an elevated turbidity reading on this date.
- At Downgradient 2, turbidity readings of 6.10 NTUs and 6.5 NTUs were recorded during intensive monitoring on October 15, 2004. No other station had an elevated turbidity reading on this date.
- At Downgradient 1, a turbidity reading of 10 NTUs was recorded on October 19, 2004. No other station had an elevated turbidity reading on this date.

- At the Upgradient station, a turbidity reading of 6.9 NTUs was recorded on October 23, 2004.
- At Downgradient 2, a turbidity reading of 6.64 NTUs was recorded on October 23, 2004.
- At Downgradient 1, a turbidity reading of 10.4 NTUs was recorded on October 26, 2004.
- At Downgradient 2, a turbidity reading of 6.87 NTUs was recorded on October 26, 2004.
- At Downgradient 1, a turbidity reading of 10.5 NTUs was recorded on October 28, 2004.
- At Downgradient 2, a turbidity reading of 6.44 NTUs was recorded on October 28, 2004. This reading was greater than 5 NTUs over background but less than the 30-day running average turbidity at the deep depths at the reference stations.

During the 2004/2005 in-water construction period, elevated turbidity measurements were periodically observed in the deep samples. Based on the spatial and temporal trends in the data, the data do not appear to indicate that project activities were responsible for the observed WQC deviations in the turbidity data. The data are considered localized occurrences and are not indicative of general water quality in the vicinity of the capping activities. No observation of lasting turbidity was made. Consequently, it was determined that the elevated turbidity measurements were not indicative of longer-term deviations or chronic effects of the construction activities but may be indicative of site-specific conditions (e.g., wave action, tidal surge).

2.4.5.3 Temperature WQC Deviations

The WQC states that temperature shall not exceed 16°C. All temperature measurements for October 2004 were below 16°C.

2.4.5.4 October 2004 Corrective Actions

The DO measurements made on September 29 and 30, 2004 were all below 6 mg/L and were likely the result of probe malfunction. In addition, the procedure for confirming or refuting low DO measurements was not followed in a timely manner. The corrective action for these circumstances was taken on October 1, 2004, but is described in Section 2.3.5.4 as a September corrective action because it relates to September sampling activities.

On November 2, 2004, the USACE requested that BBL modify the calculation of water-quality compliance criteria. The new method, which is described in Section 2.1.3.2, consisted of averaging the results from all three reference stations for each depth on any given day to derive that day's criteria. Although the new method was not implemented in the field until November, October data were evaluated using the new method by back-calculating the daily monitoring criteria using data collected daily at the reference stations during October.

2.5 November 2004 Water-Quality Monitoring

This section summarizes the water-quality monitoring and sampling performed in November 2004, including procedural deviations from the Technical Specifications, Water Quality SAP, or WQC; field observations; water-quality monitoring results; and WQC deviations and corrective actions.

2.5.1 Field Activities Completed – November 2004

Water-quality monitoring was performed between November 1 and November 22, 2004. Limited water-quality monitoring was performed during capping activities in RA 4 on November 1, 8, and 16, 2004. Intensive water-quality monitoring was performed during capping activities in RA 4 on November 22, 2004. The intensive monitoring was performed during slack tidal conditions and strong ebb or flood tidal conditions in accordance with the WQC. Approximate water-quality monitoring locations for November 2004 are shown on Figures 24 through 27.

2.5.2 Procedural Deviations from the Technical Specifications, Sampling and Analysis Plan, or Water Quality Certification – November 2004

The location of the Early Warning station is determined in reference to the capping barge and moves as the barge moves. On November 11, 2004, because the capping barge was near the shoreline, the water depth at the Early Warning station was less than 3 feet. Therefore, only shallow-depth measurements were taken at the Early Warning station on that date.

2.5.3 Field Observations – November 2004

In November, water conditions were dominated by weather conditions. Wind, waves, and stormy conditions combined to produce surface chop and surface foaming throughout the site.

On November 16, 2004, nightfall made detailed field observations difficult near the end of the monitoring activity.

2.5.4 Water-Quality Monitoring Results – November 2004

Water-quality monitoring results for the 2004/2005 in-water construction season are summarized in Table 7. Average background water-quality values are summarized in Table 8.

Complete laboratory analytical data packages for water-quality monitoring, including laboratory QA/QC sample results, are provided in Appendix C. The November 2004 water-quality monitoring results for DO, turbidity, temperature, and TSS were previously reported in the Monthly Water Quality Monitoring Report for November 2004 (BBL, 2004c). As stated in that report, BBL considered the results acceptable for informational purposes. The November 2004 water-quality monitoring results are summarized in the following subsections.

2.5.4.1 Dissolved Oxygen

DO ranged from 5.05 mg/L to 7.74 mg/L at all locations monitored during the November 2004 reporting period. The average DO recorded at all monitoring stations for samples collected from the shallow portion of the water column was 6.91 mg/L. The average DO for samples collected from the intermediate portion of the water column was 6.39 mg/L. The average DO for samples collected from the deep portion of the water column was 6.03 mg/L. Section 2.5.5.1 discusses DO WQC deviations.

2.5.4.2 *Turbidity*

Turbidity ranged from 0 NTU to 11.5 NTUs at all locations monitored during the November 2004 reporting period. The average turbidity measurements for all monitoring stations were 0.13 NTU for shallow samples, 0.27 NTU for intermediate samples, and 2.09 NTU for deep samples. The highest turbidity measurement, 11.5 NTUs, occurred at the Early Warning station on November 22, 2004 at the deep depth of the water column. The second-highest turbidity measurement, 11.3 NTUs, occurred at Downgradient 1 on November 1, 2004 at the deep portion of the water column. The remaining turbidity measurements for November 2004 were below 6.7 NTUs. Section 2.5.5.2 discusses turbidity WQC deviations.

2.5.4.3 *Temperature*

Temperature ranged from 11.07°C to 11.93°C at all the locations monitored during the November 2004 reporting period. The average temperatures recorded at all the monitoring stations were 11.48°C for shallow samples, 11.50°C for intermediate samples, and 11.44°C for deep samples.

2.5.4.4 *Total Suspended Solids*

TSS concentrations ranged from non-detect with a method reporting limit of 5 mg/L to 13 mg/L at all the locations sampled during the November 2004 reporting period. The average TSS value in November 2004 was 6.6 mg/L.

2.5.5 Water Quality Certification Deviations and Corrective Actions – November 2004

Potential WQC deviations for DO, turbidity, and temperature for the November 2004 reporting period are discussed below. No WQC violations occurred during November 2004 that could be directly attributed to capping activities.

2.5.5.1 *Dissolved Oxygen WQC Deviations*

The DO criteria for the project are twofold. First, no measurement shall be below 3.5 mg/L at any time during the activities. Second, if a DO measurement is between 6 mg/L and 3.5 mg/L, then the DO shall not be more than 0.2 mg/L below the background average. All DO readings are evaluated at both levels.

All DO measurements recorded in November 2004 were greater than 3.5 mg/L.

Eight DO measurements between 6 mg/L and 3.5 mg/L were recorded at compliance stations in November 2004. Of these, four were within 0.2 mg/L of the average daily background DO for a given depth. Ten DO measurements between 6 mg/L and 3.5 mg/L were also observed at reference stations. The low DO measurements at both the compliance and reference stations occurred in the intermediate or deep samples. The low measurements at compliance stations during this period were consistent with reference station measurements at the time of sampling. Therefore, the low DO measurements are considered indicative of background conditions in the water as opposed to WQC deviations as a result of project activities.

2.5.5.2 Turbidity WQC Deviations

The WQC states that turbidity shall not exceed 5 NTUs over background when background turbidity is 50 NTUs or less. The Early Warning station is not subject to the turbidity criteria. Background turbidity did not exceed 50 NTUs during the November 2004 monitoring.

During the November 2004 reporting period, two turbidity results were greater than 5 NTUs over the background at a compliance location. Both results were recorded for the deep sample location. One of the two results was greater than 5 NTUs over the daily background but less than the 30-day running average turbidity for deep depths at reference stations.

- At Downgradient 1, a turbidity reading of 11.3 NTUs was recorded on November 1, 2004. No other station had an elevated turbidity reading on this date.

- At Downgradient 2, a turbidity reading of 6.67 NTUs was recorded on November 8, 2004. No other station had an elevated turbidity reading on this date.

During the 2004/2005 in-water construction period, elevated turbidity measurements were periodically observed in the deep samples. Based on the spatial and temporal trends in the data, the data do not appear to indicate that project activities were responsible for the observed WQC deviations in the turbidity data. The data are considered localized occurrences and are not indicative of general water quality in the vicinity of the capping activities. No observation of lasting turbidity was made. Consequently, it was determined that the elevated turbidity measurements were not indicative of longer-term deviations or chronic effects of the construction activities but may be indicative of site-specific conditions (e.g., wave action, tidal surge).

2.5.5.3 Temperature WQC Deviations

The WQC states that temperature shall not exceed 16°C. All temperature measurements for November 2004 were below 16°C.

2.5.5.4 November 2004 Corrective Actions

On November 2, 2004, the USACE requested that BBL modify the calculation of water-quality compliance criteria. The new method, which is described in Section 2.1.3.2, consisted of averaging the results from all three reference stations for each depth on any given day to derive that day's criteria.

3. Cap Verification Monitoring

3.1 Task Descriptions

During the 2004/2005 in-water construction season, ACC placed a sediment cap over contaminated sediment in RA 4 of the MSU. Following placement of the final cap surface in RA 4, BBL performed cap verification sampling. The objectives of the cap verification sampling were to characterize surface cap material chemistry. The cap verification sampling and subsequent laboratory analysis were performed in general accordance with the Verification SAP (BBL, 2003c), the Verification QAPP (BBL, 2003d), and the Technical Specifications (USACE, 2003).

The cap verification samples were collected in consultation with the USACE project team to support decisions for final acceptance of the completed cap surface. The sampling requirements are summarized in Table 9. The samples were collected using a boat-mounted power grab sampler, and the sampling was performed in accordance with Puget Sound Estuary Program (PSEP) guidelines (PSEP, 1997). Cap verification sampling locations are shown on Figure 28.

The cap verification samples were submitted to CAS for analysis. Analytical testing requirements for the cap verification samples are summarized in Table 10. Analytical results were below the chemistry compliance criteria with the exception of one sample, as discussed in Section 3.4.1.

3.2 Data Quality Evaluation of Cap Verification Samples

This section summarizes cap verification data quality. The data quality evaluation of cap verification samples is included in Appendix D.

3.2.1 Data Quality Objectives

3.2.1.1 Data Use/Type

The analytical data were used by the USACE to determine final acceptance of a completed cap surface (i.e., cap verification) and for compliance with the Technical Specifications. Cap verification samples were submitted for chemical analyses as described in the Verification SAP (BBL, 2003c).

3.2.1.2 Measurement Quality Objectives for Chemical Data

Reporting limit goals are presented in the Verification SAP (BBL, 2003c). Precision and accuracy QC limits for chemical constituents are also presented in the Verification SAP (BBL, 2003c). Data representativeness was addressed by the sample quantities and locations identified in the Verification SAP (BBL, 2003c). Data comparability was achieved through the use of standard USEPA-approved methods. The data completeness goal was 90%.

3.2.2 Sampling and Analytical Methods

Cap verification samples were analyzed for:

- total organic carbon (TOC) (USEPA Method 9060M);
- total solids (USEPA Method 160.3M);
- total metals (USEPA Methods 6010B and 7471A);
- polychlorinated biphenyls (PCBs) (USEPA Method 8082); and
- semivolatile organic compounds (SVOCs) USEPA Method 8270).

Because of the cap material's large grain size (up to 3-inch rock), the analytical protocol was modified to include a sieving step to separate out the coarsest material. A memorandum summarizing the revised analytical protocol is presented in Appendix D; the modification was approved by the USACE (T. Shaw, USACE, personal communication) prior to its implementation. Accordingly, CAS sieved the samples upon receipt using a 1-inch mesh to separate out the material greater than 1 inch in diameter. The remaining material was analyzed and the results were reported on a dry-weight basis. These data were then corrected to the dry weight of the total sample prior to sieving.

3.2.3 Quality Control Procedures

This section presents the QC procedures used in the field and by the laboratory.

3.2.3.1 Field Quality Control Procedures

Field QC procedures consisted of collecting field duplicates at a frequency of 10% per the Technical Specifications (Section 01450, Paragraph 1.4.2). Two field duplicate samples were collected from the grab sampler and submitted blind to the laboratory for analysis. Field duplicate samples were evaluated in the cap verification data quality evaluation, which is presented in Appendix D.

3.2.3.2 Laboratory Quality Control Procedures

CAS performed laboratory QC procedures in accordance with the requirements of the Verification QAPP (BBL, 2003d). QA indicators were generally defined in terms of five parameters:

- precision;
- accuracy;
- representativeness;
- comparability; and
- completeness.

These parameters are defined and specific objectives for the site actions are set forth in the Verification QAPP (BBL, 2003d). An evaluation of the data and the five QA parameters is presented in the cap verification data quality evaluation, included in Appendix D. Analytical data packages for the cap verification samples are presented in Appendix E. The outcome for each of the five parameters is summarized in Section 3.2.4.

3.2.4 Data Assessment

This section summarizes field and laboratory QC deviations and assesses overall data quality.

3.2.4.1 Summary of Quality Control Deviations

Field duplicates were collected at the required frequency of 10% per the Technical Specifications (Section 01450, Paragraph 1.4.2). Two field duplicates were collected from 15 cap verification samples.

Laboratory QC procedures were generally within the requirements of the Verification QAPP (BBL, 2003d). Twenty results were qualified as estimated (J) because field duplicate RPDs were above control limits. Twenty-five results were qualified as not detected (U) as a result of method blank contamination. Eight results were qualified as estimated (J/UJ) because of low matrix spike recoveries. A summary of the data quality evaluation with respect to laboratory control procedures is presented in Appendix D.

3.2.4.2 Overall Assessment of Data Quality

Data precision, which was evaluated through laboratory, field, matrix spike, and laboratory control sample duplicates, was acceptable. Data accuracy, which was evaluated through laboratory control samples, surrogate spikes, and matrix spikes, was acceptable. Data representativeness was acceptable. The prescribed field and laboratory methods were followed. Data comparability was acceptable. Sampling and analytical methodologies set forth in the Verification QAPP (BBL, 2003d) were followed. Data completeness was acceptable. The completeness for this set of data is 100%, which exceeds the project-specified goal of 90%. Based on the data quality evaluation, all of the data were determined to be acceptable as qualified.

3.3 Field Activities Completed

This section summarizes the field activities performed by BBL and ACC related to cap verification sampling and analysis from December 13 through December 15, 2004 and discusses deviations from the Technical Specifications.

3.3.1 Cap Verification Sampling

Cap verification samples were collected with a power grab sampler because the cap design consisted of Gravel Mix or riprap, and it was not possible to vibracore through the Gravel Mix. The USACE modified the Technical Specifications to allow sampling by power grab (T. Shaw, USACE, personal communication). Cap verification samples were collected at locations VS-30 through VS-44 (Figure 28). Coordinates for proposed cap verification sample locations were obtained from ACC prior to sampling. Using the target coordinates, the sampling vessel navigated directly to those locations for sample collection. The final grab location coordinates were recorded in the field from the vessel-mounted GPS. Table 11 presents the final coordinates of all cap verification samples.

Table 12 summarizes cap verification sampling details, including sample depths and physical descriptions of the samples.

After the target sampling locations were determined, the water depth was measured from the sampling vessel using a fathometer. The grab samples were collected using a boat-mounted power grab sampler equipped with a bucket approximately 14 inches wide by 17 inches long by 30 inches deep. The power grab sampler was lowered to the top of the cap material and then hydraulically closed to collect the cap material. Penetration depth varied depending on the size of the gravel at each location; penetration depths are listed in Table 12.

The power grab sampler was recovered to the boat deck and the top doors were removed. Only grabs in which the sampler closed completely were considered "successful" and collected for samples. When possible, the depth from the top of the sampler to the material was measured and recorded. Overlying water was siphoned off using tubing primed with site water. Successful grab samples were geologically described. All pertinent information was recorded on field logs (Appendix F), including sample identification, sample station coordinates, recovery depth, water depth, physical/chemical characteristics, and weather conditions. All sample collection activities were conducted in accordance with PSEP guidelines (PSEP, 1997). Photographs were taken of each recovered grab (Appendix G).

Although the Technical Specifications (Section 02483, Paragraph 3.4.3.1) specify that samples be collected from the top 4 inches of the core, typically all of the material obtained in a successful grab was sampled to obtain adequate sample volume for analysis. Although the Verification SAP (BBL, 2003c) called for collecting cap verification samples in 8-ounce glass jars, larger volumes were collected with a stainless steel spoon and placed into sediment bags. The sediment bags were labeled and placed into 5-gallon buckets, which were labeled and sealed. Sample containers were placed in a cooler at 4 ± 2°C. The cap verification samples were transported under chain of custody to CAS.

All sampling equipment, including the stainless steel bowls, spoons, and power grab, were decontaminated prior to sampling and between each sample with biodegradable, non-phosphate detergent, a tap water rinse, and a distilled water rinse.

Rejected samples (i.e., those of insufficient volume or those for which the sampler did not close properly) were returned to the site by lowering the power grab sampler to the top of the cap material and opening it. No cap material in excess of what was sent to CAS was collected, so no off-site disposal of cap material was required.

The following field observations were made during sample collection:

- Sheen was observed in samples VS-31, VS-33, VS-35, VS-36, and VS-42.
- Hydrocarbon odor was noted in samples VS-33 and VS-35.

3.3.2 Procedural Deviations from the Technical Specifications and Corrective Actions

Because of the large grain size of the cap material, certain procedural deviations were necessary and approved. Those deviations are discussed in Section 3.3.1 and summarized as follows:

- Grab samples were collected rather than vibracores.
- Larger sample volumes were collected; typically, all of the grab material rather than only the top 4 inches.

- Sediment bags and 5-gallon buckets were used as sample containers (to accommodate the larger volume) rather than 8-ounce sample jars.

No corrective actions were required or performed for cap verification sampling.

3.4 Cap Verification Sampling and Testing Results

Cap verification sampling and analytical results for the 2004/2005 in-water construction season are summarized in Tables 12 through 14. Table 12 summarizes the sampling details, including the cap material description for each grab sample collected. Table 13 provides the analytical results corrected for the dry weight of the material with a grain size of less than 1 inch. Table 14 presents the analytical results corrected for the dry weight of the total sample.

3.4.1 Cap Verification Sample Chemistry

Chemistry requirements are specified in Section 01450, Table 01450-2, of the Technical Specifications. The analytical results are summarized and are compared to the chemistry criteria outlined in the Technical Specifications in Tables 13 and 14.

Many of the Washington State Sediment Management Standards (SMS) Sediment Quality Standards (SQS) require normalizing the sample results to organic carbon. However, the Technical Specifications (Table 01450-2) present dry-weight analogs of the SQS for the case in which TOC is less than 0.5%. All cap verification samples contained TOC concentrations below 0.5%. Therefore, the sample results were compared to the dry-weight analog criteria rather than to the organic-carbon normalized SQS, in accord with the Technical Specifications.

Chemistry results for the RA 4 cap verification samples were below the criteria with the exception of two PAH results for sample VS-35, which exceeded the criteria when corrected for the dry weight of the material passing the 1-inch sieve and when corrected for the dry weight of the total sample. Concentrations of acenaphthene and pyrene (corrected for the dry weight of the material passing the 1-inch sieve) were 1.1 and 1.5 times the criteria, respectively. Concentrations of acenaphthene and pyrene (corrected for the dry weight of the total sample) were 1.04 and 1.4 times the criteria, respectively.

4. Conclusions and Recommendations

4.1 Water-Quality Monitoring Conclusions and Recommendations

Water-quality monitoring was performed in RA 4 during the 2004/2005 in-water construction season. The data reporting requirements and DQOs outlined in the Technical Specifications and Water Quality QAPP were achieved for the water-quality monitoring data. As qualified, these data are acceptable for use in evaluating compliance with the Technical Specifications and WQC. No WQC violations occurred during the 2004/2005 in-water construction season that could be directly attributed to capping activities. Recommendations for future water-quality monitoring are:

- Incorporate the relocation of the Reference 3 station into the Technical Specifications for remaining contract work.

- Incorporate an exception to water-quality monitoring requirements during small-craft advisories into the Technical Specifications.

- Incorporate the September 15, 2003 WQC into the Technical Specifications.

- Incorporate weekly background water-quality monitoring into the Technical Specifications to develop a sufficient background database. The Technical Specifications require that one round of water-quality monitoring be performed at the reference stations prior to initiation of in-water work. The WQC allows for two rounds of water-quality monitoring at the reference stations before in-water construction begins. One or two rounds of monitoring provide only a "snapshot" of water-quality conditions at the reference stations, which is insufficient information to evaluate water-quality conditions during in-water construction. It is recommended that the Technical Specifications be modified to require more lengthy background monitoring prior to in-water construction. In addition, it is recommended that the Technical Specifications require weekly monitoring of all the reference stations to collect data on seasonal changes in water quality. An adequate database of background water quality would allow comparison of the compliance water-quality data to timely background data and should limit project shutdowns that result from water-quality exceedances.

- Because TSS analyses are performed only for informational purposes, the laboratory turnaround time could be extended from the current five days (expedited service) to a standard turnaround time, which would reduce the cost of this analysis by approximately 35%.

4.2 Cap Verification Sampling Conclusions and Recommendations

Cap verification sampling and analysis were performed in RA 4 during the 2004/2005 in-water construction season. In general, the data reporting requirements and DQOs outlined in the Technical Specifications and Verification QAPP were met for cap verification monitoring data. As qualified, these data are acceptable for use in evaluating compliance with the Technical Specifications. Cap verification sample chemistry results were below the criteria specified in the Technical Specifications with the exception of one sample (VS-35) that contained concentrations of acenapthene and pyrene above the criteria. Recommendations for future cap verification sampling are:

- Clarify the required proximity to target cap verification sampling locations in the Technical Specifications.

- Allow for flexibility in the Technical Specifications related to cap verification sampling (such as vibracore or power grab sampling), depending on the cap design requirements.

5. References

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TABLE 1
WATER-QUALITY MONITORING SCHEDULE
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Monitoring	**Schedule**	**Initiation Conditions for Schedule**
Ambient/Background	• Background collected 24-48 hours prior to initiating construction. • Reference (outside of the influence activity) collected with all other water-quality monitoring events.	• Background: onsite measurements prior to any in-water construction activity. • Reference: in conjunction with all other water-quality monitoring events (intensive, routine, or limited).
Intensive	• Minimum twice daily for 2 days following initiation condition for intensive monitoring.	• Startup of any in-water construction activity. • In response to any major modification to construction procedures. • In response to any exceedance of any water-quality criteria at the compliance boundary.
Routine	Once daily.	• No water-quality compliance criteria are exceeded at the compliance boundary during intensive monitoring for 2 days. • Requires USACE notification.
Limited	Once weekly.	• No water-quality compliance criteria are exceeded at the compliance boundary during routine monitoring for 1 week. • Requires USACE notification.
Continuous	During all work activities.	• Visual monitoring for sheens and distressed fish or wildlife. • Occurrence of sheens or distressed fish or wildlife will be reported to the USACE immediately and corrective action taken to contain and remove the sheen and for corrective source of the distress.

TABLE 2
SAMPLING DEPTHS
PACIFIC SOUND RESOURCES SUPERFUND SITE, MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Depth	Location in Water Column
Shallow	Approximately 3 feet below the water surface
Intermediate	Near mid-point of the water column
Deep	Within 3 feet of the mudline

TABLE 3
WATER-QUALITY MONITORING SUMMARY
PACIFIC SOUND RESOURCES SUPERFUND SITE, MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Date	Type of Monitoring	In-water Construction Activity	Tidal Stage During Sampling
9/14/2004	Background	No activity	Slack flood and strong flood
9/15/2004	Background	No activity	Slack flood and strong flood
9/16/2004	Background/Intensive	Capping in Remediation Area 4	Strong ebb (background)/ strong flood (intensive)
9/17/2004	Background/Intensive	Capping in Remediation Area 4	Strong ebb (background)/ strong flood (intensive)
9/21/2004	Routine	Capping in Remediation Area 4	Slack ebb and slack flood
9/22/2004	Routine	Capping in Remediation Area 4	Strong ebb
9/23/2004	Routine	Capping in Remediation Area 4	Strong ebb
9/24/2004	Routine	Capping in Remediation Area 4	Strong flood
9/25/2004	Routine	Capping in Remediation Area 4	Strong flood
9/29/2004	Routine	Capping in Remediation Area 4	Strong ebb
9/30/2004	Intensive	Capping in Remediation Area 4	Strong flood and slack flood
10/1/2004	Intensive	No activity	Slack flood
10/5/2004	Limited	Capping in Remediation Area 4	Strong ebb
10/12/2004	Intensive	Capping in Remediation Area 4	Strong flood/Strong ebb
10/14/2004	Intensive	Capping in Remediation Area 4	Strong ebb
10/15/2004	Intensive	Capping in Remediation Area 4	Strong flood
10/19/2004	Limited	Capping in Remediation Area 4	Strong ebb
10/23/2004	Intensive	Capping in Remediation Area 4	Strong flood
10/26/2004	Intensive	Capping in Remediation Area 4	Strong ebb/Strong flood
10/28/2004	Intensive	Capping in Remediation Area 4	Strong flood
11/1/2004	Limited	Capping in Remediation Area 4	Strong flood
11/8/2004	Limited	Capping in Remediation Area 4	Strong flood/Strong ebb
11/16/2004	Limited	Capping in Remediation Area 4	Strong flood
11/22/2004	Intensive	Capping in Remediation Area 4	Strong flood/Strong ebb

TABLE 4
WATER-QUALITY SAMPLING LOCATIONS
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Date Sampled	Sample Location	Time Sampled	Northing (a)	Easting (a)
Reference 1	9/14/2004	11:15	217,737	1,260,525
Reference 2	9/14/2004	10:35	217,985	1,262,840
Reference 3	9/14/2004	11:50	219,325	1,260,241
Reference 1	9/14/2004	13:25	217,988	1,262,710
Reference 2	9/14/2004	13:15	217,690	1,260,345
Reference 3	9/14/2004	12:40	219,324	1,260,241
Reference 1	9/15/2004	10:54	217,103	1,260,940
Reference 2	9/15/2004	12:10	217,309	1,264,025
Reference 3	9/15/2004	11:45	218,118	1,261,853
Reference 1	9/15/2004	13:50	217,317	1,261,174
Reference 2	9/15/2004	13:05	217,314	1,264,079
Reference 3	9/15/2004	13:30	218,110	1,261,067
Reference 1	9/16/2004	11:00	217,156	1,260,998
Reference 2	9/16/2004	11:45	217,296	1,264,050
Reference 3	9/16/2004	11:25	218,129	1,261,923
Reference 1	9/16/2004	13:05	217,291	1,260,964
Reference 2	9/16/2004	15:20	217,260	1,264,037
Reference 3	9/16/2004	14:55	218,257	1,261,884
Early Warning	9/16/2004	13:45	217,365	1,263,948
Downgradient 1	9/16/2004	14:05	217,169	1,264,043
Downgradient 2	9/16/2004	14:40	217,181	1,263,710
Upgradient	9/16/2004	14:20	217,850	1,263,715
Reference 1	9/17/2004	12:30	217,248	1,260,972
Reference 2	9/17/2004	11:50	217,284	1,264,074
Reference 3	9/17/2004	12:12	218,143	1,261,812
Early Warning	9/17/2004	13:00	217,298	1,261,832
Downgradient 1	9/17/2004	13:10	217,921	1,261,981
Downgradient 2	9/17/2004	13:18	217,787	1,261,702
Reference 1	9/17/2004	13:40	217,263	1,261,124
Reference 2	9/17/2004	15:30	217,450	1,263,979
Reference 3	9/17/2004	15:16	218,255	1,261,707
Early Warning	9/17/2004	14:15	217,577	1,264,018
Downgradient 1	9/17/2004	14:25	217,863	1,263,975
Downgradient 2	9/17/2004	15:05	217,039	1,262,008
Upgradient	9/17/2004	14:45	217,836	1,261,999
Reference 1	9/21/2004	16:10	217,741	1,260,353
Reference 2	9/21/2004	16:25	217,795	1,262,727
Reference 3	9/21/2004	17:15	219,125	1,261,588
Early Warning	9/21/2004	17:45	217,623	1,262,202
Downgradient 1	9/21/2004	17:50	217,476	1,262,453
Downgradient 2	9/21/2004	18:05	217,362	1,262,053
Upgradient	9/21/2004	18:15	218,882	1,261,583
Reference 1	9/22/2004	16:30	217,740	1,260,381
Reference 2	9/22/2004	17:30	217,629	1,262,902
Reference 3	9/22/2004	17:10	219,303	1,261,797
Early Warning	9/22/2004	19:30	217,684	1,262,162
Downgradient 1	9/22/2004	19:45	217,554	1,262,592

TABLE 4
WATER-QUALITY SAMPLING LOCATIONS
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Date Sampled	Sample Location	Time Sampled	Northing (a)	Easting (a)
Downgradient 2	9/22/2004	20:00	217,436	1,261,931
Upgradient	9/22/2004	18:45	218,729	1,262,649
Reference 1	9/23/2004	13:15	217,752	1,260,299
Reference 2	9/23/2004	14:30	217,691	1,262,862
Reference 3	9/23/2004	13:55	218,683	1,260,358
Early Warning	9/23/2004	17:30	218,637	1,261,647
Downgradient 1	9/23/2004	17:40	218,814	1,261,437
Downgradient 2	9/23/2004	18:15	218,906	1,261,899
Upgradient	9/23/2004	15:30	217,559	1,262,365
Reference 1	9/24/2004	16:00	217,751	1,260,333
Reference 2	9/24/2004	15:00	217,840	1,262,981
Reference 3	9/24/2004	15:30	218,927	1,260,329
Early Warning	9/24/2004	13:45	217,582	1,262,222
Downgradient 1	9/24/2004	14:00	217,449	1,262,295
Downgradient 2	9/24/2004	14:20	217,476	1,262,446
Upgradient	9/24/2004	14:40	218,811	1,258,009
Reference 1	9/25/2004	15:12	217,278	1,260,997
Reference 2	9/25/2004	13:30	217,293	1,264,198
Reference 3	9/25/2004	14:48	218,160	1,261,903
Early Warning	9/25/2004	13:45	217,215	1,262,003
Downgradient 1	9/25/2004	14:05	217,045	1,261,988
Downgradient 2	9/25/2004	14:30	217,097	1,263,984
Upgradient	9/25/2004	14:10	217,764	1,261,944
Reference 1	9/29/2004	16:38	217,129	1,261,158
Reference 2	9/29/2004	16:09	217,305	1,264,219
Reference 3	9/29/2004	16:25	217,942	1,261,866
Early Warning	9/29/2004	20:58	217,806	1,261,949
Downgradient 1	9/29/2004	21:08	217,726	1,261,697
Downgradient 2	9/29/2004	21:23	217,856	1,261,897
Upgradient	9/29/2004	21:37	217,195	1,263,920
Reference 3	9/30/2004	19:04	218,142	1,261,899
Early Warning	9/30/2004	18:18	218,142	1,261,899
Downgradient 1	9/30/2004	18:22	217,121	1,263,972
Downgradient 2	9/30/2004	18:33	217,039	1,262,021
Upgradient	9/30/2004	18:45	217,792	1,261,764
Reference 1	10/5/2004	15:14	217,690	1,260,359
Reference 2	10/5/2004	13:38	217,770	1,262,932
Reference 3	10/5/2004	15:49	219,204	1,261,685
Early Warning	10/5/2004	13:59	218,737	1,261,710
Downgradient 1	10/5/2004	14:18	218,439	1,261,402
Downgradient 2	10/5/2004	14:41	218,963	1,262,057
Upgradient	10/5/2004	14:56	217,362	1,262,581
Reference 1	10/12/2004	14:45	217,731	1,260,353
Reference 2	10/12/2004	15:30	217,811	1,262,926
Reference 3	10/12/2004	17:30	219,376	1,261,689
Early Warning A	10/12/2004	18:30	218,193	1,261,062
Downgradient 1A	10/12/2004	18:45	218,049	1,260,620

TABLE 4
WATER-QUALITY SAMPLING LOCATIONS
PACIFIC SOUND RESOURCES SUPERFUND SITE, MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Date Sampled	Sample Location	Time Sampled	Northing (a)	Easting (a)
Downgradient 2A	10/12/2004	19:10	218,301	1,261,235
Upgradient A	10/12/2004	19:30	217,082	1,261,362
Early Warning B	10/12/2004	15:51	217,158	1,261,103
Downgradient 1 B	10/12/2004	16:05	216,930	1,260,858
Downgradient 2 B	10/12/2004	16:15	217,346	1,261,540
Upgradient B	10/12/2004	16:30	218,468	1,260,957
Reference 1	10/14/2004	17:30	217,710	1,260,373
Reference 2	10/14/2004	18:20	217,801	1,262,926
Reference 3	10/14/2004	18:45	219,283	1,260,775
Early Warning	10/14/2004	20:55	218,127	1,260,800
Downgradient 1	10/14/2004	21:30	218,450	1,260,361
Downgradient 2	10/14/2004	21:50	218,813	1,260,958
Upgradient	10/14/2004	22:05	217,157	1,261,164
Reference 1	10/15/2004	12:30	217,720	1,260,367
Reference 2	10/15/2004	14:30	217,811	1,262,933
Reference 3	10/15/2004	14:20	219,745	1,260,990
Early Warning A	10/15/2004	13:15	217,321	1,261,607
Downgradient 1 A	10/15/2004	13:20	217,533	1,262,139
Downgradient 2 A	10/15/2004	13:45	216,996	1,261,113
Upgradient A	10/15/2004	14:00	218,292	1,260,652
Early Warning B	10/15/2004	15:40	217,064	1,261,238
Downgradient 1 B	10/15/2004	15:55	216,927	1,261,016
Downgradient 2 B	10/15/2004	16:05	217,312	1,262,031
Upgradient B	10/15/2004	16:20	218,080	1,260,600
Reference 1	10/19/2004	11:45	217,700	1,260,366
Reference 2	10/19/2004	14:00	217,872	1,262,927
Reference 3	10/19/2004	14:30	219,209	1,260,417
Early Warning	10/19/2004	12:30	217,908	1,264,690
Downgradient 1	10/19/2004	12:40	217,908	1,264,690
Downgradient 2	10/19/2004	13:15	218,245	1,261,008
Upgradient	10/19/2004	13:45	216,823	1,261,123
Reference 1	10/23/2004	12:45	217,662	1,260,256
Reference 2	10/23/2004	12:35	217,716	1,263,137
Reference 3	10/23/2004	12:15	219,050	1,260,277
Early Warning	10/23/2004	11:00	216,931	1,261,318
Downgradient 1	10/23/2004	11:15	216,822	1,261,185
Downgradient 2	10/23/2004	11:35	217,505	1,262,001
Upgradient	10/23/2004	11:45	218,285	1,261,029
Reference 1	10/26/2004	16:30	217,580	1,260,295
Reference 2	10/26/2004	17:00	217,821	1,262,919
Reference 3	10/26/2004	17:00	218,917	1,260,823
Early Warning A	10/26/2004	12:30	216,793	1,261,143
Downgradient 1A	10/26/2004	12:45	216,717	1,260,868
Downgradient 2A	10/26/2004	13:15	217,401	1,261,615
Upgradient A	10/26/2004	13:25	218,225	1,260,466
Early Warning B	10/26/2004	18:00	218,156	1,260,355
Downgradient 1B	10/26/2004	18:42	218,213	1,261,055

TABLE 4
WATER-QUALITY SAMPLING LOCATIONS
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Date Sampled	Sample Location	Time Sampled	Northing (a)	Easting (a)
Downgradient 2B	10/26/2004	19:00	218,078	1,260,209
Upgradient B	10/26/2004	19:30	216,772	1,261,150
Reference 1	10/28/2004	12:30	217,741	1,260,353
Reference 2	10/28/2004	13:15	218,470	1,262,432
Reference 3	10/28/2004	14:30	219,020	1,260,763
Early Warning A	10/28/2004	13:45	217,025	1,261,196
Downgradient 1A	10/28/2004	13:50	216,812	1,261,185
Downgradient 2A	10/28/2004	14:05	217,180	1,261,515
Upgradient A	10/28/2004	14:10	217,927	1,260,679
Early Warning B	10/28/2004	17:30	217,613	1,260,652
Downgradient 1B	10/28/2004	17:55	217,830	1,260,444
Downgradient 2B	10/28/2004	18:30	218,386	1,261,052
Upgradient B	10/28/2004	18:40	217,073	1,261,293
Reference 1	11/1/2004	11:15	217,741	1,260,360
Reference 2	11/1/2004	11:40	217,985	1,262,854
Reference 3	11/1/2004	11:55	219,087	1,264,528
Early Warning	11/1/2004	13:20	218,630	1,261,496
Downgradient 1	11/1/2004	13:35	219,002	1,261,633
Downgradient 2	11/1/2004	14:00	218,640	1,260,982
Upgradient	11/1/2004	14:15	217,649	1,261,922
Reference 1	11/8/2004	10:35	217,720	1,260,367
Reference 2	11/8/2004	10:45	217,792	1,262,884
Reference 3	11/8/2004	11:15	219,146	1,261,033
Early Warning	11/8/2004	14:30	218,179	1,261,260
Downgradient 1	11/8/2004	14:40	218,584	1,261,282
Downgradient 2	11/8/2004	14:45	218,634	1,261,832
Upgradient	11/8/2004	15:10	217,266	1,261,797
Reference 1	11/16/2004	14:10	217,761	1,260,333
Reference 2	11/16/2004	15:00	217,913	1,262,921
Reference 3	11/16/2004	14:40	219,229	1,260,932
Early Warning	11/16/2004	16:30	216,951	1,261,339
Downgradient 1	11/16/2004	16:40	216,661	1,261,134
Downgradient 2	11/16/2004	16:50	217,246	1,261,763
Upgradient	11/16/2004	17:20	217,969	1,261,105
Reference 1	11/22/2004	11:00	217,752	1,260,326
Reference 2	11/22/2004	11:25	217,812	1,262,905
Reference 3	11/22/2004	11:45	219,359	1,261,016
Early Warning A	11/22/2004	11:55	217,101	1,261,458
Downgradient 1 A	11/22/2004	12:00	216,800	1,261,281
Downgradient 2 A	11/22/2004	12:10	217,219	1,262,112
Upgradient A	11/22/2004	12:15	218,038	1,261,696
Early Warning B	11/22/2004	13:50	217,899	1,261,584
Downgradient 1B	11/22/2004	14:50	217,988	1,261,167
Downgradient 2B	11/22/2004	15:00	217,945	1,262,311
Upgradient B	11/22/2004	15:15	217,480	1,261,219

a.Washington State Plane Coordinates North Zone, North America Datum 83.

TABLE 5
WATER-QUALITY PARAMETERS AND COMPLIANCE CRITERIA
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Parameter	Compliance Criteria	Basis	Point of Compliance
Dissolved Oxygen	No less than 6 mg/L; if the DO is already below 6 mg/L, then additional decreases may only be 0.2 mg/L.	WAC 173-201A	Compliance boundary (300-foot radius for dredging and 600-foot radius for capping activities).
	No less than 3.5 mg/L.	WQC; Acute Effects	"Early Warning" Station.
Turbidity	No greater than 5 NTU over background when background is 50 NTUs or less; no greater than 10% increase when background is greater than 50 NTUs.	WAC 173-210A	Compliance boundary (300-foot radius for dredging and 600-foot radius for capping activities).
Temperature	<16^{0}C and no incremental increase. > 0.3^{0}C allowed when background temperature naturally exceeds 16^{0}C.	WAC 173-210A	Compliance boundary (300-foot radius for dredging and 600-foot radius for capping activities).
Sheens	No visible sheens allowed outside the work area. Sheens will be contained with booms or other appropriate controls.	WAC 173-210A	All surface water outside of containment booms around the work area.
Total Suspended Solids	For informational purposes (no criteria available).	–	–

Notes:
°C – degrees Celsius
DO – dissolved oxygen
mg/L – milligram per liter
NTU – Nephelometric turbidity unit
WAC- Washington Administrative Code
WQC – Water Quality Certification

TABLE 6
DO TITRATION RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Water Depth (ft MLLW)	Dissolved Oxygen from Titration (mg/L)	Dissolved Oxygen from YSI Probe (mg/L)
Reference 1	9/23/2004	13:15	-70	6.20	5.94
Reference 2	9/22/2004	17:30	-15	5.75	5.57
Reference 3	9/24/2004	15:30	-139	5.30	4.44
Reference 1 midpoint	10/5/2004	15:14	-69.62	6.1	5.73
Reference 2 midpoint	10/5/2004	13:38	-15.42	6.6	5.98
Reference 3 midpoint	10/5/2004	15:49	-97.01	5.9	5.68
Downgradient 1 midpoint	10/5/2004	15:46	-92.9	6.1	5.36
Reference 1 midpoint	10/12/2004	14:45	-30.66	6.3	6.18
Upgradient B midpoint	10/12/2004	16:30	-98.81	5.6	5.95
Upgradient A midpoint	10/12/2004	19:30	-7.28	7.0	7.94
Reference 1 midpoint	10/14/2004	17:30	-69.63	5.6	5.75
Upgradient midpoint	10/14/2004	22:05	-20.62	6.0	5.72
Reference 1 midpoint	10/15/2004	12:30	-72.45	6.0	6.49
Upgradient B midpoint	10/15/2004	16:20	-109.83	5.8	5.76
Reference 2 midpoint	10/19/2004	14:00	-26.22	6.4	6.48
Upgradient midpoint	10/19/2004	13:45	-10.96	6.2	6.33
Upgradient midpoint	10/23/2004	11:45	-102.24	6.3	6.24
Upgradient A midpoint	10/26/2004	13:25	-102.55	5.9	6.04
Upgradient B midpoint	10/26/2004	19:30	-14.44	6.2	6.54
Reference 2 midpoint	10/28/2004	13:15	-20.03	5.0	5.71
Downgradient 1B midpoint	10/28/2004	17:55	-56.79	6.02	6.09
Reference 1 midpoint	11/1/2004	11:15	-71.16	6.3	5.96
Upgradient midpoint	11/1/2004	14:15	-8.71	6.8	6.61
Reference 2 midpoint	11/8/2004	10:45	-17.10	6.6	6.75
Reference 1 midpoint	11/16/2004	14:10	-71.51	6.0	6.06
Reference 1 midpoint	11/22/2004	11:00	-68.57	6.8	6.62
Downgradient 2B midpoint	11/22/2004	15:00	-34.30	6.7	6.76

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Reference 2	9/14/2004	10:35	-1.7	9.07	1.2	14.34	-
Reference 2	9/14/2004	10:35	-29.7	9.58	0	13.90	5 U
Reference 2	9/14/2004	10:35	-58.7	9.01	0	13.76	-
Reference 1	9/14/2004	11:15	-2.2	8.72	0.1	14.23	-
Reference 1	9/14/2004	11:15	-69.2	9.25	0.7	13.72	5 U
Reference 1	9/14/2004	11:15	-139.2	7.12	0.1	12.87	-
Reference 3	9/14/2004	11:50	-2.2	8.47	0.2	14.19	-
Reference 3	9/14/2004	11:50	-149.2	7.08	0.5	13.01	5 U
Reference 3	9/14/2004	11:50	-299.2	6.25	0.7	12.36	-
Reference 3	9/14/2004	12:40	-1.5	8.74	0	14.25	-
Reference 3	9/14/2004	12:40	-148.5	7.37	0	12.83	5 U
Reference 3	9/14/2004	12:40	-298.5	6.86	0	12.50	-
Reference 2	9/14/2004	13:15	-0.7	9.56	1.4	14.24	-
Reference 2	9/14/2004	13:15	-69.7	9.11	0	13.18	5 U
Reference 2	9/14/2004	13:15	-137.7	7.50	0.2	12.94	-
Reference 1	9/14/2004	13:25	-0.4	10.98	0	14.10	-
Reference 1	9/14/2004	13:25	-33.4	10.27	0	13.85	5 U
Reference 1	9/14/2004	13:25	-66.4	9.11	0	13.34	-
Reference 1	9/15/2004	10:54	-0.7	8.14	(a)	13.69	-
Reference 1	9/15/2004	10:54	-47.7	7.74	(a)	13.45	5 U
Reference 1	9/15/2004	10:54	-97.7	7.68	(a)	13.35	-
Reference 3	9/15/2004	11:45	-1.6	7.28	0.1	13.77	-
Reference 3	9/15/2004	11:45	-148.6	7.23	0	13.46	5 U
Reference 3	9/15/2004	11:45	-298.6	6.93	0	13.22	-
Reference 2	9/15/2004	12:10	-1.7	8.04	0.4	13.84	-
Reference 2	9/15/2004	12:10	-28.7	7.72	0	13.58	5 U
Reference 2	9/15/2004	12:10	-62.7	7.63	0	13.56	-
Reference 2	9/15/2004	13:05	-1.2	7.61	0.5	13.77	-
Reference 2	9/15/2004	13:05	-28.2	7.81	0.2	13.60	5 U
Reference 2	9/15/2004	13:05	-57.2	7.76	0	13.58	-
Reference 3	9/15/2004	13:30	-0.5	7.22	0.1	13.92	-
Reference 3	9/15/2004	13:30	-147.5	6.30	0.2	12.86	5 U
Reference 3	9/15/2004	13:30	-297.5	5.47	0.5	12.42	-
Reference 1	9/15/2004	13:50	0.2	8.54	0.1	13.85	-
Reference 1	9/15/2004	13:50	-61.9	7.68	0	13.52	5 U
Reference 1	9/15/2004	13:50	-123.9	7.43	0	13.44	-
Reference 1	9/16/2004	11:00	0.8	7.97	0.4	13.69	-
Reference 1	9/16/2004	11:00	-40.2	8.26	0.4	13.57	5 U
Reference 1	9/16/2004	11:00	-80.2	8.11	0.3	13.55	-
Reference 3	9/16/2004	11:25	0.3	7.90	1.8	13.77	-
Reference 3	9/16/2004	11:25	-146.7	7.14	1.3	13.26	5 U
Reference 3	9/16/2004	11:25	-296.7	6.12	0.9	12.63	-
Reference 2	9/16/2004	11:45	-0.2	8.44	0.6	13.84	-
Reference 2	9/16/2004	11:45	-32.2	7.52	0.3	13.49	5 U
Reference 2	9/16/2004	11:45	-64.2	8.18	0.2	13.52	-
Reference 1	9/16/2004	13:05	-0.8	8.51	0.5	13.64	-
Reference 1	9/16/2004	13:05	-67.8	7.50	0.3	13.39	5 U

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Reference 1	9/16/2004	13:05	-137.8	6.58	0.9	12.78	-
Reference 3	9/16/2004	14:55	1.8	8.10	1.5	13.74	-
Reference 3	9/16/2004	14:55	-145.2	6.71	1.2	13.03	5 U
Reference 3	9/16/2004	14:55	-295.2	5.34	6.7	12.41	-
Reference 2	9/16/2004	15:20	2.9	8.17	2.6	13.76	-
Reference 2	9/16/2004	15:20	-29.1	7.41	2.5	13.46	5 U
Reference 2	9/16/2004	15:20	-61.1	7.11	2.4	13.33	-
Early Warning	9/16/2004	13:45	-0.2	7.81	1.4	13.96	-
Early Warning	9/16/2004	13:45	-37.2	7.30	0.4	13.49	-
Early Warning	9/16/2004	13:45	-74.2	7.48	0.3	13.47	-
Downgradient 1	9/16/2004	14:05	0.2	8.96	2.4	13.77	-
Downgradient 1	9/16/2004	14:05	-24.8	7.80	2.7	13.54	5 U
Downgradient 1	9/16/2004	14:05	-46.8	7.18	2.1	13.42	-
Upgradient	9/16/2004	14:20	0.8	7.86	1.4	13.77	-
Upgradient	9/16/2004	14:20	-91.2	7.19	1.1	13.39	5 U
Upgradient	9/16/2004	14:20	-181.2	6.84	1.5	13.21	-
Downgradient 2	9/16/2004	14:40	1.4	8.24	1.5	13.66	-
Downgradient 2	9/16/2004	14:40	-19.6	7.57	1.4	13.53	29
Downgradient 2	9/16/2004	14:40	-40.6	7.66	1.4	13.58	-
Reference 2	9/17/2004	11:50	1.5	9.84	0.3	13.74	-
Reference 2	9/17/2004	11:50	-26.5	7.96	0.2	13.41	5 U
Reference 2	9/17/2004	11:50	-55.5	7.60	0.4	13.40	-
Reference 3	9/17/2004	12:12	1.0	9.45	0.6	13.90	-
Reference 3	9/17/2004	12:12	-146.0	8.25	1	12.81	5 U
Reference 3	9/17/2004	12:12	-296.0	7.31	4.2	12.38	-
Reference 1	9/17/2004	12:30	0.7	8.35	0	13.56	-
Reference 1	9/17/2004	12:30	-32.4	8.10	0	13.42	5 U
Reference 1	9/17/2004	12:30	-65.4	7.86	0	13.38	-
Reference 1	9/17/2004	13:40	0.3	9.61	0	13.56	-
Reference 1	9/17/2004	13:40	-73.7	8.64	0	13.33	5 U
Reference 1	9/17/2004	13:40	-146.7	7.91	0.6	13.08	-
Reference 2	9/17/2004	15:30	2.7	8.49	0.8	13.66	-
Reference 2	9/17/2004	15:30	-32.3	7.79	0	13.37	5 U
Reference 2	9/17/2004	15:30	-67.3	7.82	0.8	13.35	-
Reference 3	9/17/2004	15:16	2.1	9.21	0	13.95	-
Reference 3	9/17/2004	15:16	-144.9	7.47	0.1	12.85	5 U
Reference 3	9/17/2004	15:16	-244.9	5.63	15.3	12.36	-
Early Warning	9/17/2004	13:00	0.3	7.61	0.1	13.87	-
Early Warning	9/17/2004	13:00	-91.7	7.72	0	13.33	-
Early Warning	9/17/2004	13:00	-181.7	7.06	0.6	13.10	-
Downgradient 1	9/17/2004	13:10	0.3	8.52	0.3	13.80	-
Downgradient 1	9/17/2004	13:10	-96.7	7.93	0.2	13.23	5 U
Downgradient 1	9/17/2004	13:10	-176.7	7.54	5.0	12.91	-
Downgradient 2	9/17/2004	13:18	0.3	9.17	0.2	13.90	-
Downgradient 2	9/17/2004	13:18	-96.7	8.76	0	13.26	5 U
Downgradient 2	9/17/2004	13:18	-196.7	7.85	0.8	12.93	-
Early Warning	9/17/2004	14:15	0.7	9.05	0.8	13.80	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Early Warning	9/17/2004	14:15	-46.4	8.15	0.1	13.38	-
Early Warning	9/17/2004	14:15	-91.4	7.93	0.7	13.23	-
Downgradient 1	9/17/2004	14:25	0.8	9.06	0.1	13.84	-
Downgradient 1	9/17/2004	14:25	-21.2	8.15	0	13.38	5 U
Downgradient 1	9/17/2004	14:25	-43.2	8.25	0	13.46	-
Upgradient	9/17/2004	14:45	1.3	8.68	0.3	13.95	-
Upgradient	9/17/2004	14:45	-120.7	7.47	0	13.20	13
Upgradient	9/17/2004	14:45	-235.7	6.02	5.1	12.46	-
Downgradient 2	9/17/2004	15:05	1.8	8.04	0.3	13.90	-
Downgradient 2	9/17/2004	15:05	-13.2	7.55	0	13.36	5 U
Downgradient 2	9/17/2004	15:05	-28.2	7.80	6.2	13.36	-
Reference 1	9/21/2004	16:10	4.8	6.18	0.1	13.89	-
Reference 1	9/21/2004	16:10	-64.2	5.42	0	13.02	5 U
Reference 1	9/21/2004	16:10	-135.2	5.33	0.2	12.92	-
Reference 2	9/21/2004	16:25	4.7	6.57	0.2	13.92	-
Reference 2	9/21/2004	16:25	-22.3	6.01	0.2	13.16	5 U
Reference 2	9/21/2004	16:25	-47.3	6.23	2.1	12.96	-
Reference 3	9/21/2004	17:15	4.6	6.61	0.3	13.87	-
Reference 3	9/21/2004	17:15	-142.4	5.07	0	12.86	5 U
Reference 3	9/21/2004	17:15	-242.4	5.21	6.6	12.81	-
Early Warning	9/21/2004	17:45	4.7	6.98	0.8	14.02	-
Early Warning	9/21/2004	17:45	-14.3	6.68	0.2	13.35	-
Early Warning	9/21/2004	17:45	-36.3	5.81	4.1	13.05	-
Upgradient	9/21/2004	18:15	5.0	6.19	0.8	13.54	-
Upgradient	9/21/2004	18:15	-92.1	5.88	0	12.98	39
Upgradient	9/21/2004	18:15	-192.1	5.30	4.7	12.82	-
Downgradient 1	9/21/2004	17:50	4.8	6.09	0.5	13.70	-
Downgradient 1	9/21/2004	17:50	-15.2	6.13	1.2	13.16	5 U
Downgradient 1	9/21/2004	17:50	-36.2	5.58	7.6	13.05	-
Downgradient 2	9/21/2004	18:05	4.9	6.63	0.2	13.70	-
Downgradient 2	9/21/2004	18:05	-12.1	6.42	0.0	13.36	5 U
Downgradient 2	9/21/2004	18:05	-27.1	6.65	1.1	13.33	-
Reference 1	9/22/2004	16:30	5.8	6.96	0	13.59	-
Reference 1	9/22/2004	16:30	-66.2	5.20	0	12.95	5 U
Reference 1	9/22/2004	16:30	-131.2	5.32	0.3	12.93	-
Reference 2	9/22/2004	17:30	5.1	6.36	0.9	13.31	-
Reference 2	9/22/2004	17:30	-14.9	5.57	0.9	13.14	5 U
Reference 2	9/22/2004	17:30	-26.9	5.82	0.1	13.11	-
Reference 3	9/22/2004	17:10	5.3	5.86	0	13.30	-
Reference 3	9/22/2004	17:10	-141.7	5.30	0	12.90	5 U
Reference 3	9/22/2004	17:10	-291.7	4.35	4.5	12.51	-
Early Warning	9/22/2004	19:30	5.0	6.26	0.1	13.49	-
Early Warning	9/22/2004	19:30	-17.0	5.91	0.3	13.18	-
Early Warning	9/22/2004	19:30	-42.0	5.69	0.4	13.16	-
Downgradient 1	9/22/2004	19:45	5.1	6.17	0	13.46	-
Downgradient 1	9/22/2004	19:45	-17.0	5.61	0.1	13.21	5 U
Downgradient 1	9/22/2004	19:45	-41.0	5.44	0	13.12	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Downgradient 2	9/22/2004	20:00	5.2	6.18	0	13.52	-
Downgradient 2	9/22/2004	20:00	-6.8	5.80	0	13.27	5 U
Downgradient 2	9/22/2004	20:00	-19.8	5.75	0.3	13.15	-
Upgradient	9/22/2004	18:45	4.8	6.18	0.8	13.43	-
Upgradient	9/22/2004	18:45	-72.2	5.65	0.3	13.10	5 U
Upgradient	9/22/2004	18:45	-151.2	5.54	0	12.96	-
Reference 1	9/23/2004	13:15	7.1	6.29	0.2	13.66	-
Reference 1	9/23/2004	13:15	-69.9	5.94	0.2	13.10	5 U
Reference 1	9/23/2004	13:15	-146.9	5.22	1.4	12.83	-
Reference 2	9/23/2004	14:30	7.9	6.25	0.3	13.55	-
Reference 2	9/23/2004	14:30	-17.1	6.09	0.1	13.21	6
Reference 2	9/23/2004	14:30	-44.1	5.72	0.4	13.14	-
Reference 3	9/23/2004	13:55	7.7	6.43	0.3	13.92	-
Reference 3	9/23/2004	13:55	-139.3	5.26	0.3	12.79	5 U
Reference 3	9/23/2004	13:55	-239.3	4.73	3.2	12.52	-
Upgradient	9/23/2004	15:30	7.8	6.63	0.4	14.68	-
Upgradient	9/23/2004	15:30	-10.2	6.10	0.2	13.21	5 U
Upgradient	9/23/2004	15:30	-29.2	5.66	0.3	13.20	-
Downgradient 1	9/23/2004	17:40	5.8	6.53	0.3	14.27	-
Downgradient 1	9/23/2004	17:40	-103.2	5.64	0.6	12.92	7
Downgradient 1	9/23/2004	17:40	-214.2	4.53	2.0	12.54	-
Downgradient 2	9/23/2004	18:15	5.3	6.28	0.4	14.18	-
Downgradient 2	9/23/2004	18:15	-103.7	5.49	0	13.12	5 U
Downgradient 2	9/23/2004	18:15	-191.7	4.83	15.2	12.41	-
Early Warning	9/23/2004	17:30	6.0	6.66	0.4	14.47	-
Early Warning	9/23/2004	17:30	-98.0	5.48	1.1	12.98	-
Early Warning	9/23/2004	17:30	-203.0	5.02	0.3	12.60	-
Reference 1	9/24/2004	16:00	8.3	6.15	0.0	13.46	-
Reference 1	9/24/2004	16:00	-48.7	5.58	0.0	13.02	5 U
Reference 1	9/24/2004	16:00	-106.7	4.86	1.0	12.77	-
Reference 2	9/24/2004	15:00	8.2	6.22	0.3	13.56	-
Reference 2	9/24/2004	15:00	-13.8	6.19	0.2	13.24	5 U
Reference 2	9/24/2004	15:00	-37.8	5.84	0.5	13.21	-
Reference 3	9/24/2004	15:30	8.4	6.00	0.1	13.41	-
Reference 3	9/24/2004	15:30	-138.6	4.44	0.3	12.63	9
Reference 3	9/24/2004	15:30	-238.6	4.26	1.1	12.36	-
Upgradient	9/24/2004	14:40	8.0	6.20	0.1	13.36	-
Upgradient	9/24/2004	14:40	-89.0	5.80	0.0	12.96	5 U
Upgradient	9/24/2004	14:40	-189.0	4.88	2.5	12.76	-
Downgradient 1	9/24/2004	14:00	7.3	6.61	0.7	13.66	-
Downgradient 1	9/24/2004	14:00	-9.7	6.03	0.2	13.26	5 U
Downgradient 1	9/24/2004	14:00	-27.7	5.76	0	13.22	-
Downgradient 2	9/24/2004	14:20	7.7	6.71	0.2	13.47	-
Downgradient 2	9/24/2004	14:20	-19.3	6.17	0.1	13.22	5 U
Downgradient 2	9/24/2004	14:20	-47.3	5.63	0.4	13.07	-
Early Warning	9/24/2004	13:45	6.8	6.71	0.7	13.55	-
Early Warning	9/24/2004	13:45	-11.2	6.34	0.2	13.27	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Early Warning	9/24/2004	13:45	-30.2	6.14	0	13.13	-
Reference 2	9/25/2004	13:30	5.1	6.78	0.3	13.78	-
Reference 2	9/25/2004	13:30	-12.9	5.88	0	13.22	5 U
Reference 2	9/25/2004	13:30	-31.9	5.66	0	13.13	-
Reference 1	9/25/2004	15:12	8.0	6.61	0	13.83	-
Reference 1	9/25/2004	15:12	-67.0	5.43	0	12.92	5 U
Reference 1	9/25/2004	15:12	-134.0	4.87	0	12.82	-
Reference 3	9/25/2004	14:48	7.4	6.30	0.2	13.67	-
Reference 3	9/25/2004	14:48	-139.6	5.30	0	12.86	5 U
Reference 3	9/25/2004	14:48	-239.6	4.97	15.1	12.66	-
Early Warning	9/25/2004	13:45	5.5	7.06	7.8	14.06	-
Early Warning	9/25/2004	13:45	-21.5	5.32	0.1	13.14	-
Early Warning	9/25/2004	13:45	-53.5	4.97	0	12.98	-
Downgradient 1	9/25/2004	14:05	6.2	6.17	0.2	13.80	-
Downgradient 1	9/25/2004	14:05	-5.8	5.91	0	13.34	10
Downgradient 1	9/25/2004	14:05	-20.8	5.73	1.7	13.21	-
Upgradient	9/25/2004	14:10	6.5	5.18	0.4	0.59	-
Upgradient	9/25/2004	14:10	-90.5	4.50	0.3	12.99	5 U
Upgradient	9/25/2004	14:10	-190.5	4.36	6.5	12.78	-
Downgradient 2	9/25/2004	14:30	7.1	6.57	0.1	13.93	-
Downgradient 2	9/25/2004	14:30	-11.9	6.13	0	13.21	5 U
Downgradient 2	9/25/2004	14:30	-29.9	5.49	9.8	13.14	-
Reference 2	9/29/2004	16:09	5.8	4.62 (c)	0.3	13.98	-
Reference 2	9/29/2004	16:09	-16.2	4.46 (c)	0	13.16	5 U
Reference 2	9/29/2004	16:09	-38.2	4.19 (c)	0.2	13.14	-
Reference 3	9/29/2004	16:25	6.5	4.66 (c)	0.3	13.57	-
Reference 3	9/29/2004	16:25	-140.6	3.68 (c)	0.1	12.90	5 U
Reference 3	9/29/2004	16:25	-240.6	3.52 (c)	3.3	12.76	-
Reference 1	9/29/2004	16:38	6.8	4.44 (c)	0.7	13.98	-
Reference 1	9/29/2004	16:38	-78.3	3.88 (c)	0.1	13.01	5 U
Reference 1	9/29/2004	16:38	-153.3	3.61 (c)	0.3	12.94	-
Early Warning	9/29/2004	20:58	4.9	4.09 (c)	0.3	13.91	-
Early Warning	9/29/2004	20:58	-92.1	3.42 (c)	0.1	12.89	-
Early Warning	9/29/2004	20:58	-182.1	3.16 (c)	1.1	12.74	-
Downgradient 1	9/29/2004	21:08	4.5	4.25 (c)	0.4	14.01	-
Downgradient 1	9/29/2004	21:08	-117.5	3.36 (c)	0.1	12.82	5 U
Downgradient 1	9/29/2004	21:08	-229.5	3.14 (c)	15.5	12.57	-
Downgradient 2	9/29/2004	21:23	3.6	4.35 (c)	0.4	13.99	-
Downgradient 2	9/29/2004	21:23	-118.4	3.54 (c)	0	12.85	5 U
Downgradient 2	9/29/2004	21:23	-233.4	3.35 (c)	10.6	12.57	-
Upgradient	9/29/2004	21:37	3.2	4.03 (c)	0.2	13.37	-
Upgradient	9/29/2004	21:37	-13.8	3.76 (c)	0.4	13.07	5 U
Upgradient	9/29/2004	21:37	-36.8	3.57 (c)	1.2	13.00	-
Reference 3	9/30/2004	12:56	0.5	5.51 (c)	0	13.43	-
Reference 3	9/30/2004	12:59	-146.5	4.51 (c)	0	12.98	-
Reference 3	9/30/2004	13:01	-246.5	4.22 (c)	5.7	12.84	-
Reference 3	9/30/2004	13:03	-246.5	4.20 (c)	3.4	12.84	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Reference 3	9/30/2004	13:04	-246.5	4.19 (c)	7.0	12.84	-
Reference 3	9/30/2004	13:05	-246.5	4.19 (c)	2.8	12.84	-
Reference 3	9/30/2004	13:10	-246.4	4.04 (c)	2.8	12.84	-
Reference 3	9/30/2004	13:15	-246.4	4.04 (c)	13.38 (d)	12.84	-
Reference 3	9/30/2004	13:20	-246.3	4.05 (c)	3.2	12.84	-
Reference 3	9/30/2004	13:25	-246.3	(b)	4.5	12.84	-
Reference 3	9/30/2004	13:45	-206.1	3.80 (c)	2.4	12.23	-
Reference 3	9/30/2004	13:50	-205.9	4.00 (c)	1.6	12.24	-
Reference 3	9/30/2004	13:55	-255.9	4.06 (c)	1.8	12.41	-
Reference 3	9/30/2004	14:00	-255.7	4.00 (c)	0.7	12.39	-
Reference 3	9/30/2004	14:05	-255.7	3.78 (c)	0.6	12.39	-
Reference 3	9/30/2004	14:24	-255.2	(b)	1.3	12.39	-
Reference 3	9/30/2004	14:31	-255.0	3.85 (c)	1.8	12.39	-
Reference 3	9/30/2004	14:50	-254.4	3.45 (c)	0.8	12.43	-
Reference 3	9/30/2004	14:55	-254.4	3.63 (c)	1.6	12.44	-
Reference 3	9/30/2004	15:00	-254.1	3.76 (c)	1.0	12.43	-
Reference 3	9/30/2004	19:04	7.9	5.86 (c)	0.1	13.95	-
Reference 3	9/30/2004	19:04	-89.1	4.57 (c)	0	12.90	5 U
Reference 3	9/30/2004	19:04	-189.1	3.74 (c)	3.8	12.78	-
Early Warning	9/30/2004	18:18	7.9	1.99 (c)	0	14.02	-
Early Warning	9/30/2004	18:18	-12.2	1.95 (c)	7.1	13.23	-
Early Warning	9/30/2004	18:18	-34.2	2.39 (c)	0.5	13.09	-
Downgradient 1	9/30/2004	18:22	7.9	3.42 (c)	0.2	14.14	-
Downgradient 1	9/30/2004	18:22	-11.1	2.78 (c)	0	13.13	5 U
Downgradient 1	9/30/2004	18:22	-31.1	3.47 (c)	0.2	13.09	-
Downgradient 2	9/30/2004	18:33	8.0	4.16 (c)	0.1	14.11	-
Downgradient 2	9/30/2004	18:33	-7.1	4.14 (c)	0.1	13.24	5
Downgradient 2	9/30/2004	18:33	-22.1	3.67 (c)	0.5	13.13	-
Upgradient	9/30/2004	18:45	8.0	5.57 (c)	0.1	14.04	-
Upgradient	9/30/2004	18:45	-95.1	4.16 (c)	0.3	12.92	5 U
Upgradient	9/30/2004	18:45	-203.1	3.92 (c)	9.5	12.80	-
Reference 1	10/5/2004	15:14	5.4	6.99	0.1	13.26	-
Reference 1	10/5/2004	15:14	-69.6	5.73	0.1	12.93	8
Reference 1	10/5/2004	15:14	-142.6	5.31	0.1	12.82	-
Reference 2	10/5/2004	13:38	6.6	6.29	0.2	13.25	-
Reference 2	10/5/2004	13:38	-15.4	5.98	0.1	13.07	11
Reference 2	10/5/2004	13:38	-35.4	5.84	0.0	13.08	-
Reference 3	10/5/2004	15:49	5.0	6.60	0.1	13.63	-
Reference 3	10/5/2004	15:49	-97.0	5.68	0.0	12.93	6
Reference 3	10/5/2004	15:49	-197.0	5.12	1.4	12.77	-
Upgradient	10/5/2004	15:46	5.0	6.15	0.0	13.31	-
Upgradient	10/5/2004	15:46	-16.0	5.91	0.2	13.08	7
Upgradient	10/5/2004	15:46	-38.0	5.43	0.5	12.98	-
Downgradient 1	10/5/2004	14:18	6.1	6.43	0.1	13.55	-
Downgradient 1	10/5/2004	14:18	-92.9	5.36	0.0	12.86	6
Downgradient 1	10/5/2004	14:18	-190.9	4.82	14.9	12.65	-
Downgradient 2	10/5/2004	14:41	5.8	6.64	0.0	13.55	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Downgradient 2	10/5/2004	14:41	-92.2	5.40	0.0	12.90	5 U
Downgradient 2	10/5/2004	14:41	-186.2	5.25	0.0	12.81	-
Early Warning	10/5/2004	13:59	6.4	6.57	0.0	13.61	-
Early Warning	10/5/2004	13:59	-99.7	5.83	0.2	12.85	-
Early Warning	10/5/2004	13:59	-190.7	4.95	0.4	12.68	-
Reference 1	10/12/2004	14:45	6.3	7.93	0	13.92	-
Reference 1	10/12/2004	14:45	-30.7	6.18	0	12.94	5 U
Reference 1	10/12/2004	14:45	-60.7	5.92	0.0	12.83	-
Reference 2	10/12/2004	15:30	7.5	7.66	0.1	13.79	-
Reference 2	10/12/2004	15:30	-9.5	6.80	0.3	13.09	5 U
Reference 2	10/12/2004	15:30	-34.5	6.30	0.3	12.95	-
Reference 3	10/12/2004	17:30	7.9	7.89	0	13.71	-
Reference 3	10/12/2004	17:30	-139.1	5.64	0	12.51	5 U
Reference 3	10/12/2004	17:30	-239.1	5.01	3.1	12.34	-
Upgradient	10/12/2004	16:30	8.2	7.76	0.0	13.84	-
Upgradient	10/12/2004	16:30	-98.8	5.95	0.0	12.63	5 U
Upgradient	10/12/2004	16:30	-198.8	5.19	1.0	12.40	-
Downgradient 1	10/12/2004	16:05	8.0	8.26	0.0	14.15	-
Downgradient 1	10/12/2004	16:05	-14.0	7.21	0	13.05	-
Downgradient 1	10/12/2004	16:05	-38.0	6.43	0	12.92	-
Downgradient 2	10/12/2004	16:15	8.1	8.08	0.0	14.05	-
Downgradient 2	10/12/2004	16:15	-3.9	6.74	0.3	13.01	-
Downgradient 2	10/12/2004	16:15	-8.9	6.51	0.2	13.02	-
Early Warning	10/12/2004	15:51	7.8	8.31	0.1	14.35	-
Early Warning	10/12/2004	15:51	-19.2	6.88	0	13.02	-
Early Warning	10/12/2004	15:51	-39.2	6.41	0.4	12.94	-
Upgradient	10/12/2004	19:30	4.7	8.04	0.0	14.18	-
Upgradient	10/12/2004	19:30	-7.3	7.94	0.1	13.44	5 U
Upgradient	10/12/2004	19:30	-19.3	6.50	1.2	12.93	-
Downgradient 1	10/12/2004	18:45	6.2	7.84	0.4	13.95	-
Downgradient 1	10/12/2004	18:45	-80.8	5.54	0.0	12.61	-
Downgradient 1	10/12/2004	18:45	-170.8	5.06	2.0	12.41	-
Downgradient 2	10/12/2004	19:10	5.4	7.74	0.1	13.78	-
Downgradient 2	10/12/2004	19:10	-41.6	5.60	2.8	12.74	-
Downgradient 2	10/12/2004	19:10	-86.6	5.37	0.1	12.58	-
Early Warning	10/12/2004	18:30	6.7	7.99	0.2	13.87	-
Early Warning	10/12/2004	18:30	-65.4	5.64	0	12.64	-
Early Warning	10/12/2004	18:30	-138.4	5.04	1.5	12.23	-
Reference 1	10/14/2004	17:30	7.4	7.07	0	13.79	-
Reference 1	10/14/2004	17:30	-69.6	5.75	0	12.60	5 U
Reference 1	10/14/2004	17:30	-148.6	5.13	1.8	12.34	-
Reference 2	10/14/2004	18:20	8.9	6.90	0.3	13.74	-
Reference 2	10/14/2004	18:20	-9.1	6.59	0.2	13.31	5 J
Reference 2	10/14/2004	18:20	-31.1	5.88	0.0	12.67	-
Reference 3	10/14/2004	18:45	7.3	6.96	0.1	13.36	-
Reference 3	10/14/2004	18:45	-149.7	5.55	0.0	12.52	5 U
Reference 3	10/14/2004	18:45	-239.7	5.15	0.3	12.36	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Upgradient	10/14/2004	22:05	-0.6	6.63	0.2	13.38	-
Upgradient	10/14/2004	22:05	-20.6	5.72	1.2	12.68	8
Upgradient	10/14/2004	22:05	-37.6	5.65	4.6	12.63	-
Downgradient 1	10/14/2004	21:30	0.9	6.94	0.2	13.67	-
Downgradient 1	10/14/2004	21:30	-91.1	5.67	0.0	12.58	8
Downgradient 1	10/14/2004	21:30	-146.1	5.21	6.2	12.40	-
Downgradient 2	10/14/2004	21:50	0.0	6.73	0.1	13.35	-
Downgradient 2	10/14/2004	21:50	-122.0	5.68	0.0	12.51	5 U
Downgradient 2	10/14/2004	21:50	-227.0	4.81	4.4	12.07	-
Early Warning	10/14/2004	20:55	2.4	7.20	0.1	13.62	-
Early Warning	10/14/2004	20:55	-89.6	5.72	0.0	12.58	-
Early Warning	10/14/2004	20:55	-179.6	5.01	0.5	12.22	-
Reference 1	10/15/2004	12:30	1.6	6.93	0.2	13.21	-
Reference 1	10/15/2004	12:30	-72.5	6.49	0.1	12.64	7
Reference 1	10/15/2004	12:30	-145.5	5.63	0.2	12.61	-
Reference 2	10/15/2004	14:30	3.9	6.91	0.4	13.14	-
Reference 2	10/15/2004	14:30	-23.2	6.31	0.1	12.70	9
Reference 2	10/15/2004	14:30	-58.2	5.82	0.3	12.68	-
Reference 3	10/15/2004	14:20	3.6	6.77	0.1	13.13	-
Reference 3	10/15/2004	14:20	-123.5	5.79	0.1	12.50	6
Reference 3	10/15/2004	14:20	-243.5	5.25	0.5	12.21	-
Upgradient	10/15/2004	14:00	3.0	6.83	0.0	13.11	-
Upgradient	10/15/2004	14:00	-119.0	5.74	0.3	12.59	-
Upgradient	10/15/2004	14:00	-244.0	5.29	1.7	12.32	-
Downgradient 1	10/15/2004	13:20	2.1	6.78	0.1	13.05	-
Downgradient 1	10/15/2004	13:20	-7.9	6.28	0.2	12.95	-
Downgradient 1	10/15/2004	13:20	-18.9	6.39	0.0	12.77	-
Downgradient 2	10/15/2004	13:45	2.6	7.22	0.0	13.13	-
Downgradient 2	10/15/2004	13:45	-16.4	6.38	0.4	12.79	-
Downgradient 2	10/15/2004	13:45	-39.4	6.10	0.2	12.75	-
Early Warning	10/15/2004	13:50	2.7	7.19	0.0	13.18	-
Early Warning	10/15/2004	13:50	-21.3	6.83	0.0	12.77	-
Early Warning	10/15/2004	13:50	-40.3	6.18	0.1	12.70	-
Upgradient	10/15/2004	16:20	7.2	6.94	0.2	13.12	-
Upgradient	10/15/2004	16:20	-109.8	5.76	3.1	12.47	6
Upgradient	10/15/2004	16:20	-219.8	5.02	2.8	12.17	-
Downgradient 1	10/15/2004	15:55	6.5	6.83	0.1	12.79	-
Downgradient 1	10/15/2004	15:55	-20.5	6.24	0.2	12.71	-
Downgradient 1	10/15/2004	15:55	-38.5	5.81	2.7	12.64	-
Downgradient 2	10/15/2004	16:05	6.8	6.83	0.1	13.03	-
Downgradient 2	10/15/2004	16:05	-5.2	6.41	0.0	12.82	-
Downgradient 2	10/15/2004	16:05	-16.2	6.50	0.1	12.76	-
Early Warning	10/15/2004	15:40	6.1	7.28	0.0	13.15	-
Early Warning	10/15/2004	15:40	-6.0	6.35	0.0	12.95	-
Early Warning	10/15/2004	15:40	-21.0	6.08	0.3	12.79	-
Reference 1	10/19/2004	11:45	8.0	7.12	0	12.28	-
Reference 1	10/19/2004	11:45	-89.0	6.03	0	12.52	5 U

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Reference 1	10/19/2004	11:45	-154.0	5.86	2.4	12.51	-
Reference 2	10/19/2004	14:00	5.8	6.69	0.0	12.59	-
Reference 2	10/19/2004	14:00	-26.2	6.48	0	12.57	5 U
Reference 2	10/19/2004	14:00	-51.2	6.34	0	12.52	-
Reference 3	10/19/2004	14:30	5.3	7.03	0.0	12.49	-
Reference 3	10/19/2004	14:30	-141.7	6.29	0	12.48	5 U
Reference 3	10/19/2004	14:30	-241.7	6.09	0	12.47	-
Upgradient	10/19/2004	13:45	6.0	6.54	0	12.58	-
Upgradient	10/19/2004	13:45	-11.0	6.33	0.1	12.59	5 U
Upgradient	10/19/2004	13:45	-21.0	6.13	0.4	12.57	-
Downgradient 1	10/19/2004	12:40	7.2	6.81	0	12.36	-
Downgradient 1	10/19/2004	12:40	-94.8	6.04	0.4	12.50	5 U
Downgradient 1	10/19/2004	12:40	-149.8	5.85	10	12.47	-
Downgradient 2	10/19/2004	13:15	6.6	7.24	0	12.34	-
Downgradient 2	10/19/2004	13:15	-95.4	6.08	1.3	12.51	5 U
Downgradient 2	10/19/2004	13:15	-190.4	5.22	8.0	11.87	-
Early Warning	10/19/2004	12:30	7.4	7.04	0	12.33	-
Early Warning	10/19/2004	12:30	-94.6	6.30	0.6	12.51	-
Early Warning	10/19/2004	12:30	-184.6	5.08	0.8	11.94	-
Reference 1	10/23/2004	12:45	6.8	7.10	0.1	12.48	-
Reference 1	10/23/2004	12:45	-40.2	6.37	0.4	12.41	5 U
Reference 1	10/23/2004	12:45	-115.2	6.19	0.8	12.39	-
Reference 2	10/23/2004	12:35	6.5	7.07	0	12.46	-
Reference 2	10/23/2004	12:35	-15.5	6.48	0	12.44	5
Reference 2	10/23/2004	12:35	-40.5	6.27	0.8	12.40	-
Reference 3	10/23/2004	12:15	5.9	7.19	0	12.49	-
Reference 3	10/23/2004	12:15	-106.1	6.50	0	12.35	5 U
Reference 3	10/23/2004	12:15	-241.1	5.32	0.2	11.97	-
Upgradient	10/23/2004	11:45	4.8	6.76	0.0	12.40	-
Upgradient	10/23/2004	11:45	-102.2	6.24	0	12.37	5 U
Upgradient	10/23/2004	11:45	-202.2	5.48	6.9	12.20	-
Downgradient 1	10/23/2004	11:15	3.6	6.75	0.2	12.39	-
Downgradient 1	10/23/2004	11:15	-7.4	6.42	0.2	12.42	5 U
Downgradient 1	10/23/2004	11:15	-19.4	6.24	0.5	12.42	-
Downgradient 2	10/23/2004	11:35	4.4	6.73	0.3	12.41	-
Downgradient 2	10/23/2004	11:35	-10.6	6.56	0	12.43	5 U
Downgradient 2	10/23/2004	11:35	-28.6	6.64	0	12.42	-
Early Warning	10/23/2004	11:00	3.0	6.64	0.0	12.37	-
Early Warning	10/23/2004	11:00	2.0	6.54	0.0	12.42	-
Early Warning	10/23/2004	11:00	-1.5	6.66	0.1	12.40	-
Reference 1	10/26/2004	16:30	8.5	8.5	0.3	11.72	-
Reference 1	10/26/2004	16:30	-58.5	5.64	0.5	12.08	5 U
Reference 1	10/26/2004	16:30	-118.5	5.6	22	12.05	-
Reference 2	10/26/2004	17:00	8.4	7.9	0.5	11.80	-
Reference 2	10/26/2004	17:00	-19.6	6.05	0.3	12.34	7
Reference 2	10/26/2004	17:00	-33.6	6.17	1	12.14	-
Reference 3	10/26/2004	17:00	8.2	7.88	0.4	11.77	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Reference 3	10/26/2004	17:00	-65.6	5.88	0.2	11.99	5 U
Reference 3	10/26/2004	17:00	-101.6	5.69	0.4	11.99	-
Upgradient	10/26/2004	19:30	3.4	8.06	0.7	11.60	-
Upgradient	10/26/2004	19:30	-14.4	6.54	1.4	12.21	5 U
Upgradient	10/26/2004	19:30	-23.8	5.9	1	12.29	-
Downgradient 1	10/26/2004	18:42	5.6	7.74	0.5	11.72	-
Downgradient 1 (e)	10/26/2004	18:42	-86.1	5.69	1.9	12.06	-
Downgradient 1 (e)	10/26/2004	18:42	-139.4	5.24	10.4	12.01	-
Downgradient 2	10/26/2004	19:00	5.3	8.04	0.5	11.63	-
Downgradient 2 (e)	10/26/2004	19:00	-78.6	6.01	0.7	12.05	-
Downgradient 2 (e)	10/26/2004	19:00	-146.7	5.33	7.1	11.92	-
Early Warning	10/26/2004	18:00	7.0	7.93	0.4	11.74	-
Early Warning	10/26/2004	18:00	-67.7	5.7	3.6	12.08	-
Early Warning	10/26/2004	18:00	-65.5	5.61	2.3	12.10	-
Upgradient	10/26/2004	13:25	4.5	8.29	0.3	11.63	-
Upgradient (e)	10/26/2004	13:25	-102.6	6.04	0.1	12.22	5 U
Upgradient (e)	10/26/2004	13:25	-212.6	(f)	(f)	12.19	-
Downgradient 1	10/26/2004	12:45	3.1	8.26	0.4	11.10	-
Downgradient 1	10/26/2004	12:45	-14.0	6.52	0.1	12.33	-
Downgradient 1	10/26/2004	12:45	-34.0	6.03	0	12.32	-
Downgradient 2	10/26/2004	13:15	4.1	8.54	0.4	11.42	-
Downgradient 2	10/26/2004	13:15	-22.9	6.33	0.1	12.32	-
Downgradient 2	10/26/2004	13:15	-37.9	6.87	0.1	12.30	-
Early Warning	10/26/2004	12:30	2.6	8.17	0.3	11.11	-
Early Warning	10/26/2004	12:30	-8.4	6.45	0.1	12.20	-
Early Warning	10/26/2004	12:30	-19.4	6.09	0.1	12.34	-
Reference 1	10/28/2004	12:30	2.2	5.83	0.2	12.06	-
Reference 1	10/28/2004	12:30	-65.1	5.77	0.2	12.01	5 U
Reference 1	10/28/2004	12:30	-128.8	5.44	0.8	11.93	-
Reference 2	10/28/2004	13:15	1.6	6.31	0.4	12.11	-
Reference 2	10/28/2004	13:15	-20.0	5.71	0	12.02	5 U
Reference 2	10/28/2004	13:15	-21.8	6.06	0	12.05	-
Reference 3	10/28/2004	14:30	4.6	6.44	0.3	12.06	-
Reference 3	10/28/2004	14:30	-115.1	5.74	0	12.00	7
Reference 3	10/28/2004	14:30	-237.9	5.55	4.4	11.97	-
Early Warning	10/28/2004	13:45	3.4	5.94	0.2	12.09	-
Early Warning	10/28/2004	13:45	-6.8	5.68	0.4	12.10	-
Early Warning	10/28/2004	13:45	-19.4	6.22	0.3	12.09	-
Downgradient 1	10/28/2004	13:50	3.5	6.31	0.2	12.10	-
Downgradient 1	10/28/2004	13:50	-7.9	5.73	0.3	12.10	5 U
Downgradient 1	10/28/2004	13:50	-20.6	5.87	0.4	12.10	-
Downgradient 2	10/28/2004	14:05	3.2	6.5	0.4	12.05	-
Downgradient 2	10/28/2004	14:05	-5.0	5.99	0.1	12.06	5 U
Downgradient 2	10/28/2004	14:05	-18.0	6.44	0.7	12.08	-
Upgradient	10/28/2004	14:10	3.8	6.48	0.1	12.05	-
Upgradient	10/28/2004	14:10	-82.6	5.78	0	12.02	5 U
Upgradient	10/28/2004	14:10	-163.6	5.53	1	12.01	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Early Warning	10/28/2004	17:30	7.5	5.93	0	5.93	-
Early Warning	10/28/2004	17:30	-69.7	5.87	0.1	5.87	-
Early Warning	10/28/2004	17:30	-135.1	5.64	0.1	5.64	-
Downgradient 1	10/28/2004	17:55	8.2	6.77	0	12.07	-
Downgradient 1	10/28/2004	17:55	-56.8	6.09	0	12.00	5 U
Downgradient 1	10/28/2004	17:55	-144.3	5.48	10.5	12.03	-
Downgradient 2	10/28/2004	18:30	7.4	5.9	0	12.06	-
Downgradient 2	10/28/2004	18:30	-92.8	5.76	0	12.02	5 U
Downgradient 2	10/28/2004	18:30	-190.8	5.51	9.6	12.01	-
Upgradient	10/28/2004	18:40	7.3	6.03	0.5	12.04	-
Upgradient	10/28/2004	18:40	-3.6	5.8	5	12.08	5 U
Upgradient	10/28/2004	18:40	-11.4	5.69	4	12.08	-
Reference 1	11/1/2004	11:15	6.2	6.14	-0.4	11.90	5 U
Reference 1	11/1/2004	11:15	-71.2	5.96	-0.4	11.91	-
Reference 1	11/1/2004	11:15	-148.9	5.35	0.2	11.63	-
Reference 2	11/1/2004	11:40	5.4	6.29	-0.3	11.86	-
Reference 2	11/1/2004	11:40	-16.4	5.97	-0.2	11.87	7
Reference 2	11/1/2004	11:40	-39.1	5.77	-0.1	11.87	-
Reference 3	11/1/2004	11:55	5.2	6.17	-0.4	11.93	-
Reference 3	11/1/2004	11:55	-116.6	5.76	-0.1	11.83	6
Reference 3	11/1/2004	11:55	-236.1	5.22	1.9	11.55	-
Early Warning	11/1/2004	13:20	4.7	6.9	0	11.89	-
Early Warning	11/1/2004	13:20	-100.0	6.04	0	11.87	-
Early Warning	11/1/2004	13:20	-177.5	5.8	0.5	11.77	-
Downgradient 1	11/1/2004	13:35	4.6	6.24	0	11.89	-
Downgradient 1	11/1/2004	13:35	-120.2	5.8	0.1	11.83	13
Downgradient 1	11/1/2004	13:35	-183.6	5.55	11.3	11.78	-
Downgradient 2	11/1/2004	14:00	4.1	7.74	0	11.78	-
Downgradient 2	11/1/2004	14:00	-103.1	6.08	0	11.89	6
Downgradient 2	11/1/2004	14:00	-189.1	5.77	2.7	11.79	-
Upgradient	11/1/2004	14:15	4.3	6.68	0	11.79	-
Upgradient	11/1/2004	14:15	-8.7	6.61	0	11.85	5
Upgradient	11/1/2004	14:15	-22.0	6.25	0	11.91	-
Reference 1	11/8/2004	10:35	4.6	6.72	0	11.51	-
Reference 1	11/8/2004	10:35	-80.3	6.35	0	11.61	6
Reference 1	11/8/2004	10:35	-137.0	5.88	2.6	11.69	-
Reference 2	11/8/2004	10:45	4.7	6.96	1.7	11.48	-
Reference 2	11/8/2004	10:45	-17.1	6.75	0	11.54	5 U
Reference 2	11/8/2004	10:45	-35.5	6.72	0	11.53	-
Reference 3	11/8/2004	11:15	5.5	7.06	0	11.51	-
Reference 3	11/8/2004	11:15	-115.0	6.19	0	11.68	5 U
Reference 3	11/8/2004	11:15	-242.2	5.21	2.4	11.41	-
Early Warning	11/8/2004	14:30	8.1	7.22	0	11.61	-
Early Warning	11/8/2004	14:30	-88.9	5.93	0.3	11.68	-
Early Warning	11/8/2004	14:30	-163.9	5.32	1	11.50	-
Downgradient 1	11/8/2004	14:40	7.9	7.64	0	11.57	-
Downgradient 1	11/8/2004	14:40	-102.3	6.05	0.2	11.68	5 U

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Downgradient 1	11/8/2004	14:40	-210.3	5.4	4.8	11.47	-
Downgradient 2	11/8/2004	14:45	7.6	6.96	0	11.61	-
Downgradient 2	11/8/2004	14:45	-92.7	6.2	0.1	11.68	5 U
Downgradient 2	11/8/2004	14:45	-175.1	5.29	6.6	11.50	-
Upgradient	11/8/2004	15:10	7.5	7.63	0	11.58	-
Upgradient	11/8/2004	15:10	1.3	6.78	0	11.59	5 U
Upgradient	11/8/2004	15:10	-2.4	6.77	0	11.59	-
Reference 1	11/16/2004	14:10	4.9	6.48	0	11.45	-
Reference 1	11/16/2004	14:10	-71.5	6.06	0	11.42	5 U
Reference 1	11/16/2004	14:10	-149.5	5.93	0.7	11.38	-
Reference 2	11/16/2004	15:00	5.2	6.54	0.2	11.37	-
Reference 2	11/16/2004	15:00	-14.6	6.72	0	11.44	5 U
Reference 2	11/16/2004	15:00	-33.4	6.08	0.4	11.41	-
Reference 3	11/16/2004	14:40	5.2	6.88	0	11.46	-
Reference 3	11/16/2004	14:40	-135.9	6.05	0.2	11.38	5 U
Reference 3	11/16/2004	14:40	-254.3	5.05	2.4	11.07	-
Early Warning	11/16/2004	16:30	6.8	6.98	0	11.39	-
Early Warning	11/16/2004	16:30	6.8	(g)	(g)	(g)	-
Early Warning	11/16/2004	16:30	6.8	(g)	(g)	(g)	-
Downgradient 1	11/16/2004	16:40	6.7	6.16	0	11.44	-
Downgradient 1	11/16/2004	16:40	-1.9	6.12	0.2	11.43	5 U
Downgradient 1	11/16/2004	16:40	-14.0	6.15	3.1	11.43	-
Downgradient 2	11/16/2004	16:50	7.1	6.12	0.2	11.44	-
Downgradient 2	11/16/2004	16:50	4.2	6.21	0.1	11.44	5 U
Downgradient 2	11/16/2004	16:50	-2.4	6.23	0.3	11.44	-
Upgradient	11/16/2004	17:20	7.2	6.28	0	11.41	-
Upgradient	11/16/2004	17:20	-58.6	6.16	0	11.43	5 U
Upgradient	11/16/2004	17:20	-128.6	6.23	0.5	11.40	-
Reference 1	11/22/2004	11:00	6.1	6.99	0	11.23	-
Reference 1	11/22/2004	11:00	-68.6	6.62	0	11.20	5 U
Reference 1	11/22/2004	11:00	-142.9	6.24	0.2	11.21	-
Reference 2	11/22/2004	11:25	6.8	6.8	0.2	11.27	-
Reference 2	11/22/2004	11:25	-11.7	6.57	0.1	11.27	5 U
Reference 2	11/22/2004	11:25	-30.4	6.49	0.1	11.25	-
Reference 3	11/22/2004	11:45	7.3	6.72	0.3	11.21	-
Reference 3	11/22/2004	11:45	-149.7	6.55	0	11.19	5 U
Reference 3	11/22/2004	11:45	-251.5	6.12	2.6	11.11	-
Early Warning A	11/22/2004	11:55	8.1	7.71	0.1	11.16	-
Early Warning A	11/22/2004	11:55	5.2	7.09	0.3	11.15	-
Early Warning A	11/22/2004	11:55	2.9	6.84	1	11.17	-
Downgradient 1 A	11/22/2004	12:00	7.9	7.48	0.1	11.18	-
Downgradient 1 A	11/22/2004	12:00	5.4	6.75	0.2	11.20	5 U
Downgradient 1 A	11/22/2004	12:00	0.5	6.63	0.2	11.21	-
Downgradient 2 A	11/22/2004	12:10	8.1	7.51	0.4	11.25	-
Downgradient 2 A	11/22/2004	12:10	4.6	6.72	0.6	11.27	6
Downgradient 2 A	11/22/2004	12:10	-1.1	6.49	0.6	11.29	-
Upgradient A	11/22/2004	12:15	8.0	6.82	0.4	11.27	-

TABLE 7
WATER-QUALITY SAMPLING RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Sample Elevation (ft MLLW)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Temperature (°C)	TSS (mg/L)
Upgradient A	11/22/2004	12:15	-67.5	6.6	0	11.22	5
Upgradient A	11/22/2004	12:15	-141.7	6.36	2.1	11.24	-
Early Warning B	11/22/2004	13:50	9.0	7.34	0.1	11.20	-
Early Warning B	11/22/2004	13:50	-87.1	7.31	4.6	11.23	-
Early Warning B	11/22/2004	13:50	-120.2	6.37	11.5	11.24	-
Downgradient 1B	11/22/2004	14:50	8.1	7.55	0.1	11.23	-
Downgradient 1B	11/22/2004	14:50	-58.3	6.57	0	11.22	5 U
Downgradient 1B	11/22/2004	14:50	-132.7	6.38	3.3	11.23	-
Downgradient 2B	11/22/2004	15:00	7.9	6.82	0.1	11.28	-
Downgradient 2B	11/22/2004	15:00	-34.3	6.76	0.3	11.22	5
Downgradient 2B	11/22/2004	15:00	-80.4	6.48	1.6	11.22	-
Upgradient B	11/22/2004	15:15	7.2	7.48	0.3	11.19	-
Upgradient B	11/22/2004	15:15	-5.6	6.76	1	11.25	5 U
Upgradient B	11/22/2004	15:15	-23.6	6.5	0.2	11.23	-

Notes:
U = Compound not detected.
J = Estimated value.
- = TSS sample not required and not collected.
a. Turbidity probe malfunctioned. Replaced wiper on turbidity probe. See Section 2.3.5.4.
b. DO result not recorded as a result of sampler error. The main objective of this sampling was to observe turbidity.
c. DO probe malfunctioned. Replaced membrance on DO probe. See Section 2.3.5.4.
d. Turbidity result of large wave that rocked boat during sampling.
e. Severe weather conditions, may not be representative position and depth due to drift.
f. Data not collected due to health and safety concerns based on weather.
g. Only one measurement was taken at this location because the water depth was less than 3 ft deep.

TABLE 8
AVERAGE BACKGROUND WATER QUALITY
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

		Daily Mean By Depth			Running Mean All Depths (a)		
DATE	Interval	DO (mg/L)	Turbidity (NTU)	Temperature (°C)	DO (mg/L)	Turbidity (NTU)	Temperature (°C)
9/14/2004	S	9.26	0.48	13.31			
9/14/2004	I	8.78	0.20	12.67	8.56	0.28	12.66
9/14/2004	D	7.64	0.17	12.00			
9/15/2004	S	7.81	0.24	13.81			
9/15/2004	I	7.41	0.08	13.41	8.01	0.21	13.08
9/15/2004	D	7.15	0.10	13.26			
9/16/2004	S	8.18	1.23	13.74			
9/16/2004	I	7.42	1.00	13.37	7.84	0.60	13.18
9/16/2004	D	6.91	1.90	13.04			
9/17/2004	S	9.15	0.34	13.68			
9/17/2004	I	8.15	0.24	13.27	7.93	0.79	13.21
9/17/2004	D	7.36	3.55	12.99			
9/21/2004	S	6.45	0.20	13.89			
9/21/2004	I	5.50	0.07	13.01	7.52	0.85	13.22
9/21/2004	D	5.59	2.97	12.90			
9/22/2004	S	6.39	0.30	13.40			
9/22/2004	I	5.36	0.30	13.00	7.20	0.83	13.20
9/22/2004	D	5.16	1.63	12.85			
9/23/2004	S	6.32	0.27	13.71			
9/23/2004	I	5.76	0.20	13.03	7.00	0.82	13.20
9/23/2004	D	5.22	1.67	12.83			
9/24/2004	S	6.12	0.13	13.48			
9/24/2004	I	5.40	0.17	12.96	6.81	0.76	13.18
9/24/2004	D	4.99	0.87	12.78			
9/25/2004	S	6.70	0.15	13.81			
9/25/2004	I	5.66	0.00	13.07	6.70	0.87	13.19
9/25/2004	D	5.17	5.03	12.87			
9/29/2004	S	ND	0.43	13.84			
9/29/2004	I	ND	0.03	13.02	6.75	0.84	13.20
9/29/2004	D	ND	1.27	12.95			
9/30/2004	S	ND	0.05	13.69			
9/30/2004	I	ND	0.00	12.94	6.75	0.84	13.19
9/30/2004	D	ND	2.60	12.59			
10/5/2004	S	6.63	0.13	13.38			
10/5/2004	I	5.80	0.07	12.98	7.00	0.79	13.12
10/5/2004	D	5.42	0.50	12.89			
10/12/2004	S	7.83	0.03	13.81			
10/12/2004	I	6.21	0.10	12.85	6.97	0.77	13.12
10/12/2004	D	5.74	1.13	12.71			
10/14/2004	S	6.98	0.13	13.63			
10/14/2004	I	5.96	0.07	12.81	6.66	0.80	13.16
10/14/2004	D	5.39	0.70	12.46			
10/15/2004	S	6.87	0.23	13.16			
10/15/2004	I	6.20	0.10	12.61	6.49	0.83	13.09
10/15/2004	D	5.57	0.33	12.50			
10/19/2004	S	6.95	0.00	12.45			

TABLE 8
AVERAGE BACKGROUND WATER QUALITY
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

		Daily Mean By Depth			Running Mean All Depths (a)		
DATE	Interval	DO (mg/L)	Turbidity (NTU)	Temperature (°C)	DO (mg/L)	Turbidity (NTU)	Temperature (°C)
10/19/2004	I	6.27	0.00	12.52	6.00	0.78	12.98
10/19/2004	D	6.10	0.80	12.50			
10/23/2004	S	7.12	0.03	12.48			
10/23/2004	I	6.45	0.13	12.40	6.16	0.71	12.88
10/23/2004	D	5.93	0.60	12.25			
10/26/2004	S	8.09	0.40	11.76			
10/26/2004	I	5.86	0.33	12.14	6.34	0.76	12.75
10/26/2004	D	5.82	0.70	12.06			
10/28/2004	S	6.19	0.30	12.08			
10/28/2004	I	5.74	0.07	12.01	6.28	0.76	12.68
10/28/2004	D	5.68	1.73	11.98			
11/1/2004	S	6.20	0.00	11.90			
11/1/2004	I	5.90	0.00	11.87	6.23	0.73	12.56
11/1/2004	D	5.45	0.70	11.68			
11/8/2004	S	6.91	0.57	11.50			
11/8/2004	I	6.43	0.00	11.61	6.29	0.40	12.34
11/8/2004	D	5.94	1.67	11.54			
11/16/2004	S	6.63	0.07	11.43			
11/16/2004	I	6.28	0.07	11.41	6.26	0.41	12.05
11/16/2004	D	5.69	1.17	11.29			
11/22/2004	S	6.84	0.17	11.24			
11/22/2004	I	6.58	0.03	11.22	6.29	0.46	11.76
11/22/2004	D	6.28	0.97	11.19			

S = Shallow sample depth.
I = Intermediate sample depth.
D = Deep sample depth.
ND = No data.
a. Mean of past 30 days for all depths of all reference stations.

T .E 9

CAP VERIFICATION SAMPLING REQUIREMENTS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Description	RA	Event	Sample Type	Analysis (a)	Number of Sample Locations (b)	Number of Samples Analyzed
Technical Specifications Table 02483-11	4	Final cap surface and profile	Segmented Core	Chemical analysis at surface (0-4 inches) and a 4-inch interval at the mid-point of the cap	15	30
Modification by USACE (c)	4	Final cap surface and profile	Surface grab sample	Chemical analysis at surface (0-4 inches) of the cap	15	15 (c)

RA = Remediation area.
a. Chemical analysis includes SVOCs, PCBs, metals, and TOC, reported in mg/kg dry weight. Reporting limit for TOC = 0.1%.
b. Proposed sampling locations are shown on Figure C-7 of Technical Specifications.
c. The USACE modified the Technical Specifications for cap verification sampling in RA 4 because of the coarse grained material that was placed at RA 4. See Section 3.3.1 for a description.

TABLE 10
CAP VERIFICATION SAMPLING
ANALYTICAL TEST METHODS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENT UNIT, REMEDIAL ACTION

Chemical Parameter	Required for Cap Verification	Analytical Method
Metals		
Arsenic		EPA Method 6000/7000
Cadmium		EPA Method 6000/7000
Chromium		EPA Method 6000/7000
Copper	X	EPA Method 6000/7000
Lead		EPA Method 6000/7000
Mercury	X	EPA Method 6000/7000
Silver		EPA Method 6000/7000
Zinc	X	EPA Method 6000/7000
Polynuclear Aromatic Hydrocarbons		
Total LPAH[a]	X	EPA Method 8270
Naphthalene	X	EPA Method 8270
Acenaphthylene	X	EPA Method 8270
Acenaphtlene	X	EPA Method 8270
Fluorene	X	EPA Method 8270
Phenanthrene	X	EPA Method 8270
Anthracene	X	EPA Method 8270
2-Methylnaphthalene	X	EPA Method 8270
Total HPAH[b]	X	EPA Method 8270
Fluoranthene	X	EPA Method 8270
Pyrene	X	EPA Method 8270
Benz[a]anthracene	X	EPA Method 8270
Chrysene	X	EPA Method 8270
Totalbenzofluoranthenes[c]	X	EPA Method 8270
Benzo[a]pyrene	X	EPA Method 8270
Indeno[1,2,3-c,d]pyrene	X	EPA Method 8270
Dibenz[a,h]anthracene	X	EPA Method 8270
Benzo[g,h,i]perylene	X	EPA Method 8270
Chlorinated Benzenes		
1,2 Dichlorobenzene		EPA Method 8270
1,3 Dichlorobenzene		EPA Method 8270
1,4 Dichlorobenzene		EPA Method 8270
1,2,4-Trichlorobenzene		EPA Method 8270
Hexachlorobenzene		EPA Method 8270
Phthalate Esters		
Dimethyl phthalate		EPA Method 8270
Diethyl phthalate		EPA Method 8270
Di-n-butyl phthalate		EPA Method 8270
Butyl benzyl phthalate		EPA Method 8270
Bis[2-ethylhexyl]phthalate		EPA Method 8270
Di-n-octyl phthalate		EPA Method 8270
Miscellaneous		
Dibenzofuran	X	EPA Method 8270
Hexachlorobutadiene		EPA Method 8270

TABLE 10
CAP VERIFICATION SAMPLING
ANALYTICAL TEST METHODS
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENT UNIT, REMEDIAL ACTION

Chemical Parameter	Required for Cap Verification	Analytical Method
N-nitrosodiphenylamine		EPA Method 8270
Pesticides/PCBs		
PCBs	X	EPA Method 8082
Chlorinated Pesticides		EPA Method 8081
Ionizable Organic Compounds		
Phenol	X	EPA Method 8270
2-Methylphenol	X	EPA Method 8270
4-Methylphenol	X	EPA Method 8270
2,4 Dimethylphenol	X	EPA Method 8270
Pentachlorophenol	X	EPA Method 8270
Benzyl alcohol		EPA Method 8270
Benzoic acid		EPA Method 8270
Conventional Parameters		
Total organic carbon	X	EPA Method 9060/PSEP

Notes:

[a] The total LPAH criterion represents the sum of the following low molecular weight polynuclear aromatic compounds: Naphthlene, acenaphthylene, acenaphthene, fluorine, phenanthrene, and anthracene. 2-Methylnaphthalene is not included in the LPAH definition.

[b] The total HPAH criterion represents the sum of the following high molecular weight polynuclear aromatic compounds: fluoranthene, pyrene, benz[a]anthracene, chrysene, total benzofluoranthenes, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenz[a,h]anthracene, and benzo[g,h,i]perylene.

[c] The total benzofluoranthenes criteria are to be compared to the sums of the concentrations of the b, j, and k isomers of benzofluoranthene.

TABLE 11
CAP VERIFICATION SAMPLE LOCATION COORDINATES
REMEDIATION AREA 4 SEGMENTS 1, 2 AND 3
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station Identification	Sample Identification (a)	Grab Number	Sample Date	Northing (b)	Easting (b)	Recovery Description	Grab Accepted
15	VS-30	g1	12/14/2004	217,232	1,260,996	REJECT- rock in jaw. 99.3 fsw	No
15	VS-30	g2	12/14/2004	217,203	1,260,992	REJECT- washed. 97.8 fsw	No
15	VS-30	g3	12/14/2004	217,233	1,261,013	REJECT- insufficient material and washed. 93.7 fsw	No
15	VS-30	g4	12/14/2004	217,214	1,261,024	REJECT- insufficient material and washed. 91.8 fsw	No
15	VS-30	g5	12/14/2004	217,221	1,261,002	ACCEPT- 97.3 fsw	Yes
1	VS-31	g1	12/14/2004	217,511	1,260,999	REJECT- washed. 143 fsw	No
1	VS-31	g2	12/14/2004	217,505	1,260,993	REJECT- rock in jaw. 140 fsw	No
1	VS-31	g3	12/14/2004	217,503	1,260,977	ACCEPT- 143 fsw	Yes
2	VS-32	g1	12/13/2004	217,356	1,261,272	ACCEPT- 90.4 fsw	Yes
3	VS-33	g1	12/14/2004	217,650	1,261,232	REJECT- rock in jaw and washed. 142 fsw	No
3	VS-33	g2	12/14/2004	217,665	1,261,254	REJECT- rock in jaw and washed. 146 fsw	No
3	VS-33	g3	12/14/2004	217,638	1,261,238	REJECT- washed. 140 fsw	No
3	VS-33	g4	12/14/2004	217,672	1,261,238	ACCEPT- 143 fsw	Yes
14	VS-34	g1	12/13/2004	217,247	1,261,442	REJECT- insufficient material and washed. 45.1 fsw	No
14	VS-34	g2	12/13/2004	217,246	1,261,437	REJECT- insufficient material and washed. 46.1 fsw	No
14	VS-34	g3	12/13/2004	217,241	1,261,445	REJECT- insufficient material and washed. 45.9 fsw	No
14	VS-34	g4	12/15/2004	217,262	1,261,451	REJECT- insufficient material and rock in jaw. 56.4 fsw	No
14	VS-34	g5	12/15/2004	217,257	1,261,430	SAMPLED- 54.3 fsw	Yes
4	VS-35	g1	12/13/2004	217,489	1,261,538	ACCEPT- 81.1 fsw	Yes
5	VS-36	g1	12/14/2004	217,796	1,261,512	REJECT- rock in jaws and washed. 137 fsw	No
5	VS-36	g2	12/14/2004	217,788	1,261,506	ACCEPT- 136 fsw	Yes
6	VS-37	g1	12/13/2004	217,421	1,261,738	REJECT- insufficient material and washed. 40.8 fsw	No
6	VS-37	g2	12/13/2004	217,425	1,261,749	REJECT- insufficient material and washed. 39.3 fsw	No
6	VS-37	g3	12/13/2004	217,427	1,261,739	ACCEPT- 45.6 fsw	Yes
8	VS-38	g1	12/13/2004	217,624	1,261,809	ACCEPT- 79.3 fsw	Yes
7	VS-39	g1	12/14/2004	217,926	1,261,775	ACCEPT- 139 fsw	Yes
9	VS-40	g1	12/13/2004	217,571	1,261,983	REJECT- rock in jaw and washed. 35.8 fsw	No
9	VS-40	g2	12/13/2004	217,577	1,261,994	REJECT- rock in jaw and washed. 37.2 fsw	No
9	VS-40	g3	12/13/2004	217,585	1,261,983	ACCEPT- 37.8 fsw	Yes
9	VS-40	g4	12/15/2004	217,599	1,261,986	REJECT- rock in jaws and washed. 53.9 fsw	No
9	VS-40	g5	12/15/2004	217,592	1,261,966	SAMPLED- 57.4 fsw	Yes
10	VS-41	g1	12/13/2004	217,762	1,262,072	REJECT- rock in jaw and washout. 85.2 fsw	No
10	VS-41	g2	12/13/2004	217,761	1,262,068	ACCEPT- 85.6 fsw	Yes
10	VS-41	g3	12/15/2004	217,762	1,262,053	ACCEPT- 87.3 fsw	Yes
11	VS-42	g1	12/14/2004	218,056	1,262,029	REJECT- rock in jaw. 134 fsw	No

TABLE 11
CAP VERIFICATION SAMPLE LOCATION COORDINATES
REMEDIATION AREA 4 SEGMENTS 1, 2 AND 3
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station Identification	Sample Identification (a)	Grab Number	Sample Date	Northing (b)	Easting (b)	Recovery Description	Grab Accepted
11	VS-42	g2	12/14/2004	218,068	1,262,032	REJECT- rock in jaw. 136 fsw	No
11	VS-42	g3	12/14/2004	218,054	1,262,051	ACCEPT- 134 fsw	Yes
13	VS-43	g1	12/13/2004	217,906	1,262,332	REJECT- rock in jaw and washout. 89.4 fsw	No
13	VS-43	g2	12/13/2004	217,910	1,262,345	REJECT- insufficient material and washout. 89.6 fsw	No
13	VS-43	g3	12/13/2004	217,898	1,262,345	REJECT- insufficient material and washout. 86.7 fsw	No
13	VS-43	g4	12/15/2004	217,889	1,262,337	ACCEPT- 83.6 fsw	Yes
12	VS-44	g1	12/14/2004	218,196	1,262,308	REJECT- rock in jaws. 144 fsw	No
12	VS-44	g2	12/14/2004	218,204	1,262,289	SAMPLED- rock in jaws. 146 fsw	Yes
12	VS-44	g3	12/14/2004	218,192	1,262,292	REJECT- rock in jaws. 141 fsw	No
12	VS-44	g4	12/15/2004	218,179	1,262,288	REJECT- 144 fsw	No

All samples from Remediation Area 4.
a. VS-1 indicates the sample identification, g1 indicates surface grab sample.
b. State Plane Washington North, North America Datum 83, U.S. Survey Feet.

TABLE 12
CAP VERIFICATION SAMPLING SUMMARY
REMEDIATION AREA 4, SEGMENTS 1, 2 AND 3
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample Identification	Station Identification	Remediation Area	Water Depth (ft)	Date Sample Collected	Chemistry Sample Collected (a)	Cap Material Description (b)
VS-31	Station 1	4 Segment 3	143	12/14/2004	Yes	Light to medium gray fine to medium GRAVEL, some coarse gravel and cobbles, little coarse to fine sand and silt; slight sheen.
VS-32	Station 2	4 Segment 3	90.4	12/13/2004	Yes; duplicate collected	Dark gray medium to coarse GRAVEL/COBBLES, some light gray with trace brown silt, little coarse to fine light gray sand.
VS-33	Station 3	4 Segment 3	143	12/14/2004	Yes	Light gray SAND with trace medium to coarse sand, trace brown silt; sheen on standing water and in pore water, strong hydrocarbon odor. 26 inches of recovery.
VS-35	Station 4	4 Segment 3	81.1	12/13/2004	Yes	Some light to medium gray COBBLES (<3 in) with some fine gravel (0.2-2 in), little coarse gravel (2-3 in), little light gray with trace brown sand and silt; slight sheen, faint hydrocarbon odor.
VS-36	Station 5	4 Segment 2	136	12/14/2004	Yes	Light gray fine SAND with little fine to medium gravel, little coarse sand, and little coarse gravel, trace brown silt; slight sheen on decanted water and in pore water. 24 inches of recovery.
VS-37	Station 6	4 Segment 2	45.6	12/13/2004	Yes; duplicate collected	Dark gray fine GRAVEL (0.2-2 in) with some light gray fine to medium sand, little brown silt.
VS-39	Station 7	4 Segment 2	139	12/14/2004	Yes	Some light to medium gray medium to coarse GRAVEL with some light gray with trace brown silt, little coarse sand, little fine gravel, trace very coarse gravel/cobbles, trace organics (wood pieces). 24 inches of recovery.
VS-38	Station 8	4 Segment 2	79.3	12/13/2004	Yes	Light to medium gray coarse SAND with some gray and trace brown very fine sand/silt, little fine gravel, trace coarse gravel/cobbles.
VS-40	Station 9	4 Segment 2	52.4	12/13/2004	Yes	Dark gray coarse GRAVEL/COBBLES with some fine to medium gravel, trace fine to coarse sand. 24 inches of recovery.
VS-41	Station 10	4 Segment 1	85.6	12/15/2004	Yes	Dark gray fine to medium GRAVEL with some coarse gravel/cobbles, trace fine to coarse sand. 23 inches of recovery.

TABLE 12
CAP VERIFICATION SAMPLING SUMMARY
REMEDIATION AREA 4, SEGMENTS 1, 2 AND 3
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample Identification	Station Identification	Remediation Area	Water Depth (ft)	Date Sample Collected	Chemistry Sample Collected (a)	Cap Material Description (b)
VS-42	Station 11	4 Segment 1	134	12/14/2004	Yes	Light gray fine SAND with trace coarse sand, trace fine to coarse gravel, trace brown silt; slight sheen in pore water. 23.5 inches of recovery.
VS-44	Station 12	4 Segment 1	146	12/14/2004	Yes	Gray coarse GRAVEL/COBBLES with little fine gravel and little coarse sand, trace organics (wood pieces). 10 inches of recovery.
VS-43	*Station 13*	*4 Segment 1*	87	12/15/2004	Yes	Light to medium gray fine GRAVEL with little coarse *gravel/cobbles, little light gray fine* to coarse sand, trace brown silt.
VS-34	Station 14	4 Segment 3	54.3	12/14/2004	Yes	Light to medium gray fine to medium GRAVEL with some coarse gravel, some cobbles, trace fine sand.
VS-30	Station 15	4 Segment 3	97.3	12/14/2004	Yes	Light to medium gray fine to medium GRAVEL with some fine to medium sand, little coarse gravel/cobbles, trace coarse sand, trace brown silt, trace organics (wood pieces).

All samples are surface grab samples.
a. Chemistry samples were collected in sediment bags placed in 5-gallon buckets.
Samples were submitted for analysis of SVOCs, PCBS, total metals, and TOC.
b. Recovery is depth of material recovered in grab sampler, in inches below mudline.

TABLE 13

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR SIEVED SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID:		STATION 1/VS-31	STATION 2/VS-32	Field Duplicate of VS-32 STATION 98	STATION 3/VS-33	STATION 4/VS-35	STATION 5/VS-36	STATION 6/VS-37	Field Duplicate of VS-37 STATION 99
Laboratory ID:		K2409920-001	K2409920-002	K2409920-016	K2409920-003	K2409920-004	K2409920-005	K2409920-006	K2409920-017
Date Sampled:	SQS (a)	12/14/04	12/13/04	12/13/04	12/14/04	12/13/04	12/14/04	12/13/04	12/13/04
Metals (mg/kg)									
Copper	390	2.3 U	2.3 U	2.3 U	2.3 U	7.2	2.3 U	2.4 U	2.3 U
Mercury	0.41	0.017 B	0.014	0.01 B	0.011 B	0.158	0.013 B	0.007 B	0.016 U
Zinc	410	4.1	3.4	3.5	2.3	13.6	2.5	1.1 UB	3.6
PAHs (ug/kg)									
Naphthalene	2,100	24	29 J	66 J	49	720	13	10 U	10 UJ
Acenaphthylene	1,300	1.9 J	3.3 J	6.2 J	8 J	66	10 U	10 U	10 U
Acenaphthene	500	34	27 J	92 J	230	$\boxed{550}$	17	3.2 J	1.5 J
Fluorene	540	41	30 J	88 J	480	420	13	3.3 J	10 UJ
Phenanthrene	1,500	89	77 J	240 J	1200	1,100	36	14	4.8 J
Anthracene	960	52	45 J	110 J	750	430	15	2.6 J	2.1 J
2-Methylnaphthalene	670	9.5 J	6.7 J	17	18	200	7.3 J	1.7 J	10 UJ
LPAH (b,c)	5,200	242	211 J	602 J	2717	3,286	94	23	8.4 J
Fluoranthene	1,700	190	210 J	1,000 J	1300	1,400	71	9.3 J	18
Pyrene	2,600	85	220 J	540 J	610	$\boxed{3,900}$	77	8.5 J	24
Benz(a)anthracene	1,300	43	73 J	200 J	280	370	24	2.3 J	5 J
Chrysene	1,400	47	150	230	420	490	28	2.8 J	6.2 J
Benzo(b)fluoranthene		28	73	120	160	920	19	10 U	6.6 J
Benzo(k)fluoranthene		8.3 J	24	43	48	330	6.5 J	10 U	10 U
Total Benzofluoranthenes (c,d)	3,200	36.3 J	97	163	208	1,250	26	10 U	6.6 J
Benzo(a)pyrene	1,600	16	45 J	80 J	86	530	11	10 U	4.3 J
Indeno(123-cd)pyrene	600	4.9 J	13	24	24	190	3.2 J	10 U	10 U
Dibenz(ah)anthracene	230	10 U	4.7 J	7.4 J	8.3 J	55	10 U	10 U	10 U
Benzo(ghi)perylene	670	4.5 J	12	24	20	170	2.9 J	10 U	10 UJ
HPAH (c,e)	12,000	427	825	2,268	2,956	8,355	243	23 J	64
Miscellaneous SVOCs (ug/kg)									
Dibenzofuran	540	28	20 J	70 J	180	370	10	2.2 J	10 UJ
Phenolics (ug/kg)									
Phenol	420	30 U	30 U	30 U	30 U	32 U	30 U	30 U	30 UJ
2-Methylphenol	63	10 U	10 U	10 U	10 U	5.7 J	10 U	10 U	10 U
4-Methylphenol	670	10 U	10 U	10 U	10 U	21	10 U	10 U	10 U
24-Dimethylphenol	29	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Pentachlorophenol	360	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 UJ

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR SIEVED SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 1/VS-31 K2409920-001 12/14/04	STATION 2/VS-32 K2409920-002 12/13/04	Field Duplicate of VS-32 STATION 98 K2409920-016 12/13/04	STATION 3/VS-33 K2409920-003 12/14/04	STATION 4/VS-35 K2409920-004 12/13/04	STATION 5/VS-36 K2409920-005 12/14/04	STATION 6/VS-37 K2409920-006 12/13/04	Field Duplicate of VS-37 STATION 99 K2409920-017 12/13/04
PCBs (ug/kg)									
Aroclor 1016	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1221	NA	23 U	20 U	22 U	34 U	23 U	20 U	20 U	20 U
Aroclor 1232	NA	10 U	10 U	19 U	10 U	29 U	10 U	10 U	10 U
Aroclor 1242	NA	10 U	10 U	10 U	10 U	16 U	10 U	10 U	10 U
Aroclor 1248	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1254	NA	2.5 JP	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1260	NA	3.1 J	10 U	10 U	10 U	11 U	10 U	10 U	10 U
Total PCBs (c)	130	5.6 JP	20 U	22 U	34 U	29 U	20 U	20 U	20 U
Conventionals (percent)									
Total Solids (f)	NA	86.5	87	87	84.9	84.2	86.2	84.9	84.7
Total Organic Carbon	NA	0.03 J	0.04 J	0.03 J	0.03 J	0.15	0.02 J	0.05 U	0.11

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CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR SIEVED SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 7/VS-39 K2409920-007 12/14/04	STATION 8/VS-38 K2409920-008 12/13/04	STATION 9/VS-40 K2409920-009 12/15/04	STATION 10/VS-41 K2409920-010 12/15/04	STATION 11/VS-42 K2409920-011 12/14/04	STATION 12/VS-44 K2409920-012 12/14/04	STATION 13/VS-43 K2409920-013 12/15/04	STATION 14/VS-34 K2409920-014 12/14/04
Metals (mg/kg)									
Copper	390	2.2 U	2.2 U	2.1 U	2.1 U	2.4 U	1.9 U	2.1 U	2.2 U
Mercury	0.41	0.048	0.016 B	0.047	0.01 B	0.016 B	0.016 U	0.02	0.011 B
Zinc	410	2.6	2.1 B	0.9 UB	3.4	3.3	0.7 UB	2.7	2.6
PAHs (ug/kg)									
Naphthalene	2,100	200	37	10 U	11 U	100	8.9 U	8.7 U	10 U
Acenaphthylene	1,300	5.6 J	10 U	10 U	11 U	2.3 J	8.9 U	8.7 U	10 U
Acenaphthene	500	210	37	1.3 J	11 U	62	8.9 U	1.5 J	10 U
Fluorene	540	100	15	10 U	11 U	58	8.9 U	2 J	10 U
Phenanthrene	1,500	210	36	2.6 J	11 U	140	8.9 U	6.1 J	3.3 J
Anthracene	960	140	19	2.7 J	11 U	78	8.9 U	3.4 J	2.4 J
2-Methylnaphthalene	670	53	9.8 J	10 U	11 U	27	8.9 U	8.7 U	10 U
LPAH (b,c)	5,200	866	144	6.6 J	11 U	440	8.9 U	13 J	5.7 J
Fluoranthene	1,700	1,100	75	19	11 U	180	8.9 U	8.8	7.8 J
Pyrene	2,600	950	93	14	1.8 J	140	8.9 U	7.5 J	5.6 J
Benz(a)anthracene	1,300	160	20	5.7 J	11 U	42	8.9 U	3.8 J	3.4 J
Chrysene	1,400	150	20	6.3 J	11 U	57	8.9 U	4.4 J	5.5 J
Benzo(b)fluoranthene		98	17	4.5 J	11 U	31	8.9 U	5.1 J	5.8 J
Benzo(k)fluoranthene		34	5.8 J	10 U	11 U	11	8.9 U	8.7 U	10 U
Total Benzofluoranthenes (c,d)	3,200	132	23	4.5 J	11 U	42	8.9 U	5.1 J	5.8 J
Benzo(a)pyrene	1,600	58	11	2.9 J	11 U	20	8.9 U	2.9 J	10 U
Indeno(123-cd)pyrene	600	17	3.9 J	10 U	11 U	7.7 J	8.9 U	8.7 U	10 U
Dibenz(ah)anthracene	230	5.8 J	10 U	10 U	11 U	10 U	8.9 U	8.7 U	10 U
Benzo(ghi)perylene	670	15	3.9 J	10 U	11 U	7.2 J	8.9 U	8.7 U	10 U
HPAH (c,e)	12,000	2,588	250	52	1.8 J	496	8.9 U	33	28
Miscellaneous SVOCs (ug/kg)									
Dibenzofuran	540	110	13	10 U	11 U	48	8.9 U	8.7 U	10 U
Phenolics (ug/kg)									
Phenol	420	30 U	30 U	30 U	31 U	30 U	27 U	26 U	30 U
2-Methylphenol	63	10 U	10 U	10 U	11 U	10 U	8.9 U	8.7 U	10 U
4-Methylphenol	670	10 U	10 U	10 U	11 U	10 U	8.9 U	8.7 U	10 U
24-Dimethylphenol	29	50 U	50 U	50 U	51 U	50 U	45 U	44 U	50 U
Pentachlorophenol	360	100 U	100 U	100 U	110 U	100 U	89 U	87 U	100 U

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR SIEVED SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 7/VS-39 K2409920-007 12/14/04	STATION 8/VS-38 K2409920-008 12/13/04	STATION 9/VS-40 K2409920-009 12/15/04	STATION 10/VS-41 K2409920-010 12/15/04	STATION 11/VS-42 K2409920-011 12/14/04	STATION 12/VS-44 K2409920-012 12/14/04	STATION 13/VS-43 K2409920-013 12/15/04	STATION 14/VS-34 K2409920-014 12/14/04
PCBs (ug/kg)									
Aroclor 1016	NA	10 U	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U
Aroclor 1221	NA	24 U	20 U	20 U	20 U	30 U	19 U	20 U	20 U
Aroclor 1232	NA	10 U	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U
Aroclor 1242	NA	10 U	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U
Aroclor 1248	NA	10 U	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U
Aroclor 1254	NA	10 U	10 U	10 U	110	10 U	9.3 U	10 U	10 U
Aroclor 1260	NA	10 U	10 U	10 U	10 U	10 U	9.3 U	19	10 U
Total PCBs (c)	130	24 U	20 U	20 U	110	30 U	19 U	19	20 U
Conventionals (percent)									
Total Solids (f)	NA	90.6	90.8	96.6	96.2	83.8	98.9	95.7	89.3
Total Organic Carbon	NA	0.13	0.05	0.04 J	0.05 U	0.06	0.02 J	0.03 J	0.08

T E 13

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR SIEVED SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 15/VS-30 K2409920-015 12/14/04
Metals (mg/kg)		
Copper	390	2.2 U
Mercury	0.41	0.036
Zinc	410	4.8
PAHs (ug/kg)		
Naphthalene	2,100	10 U
Acenaphthylene	1,300	10 U
Acenaphthene	500	1.1 J
Fluorene	540	10 U
Phenanthrene	1,500	5.2 J
Anthracene	960	3.6 J
2-Methylnaphthalene	670	10 U
LPAH (b,c)	5,200	10 J
Fluoranthene	1,700	25
Pyrene	2,600	11
Benz(a)anthracene	1,300	8.8 J
Chrysene	1,400	11
Benzo(b)fluoranthene		7.6 J
Benzo(k)fluoranthene		3.3 J
Total Benzofluoranthenes (c,d)	3,200	11 J
Benzo(a)pyrene	1,600	5 J
Indeno(123-cd)pyrene	600	2.2 J
Dibenz(ah)anthracene	230	10 U
Benzo(ghi)perylene	670	10 U
HPAH (c,e)	12,000	74
Miscellaneous SVOCs (ug/kg)		
Dibenzofuran	540	10 U
Phenolics (ug/kg)		
Phenol	420	30 U
2-Methylphenol	63	10 U
4-Methylphenol	670	10 U
24-Dimethylphenol	29	50 U
Pentachlorophenol	360	100 U

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR SIEVED SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 15/VS-30 K2409920-015 12/14/04
PCBs (ug/kg)		
Aroclor 1016	NA	10 U
Aroclor 1221	NA	20 U
Aroclor 1232	NA	10 U
Aroclor 1242	NA	10 U
Aroclor 1248	NA	10 U
Aroclor 1254	NA	2.3 J
Aroclor 1260	NA	10 U
Total PCBs (c)	130	2.3 J
Conventionals (percent)		
Total Solids (f)	NA	91.3
Total Organic Carbon	NA	0.06

U = Compound not detect.
J = Estimated value.
B = Estimated value. Compound detected above method detection limit but below method reporting limit.
Box indicates the sample concentration is greater than the screening criteria.

a. Washington State Sediment Management Standard Sediment Quality Standards or dry weight analog from Technical Specifications Table 01450-2.
b. The total LPAH criterion represents the sum of the following low molecular weight polycyclic aromatic compounds: Naphthlene acenaphthylene acenaphthene fluorine phenanthrene and anthracene. 2-Methylnaphthalene is not included in the LPAH definition. The LPAH criterion is not the sum of criteria values for the individual LPAH compounds listed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect the total concentration is reported as non-detect using the highest detection limit.
d. The total benzofluoranthenes criterion is the sum of the concentrations of the b j and k isomers of benzofluoranthene.
e. The total HPAH criterion represents the sum of the following high molecular weight polycyclic aromatic compounds: fluoranthene pyrene benz[a]anthracene chrysene total benzofluoranthenes benzo[a]pyrene indeno[123-cd]pyrene dibenz[ah]anthracene and benzo[ghi]perylene. The total HPAH criterion is not the sum of criteria values for the individual HPAH compounds listed.
f. Total solids for sieved fraction (less than 1 inch) of cap verification sample.

TABLE 14

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR TOTAL SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: / Laboratory ID: / Date Sampled:	SQS (a)	STATION 1/VS-31 K2409920-001 12/14/04	STATION 2/VS-32 K2409920-002 12/13/04	Field Duplicate of VS-32 STATION 98 K2409920-016 12/13/04	STATION 3/VS-33 K2409920-003 12/14/04	STATION 4/VS-35 K2409920-004 12/13/04	STATION 5/VS-36 K2409920-005 12/14/04	STATION 6/VS-37 K2409920-006 12/13/04	Field Duplicate of VS-37 STATION 99 K2409920-017 12/13/04
Metals (mg/kg)									
Copper	390	2.1 U	2.2 U	2.2 U	2.3 U	6.8	2.0 U	2.3 U	2.2 U
Mercury	0.41	0.016 B	0.013	0.009 B	0.011 B	0.149	0.011 B	0.007 B	0.015 U
Zinc	410	3.7	3.3	3.3	2.3	13	2.2	1.0 UB	3.4
PAHs (ug/kg)									
Naphthalene	2,100	22	28 J	63 J	49	678	11	9.4 U	9.6 UJ
Acenaphthylene	1,300	1.7 J	3.2 J	5.9 J	8.0 J	62	8.8 U	9.4 U	9.6 U
Acenaphthene	500	31	26 J	87 J	230	518	15	3.0 J	1.4 J
Fluorene	540	37	29 J	84 J	480	395	11	3.1 J	10 UJ
Phenanthrene	1,500	81	74 J	228 J	1,200	1,036	32	13	4.6 J
Anthracene	960	48	43 J	104 J	750	405	13	2.4 J	2.0 J
2-Methylnaphthalene	670	8.7 J	6.4 J	16	18.0	188	6.5 J	1.6 J	9.6 UJ
LPAH (b,c)	5,200	221	203 J	572 J	2,717	3,094	83	22	8.0 J
Fluoranthene	1,700	174	201 J	950 J	1,300	1,318	63	8.7 J	17
Pyrene	2,600	78	211 J	513 J	610	3,672	68	8.0 J	23
Benz(a)anthracene	1,300	39	70 J	190 J	280	348	21	2.2 J	4.8 J
Chrysene	1,400	43	144	218	420	461	25	2.6 J	5.9 J
Benzo(b)fluoranthene		26	70	114	160	866	17	9.4 U	6.3 J
Benzo(k)fluoranthene		7.6 J	23	41	48	311	5.7 J	9.4 U	10 U
Total Benzofluoranthenes (c,d)	3,200	33 J	93	155	208	1,177	23	9.4 U	6.3 J
Benzo(a)pyrene	1,600	15	43 J	76 J	86	499	10	9.4 U	4.1 J
Indeno(123-cd)pyrene	600	4.5 J	12	23	24	179	2.8 J	9.4 U	10 U
Dibenz(ah)anthracene	230	9.1 U	4.5 J	7.0 J	8.3 J	52	8.8 U	9.4 U	9.6 U
Benzo(ghi)perylene	670	4.1 J	12	23	20	160	2.6 J	9.4 U	10 UJ
HPAH (c,e)	12,000	390	791	2,154	2,956	7,866	214	21 J	61
Miscellaneous SVOCs (ug/kg)									
Dibenzofuran	540	26	19 J	66 J	180	348	8.8	2 J	10 UJ
Phenolics (ug/kg)									
Phenol	420	27 U	29 U	28 U	30 U	30 U	27 U	28 U	29 UJ
2-Methylphenol	63	9.1 U	9.6 U	9.5 U	10 U	5.4 J	8.8 U	9.4 U	9.6 U
4-Methylphenol	670	9.1 U	9.6 U	9.5 U	10 U	20	8.8 U	9.4 U	9.6 U
24-Dimethylphenol	29	46 U	48 U	47 U	50 U	47 U	44 U	47 U	48 U
Pentachlorophenol	360	91 U	96 U	95 U	100 U	94 U	88 U	94 U	96 UJ

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR TOTAL SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 1/VS-31 K2409920-001 12/14/04	STATION 2/VS-32 K2409920-002 12/13/04	Field Duplicate of VS-32 STATION 98 K2409920-016 12/13/04	STATION 3/VS-33 K2409920-003 12/14/04	STATION 4/VS-35 K2409920-004 12/13/04	STATION 5/VS-36 K2409920-005 12/14/04	STATION 6/VS-37 K2409920-006 12/13/04	Field Duplicate of VS-37 STATION 99 K2409920-017 12/13/04
PCBs (ug/kg)									
Aroclor 1016	NA	9.1 U	9.6 U	9.5 U	10 U	9.4 U	8.8 U	9.4 U	9.6 U
Aroclor 1221	NA	21 U	19 U	21 U	34 U	22 U	18 U	19 U	19 U
Aroclor 1232	NA	9.1 U	9.6 U	18 U	10 U	27 U	8.8 U	9.4 U	9.6 U
Aroclor 1242	NA	9.1 U	9.6 U	9.5 U	10 U	15 U	8.8 U	9.4 U	9.6 U
Aroclor 1248	NA	9.1 U	9.6 U	9.5 U	10 U	9.4 U	8.8 U	9.4 U	9.6 U
Aroclor 1254	NA	2.3 J	9.6 U	9.5 U	10 U	9.4 U	8.8 U	9.4 U	9.6 U
Aroclor 1260	NA	2.8 J	9.6 U	9.5 U	10 U	10 U	8.8 U	9.4 U	9.6 U
Total PCBs (c)	130	5.1 J	19 U	21 U	34 U	27 U	18 U	19 U	19 U
Conventionals (percent)									
Total Solids (f)	NA	94.6	90.8	91.6	84.9	89.4	97.5	90.5	88.5
Total Organic Carbon	NA	0.03 J	0.04 J	0.03 J	0.03 J	0.14	0.02 J	0.05 U	0.11

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CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR TOTAL SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: / Laboratory ID: / Date Sampled:	SQS (a)	STATION 7/VS-39 K2409920-007 12/14/04	STATION 8/VS-38 K2409920-008 12/13/04	STATION 9/VS-40 K2409920-009 12/15/04	STATION 10/VS-41 K2409920-010 12/15/04	STATION 11/VS-42 K2409920-011 12/14/04	STATION 12/VS-44 K2409920-012 12/14/04	STATION 13/VS-43 K2409920-013 12/15/04	STATION 14/VS-34 K2409920-014 12/14/04
Metals (mg/kg)									
Copper	390	2.1 U	2.2 U	2.1 U	2.1 U	2.4 U	1.9 U	2.1 U	2.1 U
Mercury	0.41	0.047	0.016 B	0.046	0.010 B	0.016 B	0.016 U	0.020	0.010 B
Zinc	410	2.5	2.1 B	0.88 UB	3.3	3.3	0.69 UB	2.6	2.4
PAHs (ug/kg)									
Naphthalene	2,100	195	36	9.8 U	11 U	100	8.8 U	8.5 U	9.4 U
Acenaphthylene	1,300	5.5 J	9.8 U	9.8 U	11 U	2.3 J	8.8 U	8.5 U	9.4 U
Acenaphthene	500	205	36	1.3 J	11 U	62	8.8 U	1.5 J	9.4 U
Fluorene	540	98	15	10 U	11 U	58	8.8 U	2.0 J	9.4 U
Phenanthrene	1,500	205	35	2.5 J	11 U	140	8.8 U	6.0 J	3.1 J
Anthracene	960	137	19	2.6 J	11 U	78	8.8 U	3.3 J	2.3 J
2-Methylnaphthalene	670	51.7	9.6 J	9.8 U	11 U	27	8.8 U	8.5 U	9.4 U
LPAH (b,c)	5,200	845	141	6.4 J	11 U	440	8.8 U	13 J	5.4 J
Fluoranthene	1,700	1074	73	19	11 U	180	8.8 U	8.6	7.3 J
Pyrene	2,600	927	91	14	1.8 J	140	8.8 U	7.4 J	5.3 J
Benz(a)anthracene	1,300	156	20	5.6 J	11 U	42	8.8 U	3.7 J	3.2 J
Chrysene	1,400	146	20	6.2 J	11 U	57	8.8 U	4.3 J	5.2 J
Benzo(b)fluoranthene		96	17	4.4 J	11 U	31	8.8 U	5.0 J	5.5 J
Benzo(k)fluoranthene		33	5.7 J	10 U	11 U	11	8.8 U	8.5 U	9.4 U
Total Benzofluoranthenes (c,d)	3,200	129	22	4.4 J	11 U	42	8.8 U	5.0 J	5.5 J
Benzo(a)pyrene	1,600	57	11	2.8 J	11 U	20	8.8 U	2.8 J	9.4 U
Indeno(123-cd)pyrene	600	17	3.8 J	10 U	11 U	7.7 J	8.8 U	8.5 U	9.4 U
Dibenz(ah)anthracene	230	5.7 J	9.8 U	9.8 U	11 U	10 U	8.8 U	8.5 U	9.4 U
Benzo(ghi)perylene	670	15	3.8 J	10 U	11 U	7.2 J	8.8 U	8.5 U	9.4 U
HPAH (c,e)	12,000	2,526	244	51	2 J	496	8.8 U	32	26
Miscellaneous SVOCs (ug/kg)									
Dibenzofuran	540	107	13	10 U	11 U	48	8.8 U	8.5 U	9.4 U
Phenolics (ug/kg)									
Phenol	420	29 U	29 U	29 U	30 U	30 U	27 U	25 U	28 U
2-Methylphenol	63	9.8 U	9.8 U	9.8 U	11 U	10 U	8.8 U	8.5 U	9.4 U
4-Methylphenol	670	9.8 U	9.8 U	9.8 U	11 U	10 U	8.8 U	8.5 U	9.4 U
24-Dimethylphenol	29	49 U	49 U	49 U	50 U	50 U	45 U	43 U	47 U
Pentachlorophenol	360	98 U	98 U	98 U	108 U	100 U	88 U	85 U	94 U

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR TOTAL SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: / Laboratory ID: / Date Sampled:	SQS (a)	STATION 7/VS-39 K2409920-007 12/14/04	STATION 8/VS-38 K2409920-008 12/13/04	STATION 9/VS-40 K2409920-009 12/15/04	STATION 10/VS-41 K2409920-010 12/15/04	STATION 11/VS-42 K2409920-011 12/14/04	STATION 12/VS-44 K2409920-012 12/14/04	STATION 13/VS-43 K2409920-013 12/15/04	STATION 14/VS-34 K2409920-014 12/14/04
PCBs (ug/kg)									
Aroclor 1016	NA	9.8 U	9.8 U	9.8 U	9.8 U	10 U	9.2 U	9.8 U	9.4 U
Aroclor 1221	NA	23 U	20 U	20 U	20 U	30 U	19 U	20 U	19 U
Aroclor 1232	NA	9.8 U	9.8 U	9.8 U	9.8 U	10 U	9.2 U	9.8 U	9.4 U
Aroclor 1242	NA	9.8 U	9.8 U	9.8 U	9.8 U	10 U	9.2 U	9.8 U	9.4 U
Aroclor 1248	NA	9.8 U	9.8 U	9.8 U	9.8 U	10 U	9.2 U	9.8 U	9.4 U
Aroclor 1254	NA	9.8 U	9.8 U	9.8 U	108	10 U	9.2 U	9.8 U	9.4 U
Aroclor 1260	NA	9.8 U	9.8 U	9.8 U	9.8 U	10 U	9.2 U	19	9.4 U
Total PCBs (c)	130	23 U	20 U	20 U	108	30 U	19 U	19	19 U
Conventionals (percent)									
Total Solids (f)	NA	92.8	92.7	98.9	98.3	83.8	99.9	97.6	95.0
Total Organic Carbon	NA	0.13	0.05	0.04 J	0.05 U	0.06	0.02 J	0.03 J	0.08

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR TOTAL SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 15/VS-30 K2409920-015 12/14/04
Metals (mg/kg)		
Copper	390	2.1 U
Mercury	0.41	0.035
Zinc	410	4.7
PAHs (ug/kg)		
Naphthalene	2,100	9.7 U
Acenaphthylene	1,300	9.7 U
Acenaphthene	500	1.1 J
Fluorene	540	10 U
Phenanthrene	1,500	5.0 J
Anthracene	960	3.5 J
2-Methylnaphthalene	670	9.7 U
LPAH (b,c)	5,200	10 J
Fluoranthene	1,700	24
Pyrene	2,600	11
Benz(a)anthracene	1,300	8.5 J
Chrysene	1,400	11
Benzo(b)fluoranthene		7.4 J
Benzo(k)fluoranthene		3.2 J
Total Benzofluoranthenes (c,d)	3,200	11 J
Benzo(a)pyrene	1,600	4.8 J
Indeno(123-cd)pyrene	600	2.1 J
Dibenz(ah)anthracene	230	9.7 U
Benzo(ghi)perylene	670	10 U
HPAH (c,e)	12,000	72
Miscellaneous SVOCs (ug/kg)		
Dibenzofuran	540	10 U
Phenolics (ug/kg)		
Phenol	420	29 U
2-Methylphenol	63	9.7 U
4-Methylphenol	670	9.7 U
24-Dimethylphenol	29	48 U
Pentachlorophenol	360	97 U

CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR TOTAL SAMPLE DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	SQS (a)	STATION 15/VS-30 K2409920-015 12/14/04
PCBs (ug/kg)		
Aroclor 1016	NA	9.7 U
Aroclor 1221	NA	19 U
Aroclor 1232	NA	9.7 U
Aroclor 1242	NA	9.7 U
Aroclor 1248	NA	9.7 U
Aroclor 1254	NA	2.2 J
Aroclor 1260	NA	9.7 U
Total PCBs (c)	130	19 J
Conventionals (percent)		
Total Solids (f)	NA	94.2
Total Organic Carbon	NA	0.06

U = Compound not detect.
J = Estimated value.
B = Estimated value. Compound detected above method detection limit but below method reporting limit.
Box indicates the sample concentration is greater than the screening criteria.

a. Washington State Sediment Management Standard Sediment Quality Standards or dry weight analog from Technical Specifications Table 01450-2.
b. The total LPAH criterion represents the sum of the following low molecular weight polycyclic aromatic compounds: Naphthlene acenaphthylene acenaphthene fluorine phenanthrene and anthracene. 2-Methylnaphthalene is not included in the LPAH definition. The LPAH criterion is not the sum of criteria values for the individual LPAH compounds listed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect the total concentration is reported as non-detect using the highest detection limit.
d. The total benzofluoranthenes criterion is the sum of the concentrations of the b j and k isomers of benzofluoranthene.
e. The total HPAH criterion represents the sum of the following high molecular weight polycyclic aromatic compounds: fluoranthene pyrene benz[a]anthracene chrysene total benzofluoranthenes benzo[a]pyrene indeno[123-cd]pyrene dibenz[ah]anthracene and benzo[ghi]perylene. The total HPAH criterion is not the sum of criteria values for the individual HPAH compounds listed.
f. Total solids for whole sample of cap verification sample. Only sieved sample (less than 1 inch) was analyzed for chemistry.

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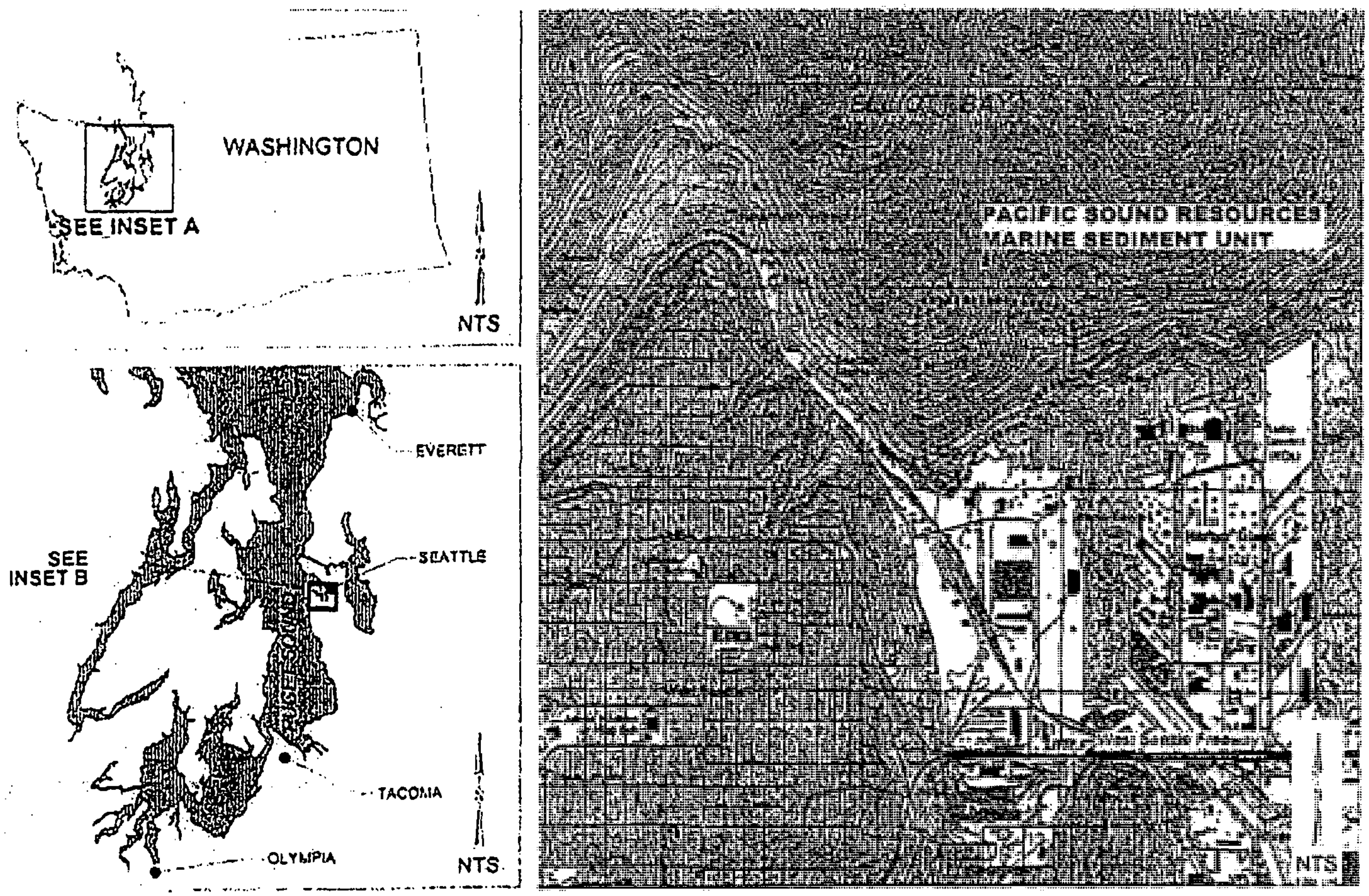
FIGURE 1
SITE AND VICINITY MAP



INSET A

INSET B

FIGURE 2a
PROJECT SITE PLAN

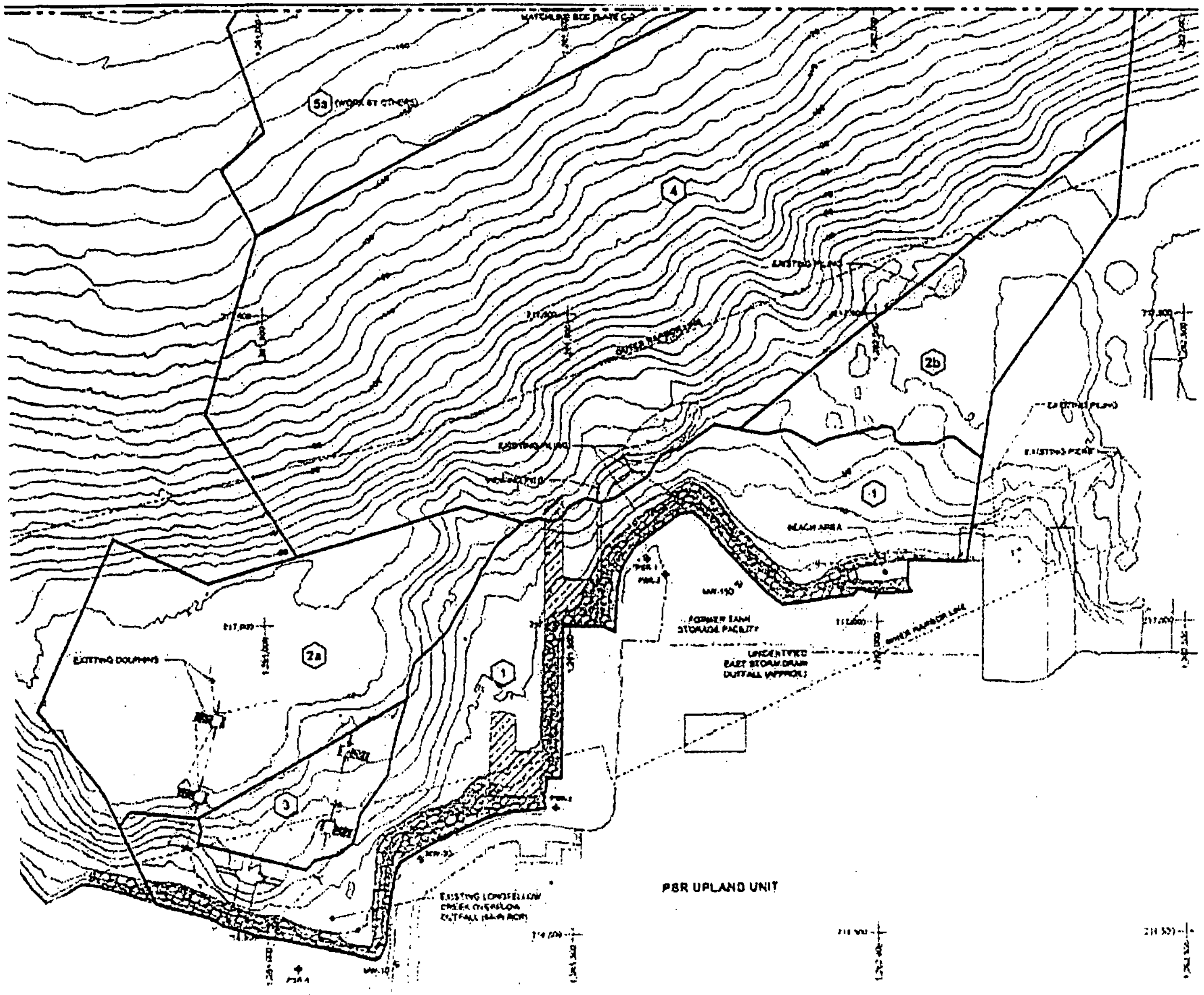


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FIGURE 2b
PROJECT SITE PLAN

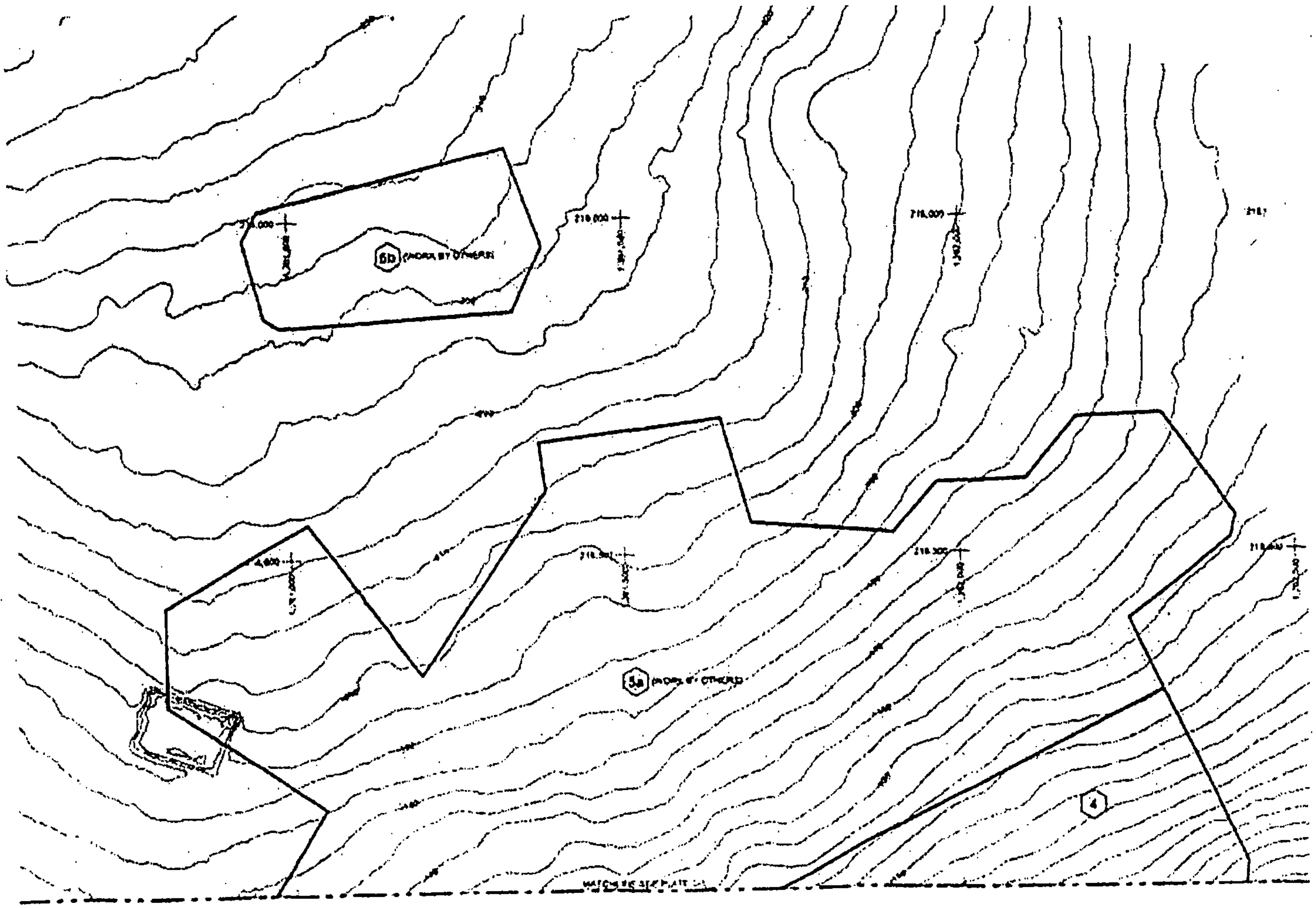

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FIGURE 3a
WATER QUALITY MONITORING LOCATIONS

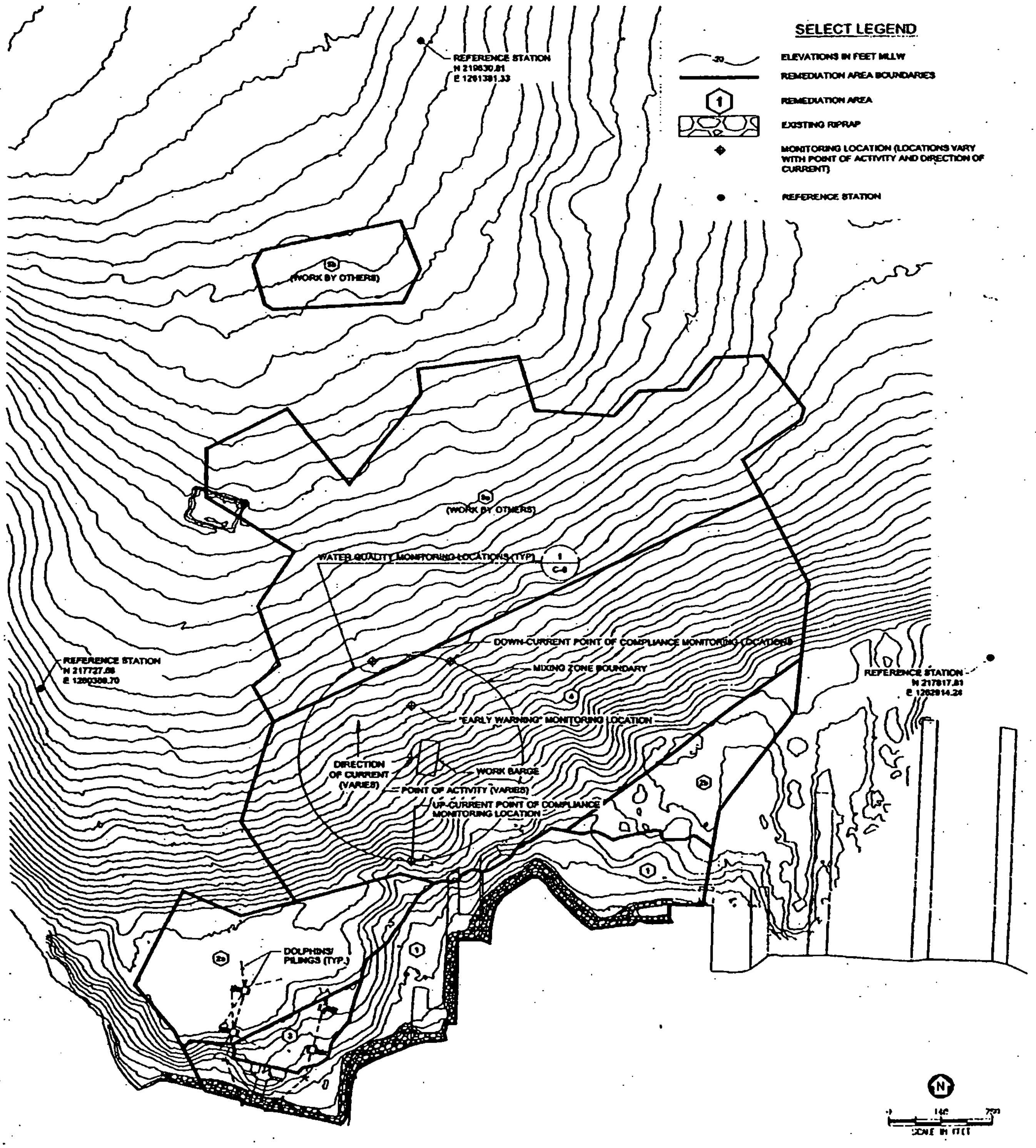

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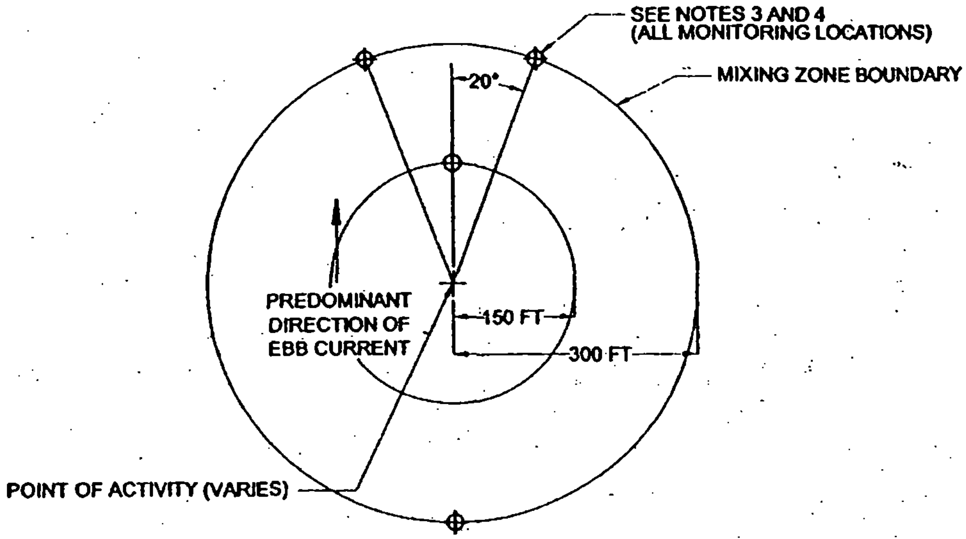
FIGURE 3b
WATER QUALITY MONITORING LOCATION DIAGRAM



WATER QUALITY MONITORING LOCATIONS (TYP)
SCALE: NTS

FIGURE 4
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER—DECEMBER, 2004

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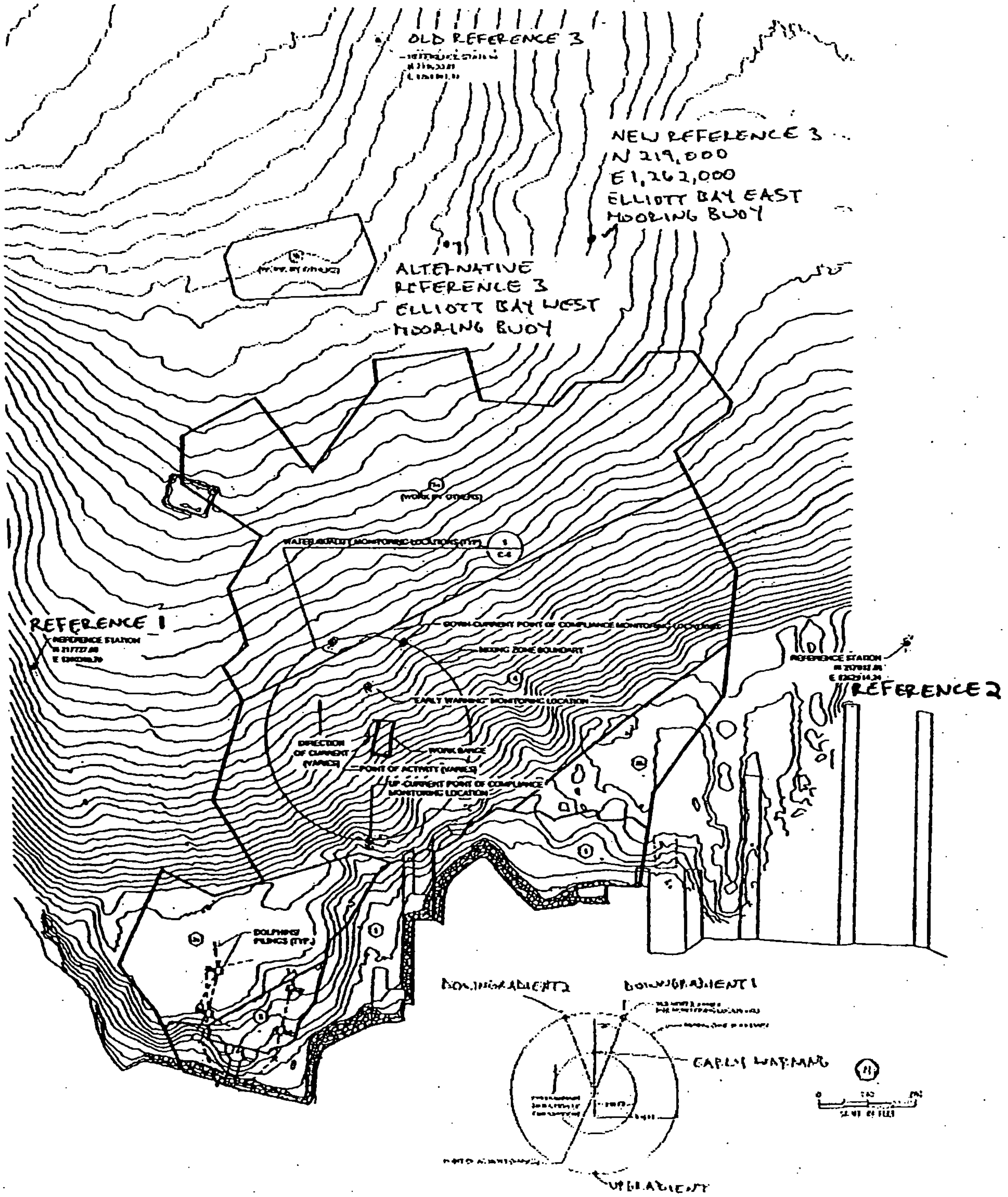
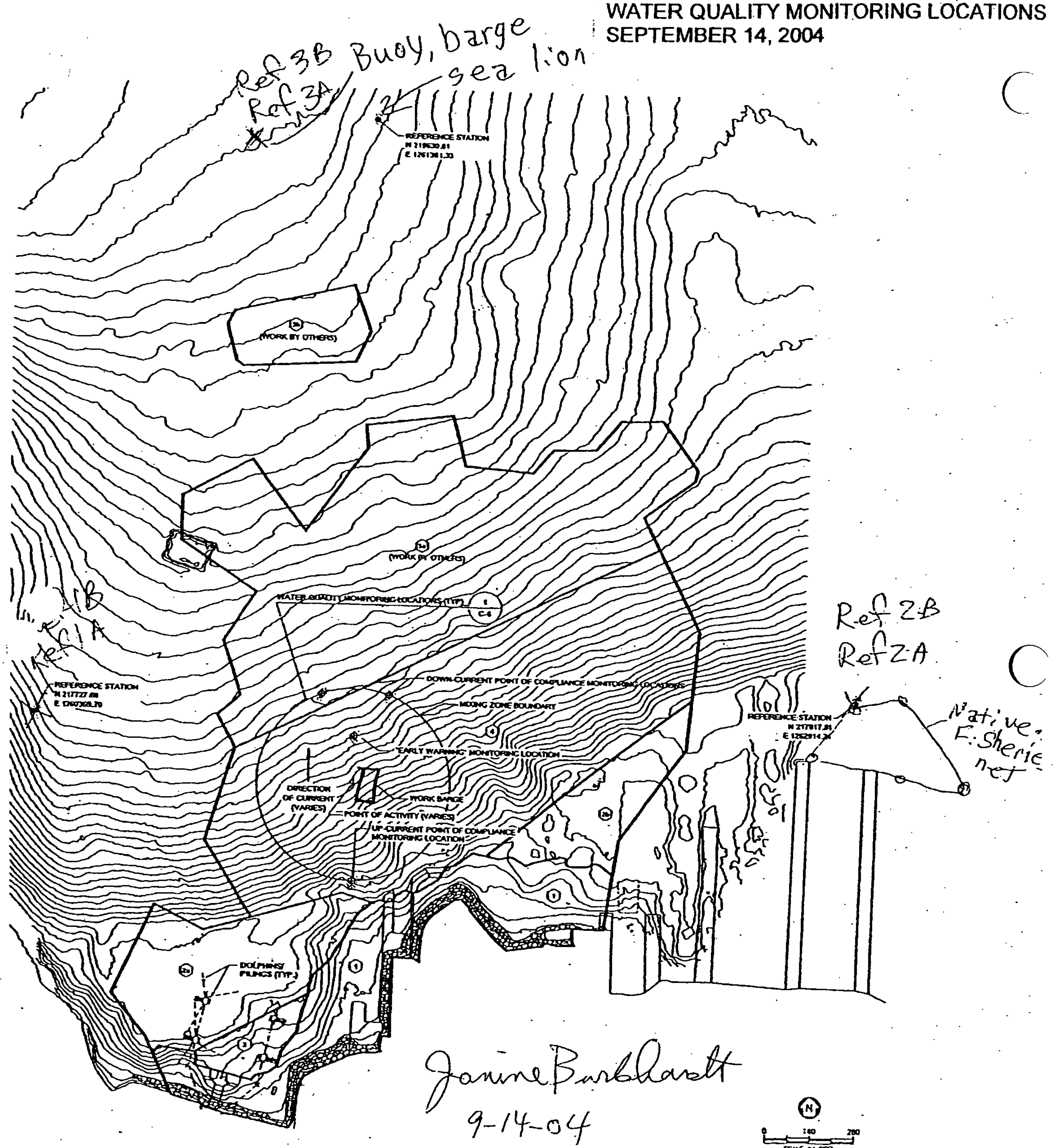


FIGURE 5
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 14, 2004



Janine Burkhardt
9-14-04

FIGURE 6
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 15, 2004

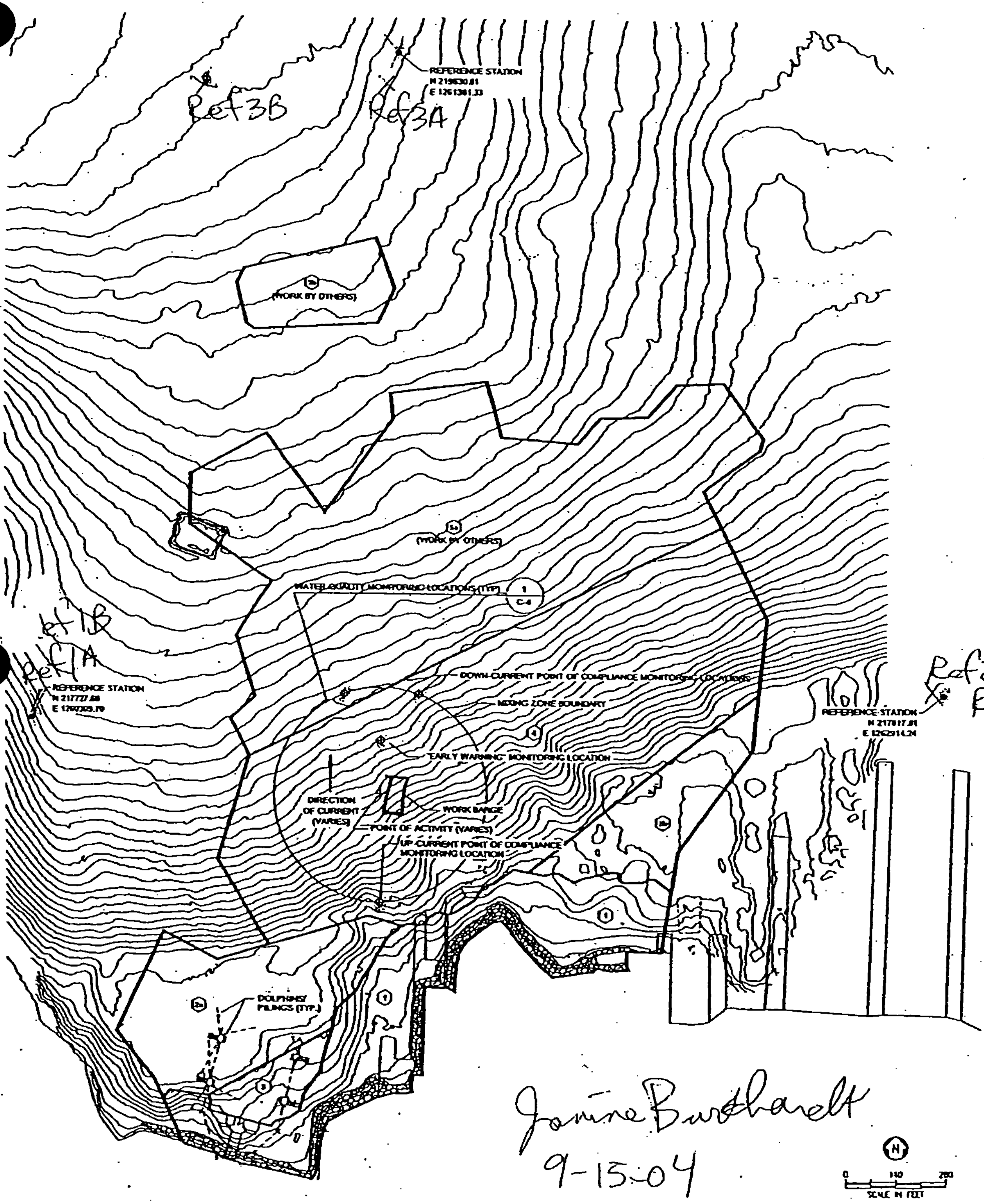
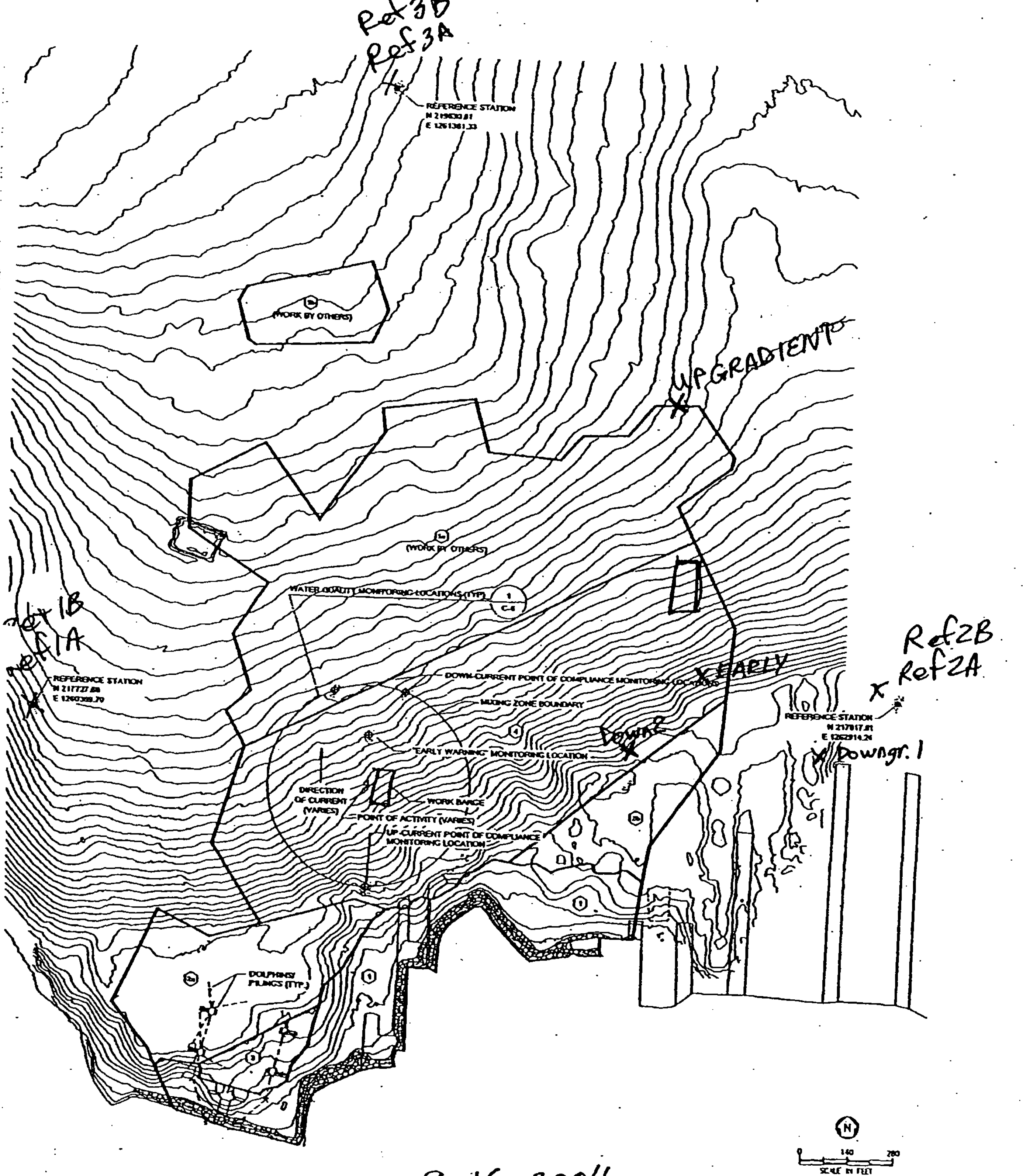


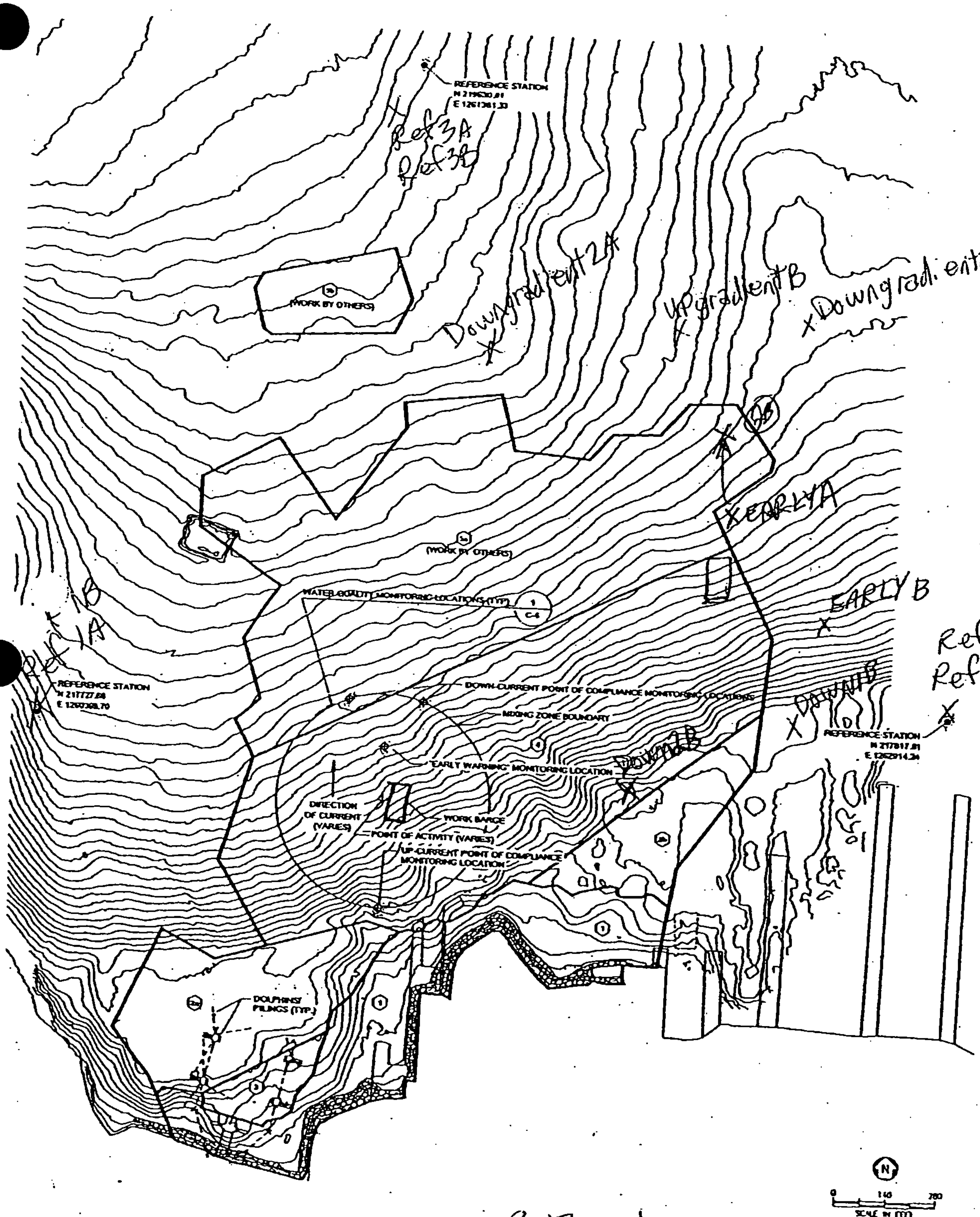
FIGURE 7
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 16, 2004



9-16-2004

J Burkhardt

FIGURE 8
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 17, 2004



9-17-04

FIGURE 9
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 21, 2004

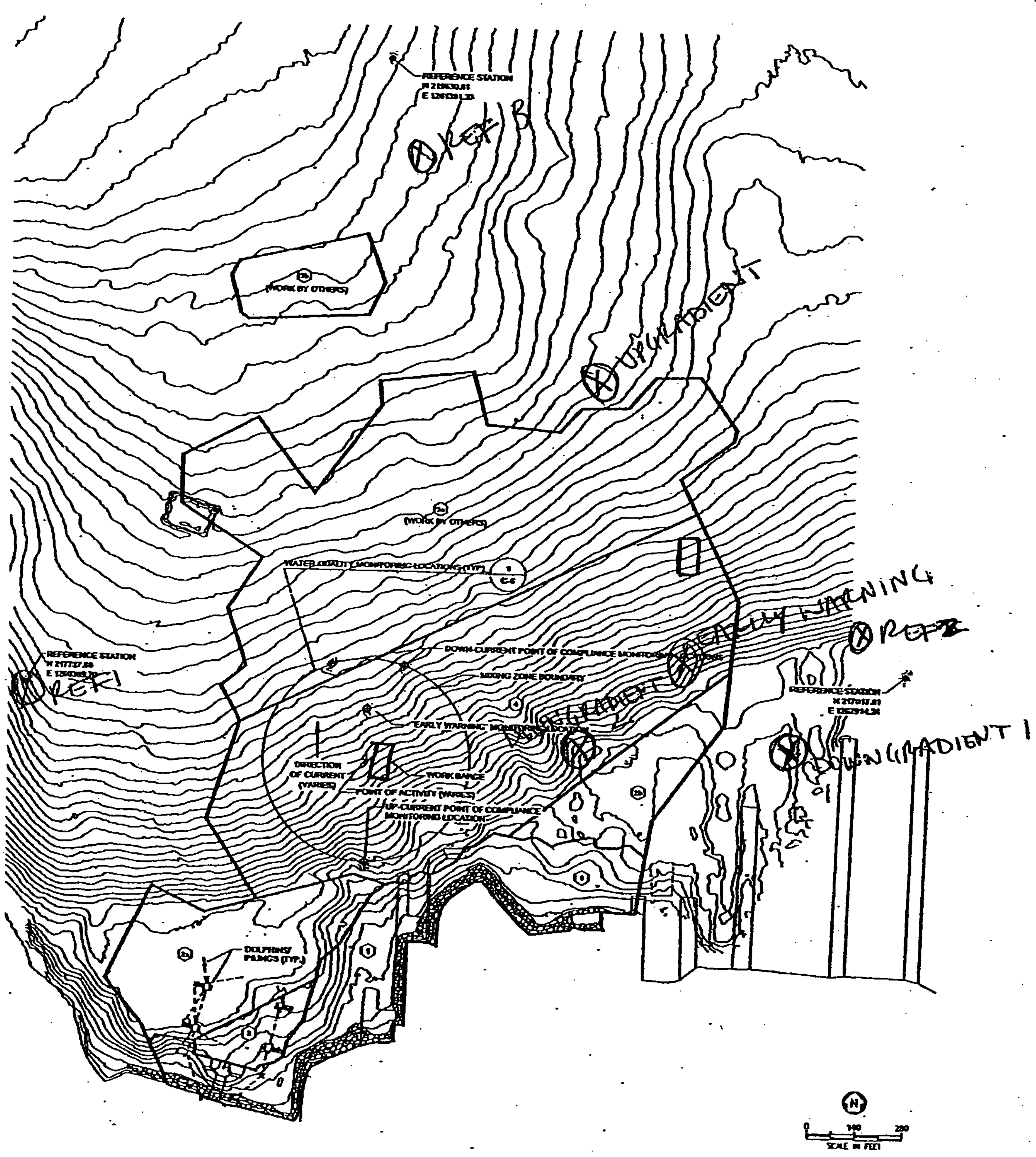
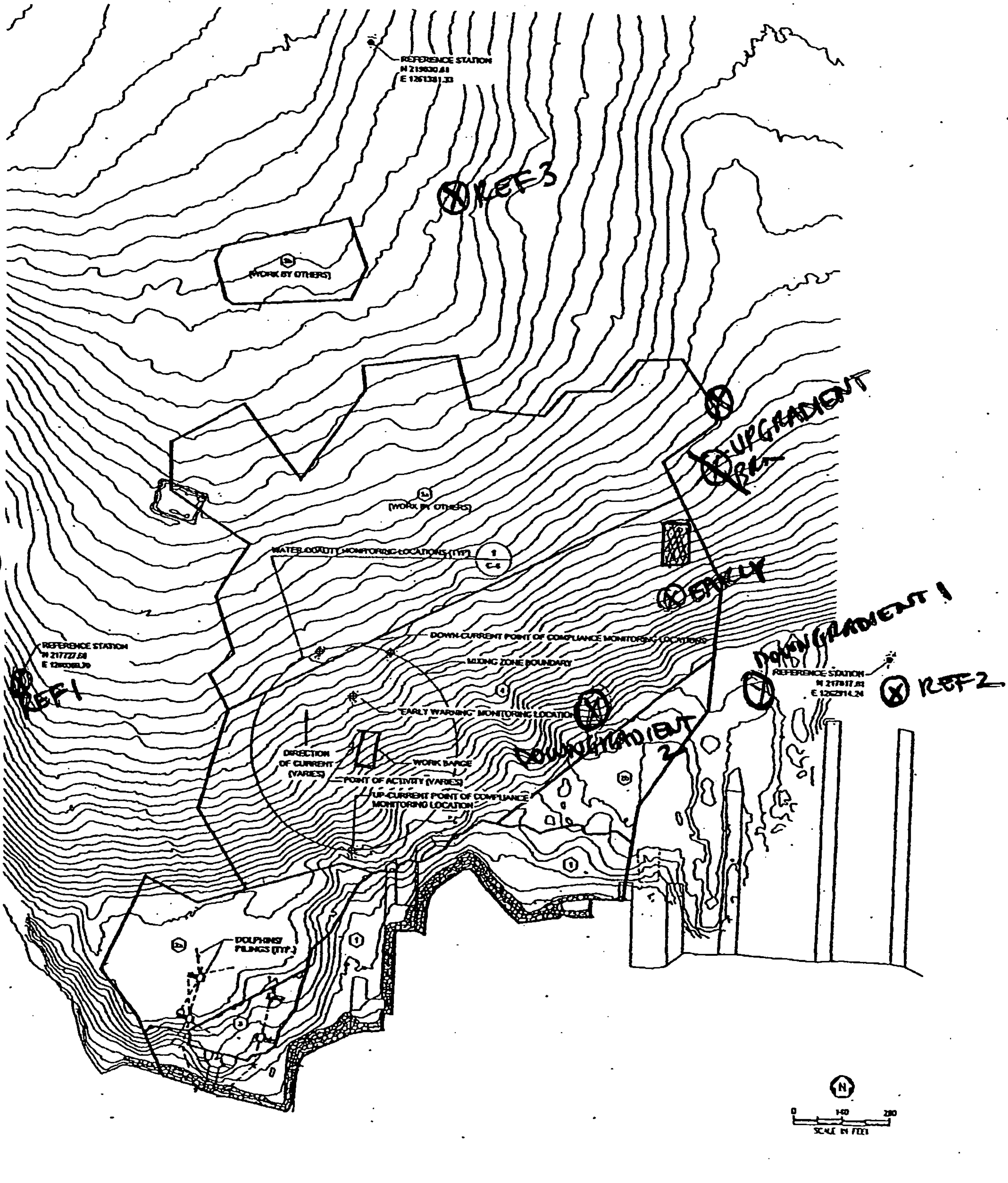
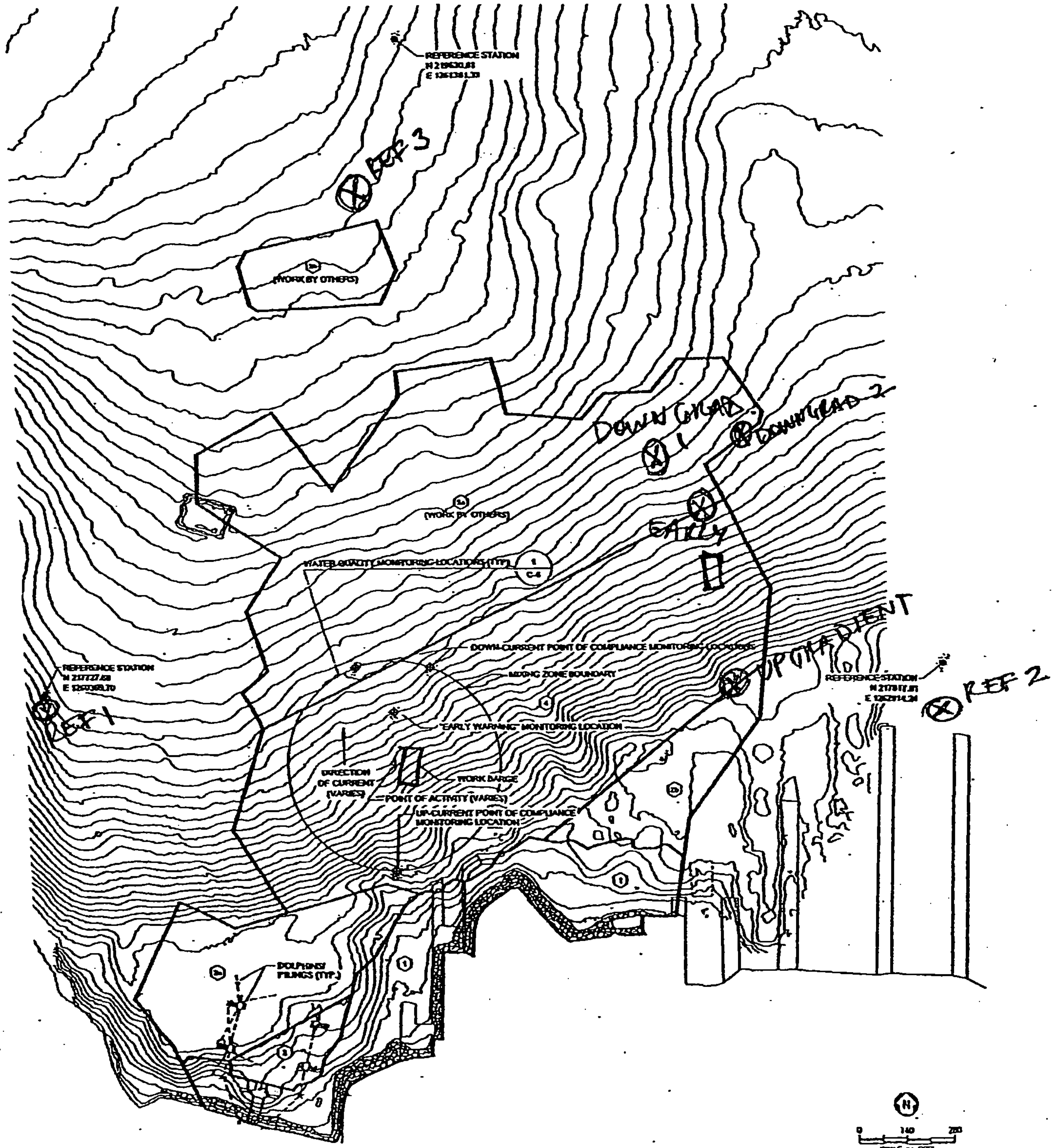


FIGURE 10
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 22, 2004



a-17

FIGURE 11
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 23, 2004



9/23/04

FIGURE 12
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 24, 2004

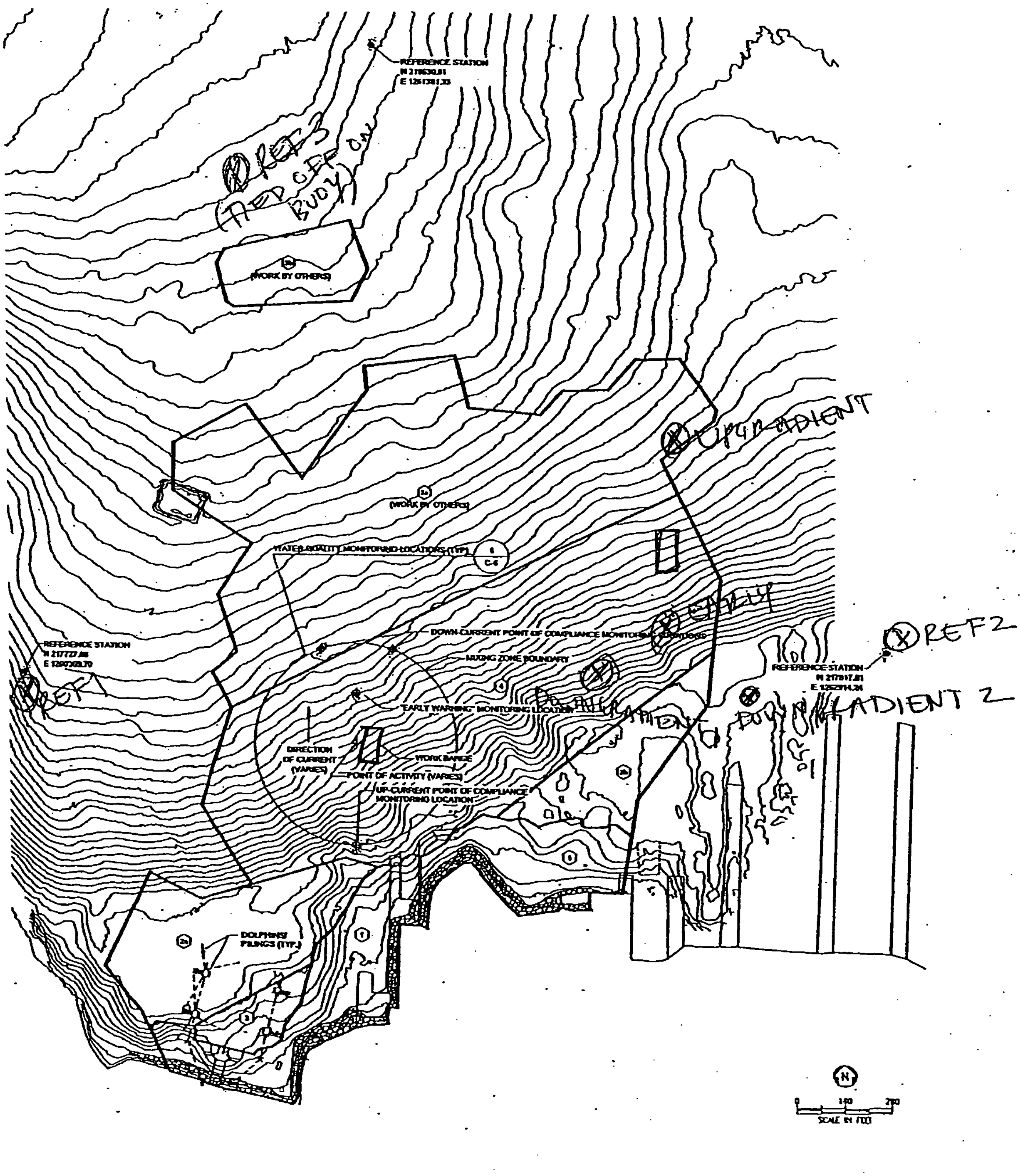
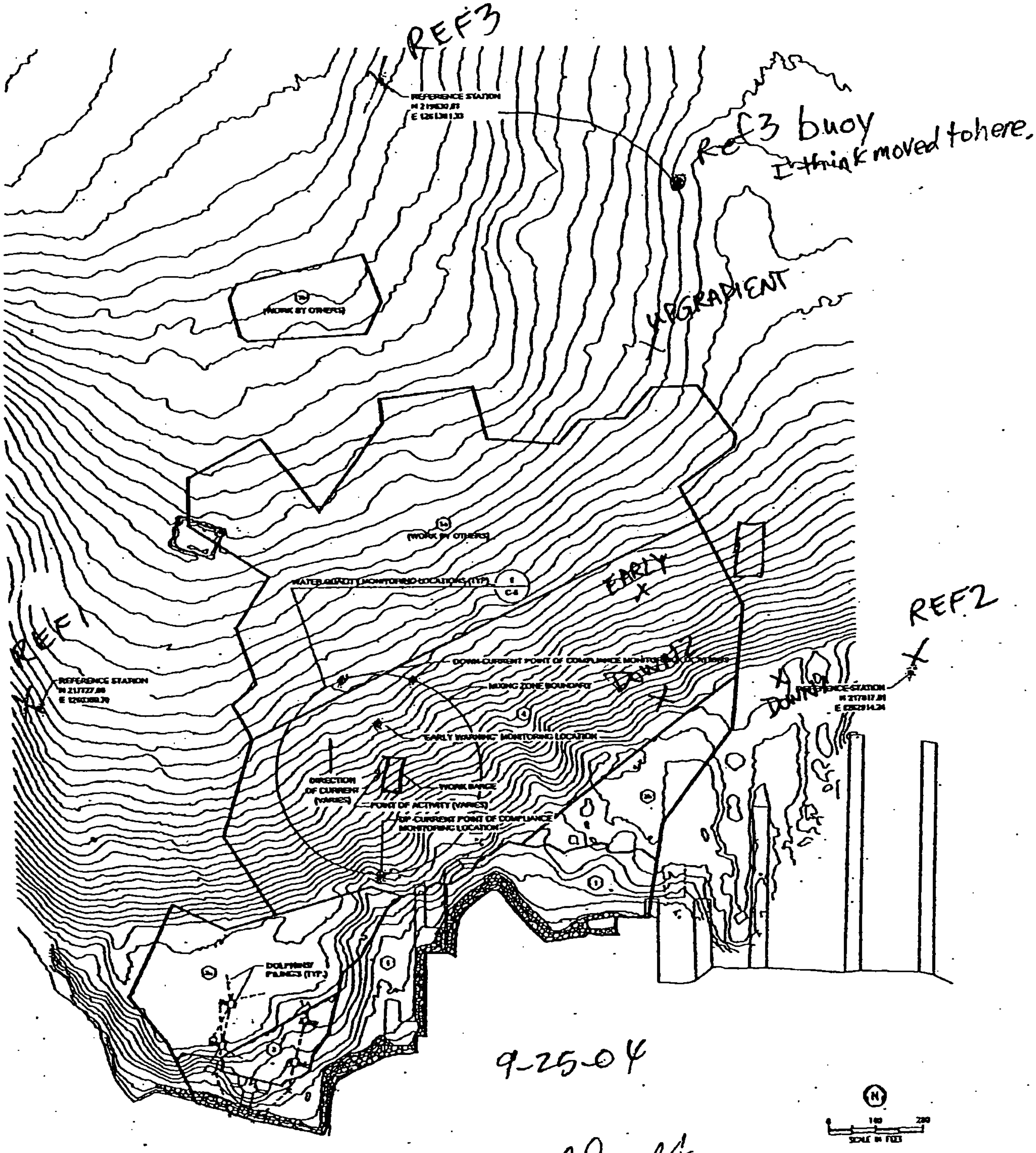
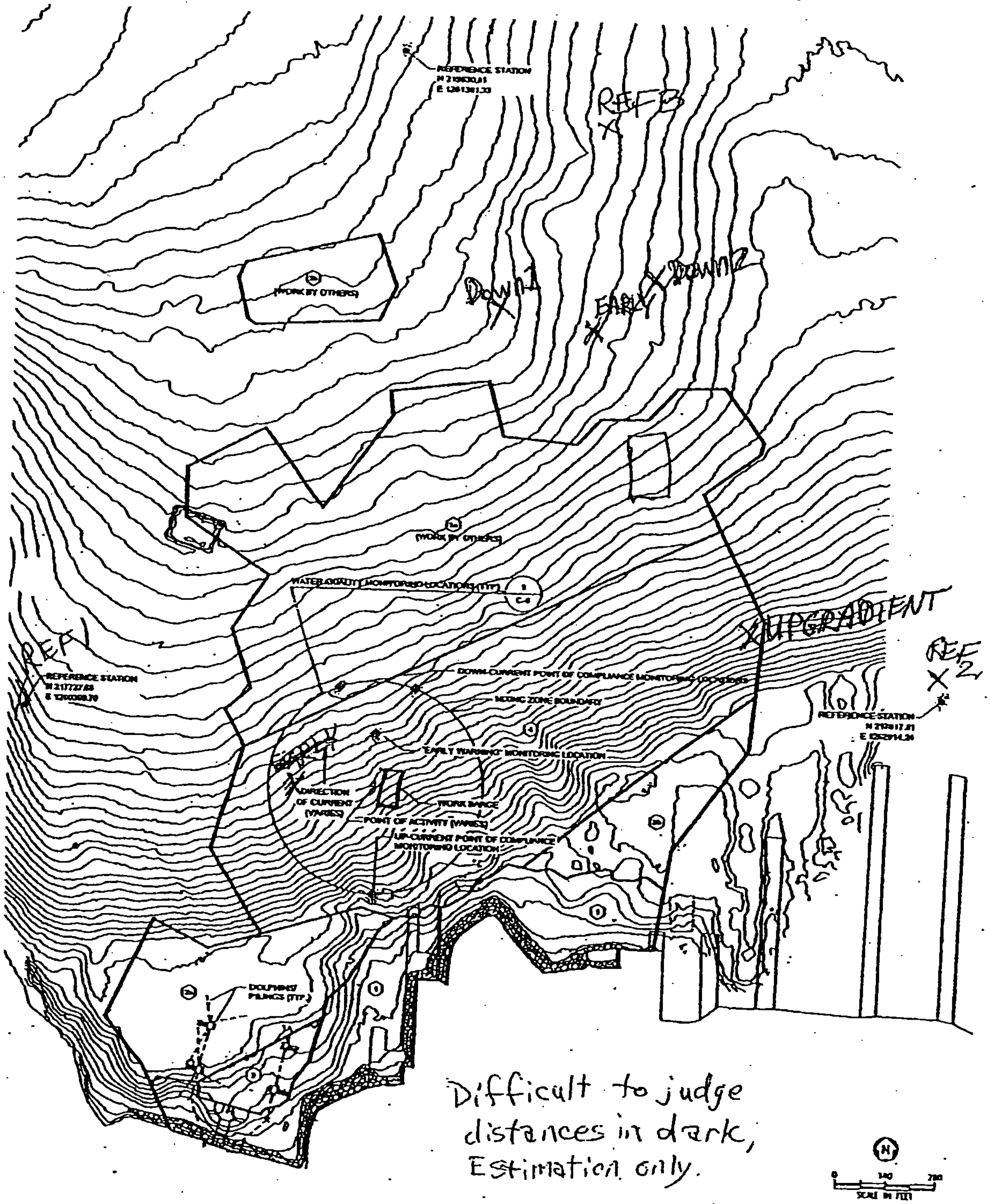


FIGURE 13
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 25, 2004



J Burkhardt

FIGURE 14
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 29, 2004

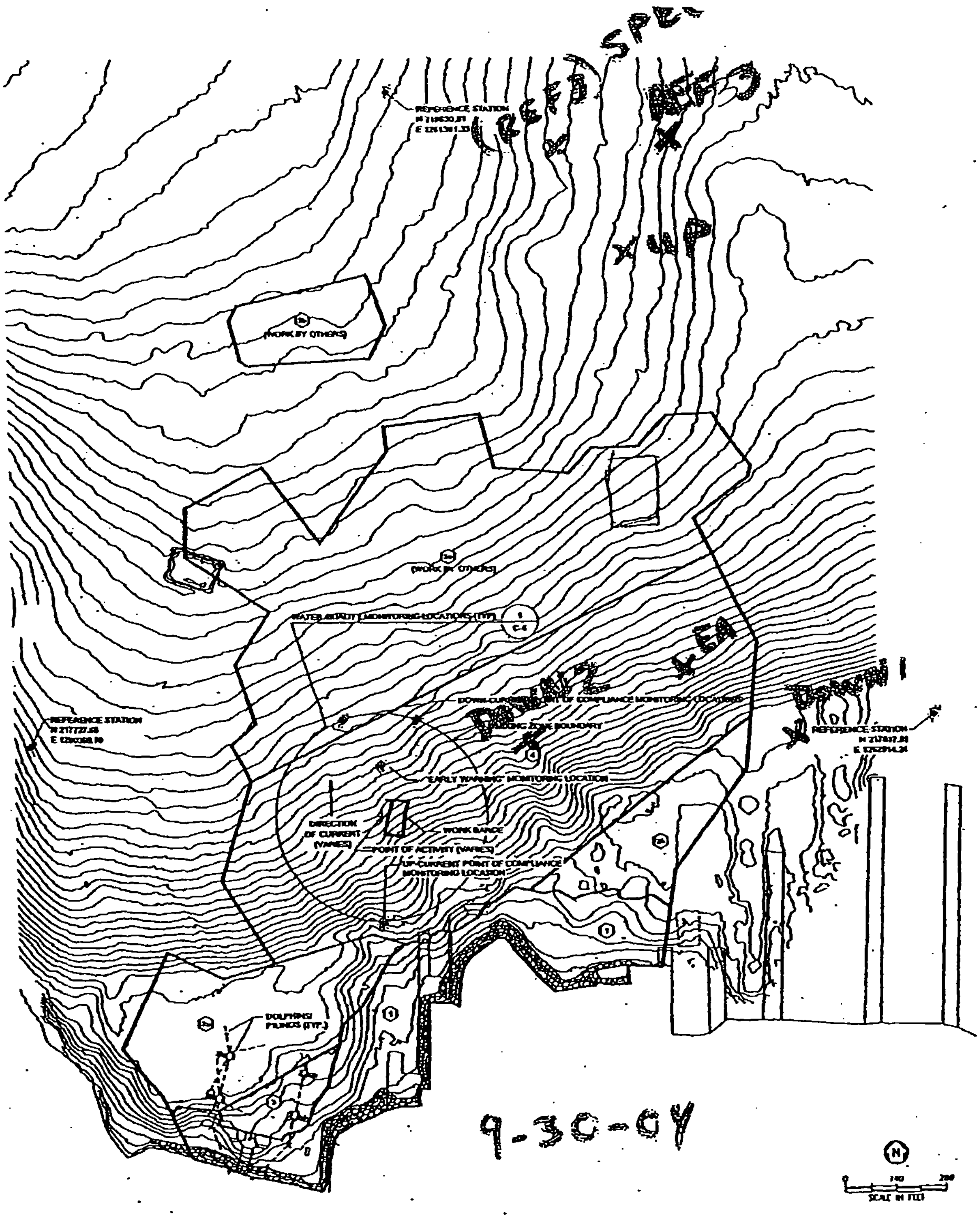


Difficult to judge distances in dark, Estimation only.

9-29-04

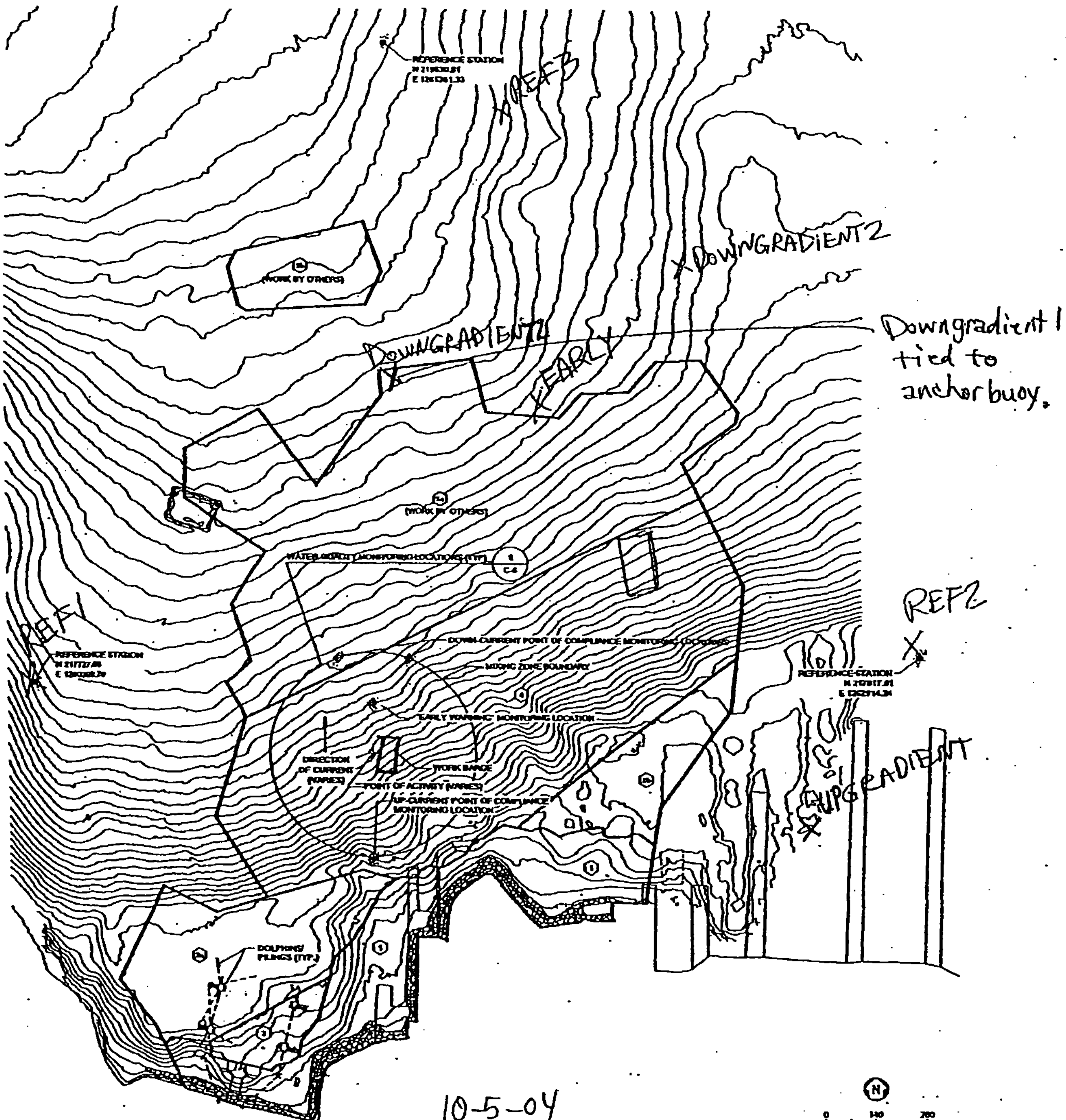
J Burkhardt

FIGURE 15
WATER QUALITY MONITORING LOCATIONS
SEPTEMBER 30, 2004



9-30-04

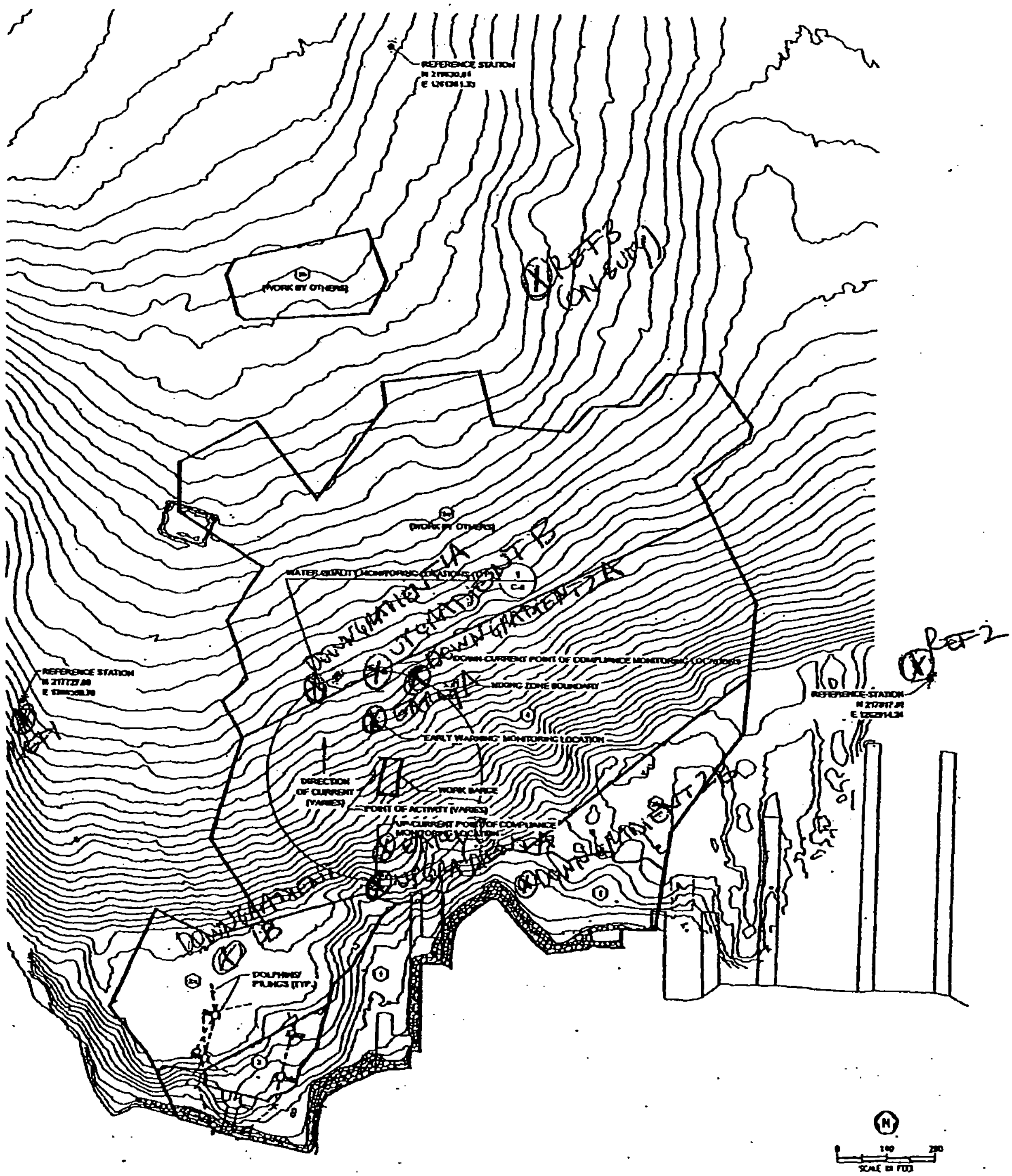
FIGURE 16
WATER QUALITY MONITORING LOCATIONS
OCTOBER 5, 2004



10-5-04

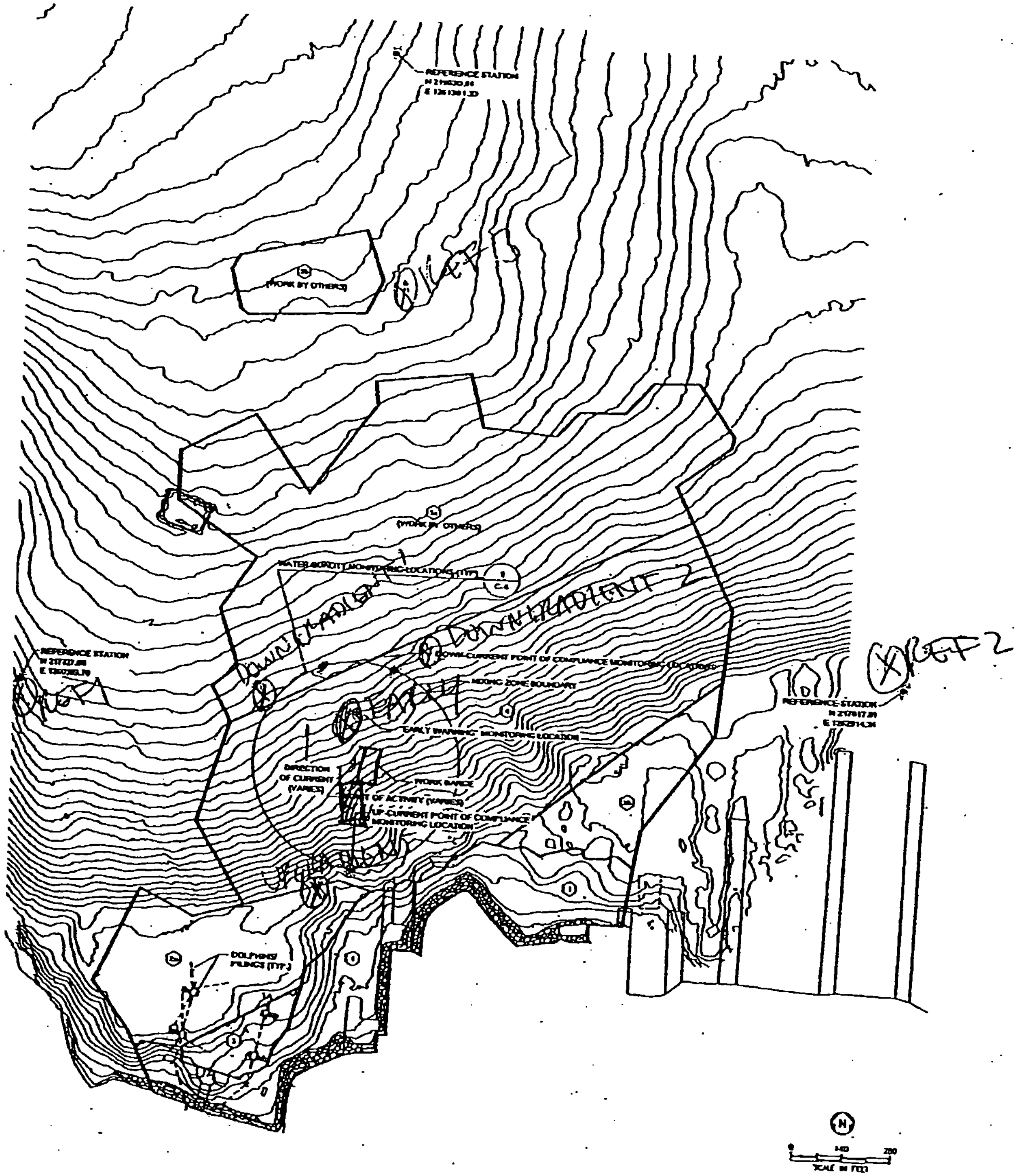
Janine Burkhardt

FIGURE 17
WATER QUALITY MONITORING LOCATIONS
OCTOBER 12, 2004



10/12/04
INTENSIVE

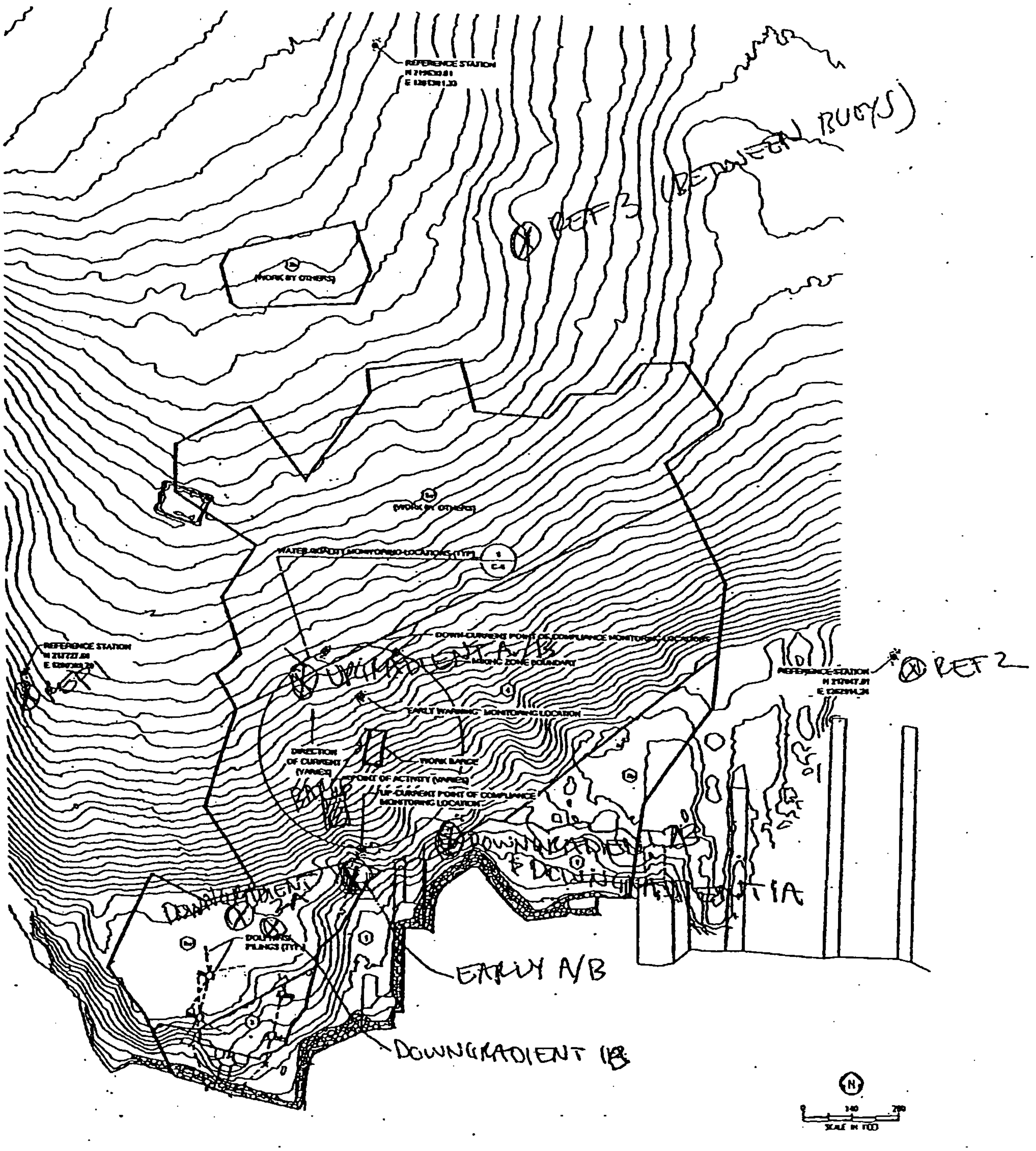
FIGURE 18
WATER QUALITY MONITORING LOCATIONS
OCTOBER 14, 2004



10/14/04

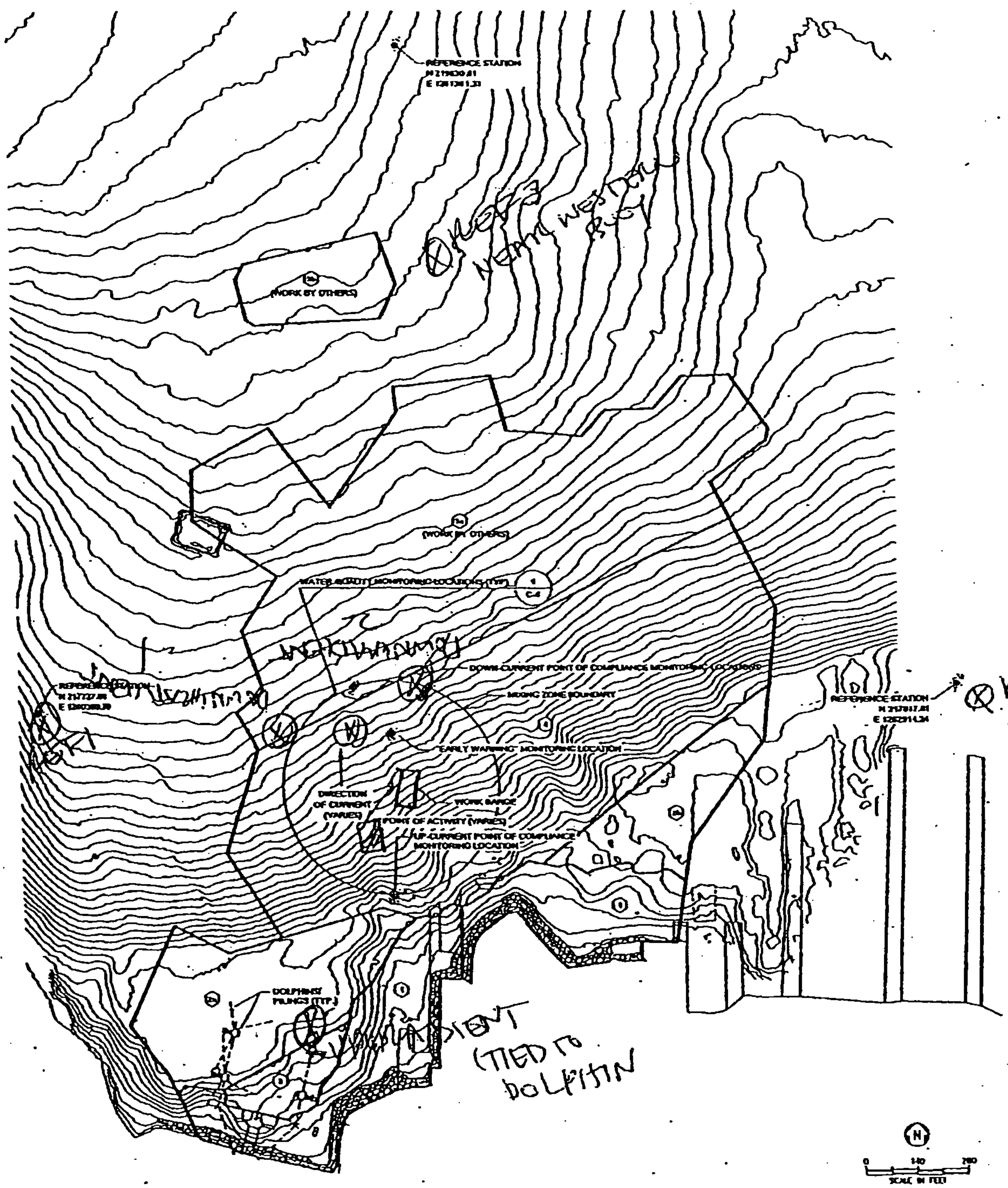
INTENSIVE

FIGURE 19
WATER QUALITY MONITORING LOCATIONS
OCTOBER 15, 2004



10/5/04
INTENSIVE

FIGURE 20
WATER QUALITY MONITORING LOCATIONS
OCTOBER 19, 2004



10/19/04
LIMITED

FIGURE 21
WATER QUALITY MONITORING LOCATIONS
OCTOBER 23, 2004

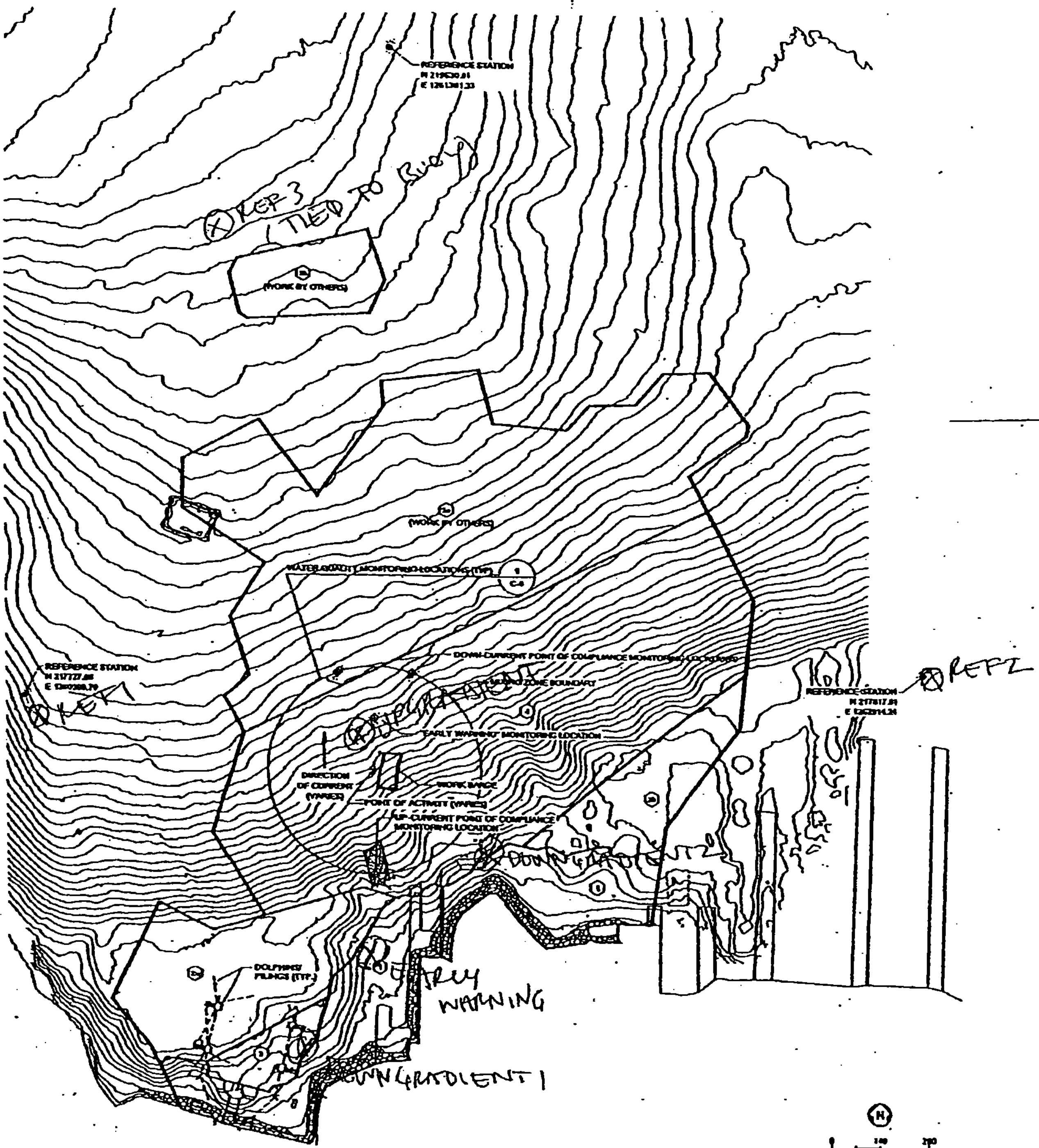
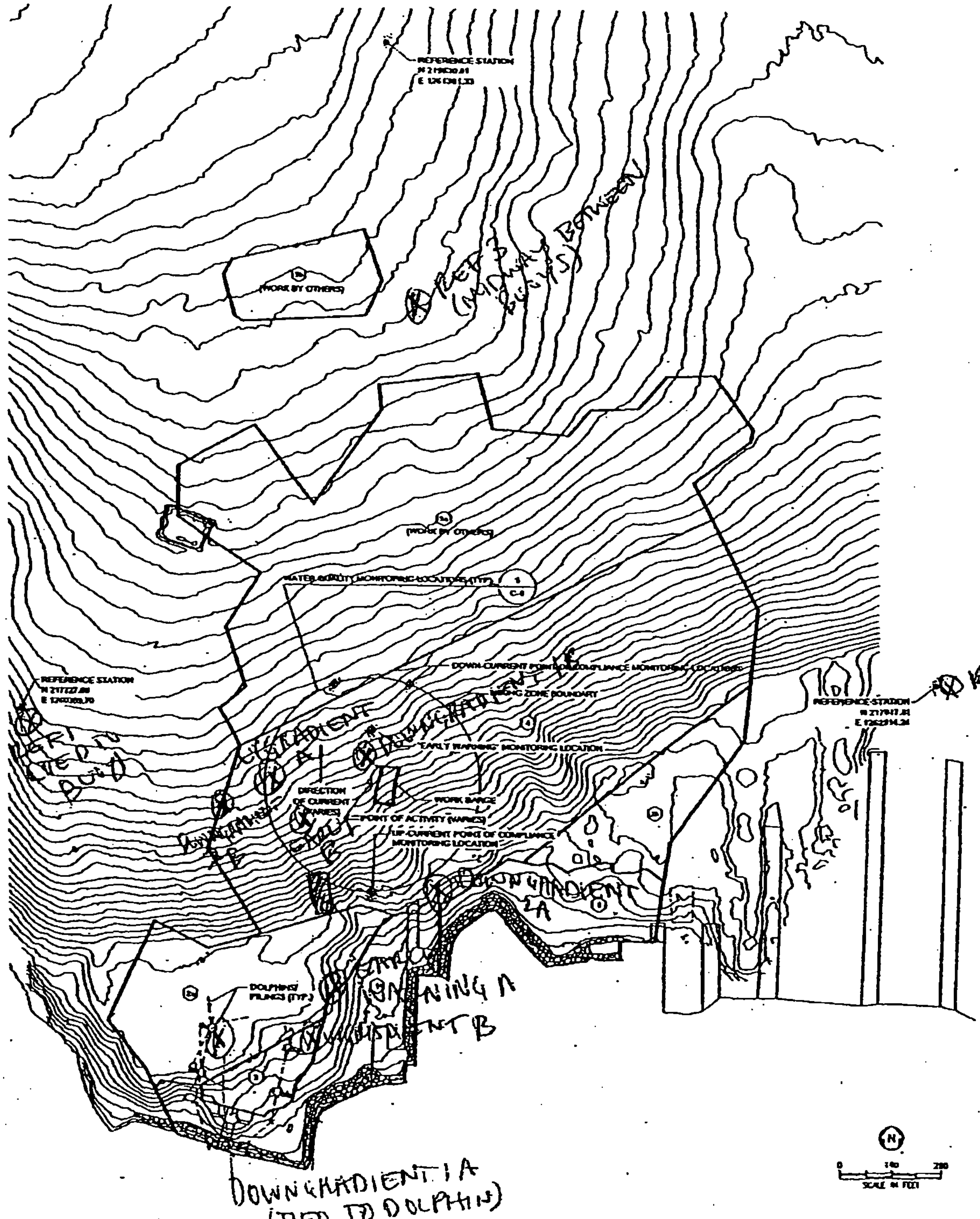


FIGURE 22
WATER QUALITY MONITORING LOCATIONS
OCTOBER 26, 2004



10/26/04
INTENSIVE

FIGURE 23
WATER QUALITY MONITORING LOCATIONS
OCTOBER 28, 2004

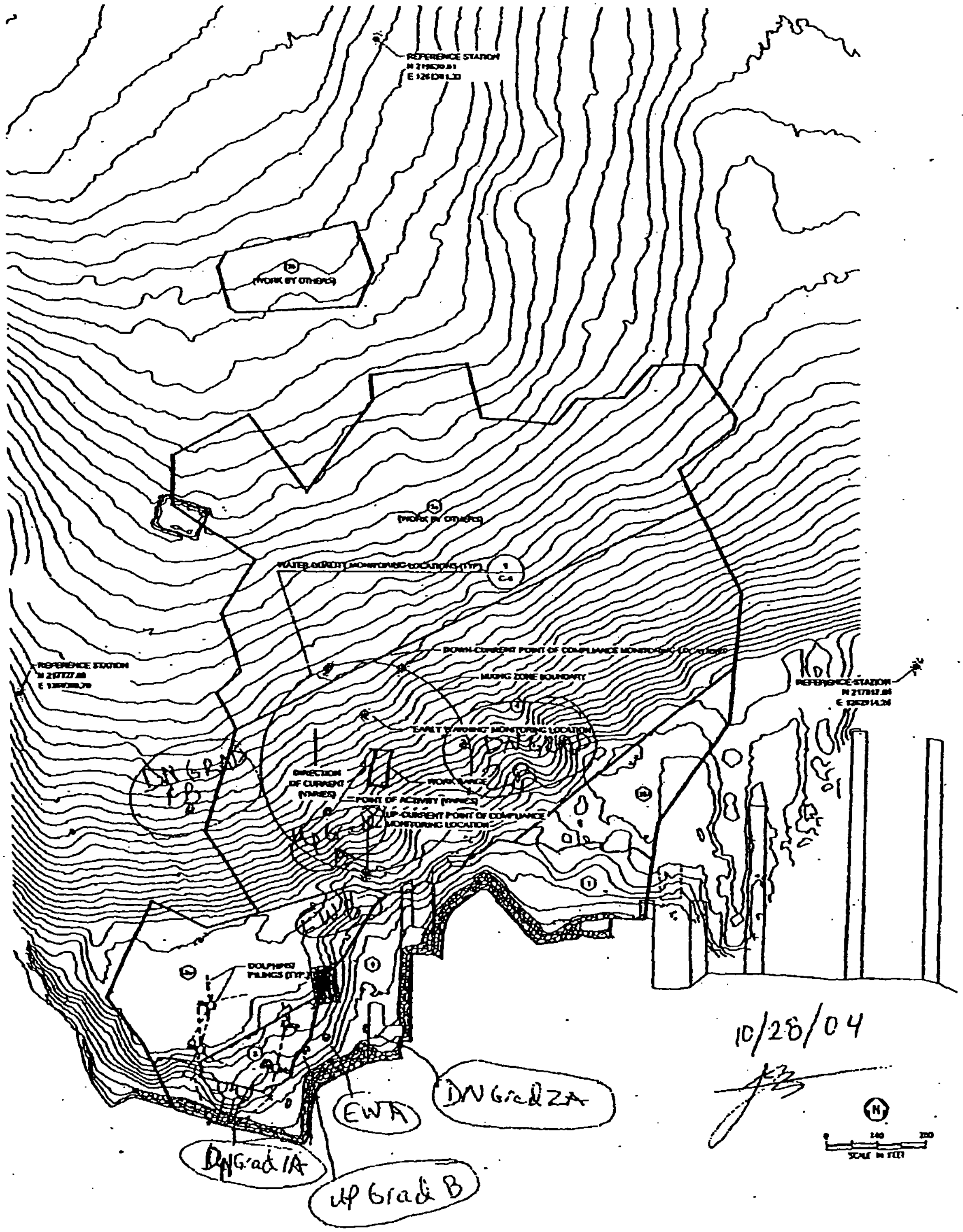
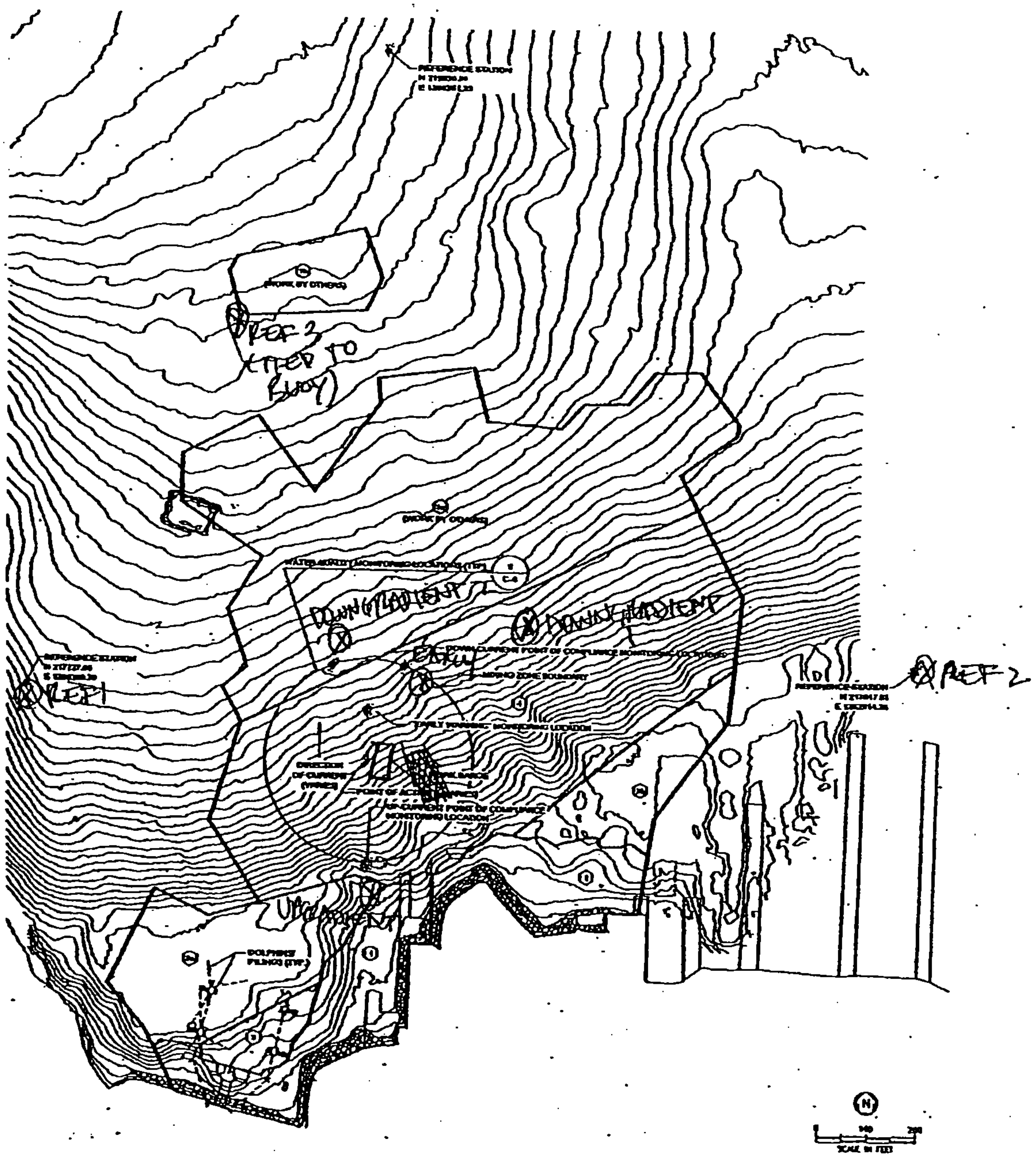


FIGURE 24
WATER QUALITY MONITORING LOCATIONS
NOVEMBER 1, 2004



11/1/04
ROUTINE

FIGURE 25
WATER QUALITY MONITORING LOCATIONS
NOVEMBER 8, 2004

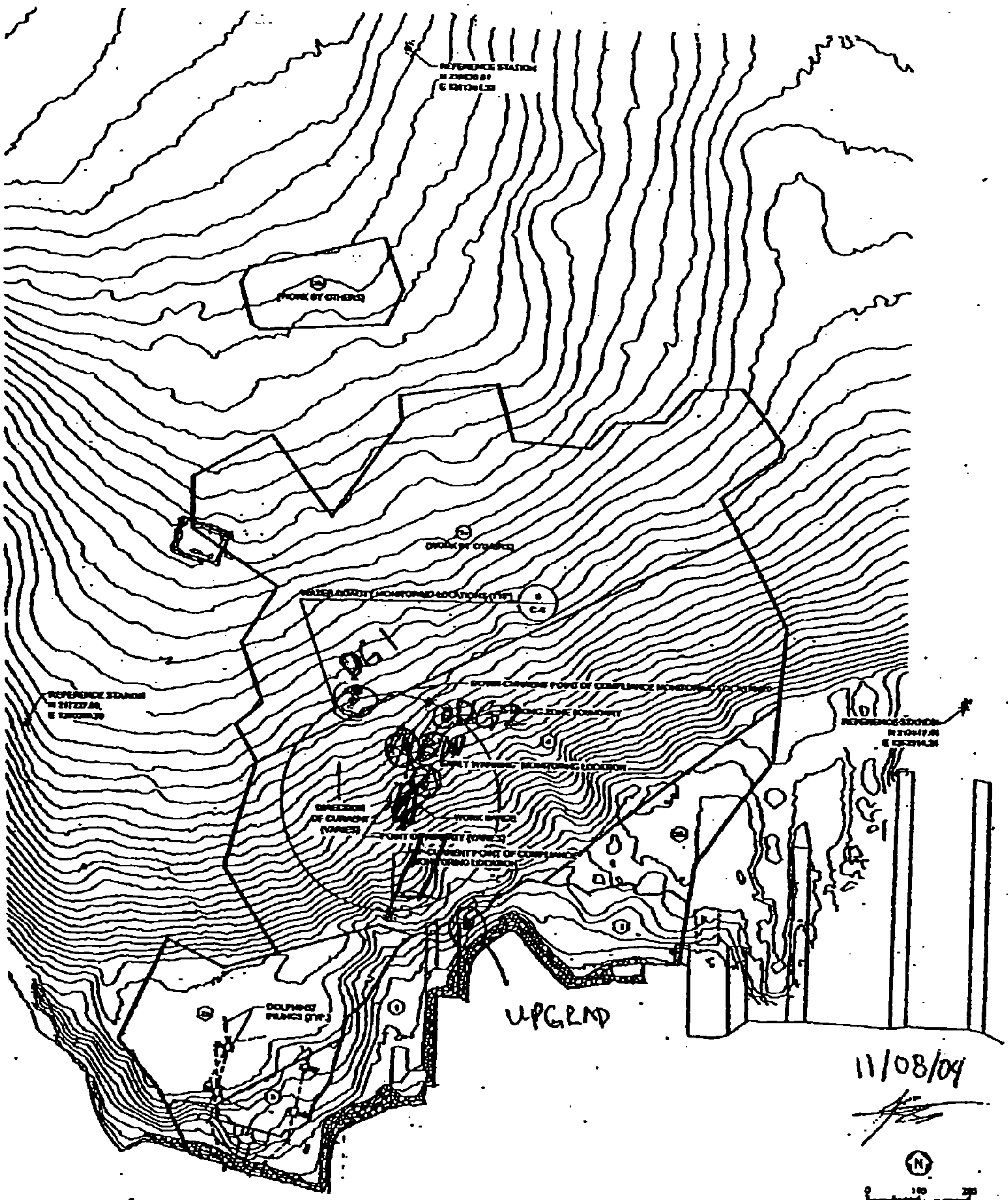
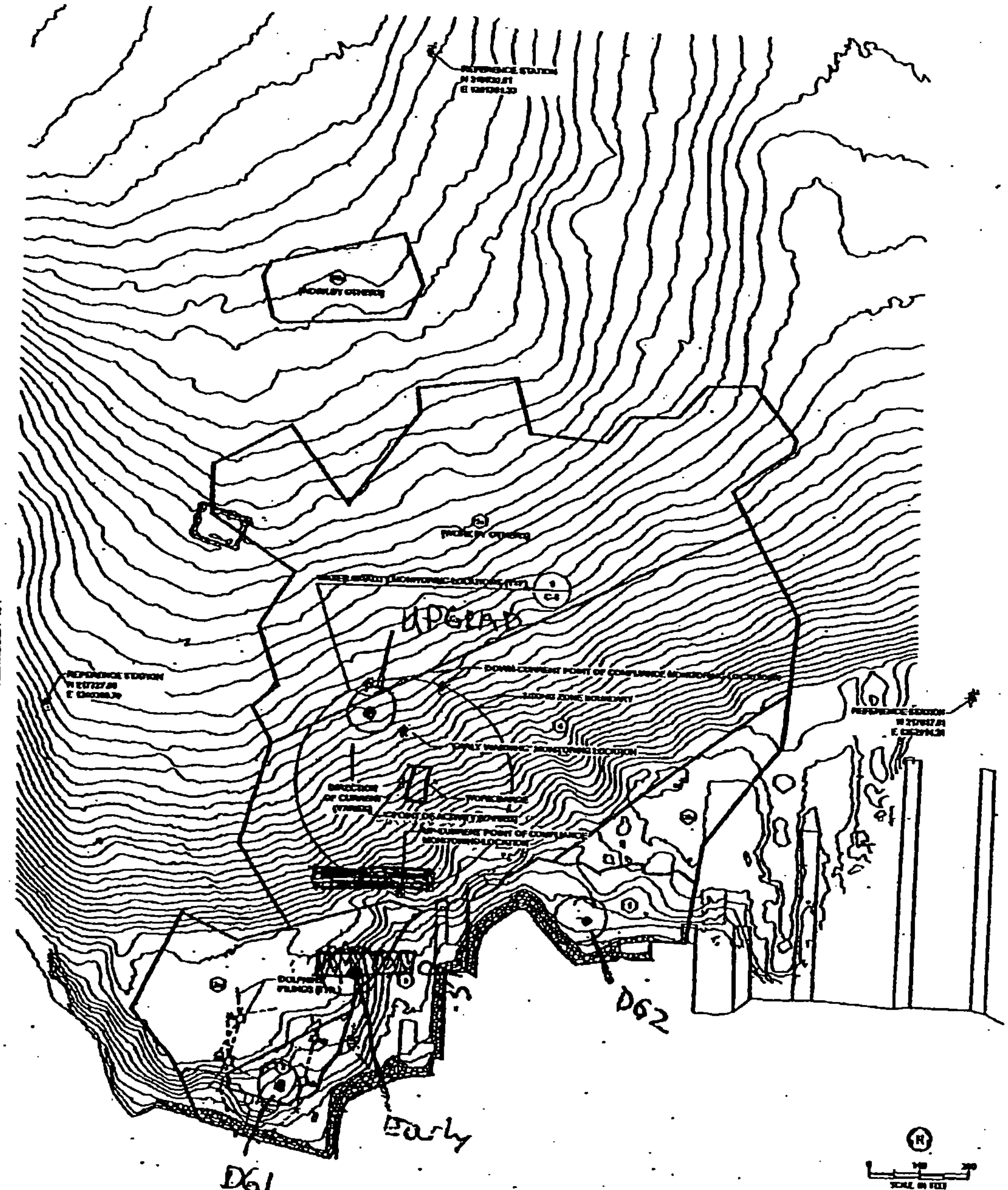
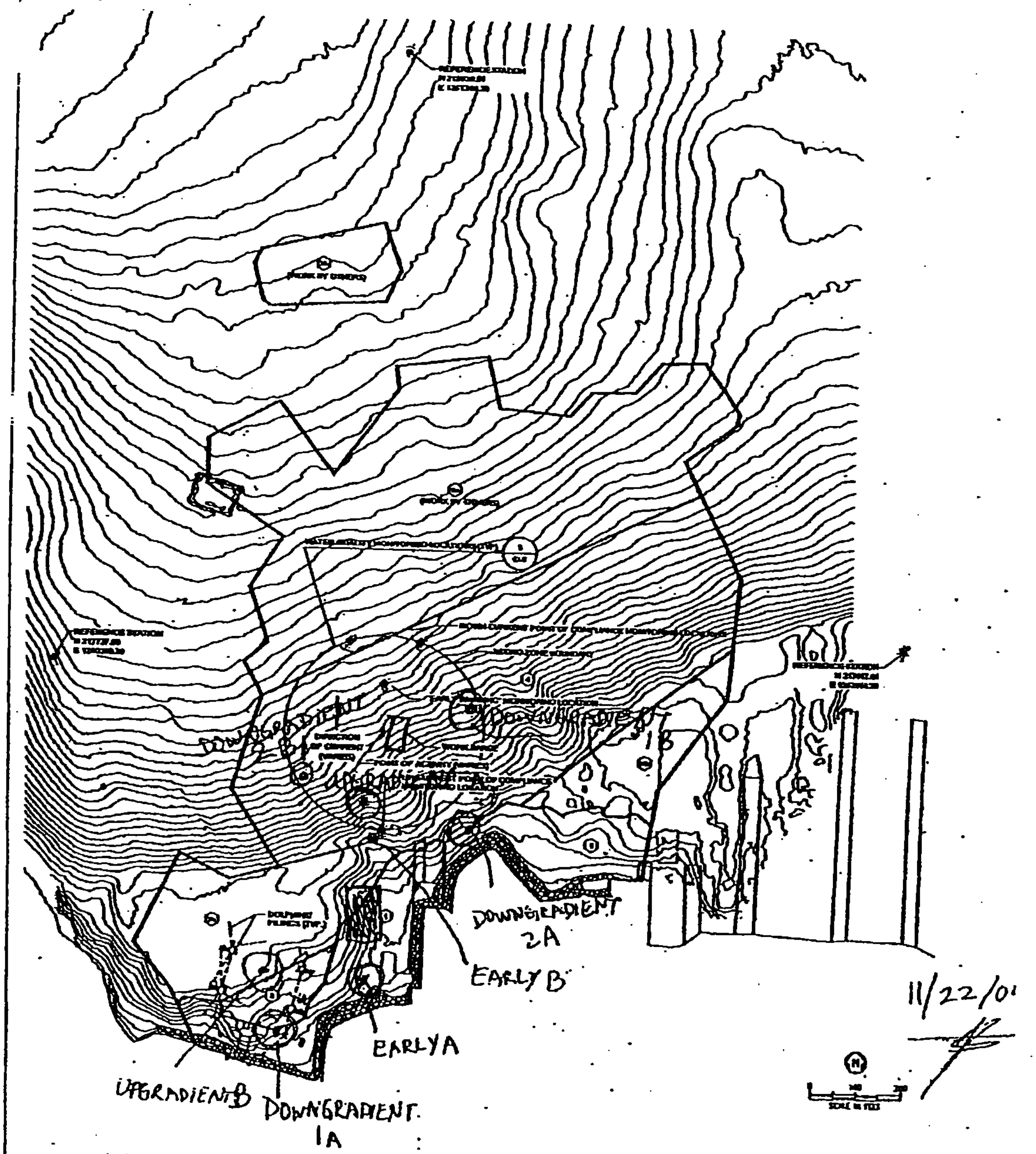


FIGURE 26
WATER QUALITY MONITORING LOCATIONS
NOVEMBER 16, 2004



Barge was moving while dumping.
Shaded rectangle represents the
path during the dump.

FIGURE 27
WATER QUALITY MONITORING LOCATIONS
NOVEMBER 22, 2004



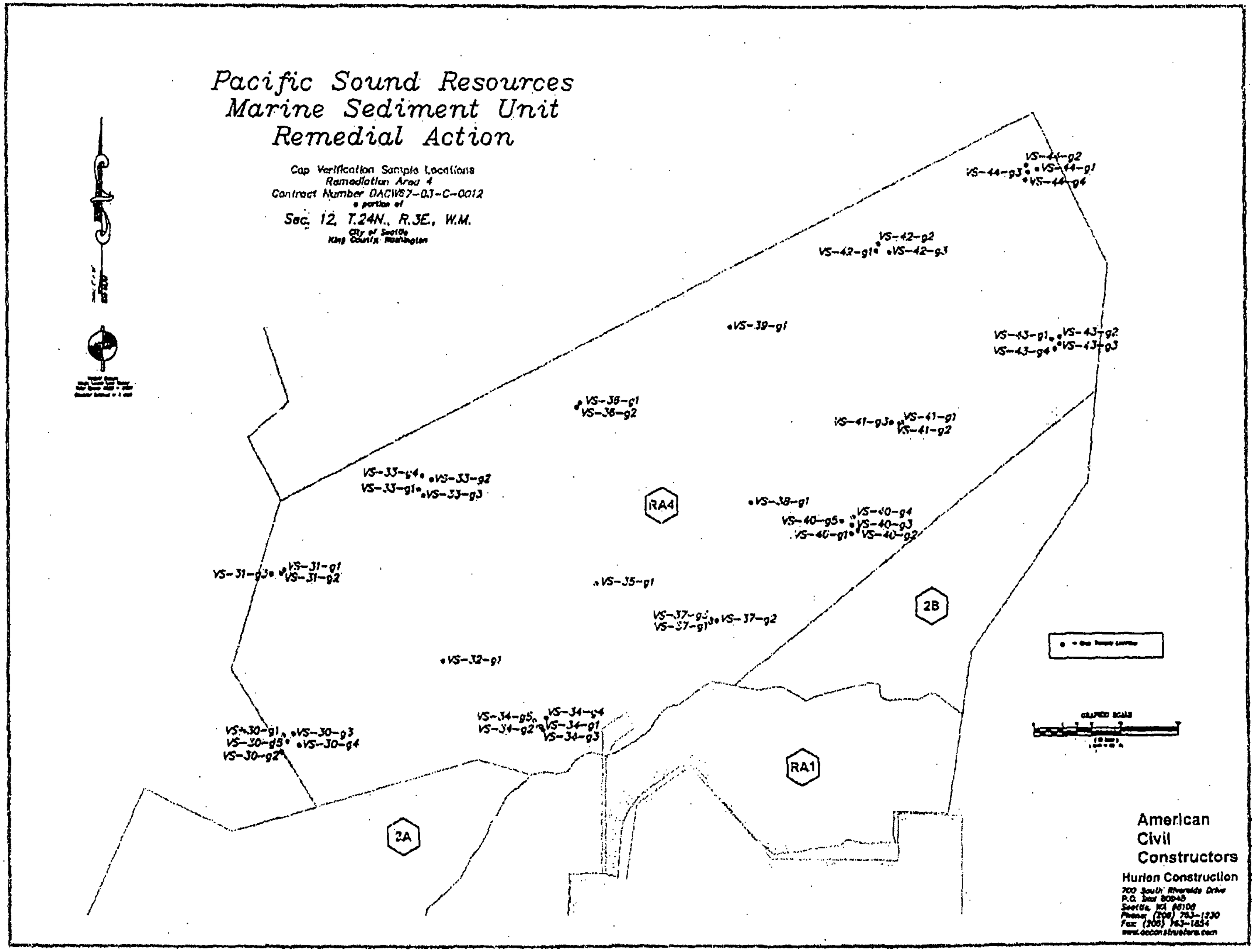


FIGURE 28
WATER QUALITY MONITORING LOCATIONS

Appendix A – Water Quality Field Quality Control Documentation

17 pages including cover page

Appendix A-1 – Field Calibration Logs

 CIE OR 03 PLB IL Ambrey

9-8-04

YSI 6920 11:30 AM

DO 100.3%

Barometric pressure 763.5 mm Hg

Turbidity 0 NTU -1.2 NTU

11.2 NTU 9.4 NTU

Temperature: 23.03°C

DO charge 34.9

Specific conductivity 50.0 50.55 ms/cm

Volts 12.3

REPLACED DO MEMBRANE

9-14-04 8:50

YSI 6920 JEB

DO 118.2%

Barometric pressure 761.9 mmHg

Turbidity 0 NTU 2.1 → 0

11.2 NTU 12.5 → 11.2

Sp Cond 49.49 mS/cm

Temp 21.09 °C

DO charge 58.4

Volts 12.3

Turbidity 0 NTU → 0.0

11.2 NTU → 11.2

~~Spe~~

9-15-04 9:35

YSI 6920 JB

DO 115.8%

Barometric Pressure 754.8 mm Hg

Turbidity 0.0 NTU → 0.0

11.2 NTU → 11.2

Temp 19.74 °C

Do charge 54.3

Specific Conductivity 50.17 →

Voltage 12.0

9-16-04 9:39

YSI 6920 JB

DO 116.2 %

Barometric Pressure 759.0

DO charge 57.4

Temp 19.50 °C

Volts 12.2

Turbidity reading

DI 0.2

11.2 soln 11.3

10:30

0.0 NTU → 0.0

11.2 NTU → 11.2 sea -0.3

spec cond 49.88

-0.7 NTU → 0.0

11.5 → 11.2 Sea 0.1

9-17-04 11:15

YSI 6920 JB

DO 119.4 %

Barometric pressure 754.1 mm Hg

Voltage 12.2

Temp 19.31 °C

DO charge 55.3

Sp. Conductivity 50.00 mS/cm

Turbidity

DI water reads 19.3

Looked at wiper (missing a screw)

found allen wrench and tightened screw

-0.2 → 0.0 NTU

10.8 → 11.2 NTU

TURBIDITY WIPER CAME LOOSE. TIGHTENED IT.

9/21/04 15:00 BRM

YSI 6920 Calibration

DO% 101.1%
Barometric pressure 768.8 mm Hg
Voltage 12.3
Temp 17.68 °C
DO Charge 50.2
Sp. conductivity 50.94 mS/cm
Turbidity 0.0 NTU → 0.0
11.2 NTU → 11.0

9/21/04
REPLACED TURBIDITY OPTICS
CLEANER

9/22/04 15:15 BRM

YSI 6920 Calibration

DO% 100.5%
Barometric pressure 763.8 mmHg
Voltage 12.3
Temp 19.31 °C
DO Charge 50.2
Sp. conductivity 48.69
Turbidity 0.0 NTU → 0.3 NTU
11.2 NTU → 10.6 NTU

9/23/04 BRM 12:15
YSI 6920 Calibration

DO% 100.7
Barometric pressure 765.7 mm Hg
Voltage 12.2
Temp 19.65
DO charge 49.2
Sp. conductivity 49.63
Turbidity 0.0 NTU → -1.0
11.2 NTU → 13.0

YSI 6920 Calibration
DO% 100.5%
Barometric Pressure 763.8 mm Hg
Voltage 12.3
Temp 16.41
DO charge 48.2
Sp. Conductivity 50.49 gmm
Turbidity 0.0 NTU → ~~0.2~~ 0.1
11.2 NTU → 9.2

9-25-04 12:00
JB

DO% 94.0
Barometric Pressure 761.8 mm Hg
Voltage 12.3
Temp 16.82 °C
DO charge 60.4
Sp. Conductivity 49.43 → 50.00
Turbidity 0.0 → 0.0 NTU
10.5 → 11.2 NTU

9-29-04 14:50
JB

YSI 6920 Calibration

Turb -0.3 → 0.0
10.1 → 11.2

Volts 12.3
DO 101.8%
Temp 20.80°C
Barometer 760.8 mm Hg
Specific Conductivity 50.0

9/30/04 11:45
YSI 6920 JB

DO 97.3%
Barometric Pressure 760.4
Temp 3.42°C
Turbidity 0.2 → 0.0
10.2 → 11.2
sp Conductivity 50.0

Volts 12.3

10-1-04 SMD 13 15
DO 762.5 mm Hg
DO 100.3%
TEMP 18.83°C
VOLTS 12.3
TURBIDITY 0 NTU 0.3 NTU ok
11.2 NTU 10.6 NTU ok
SPECIFIC CONDUCTIVITY 50 NTU 49.67 ok

CHANGED DO MEMBRANE 19:45

10-5-04 12:30
Press (Abs Depth) 1.012 ft. JB
Turbidity 0.1 → 0.0
10.6 → 11.2
Barometric Press 760.4 mm Hg
DO 87.7%
Temp 17.81°C
Specific Conductivity 49.251 → 50.00

10/12/04 YSI 6920 Calibration
13:00 BHm

DO% 101.4%
Barometric Pressure 770.7
Voltage 12.3
Temp 18.57
DO Charge 57.4

Specific Conductivity 49.00 ok
Turbidity 0.0 0.1 NTU 11.2 ?
Depth 0.440 FT 11.8

Batteries changed on computer

10/14/04 16:30 gnm

YSI 6920 Calibration

DO% 100.5%
Barometric Pressure 763.9 mm Hg
voltage 12.3
Temp 20.52° F
DO Charge 57.4

Specific Conductivity 49.30 mS/cm
Turbidity 0.0 -0.1 NTU
11.2 11.0 NTU
Depth -0.302 FT

10/15/04 11:15 gnm

YSI 6920 Calibration

DO% 100.1%
Barometric Pressure 760.7 mm Hg
voltage 12.3
Temp 19.65 °C
DO Charge 56.3

Specific Conductivity 49.57 mS/cm
Turbidity 0.0 NTU 0.0 NTU
11.2 NTU 11.5 NTU
Depth -0.012 FT

10/19/04 YSI 6920 CALIBRATION 10:30

DO % 97.6
Barometric Pressure 741.9 mm Hg
Voltage 12.3 volts
Temp 16.37 °C
DO Charge 53.3

Specific Conductivity 56.8
Turbidity 0.0 NTU 0.2 NTU
11.2 NTU 11.2 NTU

Depth ~~-0.795~~ FT

10/23/04 YSI Calibration 6920 10:15 AM

DO % 99.7
Barometric Pressure 757.4 mmHg
Voltage 12.3
Temp 16.77 °C
Do Charge ~~0.679 FT~~

Specific Conductivity 50 mS/cm 49.78 OK
Turbidity 0.0 NTU -0.3 NTU
11.2 NTU 11.2 NTU

DEPTH 0.679 FT

12:00

10/25/04 YSI 6920 [initials]
Calibration

DO % 98.7%
Barometric pressure 750.7 mm Hg
Voltage 12.2
Temp 13.89 °C
DO Charge 52.3

Specific Conductivity 50 mS/cm 49.93 ok
Turbidity 0.0 NTU 0.0 ok
11.2 NTU 11.1 ok

Depth -0.302 FT ok

10/26/04 YSI 6920 [initials]
Calibration 11:30

DO % ~~44~~ 98.8%
Barometric pressure 751.0 mmHg
Voltage 12.3 Volts
Temp 14.16 °C
DO Charge 52.3

Specific Conductivity 50.0
Turbidity 0.0 NTU 0.2
11.2 NTU 11.6
Depth 0.0 FT 0.048 FT

10/28/04 YSI 6920 11:00 am.
Callibration

DO% 99.9%
Barometric Pressure 758.9 mmHg
Voltage 12.3
Temp 13.85 °C
DO change 51.2

Specific conductivity 50 uS/cm 49.5 ok
Turbidity 0.0 0.1 ok
11.2 ~~11.3~~ 10.9 ok

Depth 0.356 ok

11/1/04 YSI 6920 ~~8am~~ 10:15
Calibration

DO% 100.4%
Barometric Pressure 765.1
Voltage 12.3
Temp 8.39
DO Change 49.2

Specific Conductivity 50.0 50.06 mS/cm²
Turbidity 0.0 NTU 0.4 NTU ok
11.2 NTU 10.9 NTU ok

Depth 0.336 FT

11/8/04 YSI 6920 8:30
Callibration

DO % 99.9 %
Barometric pressure 758.9
Voltage 12.3 v
Temp 12.66
DO change 48.2

Specific Conductivity 50 mS/cm 48.72 ck

Turbidity 0.0 NTU -0.2
11.2 NTU 11.3

Depth 0 ft -0.312

11/16/04 YSI 6920 12:00
Callibration

DO % 100.4 %
Barometric Pressure 763.1 mmHg
Voltage 12.2 volt
Temp 13.14
DO change 46.1

Specific conductivity 50 mS/cm 49.5

Turbidity 0.0 NTU -0.1 NTU
11.2 NTU 11.2

Depth 0 ft. 0.155 ft

11/22/04 YSI 6920 9:30
Callibration

DO%	100.7		
Barometric Pressure		765.5	
Voltage	12.3		
Temp	20.31		
DO charge	47.1		
Specific Conductivity		50	52.41
Turbidity		0.0	-0.1
		11.2	11.2
Depth	0 ft	0.030	

Appendix A-2 Dissolved Oxygen Titration Test Data

TABLE A-2
DO TITRATION RESULTS
PACIFIC SOUND RESOURCES SUPERFUND SITE, MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Station	Date	Time	Water Depth (ft MLLW)	Dissolved Oxygen from Titration (mg/L)	Dissolved Oxygen from YSI Probe (mg/L)
Reference 1	9/23/2004	13:15	-70	6.20	5.94
Reference 2	9/22/2004	17:30	-15	5.75	5.57
Reference 3	9/24/2004	15:30	-139	5.30	4.44
Reference 1 midpoint	10/5/2004	15:14	-69.62	6.1	5.73
Reference 2 midpoint	10/5/2004	13:38	-15.42	6.6	5.98
Reference 3 midpoint	10/5/2004	15:49	-97.01	5.9	5.68
Downgradient 1 midpoint	10/5/2004	15:46	-92.9	6.1	5.36
Reference 1 midpoint	10/12/2004	14:45	-30.66	6.3	6.18
Upgradient B midpoint	10/12/2004	16:30	-98.81	5.6	5.95
Upgradient A midpoint	10/12/2004	19:30	-7.28	7.0	7.94
Reference 1 midpoint	10/14/2004	17:30	-69.63	5.6	5.75
Upgradient midpoint	10/14/2004	22:05	-20.62	6.0	5.72
Reference 1 midpoint	10/15/2004	12:30	-72.45	6.0	6.49
Upgradient B midpoint	10/15/2004	16:20	-109.83	5.8	5.76
Reference 2 midpoint	10/19/2004	14:00	-26.22	6.4	6.48
Upgradient midpoint	10/19/2004	13:45	-10.96	6.2	6.33
Upgradient midpoint	10/23/2004	11:45	-102.24	6.3	6.24
Upgradient A midpoint	10/26/2004	13:25	-102.55	5.9	6.04
Upgradient B midpoint	10/26/2004	19:30	-14.44	6.2	6.54
Reference 2 midpoint	10/28/2004	13:15	-20.03	5.0	5.71
Downgradient 1B midpoint	10/28/2004	17:55	-56.79	6.02	6.09
Reference 1 midpoint	11/1/2004	11:15	-71.16	6.3	5.96
Upgradient midpoint	11/1/2004	14:15	-8.71	6.8	6.61
Reference 2 midpoint	11/8/2004	10:45	-17.10	6.6	6.75
Reference 1 midpoint	11/16/2004	14:10	-71.51	6.0	6.06
Reference 1 midpoint	11/22/2004	11:00	-68.57	6.8	6.62
Downgradient 2B midpoint	11/22/2004	15:00	-34.30	6.7	6.76

Appendix B – Water-Quality Data Quality Evaluation

19 pages including cover page

MEMORANDUM

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BLASLAND, BOUCK & LEE, INC.
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To: Paul Krause, BBL **Date:** 12/13/04

From: Shannon Dunn, BBL **cc:** Kris Fabian, BBL

Re: Water Quality Monitoring Data Quality Evaluation
Construction Year 2004/2005
Pacific Sound Resources Superfund Site
Marine Sediments Operable Unit
Remedial Action

This memorandum provides the results of a data quality evaluation for 187 water samples (including 28 field duplicate samples) collected at the Pacific Sound Resources Superfund Site, Marine Sediments Operable Unit in Seattle, Washington as part of the water quality monitoring program. Water samples were collected from the midpoint of the water column between September 14 and November 22, 2004. A data quality evaluation was performed for the following analysis:

- total suspended solids (TSS) (U.S. Environmental Protection Agency [USEPA] Method 160.2).

All analyses were performed by Columbia Analytical Services (CAS), of Kelso, Washington. This data quality evaluation covers CAS data packages K2407097, K2407134, K2407187, K2407222, K2407355, K2407445, K2407487, K2407686, K2407714, K2407804, K2408098, K2408183, K2408297, K2408459, K2408564, K2408643, K2408671, K2408890, K2409197, and K2409301. The data quality evaluation was performed in accordance with the *Water Quality Monitoring Plan Field Sampling Plan/Quality Assurance Project Plan* (QAPP) (BBL, 2003) and with applicable portions of the USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA, 2002). Table 1 summarizes the sampling details, such as date and location.

The data quality evaluation considered the following elements:

- chain-of-custody records;
- holding times;
- method blank analyses;
- laboratory control sample (LCS) recoveries;
- laboratory duplicate relative percent differences (RPDs);
- field duplicate RPDs;
- quantitation limits; and

- conclusions and completeness.

Data qualifiers are added to sample results based on the data quality evaluation. The absence of a data qualifier indicates that the datum is acceptable without qualification. The data to which data evaluation qualifiers were applied are summarized in Table 2.

CHAIN-OF-CUSTODY RECORDS

A signed chain-of-custody record accompanied each data package. The laboratory received all samples in good condition and all requested analyses were performed, with the following exceptions:

- The coolers associated with data packages K2407097 and K2407222 were received with temperatures slightly above the acceptable range of 2°C to 6°C. However, the temperature blanks, which are considered more representative of the actual sample temperature, were received with temperatures within the acceptable range. The data quality is believed to be unaffected by the cooler temperatures. No qualifiers were assigned to the data based on the temperatures.

- The temperatures of the coolers and of the temperature blanks associated with data packages K2407134, K2407187, and K2407804 were slightly above the acceptable range. The data quality is believed to be unaffected by the cooler and temperature blank temperatures. No qualifiers were assigned to the data based on temperature.

- For data package K2407222, sample Downgradient 2B2 was not listed on the chain-of-custody form. CAS notified BBL of the discrepancy and confirmed the analysis requested for the sample. The data quality is believed to be unaffected by this omission on the chain-of–custody form.

- The cooler temperature was acceptable but the temperature blank temperature was above the acceptable range for data package K2407445. The data quality is believed to be unaffected by the temperature blank temperature. No qualifiers were assigned to the data based on the temperature.

- The sample Early Warning, listed on the chain-of-custody form associated with data package K2407487, was not received by the laboratory. CAS notified BBL and confirmed that there was no sample. The Early Warning location is not sampled for TSS. This non-existent sample was listed on the chain-of-custody form as a result of sampler error.

- For data package K2407686, CAS received one sample (labeled "titration") that was not listed on the chain-of-custody form. This sample was not for TSS analysis, was included in the shipment in error, and was not analyzed. In addition, the cooler was received at a temperature of 15.5°C, which was outside the acceptable range. The data quality is believed to be unaffected by the cooler temperature. No qualifiers were assigned to the data based on the temperature.

- For data package K2408098, CAS received a sample labeled "Upgradient" that was identified as "Upgradient A" on the chain-of-custody form. CAS resolved the discrepancy by process of elimination. The data quality is believed to unaffected. No qualifiers were assigned to the data.

- For data package K2408183, the sample bottle for Downgradient 1A was labeled as Upgradient A. CAS resolved the discrepancy through the date and time written on the bottle. The cooler temperature (0.5°C) was slightly below the acceptable range. The data quality is believed to be unaffected. No qualifiers were assigned to the data.

- For data packages K2408671 and K2408890, the cooler temperatures were slightly below the acceptable range. However, the temperature blanks, which are considered more representative of the actual sample temperature, were received with temperatures within the acceptable range. The data quality is believed to be unaffected by the cooler temperatures. No qualifiers were assigned to the data based on the temperature.

- For data package K2409197, the cooler and temperature blank temperatures (0.6°C and 0.8°C, respectively) were slightly below the acceptable range. The data quality is believed to be unaffected by the cooler and temperature blank temperatures. No qualifiers were assigned to the data based on temperature.

- For data package K2409301, the cooler temperature (0.5°C) was slightly below the acceptable range. The data quality is believed to be unaffected by the cooler temperature. No qualifiers were assigned to the data based on temperature.

HOLDING TIMES

For all analyses and all samples, the time between sample collection and analysis was determined to be within USEPA and project-specified holding times.

METHOD BLANKS

Method blanks were analyzed with each batch of samples for each analysis. No contamination was detected in the method blanks.

LABORATORY CONTROL SAMPLE RESULTS

At least one laboratory control sample was analyzed with each batch of samples for each analysis. Laboratory-specified control limits were met for each LCS recovery. There are no project-specified control limits for LCS recoveries.

LABORATORY DUPLICATE

At least one laboratory duplicate sample was analyzed for each batch of samples for each analysis. Laboratory duplicate analyses were performed on project-specific samples. All RPDs between the duplicate results were within laboratory- and project-specified control limits.

FIELD DUPLICATE

Field duplicates were collected at a frequency of 17%, which exceeded the 10% specified in Technical Specification 01450. Field duplicate RPDs were within project-specified control limits, with the following exceptions:

- For data package K2408183, the field duplicate RPDs for (1) sample REF2 10/14 and field duplicate REF99 10/14 (89%) and (2) sample Downgradient1B 10/15 and field duplicate Downgradient98 10/15 (60%) were above project-specified control limits. TSS results for these samples were qualified as estimated (J).

- The field duplicate RPDs for (1) sample Downgradient 1B and field duplicate Downgradient 99 (data package K2408564) and (2) sample Downgradient 1-B and field duplicate Downg 88 (data package K2408643) were above project-specified control limits. TSS was detected in the parent samples but not in field duplicate sample. TSS results for these samples were near the method reporting limit (MRL). The field duplicate RPD fell within the alternative USEPA recommended control limit of +/- the MRL if either the sample or duplicate value is less than five times the MRL (USEPA, 2002). The data were determined to be unaffected by the out-of-control RPDs because the results were near the MRLs. No qualifiers were added to the data because the field duplicate RPDs were within the USEPA recommended control limit.

Reporting Limits

Project-specified quantitation limits were met for all samples.

Overall Data Quality and Completeness

Data representativeness was acceptable. The prescribed field and laboratory methods were followed. Data comparability was acceptable. Sampling and analytical methodologies set forth in the QAPP were followed. Data completeness was acceptable. No data were rejected. The completeness for this set of data is 100%, which exceeds the project-specified goal of 90%. Data precision was evaluated through laboratory and field duplicates and was acceptable. Data accuracy was evaluated through laboratory control samples and was acceptable. Based on this data quality evaluation, all of the data were determined to be acceptable as qualified. Table 3 presents the chemistry results for the water-quality monitoring samples.

References

Blasland, Bouck & Lee (BBL). 2003. *Water Quality Monitoring Plan, Field Sampling Plan/Quality Assurance Project Plan*. Prepared for ACC-Hurlen, Seattle, Washington. August.

U.S. Environmental Protection Agency (USEPA). 2002. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. U.S. Environmental Protection Agency. EPA540-R-01-008. July.

SMD

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TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
REF2A	09/14/04	10:45	Reference 2	217,985	1,262,840	-30	none
REF1A	09/14/04	11:25	Reference 1	217,737	1,260,525	-69	none
REF3A	09/14/04	12:10	Reference 3	219,325	1,260,241	-149	none
REF3A2	09/14/04	12:15	Reference 3	219,325	1,260,241	-149	Field duplicate of REF3A, 9/14/04 12:10
REF3B	09/14/04	12:45	Reference 3	219,324	1,260,241	-148	none
REF2B	09/14/04	13:20	Reference 2	217,690	1,260,345	-70	none
REF1B	09/14/04	13:30	Reference 1	217,988	1,262,710	-33	none
REF1A	09/15/04	10:55	Reference 1	217,103	1,260,940	-48	none
REF3A	09/15/04	11:55	Reference 3	218,118	1,261,853	-149	none
REF2A	09/15/04	12:15	Reference 2	217,309	1,264,025	-29	none
REF2A2	09/15/04	12:20	Reference 2	217,309	1,264,025	-29	Field duplicate of REF2A, 9/15/04 12:15
REF2B	09/15/04	13:10	Reference 2	217,314	1,264,079	-28	none
REF3B	09/15/04	13:40	Reference 3	218,110	1,261,067	-147	none
REF1B	09/15/04	14:05	Reference 1	217,317	1,261,174	-62	none
REF1A	09/16/04	11:05	Reference 1	217,156	1,260,998	-40	none
REF3A	09/16/04	11:25	Reference 3	218,129	1,261,923	-147	none
REF2A	09/16/04	11:45	Reference 2	217,296	1,264,050	-32	none
REF1B	09/16/04	13:06	Reference 1	217,291	1,260,964	-68	none
DOWNGRADIENT 1	09/16/04	14:10	Downgradient 1	217,169	1,264,043	-25	none
DOWNGRADIENT 1B	09/16/04	14:15	Downgradient 1	217,169	1,264,043	-25	Field duplicate of DOWNGRADIENT 1, 9/16/04 14:10
UPGRADIENT	09/16/04	14:25	Upgradient	217,850	1,263,715	-91	none
DOWNGRADIENT 2	09/16/04	14:45	Downgradient 2	217,181	1,263,710	-20	none
REF3B	09/16/04	15:00	Reference 3	218,257	1,261,884	-145	none
REF2B	09/16/04	15:25	Reference 2	217,260	1,264,037	-29	none
REF2A	09/17/04	11:50	Reference 2	217,284	1,264,074	-27	none
REF3A	09/17/04	12:15	Reference 3	218,143	1,261,812	-146	none

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
REF1A	09/17/04	12:35	Reference 1	217,248	1,260,972	-32	none
DOWNGRADIENT 1A	09/17/04	13:10	Downgradient 1	217,921	1,261,981	-97	none
DOWNGRADIENT 2A	09/17/04	13:25	Downgradient 2	217,787	1,261,702	-97	none
REF 1B	09/17/04	13:45	Reference 1	217,263	1,261,124	-74	none
DOWNGRADIENT 1B	09/17/04	14:35	Downgradient 1	217,863	1,263,975	-21	none
UPGRADIENT	09/17/04	14:50	Upgradient	217,836	1,261,999	-121	none
DOWNGRADIENT 2B	09/17/04	15:10	Downgradient 2	217,039	1,262,008	-13	none
DOWNGRADIENT 2B2	09/17/04	15:15	Downgradient 2	217,039	1,262,008	-13	Field duplicate of DOWNGRADIENT 2B, 9/17/04 15:10
REF 3B	09/17/04	15:25	Reference 3	218,255	1,261,707	-145	none
REF 2B	09/17/04	15:40	Reference 2	217,450	1,263,979	-32	none
DOWNGRADIENT 99	09/21/04	10:00	Downgradient 1	217,476	1,262,453	-15	Field duplicate of DOWNGRADIENT 1, 9/21/04 17:50
REF 1	09/21/04	16:10	Reference 1	217,741	1,260,353	-64	none
REF 2	09/21/04	16:25	Reference 2	217,795	1,262,727	-22	none
REF 3	09/21/04	17:15	Reference 3	219,125	1,261,588	-142	none
DOWNGRADIENT 1	09/21/04	17:50	Downgradient 1	217,476	1,262,453	-15	none
DOWNGRADIENT 2	09/21/04	18:05	Downgradient 2	217,362	1,262,053	-12	none
UPGRADIENT	09/21/04	18:15	Upgradient	218,882	1,261,583	-92	none
DUPLICATE 90 9/22	09/22/04	11:00	Upgradient	218,729	1,262,649	-92	Field duplicate of UPGRADIENT, 9/22/04 18:45
REF 1 9/22	09/22/04	16:30	Reference 1	217,740	1,260,381	-66	none
REF 3 9/22	09/22/04	17:10	Reference 3	219,303	1,261,797	-142	none
REF 2 9/22	09/22/04	17:30	Reference 2	217,629	1,262,902	-15	none
UPGRADIENT 9/22	09/22/04	18:45	Upgradient	218,729	1,262,649	-72	none
DOWNGRADIENT 1 9/22	09/22/04	19:45	Downgradient 1	217,554	1,262,592	-17	none
DOWNGRADIENT 2 9/22	09/22/04	20:00	Downgradient 2	217,436	1,261,931	-7	none

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
DUPLICATE 91 9/23	09/23/04	12:00	Downgradient 1	218,814	1,261,437	-7	Field duplicate of DOWNGRADIENT 1 9/23, 9/23/04 17:40
REF 1 9/23	09/23/04	13:15	Reference 1	217,752	1,260,299	-70	none
REF 3 9/23	09/23/04	13:55	Reference 3	218,683	1,260,358	-139	none
REF 2 9/23	09/23/04	14:30	Reference 2	217,691	1,262,862	-17	none
UPGRADIENT 9/23	09/23/04	15:30	Upgradient	217,559	1,262,365	-10	none
DOWNGRADIENT 1 9/23	09/23/04	17:40	Downgradient 1	218,814	1,261,437	-103	none
DOWNGRADIENT 2 9/23	09/23/04	18:15	Downgradient 2	218,906	1,261,899	-104	none
DUPLICATE 92	09/24/04	08:00	Upgradient	218,811	1,258,009	-10	Field duplicate of UPGRADIENT 9/24, 9/24/04 14:40
DOWNGRADIENT 1 9/24	09/24/04	14:00	Downgradient 1	217,449	1,262,295	-10	none
DOWNGRADIENT 2 9/24	09/24/04	14:20	Downgradient 2	217,476	1,262,446	-19	none
UPGRADIENT 9/24	09/24/04	14:40	Upgradient	218,811	1,258,009	-89	none
REF 2 9/24	09/24/04	15:00	Reference 2	217,840	1,262,981	-14	none
REF 3 9/24	09/24/04	15:30	Reference 3	218,927	1,260,329	-139	none
REF 1 9/24	09/24/04	16:00	Reference 1	217,751	1,260,333	-49	none
REF 2 9/25	09/25/04	13:35	Reference 2	217,293	1,264,198	-13	none
DOWNGRADIENT 1 9/25	09/25/04	14:08	Downgradient 1	217,045	1,261,988	-6	none
UPGRADIENT 9/25	09/25/04	14:15	Upgradient	217,764	1,261,944	-90	none
DOWNGRADIENT 2 9/25	09/25/04	14:32	Downgradient 2	217,097	1,263,984	-12	none
REF 3 9/25	09/25/04	14:50	Reference 3	218,160	1,261,903	-140	none
DUPLICATE 93	09/25/04	14:55	Reference 3	218,160	1,261,903	-140	Field duplicate of REF 3 9/25, 9/25/04 14:50
REF 1 9/25	09/25/04	15:15	Reference 1	217,278	1,260,997	-67	none
REF2	09/29/04	16:09	Reference 2	217,305	1,264,219	-16	none
REF3	09/29/04	16:30	Reference 3	217,942	1,261,866	-141	none
REF1	09/29/04	16:38	Reference 1	217,129	1,261,158	-78	none
DOWNGRADIENT 1	09/29/04	21:08	Downgradient 1	217,726	1,261,697	-118	none
DOWNGRADIENT 2	09/29/04	21:25	Downgradient 2	217,856	1,261,897	-118	none

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
DOWNGRADIENT 2B	09/29/04	21:30	Downgradient 2	217,856	1,261,897	-118	Field duplicate of DOWNGRADIENT 2, 9/29/04 21:25
UPGRADIENT	09/29/04	21:40	Upgradient	217,195	1,263,920	-14	none
DOWNGRADIENT 1	09/30/04	18:25	Downgradient 1	217,121	1,263,972	-11	none
DOWNGRADIENT 2	09/30/04	18:35	Downgradient 2	217,039	1,262,021	-7	none
UPGRADIENT 2	09/30/04	18:50	Upgradient	217,792	1,261,764	-95	Field duplicate of UPGRADIENT, 9/30/04 18:55
UPGRADIENT	09/30/04	18:55	Upgradient	217,792	1,261,764	-95	none
REF3	09/30/04	19:15	Reference 3	218,142	1,261,899	-89	none
REF2	10/05/04	13:40	Reference 2	217,770	1,262,932	-15.42	none
DOWNGRADIENT 1	10/05/04	14:20	Downgradient 1	218,439	1,261,402	-92.9	none
DOWNGRADIENT 2	10/05/04	14:45	Downgradient 2	218,963	1,262,057	-92.23	none
UPGRADIENT	10/05/04	15:00	Upgradient	217,362	1,262,581	-16.01	none
UPGRADIENT 2	10/05/04	15:05	Upgradient	217,362	1,262,581		none
REF1	10/05/04	15:20	Reference 1	217,690	1,260,359	-69.62	none
REF3	10/05/04	15:50	Reference 3	219,204	1,261,685	-97.01	none
DUP A	10/12/04	08:00	Downgradient 1	218,049	1,260,620	-80.78	Field duplicate of DOWNGRADIENT 1A, 10/12/04 18:45
DUP B	10/12/04	12:00	Reference 3	219,376	1,261,689	-139.13	Field duplicate of REF3, 10/12/04 17:30
REF1	10/12/04	14:45	Reference 1	217,731	1,260,353	-30.66	none
REF2	10/12/04	15:30	Reference 2	217,811	1,262,926	-9.51	none
DOWNGRADIENT 1B	10/12/04	16:05	Downgradient 1	216,930	1,260,858	-13.97	none
DOWNGRADIENT 2B	10/12/04	16:15	Downgradient 2	217,346	1,261,540	-3.89	none
UPGRADIENT B	10/12/04	16:30	Upgradient	218,468	1,260,957	-98.81	none
REF3	10/12/04	17:30	Reference 3	219,376	1,261,689	-139.13	none
DOWNGRADIENT 1A	10/12/04	18:45	Downgradient 1	218,049	1,260,620	-80.78	none
DOWNGRADIENT 2A	10/12/04	19:10	Downgradient 2	218,301	1,261,235	-41.58	none

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
UPGRADIENT A	10/12/04	19:30	Upgradient	217,082	1,261,362	-7.28	none
REF2 10/14	10/14/04	06:20	Reference 2	217,801	1,262,926	-9.13	none
REF3 10/14	10/14/04	06:45	Reference 3	219,283	1,260,775	-149.67	none
REF99 10/14	10/14/04	08:20	Reference 2	217,801	1,262,926	-9.13	Field duplicate of REF2 10/14, 10/14/04 06:20
DOWNGRADIENT1A 10/14	10/14/04	09:30	Downgradient 1	218,450	1,260,361	-91.13	none
DOWNGRADIENT2A 10/14	10/14/04	09:50	Downgradient 2	218,813	1,260,958	-122	none
REF1 10/14	10/14/04	10:05	Reference 1	217,710	1,260,373	-69.63	none
UPGRADIENTA 10/14	10/14/04	10:05	Upgradient	217,157	1,261,164	-20.62	none
REF1 10/15	10/15/04	12:30	Reference 1	217,720	1,260,367	-72.45	none
DOWNGRADIENT1A 10/15	10/15/04	13:20	Downgradient 1	217,533	1,262,139	-7.91	none
DOWNGRADIENT2A 10/15	10/15/04	13:45	Downgradient 2	216,996	1,261,113	-16.39	none
UPGRADIENTA 10/15	10/15/04	14:00	Upgradient	218,292	1,260,652	-119.01	none
REF3 10/15	10/15/04	14:20	Reference 3	219,745	1,260,990	-123.45	none
REF2 10/15	10/15/04	14:30	Reference 2	217,811	1,262,933	-23.15	none
DOWNGRADIENT1B 10/15	10/15/04	15:55	Downgradient 1	216,927	1,261,016	-20.5	none
DOWNGRADIENT2B 10/15	10/15/04	16:05	Downgradient 2	217,312	1,262,031	-5.22	none
DOWNGRADIENT98 10/15	10/15/04	16:20	Downgradient 1	216,927	1,261,016	-20.5	Field duplicate of DOWNGRADIENT 1B 10/15, 10/15/04 15:55
UPGRADIENTB 10/15	10/15/04	16:20	Upgradient	218,080	1,260,600	-109.83	none
DOWNGRADIENT99 10/15	10/15/04	17:20	Downgradient 1	217,533	1,262,139	-7.91	Field duplicate of DOWNGRADIENT 1A 10/15, 10/15/04 13:20
DOWNGRADIENT99	10/19/04	08:00	Downgradient 1	217,908	1,264,690	-94.79	Field duplicate of DOWNGRADIENT 1, 10/19/04 12:40
REF 1	10/19/04	11:45	Reference 1	217,700	1,260,366	-89.03	none
DOWNGRADIENT 1	10/19/04	12:40	Downgradient 1	217,908	1,264,690	-94.79	none
DOWNGRADIENT 2	10/19/04	13:15	Downgradient 2	218,245	1,261,008	-95.41	none

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
UPGRADIENT	10/19/04	13:45	Upgradient	216,823	1,261,123	-10.96	none
REF 2	10/19/04	14:00	Reference 2	217,872	1,262,927	-26.22	none
REF 3	10/19/04	14:30	Reference 3	219,209	1,260,417	-141.69	none
DOWNGRADIENT 1	10/23/04	11:15	Downgradient 1	216,822	1,261,185	-7.42	none
DOWNGRADIENT 2	10/23/04	11:35	Downgradient 2	217,505	1,262,001	-10.63	none
UPGRADIENT	10/23/04	11:45	Upgradient	218,285	1,261,029	-102.24	none
REF3	10/23/04	12:15	Reference 3	219,050	1,260,277	-106.13	none
REF2	10/23/04	12:35	Reference 2	217,716	1,263,137	-15.47	none
REF-1	10/23/04	12:45	Reference 1	217,662	1,260,256	-40.16	none
REF-99	10/23/04	16:20	Reference 3	219,050	1,260,277	-106.13	Field duplicate of REF3, 10/23/04 12:15
UPGRADIENT 99	10/26/04	08:00	Upgradient	216,772	1,261,150	-14.44	Field duplicate of UPGRADIENT B, 10/26/04 19:30
DOWNGRADIENT 99	10/26/04	09:00	Downgradient 1	218,213	1,261,055	-86.14	Field duplicate of DOWNGRADIENT 1B, 10/26/04 18:42
DOWNGRADIENT 1A	10/26/04	12:45	Downgradient 1	216,717	1,260,868	-13.95	none
DOWNGRADIENT 2A	10/26/04	13:15	Downgradient 2	217,401	1,261,615	-22.91	none
UPGRADIENT A	10/26/04	13:25	Upgradient	218,225	1,260,466	-102.55	none
REF 1	10/26/04	16:30	Reference 1	217,580	1,260,295	-58.47	none
REF 2	10/26/04	17:00	Reference 2	217,821	1,262,919	-19.62	none
REF 3	10/26/04	17:00	Reference 3	218,917	1,260,823	-65.62	none
DOWNGRADIENT 1B	10/26/04	18:42	Downgradient 1	218,213	1,261,055	-86.14	none
DOWNGRADIENT 2B	10/26/04	19:00	Downgradient 2	218,078	1,260,209	-78.6	none
UPGRADIENT B	10/26/04	19:30	Upgradient	216,772	1,261,150	-14.44	none
REF-1	10/28/04	12:30	Reference 1	217,741	1,260,353	-65.05	none
REF-2	10/28/04	13:30	Reference 2	218,470	1,262,432	-20.03	none
DOWNG 99	10/28/04	13:50	Downgradient 1	216,812	1,261,185	-7.91	Field duplicate of DOWNGRADIENT 1-A, 10/28/04 13:50

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
DOWNGRADIENT 1-A	10/28/04	13:50	Downgradient 1	216,812	1,261,185	-7.91	none
DOWNGRADIENT 2-A	10/28/04	14:05	Downgradient 2	217,180	1,261,515	-5.02	none
UPGRADIENT A	10/28/04	14:10	Upgradient	217,927	1,260,679	-82.58	none
REF-3	10/28/04	14:45	Reference 3	219,020	1,260,763	-115.13	none
DOWN 88	10/28/04	17:55	Downgradient 1	217,830	1,260,444	-56.79	Field duplicate of DOWNGRADIENT 1-B, 10/28/04 17:55
DOWNGRADIENT 1-B	10/28/04	17:55	Downgradient 1	217,830	1,260,444	-56.79	none
DOWNGRADIENT 2-B	10/28/04	18:30	Downgradient 2	218,386	1,261,052	-92.84	none
UPGRADIENT B	10/28/04	18:40	Upgradient	217,073	1,261,293	-3.55	none
REF99	11/01/04	08:00	Reference 3	219,087	1,264,528	-116.61	Field duplicate of REF-3, 11/1/04 11:55
REF1	11/01/04	11:15	Reference 1	217,741	1,260,360	-71.16	none
REF2	11/01/04	11:40	Reference 2	217,985	1,262,854	-16.39	none
REF3	11/01/04	11:55	Reference 3	219,087	1,264,528	-116.61	none
DOWNGRADIENT 1	11/01/04	13:35	Downgradient 1	219,002	1,261,633	-120.18	none
DOWNGRADIENT 2	11/01/04	14:00	Downgradient 2	218,640	1,260,982	-103.07	none
UPGRADIENT	11/01/04	14:15	Upgradient	217,649	1,261,922	-8.71	none
UPGRADIENT #99	11/08/04	08:00	Reference 3	219,146	1,261,033	-114.96	Field duplicate of REF 33, 11/8/04 11:15
REF#1	11/08/04	10:35	Reference 1	217,720	1,260,367	-80.32	none
REF#2	11/08/04	10:45	Reference 2	217,792	1,262,884	-17.1	none
REF#3	11/08/04	11:15	Reference 3	219,146	1,261,033	-114.96	none
UPGRADIENT	11/08/04	14:40	Upgradient	217,266	1,261,797	1.3	none
DOWNGRADIENT #1	11/08/04	14:45	Downgradient 1	218,584	1,261,282	-102.33	none
DOWNGRADIENT #2	11/08/04	15:10	Downgradient 2	218,634	1,261,832	-92.7	none
REF #99	11/16/04	08:00	Reference 1	217,761	1,260,333	-71.51	Field duplicate of REF #1, 11/16/04 14:10
REF #1	11/16/04	14:10	Reference 1	217,761	1,260,333	-71.51	none

TABLE 1
WATER QUALITY SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Sample ID	Date Sampled	Time Sampled	Sample Location	Northing (a)	Easting (a)	Sample Elevation (ft MLLW)	QA/QC
REF #3	11/16/04	14:40	Reference 3	219,229	1,260,932	-135.91	none
REF #2	11/16/04	15:00	Reference 2	217,913	1,262,921	-14.55	none
DOWNGRADIENT #2	11/16/04	16:30	Downgradient 2	217,246	1,261,763	4.2	none
DOWNGRADIENT #1	11/16/04	16:40	Downgradient 1	216,661	1,261,134	-1.92	none
UPGRADIENT	11/16/04	17:20	Upgradient	217,969	1,261,105	-58.58	none
DUPLICATE 92	11/22/04	08:00	Reference 2	217,812	1,262,905	-11.72	Field duplicate of REF 2, 11/22/04 11:25
REF 1	11/22/04	11:00	Reference 1	217,752	1,260,326	-68.57	none
REF 2	11/22/04	11:25	Reference 2	217,812	1,262,905	-11.72	none
REF 3	11/22/04	11:45	Reference 3	219,359	1,261,016	-149.68	none
DOWNGRADIENT 1-A	11/22/04	12:00	Downgradient 1	216,800	1,261,281	5.43	none
DOWNGRADIENT 2-A	11/22/04	12:10	Downgradient 2	217,219	1,262,112	4.6	none
UPGRADIENT 1-A	11/22/04	12:15	Upgradient	218,038	1,261,696	-67.5	none
DOWNGRADIENT 1-B	11/22/04	14:50	Downgradient 1	217,988	1,261,167	-58.29	none
DOWNGRADIENT 2-B	11/22/04	15:00	Downgradient 2	217,945	1,262,311	-34.3	none
UPGRADIENT 1-B	11/22/04	15:15	Upgradient	217,480	1,261,219	-5.57	none
DUPLICATE 99	11/22/04	16:00	Downgradient 2	217,945	1,262,311	-34.3	Field duplicate of DOWNGRADIENT 2-B, 11/22/04 15:00

a. Washington State Plane North Zone, North America Datum 83.

TABLE 2
WATER QUALITY SAMPLE DATA QUALIFIER SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Constituent	Sample	Laboratory ID	Qualifier	Reason
TSS	REF2 10/14	K2408183-001	J	High field duplicate RPD
TSS	REF99 10/14	K2408183-002	J	High field duplicate RPD
TSS	DOWNGRADIENT1B 10/15	K2408183-015	J	High field duplicate RPD
TSS	DOWNGRADIENT98 10/15	K2408183-016	J	High field duplicate RPD

U = Compound not detected.
J = Estimated value.

TABLE 3
TSS RESULTS FOR CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Station ID	Sample ID	Laboratory ID	Date Sampled	Time Sampled	TSS (mg/L)
Reference 1	REF1A	K2407097-003	09/14/04	11:25	5 U
Reference 1	REF1B	K2407097-007	09/14/04	13:30	5 U
Reference 2	REF2A	K2407097-004	09/14/04	10:45	5 U
Reference 2	REF2B	K2407097-006	09/14/04	13:20	5 U
Reference 3	REF3A	K2407097-001	09/14/04	12:10	5 U
Reference 3	REF3A2	K2407097-002	09/14/04	12:15	5 U
Reference 3	REF3B	K2407097-005	09/14/04	12:45	5 U
Reference 1	REF1A	K2407134-001	09/15/04	10:55	5 U
Reference 1	REF1B	K2407134-005	09/15/04	14:05	5 U
Reference 2	REF2A	K2407134-002	09/15/04	12:15	5 U
Reference 2	REF2A2	K2407134-003	09/15/04	12:20	5 U
Reference 2	REF2B	K2407134-006	09/15/04	13:10	5 U
Reference 3	REF3A	K2407134-004	09/15/04	11:55	5 U
Reference 3	REF3B	K2407134-007	09/15/04	13:40	5 U
Downgradient 1	DOWNGRADIENT 1	K2407187-005	09/16/04	14:10	5 U
Downgradient 1	DOWNGRADIENT 1B	K2407187-006	09/16/04	14:15	5 U
Downgradient 2	DOWNGRADIENT 2	K2407187-008	09/16/04	14:45	29
Reference 1	REF1A	K2407187-001	09/16/04	11:05	5 U
Reference 1	REF1B	K2407187-004	09/16/04	13:06	5 U
Reference 2	REF2A	K2407187-002	09/16/04	11:45	5 U
Reference 2	REF2B	K2407187-010	09/16/04	15:25	5 U
Reference 3	REF3A	K2407187-003	09/16/04	11:25	5 U
Reference 3	REF3B	K2407187-009	09/16/04	15:00	5 U
Upgradient	UPGRADIENT	K2407187-007	09/16/04	14:25	5 U
Downgradient 1	DOWNGRADIENT 1A	K2407222-004	09/17/04	13:10	5 U
Downgradient 1	DOWNGRADIENT 1B	K2407222-007	09/17/04	14:35	5 U
Downgradient 2	DOWNGRADIENT 2A	K2407222-005	09/17/04	13:25	5 U
Downgradient 2	DOWNGRADIENT 2B	K2407222-009	09/17/04	15:10	5 U
Downgradient 2	DOWNGRADIENT 2B2	K2407222-012	09/17/04	15:15	5 U
Reference 1	REF1A	K2407222-003	09/17/04	12:35	5 U
Reference 1	REF 1B	K2407222-006	09/17/04	13:45	5 U
Reference 2	REF2A	K2407222-001	09/17/04	11:50	5 U
Reference 2	REF 2B	K2407222-011	09/17/04	15:40	5 U
Reference 3	REF3A	K2407222-002	09/17/04	12:15	5 U
Reference 3	REF 3B	K2407222-010	09/17/04	15:25	5 U
Upgradient	UPGRADIENT	K2407222-008	09/17/04	14:50	13

TABLE 3
TSS RESULTS FOR CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Station ID	Sample ID	Laboratory ID	Date Sampled	Time Sampled	TSS (mg/L)
Reference 1	REF 1 9/22	K2407445-001	09/22/04	16:30	5 U
Reference 2	REF 2 9/22	K2407445-002	09/22/04	17:30	5 U
Reference 3	REF 3 9/22	K2407445-003	09/22/04	17:10	5 U
Upgradient	DUPLICATE 90 9/22	K2407445-007	09/22/04	11:00	5 U
Upgradient	UPGRADIENT 9/22	K2407445-006	09/22/04	18:45	5 U
Downgradient 1	DUPLICATE 91 9/23	K2407445-014	09/23/04	12:00	5 U
Downgradient 1	DOWNGRADIENT 1 9/23	K2407445-009	09/23/04	17:40	7
Downgradient 2	DOWNGRADIENT 2 9/23	K2407445-008	09/23/04	18:15	5 U
Reference 1	REF 1 9/23	K2407445-013	09/23/04	13:15	5 U
Reference 2	REF 2 9/23	K2407445-011	09/23/04	14:30	6
Reference 3	REF 3 9/23	K2407445-012	09/23/04	13:55	5 U
Upgradient	UPGRADIENT 9/23	K2407445-010	09/23/04	15:30	5 U
Downgradient 1	DOWNGRADIENT 1 9/24	K2407487-001	09/24/04	14:00	5 U
Downgradient 2	DOWNGRADIENT 2 9/24	K2407487-002	09/24/04	14:20	5 U
Reference 1	REF 1 9/24	K2407487-005	09/24/04	16:00	5 U
Reference 2	REF 2 9/24	K2407487-004	09/24/04	15:00	5 U
Reference 3	REF 3 9/24	K2407487-006	09/24/04	15:30	9
Upgradient	DUPLICATE 92	K2407487-007	09/24/04	08:00	5 U
Upgradient	UPGRADIENT 9/24	K2407487-003	09/24/04	14:40	5 U
Downgradient 1	DOWNGRADIENT 1 9/25	K2407487-009	09/25/04	14:08	10
Downgradient 2	DOWNGRADIENT 2 9/25	K2407487-011	09/25/04	14:32	5 U
Reference 1	REF 1 9/25	K2407487-013	09/25/04	15:15	5 U
Reference 2	REF 2 9/25	K2407487-008	09/25/04	13:35	5 U
Reference 3	REF 3 9/25	K2407487-012	09/25/04	14:50	5 U
Reference 3	DUPLICATE 93	K2407487-014	09/25/04	14:55	5 U
Upgradient	UPGRADIENT 9/25	K2407487-010	09/25/04	14:15	5 U
Downgradient 1	DOWNGRADIENT 1	K2407686-004	09/29/04	21:08	5 U
Downgradient 2	DOWNGRADIENT 2	K2407686-005	09/29/04	21:25	5 U
Downgradient 2	DOWNGRADIENT 2B	K2407686-006	09/29/04	21:30	5 U
Reference 1	REF1	K2407686-003	09/29/04	16:38	5 U
Reference 2	REF2	K2407686-002	09/29/04	16:09	5 U
Reference 3	REF3	K2407686-001	09/29/04	16:30	5 U
Upgradient	UPGRADIENT	K2407686-007	09/29/04	21:40	5 U
Downgradient 1	DOWNGRADIENT 1	K2407714-004	09/30/04	18:25	5 U
Downgradient 2	DOWNGRADIENT 2	K2407714-005	09/30/04	18:35	5
Reference 3	REF3	K2407714-001	09/30/04	19:15	5 U
Upgradient	UPGRADIENT 2	K2407714-003	09/30/04	18:50	5 U
Upgradient	UPGRADIENT	K2407714-002	09/30/04	18:55	5 U
Downgradient 1	DOWNGRADIENT 1	K2407804-003	10/05/04	14:20	6
Downgradient 2	DOWNGRADIENT 2	K2407804-004	10/05/04	14:45	5 U
Reference 1	REF1	K2407804-001	10/05/04	15:20	8
Reference 2	REF2	K2407804-007	10/05/04	13:40	11
Reference 3	REF3	K2407804-002	10/05/04	15:50	6
Upgradient	UPGRADIENT	K2407804-005	10/05/04	15:00	7
Upgradient	UPGRADIENT 2	K2407804-006	10/05/04	15:05	6

TABLE 3
TSS RESULTS FOR CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Station ID	Sample ID	Laboratory ID	Date Sampled	Time Sampled	TSS (mg/L)
Downgradient 1	DUP A	K2408098-008	10/12/04	08:00	5 U
Downgradient 1	DOWNGRADIENT 1B	K2408098-004	10/12/04	16:05	5 U
Downgradient 1	DOWNGRADIENT 1A	K2408098-007	10/12/04	18:45	5 U
Downgradient 2	DOWNGRADIENT 2B	K2408098-005	10/12/04	16:15	5 U
Downgradient 2	DOWNGRADIENT 2A	K2408098-009	10/12/04	19:10	7
Reference 1	REF1	K2408098-001	10/12/04	14:45	5 U
Reference 2	REF2	K2408098-002	10/12/04	15:30	5 U
Reference 3	DUP B	K2408098-011	10/12/04	12:00	5 U
Reference 3	REF3	K2408098-003	10/12/04	17:30	5 U
Upgradient	UPGRADIENT B	K2408098-006	10/12/04	16:30	5 U
Upgradient	UPGRADIENT A	K2408098-010	10/12/04	19:30	5 U
Downgradient 1	DOWNGRADIENT1A 10/14	K2408183-004	10/14/04	09:30	8
Downgradient 2	DOWNGRADIENT2A 10/14	K2408183-005	10/14/04	09:50	5 U
Reference 1	REF1 10/14	K2408183-007	10/14/04	10:05	5 U
Reference 2	REF2 10/14	K2408183-001	10/14/04	06:20	5 J
Reference 2	REF99 10/14	K2408183-002	10/14/04	08:20	13 J
Reference 3	REF3 10/14	K2408183-003	10/14/04	06:45	5 U
Upgradient	UPGRADIENTA 10/14	K2408183-006	10/14/04	10:05	8
Downgradient 1	DOWNGRADIENT1A 10/15	K2408183-011	10/15/04	13:20	5 U
Downgradient 1	DOWNGRADIENT1B 10/15	K2408183-015	10/15/04	15:55	7 J
Downgradient 1	DOWNGRADIENT98 10/15	K2408183-016	10/15/04	16:20	13 J
Downgradient 1	DOWNGRADIENT99 10/15	K2408183-012	10/15/04	17:20	6
Downgradient 2	DOWNGRADIENT2A 10/15	K2408183-013	10/15/04	13:45	6
Downgradient 2	DOWNGRADIENT2B 10/15	K2408183-017	10/15/04	16:05	8
Reference 1	REF1 10/15	K2408183-008	10/15/04	12:30	7
Reference 2	REF2 10/15	K2408183-009	10/15/04	14:30	9
Reference 3	REF3 10/15	K2408183-010	10/15/04	14:20	6
Upgradient	UPGRADIENTA 10/15	K2408183-014	10/15/04	14:00	5 U
Upgradient	UPGRADIENTB 10/15	K2408183-018	10/15/04	16:20	6
Downgradient 1	DOWNGRADIENT99	K2408297-001	10/19/04	08:00	5 U
Downgradient 1	DOWNGRADIENT 1	K2408297-002	10/19/04	12:40	5 U
Downgradient 2	DOWNGRADIENT 2	K2408297-003	10/19/04	13:15	5 U
Reference 1	REF 1	K2408297-006	10/19/04	11:45	5 U
Reference 2	REF 2	K2408297-007	10/19/04	14:00	5 U
Reference 3	REF 3	K2408297-005	10/19/04	14:30	5 U
Upgradient	UPGRADIENT	K2408297-004	10/19/04	13:45	5 U
Downgradient 1	DOWNGRADIENT 1	K2408459-006	10/23/04	11:15	5 U
Downgradient 2	DOWNGRADIENT 2	K2408459-004	10/23/04	11:35	5 U
Reference 1	REF-1	K2408459-002	10/23/04	12:45	5 U
Reference 2	REF2	K2408459-007	10/23/04	12:35	5
Reference 3	REF3	K2408459-005	10/23/04	12:15	5 U
Reference 3	REF-99	K2408459-001	10/23/04	16:20	5 U
Upgradient	UPGRADIENT	K2408459-003	10/23/04	11:45	5 U
Downgradient 1	DOWNGRADIENT 99	K2408564-008	10/26/04	09:00	8
Downgradient 1	DOWNGRADIENT 1A	K2408564-001	10/26/04	12:45	5 U

TABLE 3
TSS RESULTS FOR CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Station ID	Sample ID	Laboratory ID	Date Sampled	Time Sampled	TSS (mg/L)
Downgradient 1	DOWNGRADIENT 1B	K2408564-007	10/26/04	18:42	5 U
Downgradient 2	DOWNGRADIENT 2A	K2408564-002	10/26/04	13:15	10
Downgradient 2	DOWNGRADIENT 2B	K2408564-009	10/26/04	19:00	5 U
Reference 1	REF 1	K2408564-004	10/26/04	16:30	5 U
Reference 2	REF 2	K2408564-005	10/26/04	17:00	7
Reference 3	REF 3	K2408564-006	10/26/04	17:00	5 U
Upgradient	UPGRADIENT 99	K2408564-011	10/26/04	08:00	6
Upgradient	UPGRADIENT A	K2408564-003	10/26/04	13:25	5 U
Upgradient	UPGRADIENT B	K2408564-010	10/26/04	19:30	5 U
Downgradient 1	DOWNG 99	K2408643-004	10/28/04	13:50	5 U
Downgradient 1	DOWNGRADIENT 1-A	K2408643-003	10/28/04	13:50	5 U
Downgradient 1	DOWN 88	K2408643-009	10/28/04	17:55	7
Downgradient 1	DOWNGRADIENT 1-B	K2408643-008	10/28/04	17:55	5 U
Downgradient 2	DOWNGRADIENT 2-A	K2408643-005	10/28/04	14:05	5 U
Downgradient 2	DOWNGRADIENT 2-B	K2408643-010	10/28/04	18:30	5 U
Reference 1	REF-1	K2408643-001	10/28/04	12:30	5 U
Reference 2	REF-2	K2408643-002	10/28/04	13:30	5 U
Reference 3	REF-3	K2408643-007	10/28/04	14:45	7
Upgradient	UPGRADIENT A	K2408643-006	10/28/04	14:10	5 U
Upgradient	UPGRADIENT B	K2408643-011	10/28/04	18:40	5 U
Downgradient 1	DOWNGRADIENT 1	K2408671-006	11/01/04	13:35	13
Downgradient 2	DOWNGRADIENT 2	K2408671-007	11/01/04	14:00	6
Reference 1	REF1	K2408671-001	11/01/04	11:15	5 U
Reference 2	REF2	K2408671-002	11/01/04	11:40	7
Reference 3	REF99	K2408671-005	11/01/04	08:00	5 U
Reference 3	REF3	K2408671-003	11/01/04	11:55	6
Upgradient	UPGRADIENT	K2408671-004	11/01/04	14:15	5
Downgradient 1	DOWNGRADIENT #1	K2408890-005	11/08/04	14:45	5 U
Downgradient 2	DOWNGRADIENT #2	K2408890-006	11/08/04	15:10	5 U
Reference 1	REF#1	K2408890-001	11/08/04	10:35	6
Reference 2	REF#2	K2408890-002	11/08/04	10:45	5 U
Reference 3	UPGRADIENT #99	K2408890-007	11/08/04	08:00	5 U
Reference 3	REF#3	K2408890-003	11/08/04	11:15	5 U
Upgradient	UPGRADIENT	K2408890-004	11/08/04	14:40	5 U
Downgradient 1	DOWNGRADIENT #1	K2409197-005	11/16/04	16:40	5 U
Downgradient 2	DOWNGRADIENT #2	K2409197-006	11/16/04	16:30	5 U
Reference 1	REF #99	K2409197-007	11/16/04	08:00	5 U
Reference 1	REF #1	K2409197-001	11/16/04	14:10	5 U
Reference 2	REF #2	K2409197-002	11/16/04	15:00	5 U
Reference 3	REF #3	K2409197-003	11/16/04	14:40	5 U
Upgradient	UPGRADIENT	K2409197-004	11/16/04	17:20	5 U
Downgradient 1	DOWNGRADIENT 1-A	K2409301-005	11/22/04	12:00	5 U
Downgradient 1	DOWNGRADIENT 1-B	K2409301-008	11/22/04	14:50	5 U
Downgradient 2	DOWNGRADIENT 2-A	K2409301-006	11/22/04	12:10	6
Downgradient 2	DOWNGRADIENT 2-B	K2409301-009	11/22/04	15:00	5

TABLE 3
TSS RESULTS FOR CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Station ID	Sample ID	Laboratory ID	Date Sampled	Time Sampled	TSS (mg/L)
Downgradient 2	DUPLICATE 99	K2409301-011	11/22/04	16:00	5 U
Reference 1	REF 1	K2409301-001	11/22/04	11:00	5 U
Reference 2	DUPLICATE 92	K2409301-010	11/22/04	08:00	5 U
Reference 2	REF 2	K2409301-002	11/22/04	11:25	5 U
Reference 3	REF 3	K2409301-003	11/22/04	11:45	5 U
Upgradient	UPGRADIENT 1-A	K2409301-004	11/22/04	12:15	5
Upgradient	UPGRADIENT 1-B	K2409301-007	11/22/04	15:15	5 U

U = Compound not detected.
J = Estimated value.

Appendix C – Water Quality Analytical Data Packages

(Provided in separate box)

2 pages including cover page

Water quality CAS data packages include K2407097, K2407134, K2407187, K2407222, K2407355, K2407445, K2407487, K2407686, K2407714, K2407804, K2408098, K2408183, K2408297, K2408459, K2408564, K2408643, K2408671, K2408890, K2409197, and K2409301.

Appendix D – Cap Verification Data Quality Evaluation

16 pages including cover page

MEMORANDUM

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

To: Paul Krause, PhD, Blasland, Bouck & Lee (BBL)

Date: 1/19/05

From: Shannon Dunn, BBL

cc: Kris Fabian, BBL

Re: Cap Verification Data Quality Evaluation
Construction Year 2004/2005
Pacific Sound Resources Superfund Site
Marine Sediments Operable Unit
Remedial Action

This memorandum provides the results of a data quality evaluation for 17 sediment samples (including 2 field duplicate samples) collected at the Pacific Sound Resources Superfund Site, Marine Sediments Operable Unit in Seattle, Washington as part of the cap verification sampling. Cap verification samples were collected between December 13 and 15, 2004. Cap verification samples were collected from surface sediment (approximately 0 to 6 inches below the mudline). A data quality evaluation was performed for the following analyses:

- total solids [U.S. Environmental Protection Agency (USEPA) Method 160.3M];
- total organic carbon (TOC) (Puget Sound Estuary Protocols);
- metals (USEPA Methods 6010B and 7471A);
- polychlorinated biphenyls (PCBs) (USEPA Method 8082); and
- semivolatile organic compounds (SVOCs) (USEPA Method 8270C).

All analyses were performed by Columbia Analytical Services (CAS), of Kelso, Washington. This data quality evaluation covers CAS data package K2409920. The data quality evaluation was performed in accordance with the *Pacific Sound Resources Verification Sampling, II Quality Assurance Project Plan* (QAPP) (BBL, 2003), and with applicable portions of the USEPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* and *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA, 1999 and 2002). Table 1 summarizes the sampling details, such as date and location.

The data quality evaluation considered the following elements:

- chain-of-custody records;
- holding times;
- method blank analyses;
- surrogate recoveries;
- laboratory matrix spike and matrix spike duplicate (MS/MSD) recoveries;
- laboratory control sample (LCS) recoveries;
- laboratory duplicate relative percent differences (RPDs);

- field duplicate RPDs;
- quantitation limits; and
- conclusions and completeness.

Data qualifiers are added to sample results based on the data quality evaluation. The absence of a data qualifier indicates that the datum is acceptable without qualification. The data to which qualifiers were applied are summarized in Table 2.

Because of the cap material's large grain size (up to 3-inch rock), the analytical protocol was modified to include a sieving step to separate out the coarsest material. A memorandum summarizing the revised analytical protocol is attached to this data quality evaluation memorandum. In accord with the modification, CAS sieved the samples upon receipt using a 1-inch mesh to separate out the material greater than 1 inch in diameter. The remaining material was analyzed and the results were reported on a dry-weight basis. These data were then corrected to the dry weight of the total sample prior to sieving.

CHAIN-OF-CUSTODY RECORDS

A signed chain-of-custody record accompanied each data package. The laboratory received all samples in good condition and all requested analyses were performed.

HOLDING TIMES

For all analyses and all samples, the time between sample collection and analysis was determined to be within USEPA and project-specified holding times.

METHOD BLANKS

Method blanks were analyzed with each batch of samples for each analysis except total solids (there is no method blank for the total solids method). No contamination was detected in the method blanks, with the following exceptions:

- Zinc was detected in the method blank for metals. Zinc results were qualified as non-detect (U) in samples from Station 6/VS-37, Station 9/VC-40, and Station 12/VS-44.

- Phenol and naphthalene were detected in the SVOC method blank. Phenol results were qualified as non-detect (U) in all samples except those from Station 4/VS-35 and Station 14/VS-34. Naphthalene results were qualified as non-detect (U) in samples from Station 6/VS-37, Station 9/VS-40, Station 10/VS-41, Station 12/VS-44, Station 13/VS-43, Station 15/VS-30, and Station 99.

SURROGATES

Surrogate spikes for each organic analysis (PCBs and SVOCs) were analyzed for each sample. All surrogate recoveries were within the laboratory-specified control limits.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

A minimum of one MS/MSD pair per 20 samples (or per laboratory batch if fewer than 20 samples were obtained) was analyzed for each organic analysis (PCBs and SVOCs). A minimum of one MS per 20 samples (or per laboratory batch if fewer than 20 samples were obtained) was analyzed for TOC and metals analyses. Each MS/MSD was generated using a project sample. Recoveries and RPDs for the MS/MSDs were within the laboratory- and project-specified control limits with the following exceptions:

- MS/MSD recoveries of SVOCs naphthalene, fluorene, and pentachlorophenol were below laboratory- and project-specified control limits, indicating a potential low bias. Naphthalene, fluorene, and pentachlorophenol results were qualified as estimated (J) in sample Station 99.

- MS recoveries of SVOCs phenol, 2-methylnaphthalene, acenaphthene, dibenzofuran, and benzo(g,h,i)perylene were below laboratory- and project-specified control limits, indicating a potential low bias. MSD recoveries for these compounds were within laboratory- and project-specified control limits. Phenol, acenaphthene, 2-methylnaphthene, dibenzofuran, and benzo(g,h,i)perylene results were qualified as estimated (J) in sample Station 99.

- For SVOCs 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol, the MS/MSD recoveries were below project-specified control limits but within laboratory-specified control limits. No qualifiers were assigned because recoveries were within laboratory control limits.

LABORATORY CONTROL SAMPLE

At least one LCS was analyzed with each batch of samples for each analysis except total solids (there is no LCS for the total solids method). Laboratory- and project-specified control limits were met for each LCS recovery, with the following exceptions:

- The LCS recoveries of 2-methylphenol, 4-methylphenol, and 2,4-dimethylphenol were below project-specified control limits but within laboratory-specified control limits. No qualifiers were assigned because LCS recoveries were within laboratory control limits.

LABORATORY DUPLICATE

At least one laboratory duplicate sample was analyzed for each batch of samples for each analysis. Laboratory duplicate analyses were performed on project-specific samples. All RPDs between the duplicate results were within laboratory- and project-specified control limits, with the following exceptions:

- The laboratory duplicate and triplicate RPDs for TOC for sample Station 1/VS-31 were above laboratory-specified control limits but within project-specified control limits. TOC results for this sample were near the method reporting limit (MRL). The laboratory duplicate RPDs fell within the alternative USEPA recommended control limit of +/- two times the MRL if either the sample or duplicate value is less than five times the MRL (USEPA, 2002). Therefore, the data were determined to be unaffected by the out-of-control RPDs because the results were near the MRL. No qualifiers were added to the data because the laboratory duplicate RPDs were within the USEPA recommended control limit.

- The laboratory duplicate RPD for zinc for sample Station 99 was above laboratory- and project-specified control limits. Zinc results for this sample were near the MRL. The laboratory duplicate RPD fell within the alternative USEPA recommended control limit of +/- two times the MRL (USEPA, 2002). Therefore, the data were determined to be unaffected by the out-of-control RPD because the results were near the MRL. No qualifiers were added to the data because the laboratory duplicate RPD was within the USEPA recommended control limit.

FIELD DUPLICATE

Field duplicates were collected at a frequency of 13%, which exceeded the 10% specified in Technical Specification 01450. Field duplicate RPDs were within project-specified control limits, with the following exceptions:

- The TOC and zinc field duplicate RPDs for sample Station 6/VS-37 and field duplicate Station 99 were above project-specified control limits. TOC and zinc were detected in the field duplicate sample but not in the parent sample. TOC and zinc results for these samples were near the MRLs. The field duplicate RPDs fell within the alternative USEPA recommended control limit of +/- two times the MRL (USEPA, 2002). Therefore, the data were determined to be unaffected by the out-of-control RPDs because the results were near the MRLs. No qualifiers were added to the data because the laboratory duplicate RPDs were within the USEPA recommended control limit.

- Field duplicate RPDs for sample Station 2/VS-32 and field duplicate Station 98 were above project specified control limits for SVOCs naphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, and benzo(a)pyrene. These results were qualified as estimated (J) in samples Station 2/VS-32 and Station 98.
- Field duplicate RPDs for sample Station 2/VS-32 and field duplicate Station 98 were above project-specified control limits for SVOCs 2-methylnaphthene, acenaphthylene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene. SVOC results for these samples were near the MRLs. The field duplicate RPDs fell within the alternative USEPA recommended control limit of +/- two times the MRL (USEPA, 2002). Therefore, the data were determined to be unaffected by the out-of-control RPDs because the results were near the MRLs. No qualifiers were added to the data because the laboratory duplicate RPDs were within the USEPA recommended control limit.

- Field duplicate RPDs for sample Station 6/VS-37 and field duplicate Station 99 were above project-specified control limits for SVOCs 2-methylnaphthene, acenaphthene, dibenzofuran, fluorene, phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, and benzo(a)pyrene. SVOC results for these samples were near the MRLs. The field duplicate RPDs fell within the alternative USEPA recommended control limit of +/- two times the MRL (USEPA, 2002). Therefore, the data were determined to be unaffected by the out-of-control RPDs because the results were near the MRLs. No qualifiers were added to the data because the laboratory duplicate RPDs were within the USEPA recommended control limit.

REPORTING LIMITS

Project-specified quantitation limits were met for all samples, with the following exceptions:

- The MRLs for PCB Aroclor 1221 were above the reporting limit goal of 10 µg/kg in all samples. The MRL ranged from 1.9 to 3.4 times the reporting limit goal.

- In sample Station 98, the MRL for PCB Aroclor 1232 was 1.9 times the reporting limit goal. The chromatogram indicated the presence of non-target background components. The matrix interference prevented adequate resolution of the target compound at the reporting limit.

- The MRLs for SVOCs phenol and pentachlorophenol were above the reporting limit goals of 10 and 50 µg/kg, respectively, in all samples. The MRL for phenol ranged from 2.6 to 3.1 times the reporting limit goal. The MRL for pentachlorophenol ranged from 1.7 to 2.2 times the reporting limit goal.

- In sample Station 10/VS-41, the MRLs for all SVOCs were approximately 1.1 times the reporting limit goals.

The MRLs discussed above for PCB Aroclors, phenol, and pentachlorophenol are below the criteria presented in the Technical Specifications (Table 01450-2). The data are therefore believed to be unaffected by these slightly elevated MRLs.

OVERALL DATA QUALITY AND COMPLETENESS

Other factors that may affect the use of the data include the following:

- The stock solution used to prepare the metals calibration standards was used three days past the manufacturer's recommended one-year expiration date. A current calibration verification standard from an independent source was prepared and analyzed along with the calibration standards as per CAS standard operating procedures. The result of this independent check agreed with the calibration standards, which confirmed the calibration standard's continued accuracy. The results of the verification check indicate the samples were not affected by use of the expired standard.

- PCB Aroclor 1254 in sample Station 1/VS-31 was qualified (JP) to indicate the confirmation comparison criteria are not applicable because at least one of the values is below the method reporting limit.

- The primary evaluation criterion was exceeded for SVOCs pentachlorophenol and hexachlorocyclopentadiene in ICAL ID CAL 4123. The primary evaluation criterion was exceeded for di-n-octyl phthalate in ICAL ID CAL 4117. In accordance with CAS standard operating procedures, the alternative evaluation specified in the USEPA method was performed using the mean relative standard deviation (RSD) of all analytes in the calibration. The results of the mean RSD calculations were 7.1% and 7.2%, respectively. The calibration meets the alternative evaluation criteria. CAS policy does not allow the use of averaging if any analyte in the ICAL exceeds 30% RSD.

- The upper control criterion was exceeded for hexachlorocyclopentadiene in the second source calibration verification for calibration CAL 4123. The analyte in question was not reported in the associated field samples.

Data representativeness was acceptable. The prescribed field and laboratory methods were followed. Data comparability was acceptable. Sampling and analytical methodologies set forth in the QAPP were followed. Data completeness was acceptable. No data were rejected. The completeness for this set of data is 100%, which exceeds the project-specified goal of 90%. Data precision was evaluated through laboratory and field duplicates and was acceptable. Data accuracy was evaluated through laboratory control samples and was acceptable. Based on this data quality evaluation, all of the data were determined to be acceptable as qualified. Table 3 presents the chemistry results for the cap verification samples.

References

Blasland, Bouck & Lee. 2003. *Pacific Sound Resource Verification Sampling, II Quality Assurance Project Plan*. August.

Blasland, Bouck & Lee. 2004. *Cap Verification Sampling in Remediation Area 4, Pacific Sound Resources Superfund Site*. December.

U.S. Environmental Protection Agency (USEPA). 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*. U.S. Environmental Protection Agency. EPA540/R-99/008. October.

USEPA. 2002. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. U.S. Environmental Protection Agency. EPA540-R-01-008. July.

SMD

TABLE 1
CAP VERIFICATION SAMPLING SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample Identification (a)	Sample Date	Time Sampled	Northing (b)	Easting (b)	Elevation (ft MLLW)	QA/QC
Station 15/VS-30	12/14/2004	10:03	217,221	1,261,002	-86.7	none
Station 1/VS-31	12/14/2004	11:03	217,503	1,260,977	-133.9	none
station 2/VS-32	12/13/2004	15:45	217,356	1,261,272	-78.8	none
Station 98	12/13/2004	9:00	217,356	1,261,272	-78.8	Field duplicate of VS-32
Station 3/VS-33	12/14/2004	12:01	217,672	1,261,238	-134.8	none
Station 14/VS-34	12/15/2004	16:32	217,257	1,261,430	-44.7	none
Station 4/VS-35	12/13/2004	13:40	217,489	1,261,538	-71.6	none
Station 5/VS-36	12/14/2004	13:24	217,788	1,261,506	-127.7	none
Station 6/VS-37	12/13/2004	11:44	217,427	1,261,739	-37.4	none
Station 99	12/13/2004	8:00	217,427	1,261,739	-37.4	Field duplicate of VS-37
Station 8/VS-38	12/13/2004	14:10	217,624	1,261,809	-69.2	none
Station 7/VS-39	12/14/2004	14:06	217,926	1,261,775	-130.2	none
Station 9/VS-40	12/13/2004	12:30	217,585	1,261,983	-29.4	none
Station 10/VS-41	12/15/2004	9:19	217,762	1,262,053	-73.0	none
Statioin 11/VS-42	12/14/2004	15:00	218,054	1,262,051	-124.3	none
Station 13/VS-43	12/15/2004	9:45	217,889	1,262,337	-74.8	none
Station 12/VS-44	12/14/2004	15:40	218,204	1,262,289	-135.6	none

a. All samples are from Remediation Area 4.
b. State Plan Washington North, NAD83, U.S. Survey Feet.

TABLE 2
CAP VERIFICATION SAMPLE DATA QUALIFIER SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Constituent	Sample	Laboratory ID	Qualifier	Reason
Zinc	Station 6/VS-37	K2409920-006	U	Method blank contamination
Zinc	Station 9/VS-40	K2409920-009	U	Method blank contamination
Zinc	Station 12/VS-44	K2409920-012	U	Method blank contamination
Naphthalene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Naphthalene	Station 98	K2409920-016	J	High field duplicate RPD
Acenaphthene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Acenaphthene	Station 98	K2409920-016	J	High field duplicate RPD
Dibenzofuran	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Dibenzofuran	Station 98	K2409920-016	J	High field duplicate RPD
Fluorene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Fluorene	Station 98	K2409920-016	J	High field duplicate RPD
Phenanthrene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Phenanthrene	Station 98	K2409920-016	J	High field duplicate RPD
Anthracene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Anthracene	Station 98	K2409920-016	J	High field duplicate RPD
Fluoranthene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Fluoranthene	Station 98	K2409920-016	J	High field duplicate RPD
Pyrene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Pyrene	Station 98	K2409920-016	J	High field duplicate RPD
Benz(a)anthracene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Benz(a)anthracene	Station 98	K2409920-016	J	High field duplicate RPD
Benzo(a)pyrene	Station 2/VS-32	K2409920-002	J	High field duplicate RPD
Benzo(a)pyrene	Station 98	K2409920-016	J	High field duplicate RPD
Phenol	Station 1/VS-31	K2409920-001	U	Method blank contamination
Phenol	Station 2/VS-32	K2409920-002	U	Method blank contamination
Phenol	Station 3/VS-33	K2409920-003	U	Method blank contamination
Phenol	Station 5/VS-36	K2409920-005	U	Method blank contamination
Phenol	Station 6/VS-37	K2409920-006	U	Method blank contamination
Phenol	Station 7/VS-39	K2409920-007	U	Method blank contamination
Phenol	Station 8/VS-38	K2409920-008	U	Method blank contamination
Phenol	Station 9/VS-40	K2409920-009	U	Method blank contamination
Phenol	Station 10/VS-41	K2409920-010	U	Method blank contamination
Phenol	Station 11/VS-42	K2409920-011	U	Method blank contamination

TABLE 2
CAP VERIFICATION SAMPLE DATA QUALIFIER SUMMARY
CONSTRUCTION YEAR 2004 TO 2005
PACIFIC SOUND RESOURCES SUPERFUND SITE,
MARINE SEDIMENTS OPERABLE UNIT
REMEDIAL ACTION

Constituent	Sample	Laboratory ID	Qualifier	Reason
Phenol	Station 12/VS-44	K2409920-012	U	Method blank contamination
Phenol	Station 13/VS-43	K2409920-013	U	Method blank contamination
Phenol	Station 15/VS-30	K2409920-015	U	Method blank contamination
Phenol	Station 98	K2409920-016	U	Method blank contamination
Phenol	Station 99	K2409920-017	U	Method blank contamination
Naphthalene	Station 6/VS-37	K2409920-006	U	Method blank contamination
Naphthalene	Station 9/VS-40	K2409920-009	U	Method blank contamination
Naphthalene	Station 10/VS-41	K2409920-010	U	Method blank contamination
Naphthalene	Station 12/VS-44	K2409920-012	U	Method blank contamination
Naphthalene	Station 13/VS-43	K2409920-013	U	Method blank contamination
Naphthalene	Station 15/VS-30	K2409920-015	U	Method blank contamination
Naphthalene	Station 99	K2409920-017	U	Method blank contamination
Phenol	Station 99	K2409920-017	UJ	Low MS/MSD recovery
Naphthalene	Station 99	K2409920-017	UJ	Low MS/MSD recovery
2-Methylnaphthalene	Station 99	K2409920-017	UJ	Low MS/MSD recovery
Acenaphthene	Station 99	K2409920-017	J	Low MS/MSD recovery
Dibenzofuran	Station 99	K2409920-017	UJ	Low MS/MSD recovery
Fluorene	Station 99	K2409920-017	UJ	Low MS/MSD recovery
Pentachlorophenol	Station 99	K2409920-017	UJ	Low MS/MSD recovery
Benzo(g,h,i)perylene	Station 99	K2409920-017	UJ	Low MS/MSD recovery

U = Compound not detected.
J = Estimated value.

TABLE 3
CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR FINES DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: Laboratory ID: Date Sampled:	STATION 1/VS-31 K2409920-001 12/14/04	STATION 2/VS-32 K2409920-002 12/13/04	Field Duplicate of VS-32 STATION 98 K2409920-016 12/13/04	STATION 3/VS-33 K2409920-003 12/14/04	STATION 4/VS-35 K2409920-004 12/13/04	STATION 5/VS-36 K2409920-005 12/14/04	STATION 6/VS-37 K2409920-006 12/13/04	Field Duplicate of VS-37 STATION 99 K2409920-017 12/13/04	STATION 7/VS-39 K2409920-007 12/14/04
Metals (mg/kg)									
Copper	2.3 U	2.3 U	2.3 U	2.3 U	7.2	2.3 U	2.4 U	2.3 U	2.2 U
Mercury	0.017 B	0.014	0.01 B	0.011 B	0.158	0.013 B	0.007 B	0.016 U	0.048
Zinc	4.1	3.4	3.5	2.3	13.6	2.5	1.1 UB	3.6	2.6
PAHs (ug/kg)									
Naphthalene	24	29 J	66 J	49	720	13	10 U	10 UJ	200
Acenaphthylene	1.9 J	3.3 J	6.2 J	8 J	66	10 U	10 U	10 U	5.6 J
Acenaphthene	34	27 J	92 J	230	550	17	3.2 J	1.5 J	210
Fluorene	41	30 J	88 J	480	420	13	3.3 J	10 UJ	100
Phenanthrene	89	77 J	240 J	1200	1,100	36	14	4.8 J	210
Anthracene	52	45 J	110 J	750	430	15	2.6 J	2.1 J	140
2-Methylnaphthalene	9.5 J	6.7 J	17	18	200	7.3 J	1.7 J	10 UJ	53
LPAH (b,c)	242	211 J	602 J	2717	3,286	94	23	8.4 J	866
Fluoranthene	190	210 J	1,000 J	1300	1,400	71	9.3 J	18	1,100
Pyrene	85	220 J	540 J	610	3,900	77	8.5 J	24	950
Benz(a)anthracene	43	73 J	200 J	280	370	24	2.3 J	5 J	160
Chrysene	47	150	230	420	490	28	2.8 J	6.2 J	150
Benzo(b)fluoranthene	28	73	120	160	920	19	10 U	6.6 J	98
Benzo(k)fluoranthene	8.3 J	24	43	48	330	6.5 J	10 U	10 U	34
Total Benzofluoranthenes (c,d)	36.3 J	97	163	208	1,250	26	10 U	6.6 J	132
Benzo(a)pyrene	16	45 J	80 J	86	530	11	10 U	4.3 J	58
Indeno(123-cd)pyrene	4.9 J	13	24	24	190	3.2 J	10 U	10 U	17
Dibenz(ah)anthracene	10 U	4.7 J	7.4 J	8.3 J	55	10 U	10 U	10 U	5.8 J
Benzo(ghi)perylene	4.5 J	12	24	20	170	2.9 J	10 U	10 UJ	15
HPAH (c,e)	427	825	2,268	2,956	8,355	243	23 J	64	2,588
Miscellaneous SVOCs (ug/kg)									
Dibenzofuran	28	20 J	70 J	180	370	10	2.2 J	10 UJ	110
Phenolics (ug/kg)									
Phenol	30 U	30 U	30 U	30 U	32 U	30 U	30 U	30 UJ	30 U
2-Methylphenol	10 U	10 U	10 U	10 U	5.7 J	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	21	10 U	10 U	10 U	10 U
24-Dimethylphenol	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Pentachlorophenol	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 UJ	100 U

TABLE 3
CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR FINES DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

			Field Duplicate of VS-32					Field Duplicate of VS-37	
Sample ID:	STATION 1/VS-31	STATION 2/VS-32	STATION 98	STATION 3/VS-33	STATION 4/VS-35	STATION 5/VS-36	STATION 6/VS-37	STATION 99	STATION 7/VS-39
Laboratory ID:	K2409920-001	K2409920-002	K2409920-016	K2409920-003	K2409920-004	K2409920-005	K2409920-006	K2409920-017	K2409920-007
Date Sampled:	12/14/04	12/13/04	12/13/04	12/14/04	12/13/04	12/14/04	12/13/04	12/13/04	12/14/04
PCBs (ug/kg)									
Aroclor 1016	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1221	23 U	20 U	22 U	34 U	23 U	20 U	20 U	20 U	24 U
Aroclor 1232	10 U	10 U	19 U	10 U	29 U	10 U	10 U	10 U	10 U
Aroclor 1242	10 U	10 U	10 U	10 U	16 U	10 U	10 U	10 U	10 U
Aroclor 1248	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1254	2.5 JP	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1260	3.1 J	10 U	10 U	10 U	11 U	10 U	10 U	10 U	10 U
Total PCBs (c)	5.6 JP	20 U	22 U	34 U	29 U	20 U	20 U	20 U	24 U
Conventionals (percent)									
Total Solids (f)	86.5	87	87	84.9	84.2	86.2	84.9	84.7	90.6
Total Organic Carbon	0.03 J	0.04 J	0.03 J	0.03 J	0.15	0.02 J	0.05 U	0.11	0.13

TABLE 3
CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR FINES DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: / Laboratory ID: / Date Sampled:	STATION 8/VS-38 K2409920-008 12/13/04	STATION 9/VS-40 K2409920-009 12/15/04	STATION 10/VS-41 K2409920-010 12/15/04	STATION 11/VS-42 K2409920-011 12/14/04	STATION 12/VS-44 K2409920-012 12/14/04	STATION 13/VS-43 K2409920-013 12/15/04	STATION 14/VS-34 K2409920-014 12/14/04	STATION 15/VS-30 K2409920-015 12/14/04
Metals (mg/kg)								
Copper	2.2 U	2.1 U	2.1 U	2.4 U	1.9 U	2.1 U	2.2 U	2.2 U
Mercury	0.016 B	0.047	0.01 B	0.016 B	0.016 U	0.02	0.011 B	0.036
Zinc	2.1 B	0.9 UB	3.4	3.3	0.7 UB	2.7	2.6	4.8
PAHs (ug/kg)								
Naphthalene	37	10 U	11 U	100	8.9 U	8.7 U	10 U	10 U
Acenaphthylene	10 U	10 U	11 U	2.3 J	8.9 U	8.7 U	10 U	10 U
Acenaphthene	37	1.3 J	11 U	62	8.9 U	1.5 J	10 U	1.1 J
Fluorene	15	10 U	11 U	58	8.9 U	2 J	10 U	10 U
Phenanthrene	36	2.6 J	11 U	140	8.9 U	6.1 J	3.3 J	5.2 J
Anthracene	19	2.7 J	11 U	78	8.9 U	3.4 J	2.4 J	3.6 J
2-Methylnaphthalene	9.8 J	10 U	11 U	27	8.9 U	8.7 U	10 U	10 U
LPAH (b,c)	144	6.6 J	11 U	440	8.9 U	13 J	5.7 J	10 J
Fluoranthene	75	19	11 U	180	8.9 U	8.8	7.8 J	25
Pyrene	93	14	1.8 J	140	8.9 U	7.5 J	5.6 J	11
Benz(a)anthracene	20	5.7 J	11 U	42	8.9 U	3.8 J	3.4 J	8.8 J
Chrysene	20	8.3 J	11 U	57	8.9 U	4.4 J	5.5 J	11
Benzo(b)fluoranthene	17	4.5 J	11 U	31	8.9 U	5.1 J	5.8 J	7.6 J
Benzo(k)fluoranthene	5.8 J	10 U	11 U	11	8.9 U	8.7 U	10 U	3.3 J
Total Benzofluoranthenes (c,d)	23	4.5 J	11 U	42	8.9 U	5.1 J	5.8 J	11 J
Benzo(a)pyrene	11	2.9 J	11 U	20	8.9 U	2.9 J	10 U	5 J
Indeno(123-cd)pyrene	3.9 J	10 U	11 U	7.7 J	8.9 U	8.7 U	10 U	2.2 J
Dibenz(ah)anthracene	10 U	10 U	11 U	10 U	8.9 U	8.7 U	10 U	10 U
Benzo(ghi)perylene	3.9 J	10 U	11 U	7.2 J	8.9 U	8.7 U	10 U	10 U
HPAH (c,e)	250	52	1.8 J	496	8.9 U	33	28	74
Miscellaneous SVOCs (ug/kg)								
Dibenzofuran	13	10 U	11 U	48	8.9 U	8.7 U	10 U	10 U
Phenolics (ug/kg)								
Phenol	30 U	30 U	31 U	30 U	27 U	26 U	30 U	30 U
2-Methylphenol	10 U	10 U	11 U	10 U	8.9 U	8.7 U	10 U	10 U
4-Methylphenol	10 U	10 U	11 U	10 U	8.9 U	8.7 U	10 U	10 U
24-Dimethylphenol	50 U	50 U	51 U	50 U	45 U	44 U	50 U	50 U
Pentachlorophenol	100 U	100 U	110 U	100 U	89 U	87 U	100 U	100 U

TABLE 3
CAP VERIFICATION CHEMISTRY RESULTS CORRECTED FOR FINES DRY WEIGHT
PACIFIC SOUND RESOURCES SUPERFUND SITE
MARINE SEDIMENTS OPERABLE UNIT, REMEDIAL ACTION

Sample ID: / Laboratory ID: / Date Sampled:	STATION 8/VS-38 K2409920-008 12/13/04	STATION 9/VS-40 K2409920-009 12/15/04	STATION 10/VS-41 K2409920-010 12/15/04	STATION 11/VS-42 K2409920-011 12/14/04	STATION 12/VS-44 K2409920-012 12/14/04	STATION 13/VS-43 K2409920-013 12/15/04	STATION 14/VS-34 K2409920-014 12/14/04	STATION 15/VS-30 K2409920-015 12/14/04
PCBs (ug/kg)								
Aroclor 1016	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U	10 U
Aroclor 1221	20 U	20 U	20 U	30 U	19 U	20 U	20 U	20 U
Aroclor 1232	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U	10 U
Aroclor 1242	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U	10 U
Aroclor 1248	10 U	10 U	10 U	10 U	9.3 U	10 U	10 U	10 U
Aroclor 1254	10 U	10 U	110	10 U	9.3 U	10 U	10 U	2.3 J
Aroclor 1260	10 U	10 U	10 U	10 U	9.3 U	19	10 U	10 U
Total PCBs (c)	20 U	20 U	110	30 U	19 U	19	20 U	2.3 J
Conventionals (percent)								
Total Solids (f)	90.8	96.6	96.2	83.8	98.9	95.7	89.3	91.3
Total Organic Carbon	0.05	0.04 J	0.05 U	0.06	0.02 J	0.03 J	0.08	0.06

U = Compound not detect.
J = Estimated value.
B = Estimated value. Compound detected above method detection limit but below method reporting limit.
Box indicates the sample concentration is greater than the screening criteria.

a. Washington State Sediment Management Standard Sediment Quality Standards or dry weight analog from Technical Specifications Table 01450-2.
b. The total LPAH criterion represents the sum of the following low molecular weight polycyclic aromatic compounds: Naphthlene acenaphthylene acenaphthene fluorine phenanthrene and anthracene. 2-Methylnaphthalene is not included in the LPAH definition. The LPAH criterion is not *the sum of criteria values for the individual LPAH compounds listed.*
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect the total concentration is reported as non-detect using the highest detection limit.
d. The total benzofluoranthenes criterion is the sum of the concentrations of the b j *and k isomers of benzofluoranthene.*
e. The total HPAH criterion represents the sum of the following high molecular weight polycyclic aromatic compounds: fluoranthene pyrene benz[a]anthracene chrysene total benzofluoranthenes benzo[a]pyrene indeno[123-cd]pyrene dibenz[ah]anthracene and benzo[ghi]perylene. The total HPAH criterion is not the sum of criteria values for the individual HPAH compounds listed.
f. Total solids for fine fraction (less than 1 inch) of cap verification sample.

MEMORANDUM

BBL®
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engineers, scientists, economists

To: George Gardner, American Civil Constructors (ACC)

Date: December 10, 2004

From: Dr. Paul Krause, Blasland, Bouck & Lee (BBL)

cc:

Re: Cap Verification Sampling in Remediation Area 4
Pacific Sound Resources Superfund Site.

Beginning December 13, 2004, BBL will collect sediment samples (cap verification samples) from the Pacific Sound Resources Superfund site. Approximately 17 samples will be collected (15 samples and two field duplicate samples). The sediment samples will consist of cap material that was placed at the site. The cap material contains primarily gravel (3.25 inch and smaller grain size) with some fine grained material. Because we expect that the samples will be highly heterogeneous with both large rocks and fine grained samples it is important to be able to keep the concentrations of contaminants found in the fine grained portion in perspective. Therefore, we have set up the following sampling and analytical process for these samples.

Per instructions from ACC and US Army Corps of Engineers (USACE), BBL will collect surface grab samples rather than cores in Remediation Area 4 at the Pacific Sound Resources Superfund site. Surface grab samples will be collected with Marine Sampling Systems of Burley, Washington power grab sampler. Grab samples will be collected at 15 locations. Coordinates for the locations will be provided to BBL by ACC.

Acceptance criterion for the grab sampler is that the sampler completely closed. If a rock or debris is caught in the mouth of the sampler, the sample will be rejected. Once an acceptable sample is retrieved, overlying water will be siphoned off the sample. Given the large grain size of the material, standard laboratory glass containers will not be used for sample collection. Standard laboratory glass jars may not be large enough to contain the gravel sized material in the sample. The sediment sample will be placed in plastic bags that will be stored in 5 gallon buckets. The samples will be transported to Columbia Analytical Services (CAS) of Kelso, Washington in the 5 gallon buckets, which will be kept on ice to keep the samples at the appropriate temperature.

Some 17 samples will be collected in plastic 5-gallon buckets and delivered to CAS on approximately December 16, 2004. The large volume of sample will be collected to ensure there is adequate volume of fine grained material for analysis. These samples will contain both the fine-grained portion and rocky portion of the whole sample. The following procedure will be used for analysis of the samples.

1) Carefully remove all large rock pieces from the sample and gently rinse any fine material back into the whole sample.

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2) Dry the rock portion and provide a dry-weight mass (total solids) for the rock portion of the sample.
3) Allow the fine material sample to air dry to remove the excess standing water. Weigh the total fine material. Remove a representative aliquot of the remaining fine material sample and provide a total solid percentage for this portion of the sample. Calculate the total dry weight of fine material based on this percentage.
4) Extract a representative aliquot of the remaining sample for chemical analysis using the contract required methods and standard CAS procedures. Samples will be analyzed for metals (copper, mercury, and zinc), semivolatile organics (Sediment Management Standards list of PAHs, phenols, and dibenzofuran), PCBs, and TOC per the contract.
5) Report the results of the concentration of each analyte in terms of dry-wt of fine-grained sample (extracted sample). Also report the total dry-weight mass for the fine-grained and rock sample portions.

PRK/smd

Appendix E – Cap Verification Analytical Data Packages

(Provided in separate box)

2 pages including cover page

Cap verification CAS data package includes K2409920.

Appendix F – Surface Grab Sample Forms

20 pages including cover page

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Project Name PSR
Project No. 24520 Event Cap Verification
Sample No. Station 2 / US-32
Date Collected 12/13/04 Time 15:45

Soil/Sediment Sample Collection Form

Weather cloudy Collector(s) JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 2

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited ☐ Other:

Locations: 47°35'07.78"N, 122°22'11.19"W

Depth Ranges:

Elevation and Reference: 90.4 ft of water

SAMPLE COLLECTION DATA

Sample Collected From: ☒ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: (By Numerical Order) [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 40% med-coarse gravel/cobbles 15% coarse sand, 25% silt, 20% fine-med sand trace brown silt ligh gray fines, dark gray gravel

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semivolatiles, PCB, total Metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s) Station 98, 09:00

Photo No. Roll No.

Comments: 1st attempt small rocks holding jaws slightly apart. Small component of fines washed away. Acceptable for sample
Duplicate sample taken

☐ Continued on Back

Signature Date 12/13/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520 Event: Cap Verification
Sample No.: Station 1 / VS-31
Date Collected: 12/14/04 Time: 11:03
Weather: overcast, strong wind Collector(s): JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other
Sample Location: Station 1

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited ☐ Other:
Locations: 47° 35' 09.17" N, 122° 22' 15.54" W
Depth Ranges:

Elevation and Reference: 143 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Gr
Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other
Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other
Decon Procedure (By Numerical Order): 1 Alconox Wash 2 Tap Rinse 3 DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 40% fine-med gravel, 30% coarse gravel and cobbles, 10% coarse sand 20% fine sand and silt, trace brown silt. light to med gray limestone sand and gravel by Volume. Light sheen present, no hydrocarbon odor.

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semivols, PCB, TOC, total metal
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s):

Photo No.: Roll No.:

Comments: 1st - wood caught in jaws - reject
2nd - jaws not closed - reject
3rd - jaws completely closed, water siphoned off top, ⇒ accept for Se

☐ Continued on B

Signature: [signature] Date: 12/14/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520 Event: Cap Verification

Sample No.: Station 3 / VS-33
Date Collected: 12/14/04 Time: 12:01

Weather: Overcast, strong wind Collector(s): JRS / BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 3

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47°35' 14.82" N, 122° 22' 00.03" W

Depth Ranges:

☐ Other:

Elevation and Reference: 143 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure (By Numerical Order): [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 90% fine sand, 10% med-coarse coarse sand, trace silt. light gray limestone trace brown silt, trace ~~fine~~ grav. Some hydrocarbon sheen on standing water and in pore-space water. Strong hydrocarbon odor

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semivols, PCB, TOC, total metals
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 1st - incomplete jaw closure. Sediment lost as pulled from water. Sediment falling into water leaves a hydrocarbon sheen on the water
2nd - same as 1st
3rd - large rock caught in jaws. Very little sediment in sampler.
4th - accepted - 4 in from top of bucket to top of sed. Fully closed jaws.

☐ Continued on Back

Signature: [signature] Date: 12/14/04

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520.037 Event: Cap Verification
Sample No.: ~~Location~~ Station 4 JS / VS-35
Date Collected: 12/13/04 Time: 13:40
Weather: Overcast/sunny Collector(s): JRS / BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other
Sample Location: Station 4

Sample Composited: ☐ Horizontally ☒ Vertically ☐ Not Composited
Locations: 47°35'09.15"N, 122°22'07.34"W
Depth Ranges:
☐ Other:

Elevation and Reference: 81.1 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab
Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other
Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other
Decon Procedure (By Numerical Order): 1 Alconox Wash 2 Tap Rinse 3 DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): By volume: 30% cobbles (>3 in) 20% v. coarse gravel (2.0-3.0 in), 30% fine gravel (0.2-2 in), 20% sand/s light-medium gray, minor brown silt trace olive-brown mud ⇒ slight hydrocarbon odor and light sheen.

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semivol, PCB, total Metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s):

Photo No.: Roll No.:

Comments: 1st attempt - not fully closed, some fines draining when pulled onboard. - fines from interior of sample not affected, only fines from top surface lost - Accepted

☐ Continued on Back

Signature: [signature] Date: 12/13/04

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Soil/Sediment Sample Collection Form

Project Name PSR
Project No. 24520 Event Cap Verification

Sample No. Station 5 / VS-36
Date Collected 12/14/04 Time 13:24

Weather overcast windy Collector(s) JRS / BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other
Sample Location: station 5

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited
Locations: 47° 35' 12.70" N, 122° 22' 07.90" W
Depth Ranges:
☐ Other:

Elevation and Reference: 136 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab
Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other
Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other
Decon Procedure (By Numerical Order): [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 70% fine sand, 10% fine-med gravel 10% coarse sand 10% coarse gravel. light gray limestone sand and gravel, trace brown silt. slight sheen on decanted water and in pore water. No hydrocarbon odor

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	semivolatiles, PCB, TOC, total metals
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s)

Photo No. Roll No.

Comments: 1st - incomplete closure of jaws - rejected
2nd - accepted - complete jaw closure - siphoned water off
Sediment collected is 6 in from top of sampler bucket

☐ Continued on Back

Signature [signature] Date 12/14/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520 Event: Cap Verification
Sample No.: Station 6 / VS-37
Date Collected: 12/13/04 Time: 11:44
Weather: Overcast/rainy Collector(s): JRS + BRN

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other
Sample Location: location 6

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited
Locations: N 47 35' 08.58 W 122° 22' 04.40
Depth Ranges:
☐ Other:

Elevation and Reference: WATER DEPTH 45.6 FT

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other GRAB SAMPLE
Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other
Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other
Decon Procedure (By Numerical Order): 1 Alconox Wash 2 Tap Rinse 3 DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): By volume: 20% gravel (>2 in), 40% fine gravel (0.2-2.0 in) 30% fine-med sand, 10% silt
light gray sand + silt, brown silt/mud, dk gray limestone gravel

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semi Vols, PCB, Total Metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s): Station 99, 08:00

Photo No. Roll No.

Comments: ROCKS GETTING STUCK IN JAWS, CLEAR TRAIL OF FINES COMING OUT OF SAMPLER IN THE WATER.
3rd attempt successfully closed jaws
Duplicate sample collected

☐ Continued on Back

Signature: [signature] Date: 12/13/04

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Soil/Sediment Sample Collection Form

Project Name FSR

Project No. 24520 Event Cap Verification

Sample No. Station 7 / VS-39
Date Collected 12/14/04 Time 14:06

Weather overcast Strong wind Collector(s) JRS / BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 7

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47°35'13.51"N, 122° 22' 04.02" W

Depth Ranges:

☐ Other:

Elevation and Reference: 139 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: (By Numerical Order) [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 30% coarse sand and fine gravel 30% medium to coarse gravel, 10% very coarse gravel/cobbles. 30% fine sand and silt. Light to medium gray limestone sand and gravel, trace brown silt and wood fragments

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5gal	1	☐ Glass ☒ Plastic ☐ Other	Semivol, PCB, TOC, total metals
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 1st attempt - accepted - jaws completely closed. Sed. most 6in from top of sample bucket.

☐ *Continued on Back*

Signature [signature] Date 12/14/04

Soil/SedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name PSR
Project No. 24520 Event Cap Verification

Sample No. Station 8/ VS-34
Date Collected 12/13/04 Time 14:10

Weather overcast/sunny Collector(s) JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 8

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47°35' 10.54"N, 122°22' 03.43"W

Depth Ranges:

☐ Other:

Elevation and Reference: 79.3 ft. of water

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: (By Numerical Order) 1 Alconox Wash 2 Tap Rinse 3 DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 50% coarse sand, 20% v fine sand silt, 20% fine gravel, 10% coarse gravel/ cobbles By volume light-medium gray limestone; trace brown silt

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 Gal	1	☐ Glass ☒ Plastic ☐ Other	Semivol, PCB total Metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 1st attempt - completely closed jaws, standing water at top of samples sciphoned off using teflon tube + turkey baster. 1st attempt accepted

☐ Continued on Back

Signature [signature] Date 12/13/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 34570
Event: Cap Verification

Sample No.: ~~Station 9~~ PS-VS-40
Date Collected: 12/13/04
Time: 12:30

Weather: overcast
Collector(s): JRS / BEM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other ______

Sample Location: Station 9

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited
Locations: 47 35 10.19 N, 122 22 00.88 W
Depth Ranges: ______
☐ Other: ______

Elevation and Reference: 37.8 ft of water

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☐ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other ______

Made of: ☐ Stainless Steel ☐ Steel ☐ Plastic ☐ Other ______

Decon Procedure (By Numerical Order): ☐ Alconox Wash ☐ Tap Rinse ☐ DI Water Rinse ☐ Other ______ ☐ Other ______ ☐ Other ______

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 30% coarse gravel (>2 in) 40% fine gravel (0.2-2 in) 20% v. coarse sand, & 10% fine sand

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
	NA	☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s). ______

Photo No. ______ Roll No. ______

Comments: 1st attempt – jaws stuck open by large gravel → photo taken
2nd attempt → same as 1st → photo taken
↳ fines washing out of jaws as raised from the water
3rd attempt – mostly closed, small gravel holding jaws ~1/4 in apart at sides.
~~Most~~ Little fine material was likely to escape → overall coarseness of sample likely representative of grainsize at bottom → photos taken
NO sample taken + sample collected 12/15/04

Continued on Back

Signature ______ Date 12/13/04

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520
Event: Cap Verification

Sample No.: Station 89/15 / VS-3840-15
Date Collected: 12/15/05
Time: 08:56

Weather: Sunny, light wind
Collector(s): JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 89/15

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47° 35' 10.25"N, 122°, 22' 01.14"W

Depth Ranges:

☐ Other:

Elevation and Reference: 52.4 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Ponar 6

Sample Collected With: ☐ Bowl ☐ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure (By Numerical Order): [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 60% cobbles and coarse gravel, 35% fine-med gravel, 5% fine to coarse sand, dark gray limestone gravel ~~etc~~

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 4th attempt - incomplete closure of jaws - reject
5th attempt - jaws completely closed, water drains quickly out of sample due to high permeability of material
Sample is 6 in from top of bucket

1st - 3rd attempts on 12/13/04

☐ Continued on

Signature Date 12/15/04

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520
Event: Cap Verificat

Sample No.: ~~Station 10~~ JS / JS-41
Date Collected: 12/13/04
Time: 14:55

Weather: cloudy
Collector(s): JRS / BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other ______

Sample Location: Station 10

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47° 35' ~~11.54~~ 11.74" N, 122° 22' 07.34" W

Depth Ranges: JS

☐ Other: ______

Elevation and Reference: 85.6 ft of water

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Gra

Sample Collected With: ☐ Bowl ☐ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other ______

Made of: ☐ Stainless Steel ☐ Steel ☐ Plastic ☐ Other ______

Decon Procedure (By Numerical Order): [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ______ ☐ Other ______ ☐ Other ______

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 30% v. coarse gravel/cobbles 50% fine-medium gravel, 10% v coarse sand, 10% fine-med sand.
dark gray

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
–	NA	☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s). ______

Photo No. ______ Roll No. ______

Comments: 1st attempt – large rock holding jaws apart
2nd attempt – insignificant fines despite complete jaw closure
No fines were observed washing out of sample
photos documenting sample texture, no sample collected due to lack of fines at location.
NO SAMPLE COLLECTED (sample collected 12/15/04)

☐ Continued on Back

Signature ______ Date 12/23/04

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Soil/Sediment Sample Collection Form

Project Name PSR
Project No. 24520
Event Cap Verification

Sample No. Station 10 / VS-41
Date Collected 12/15/04 Time 09:19

Weather Sunny, light wind Collector(s) JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 10

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47° 35' 11.95" N, 122° 22' 59.91" W

Depth Ranges:

☐ Other:

Elevation and Reference:

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other
(By Numerical Order) ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 65% fine-medium gravel, 35% coarse gravel and cobbles, trace fine-coarse sand, dark gray limestone sand and gravel

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semivol, PCB, total metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 3rd attempt - accept - complete closure of jaws
standing water at top drains quickly through
sample material

recovery = 7 in from top of bucket

1st + 2nd attempts made 12/13/04

☐ Continued on Back

Signature Date

SoilSedSmplCollForm (M) 10/97

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Project Name PSR

Project No. 24520 Event Cap Verification

Sample No. Station 11 / VS-42

Date Collected 12/14/04 Time 15:00

Soil/Sediment Sample Collection Form

Weather overcast, strong wind Collector(s) JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☐ Sediment ☐ Other

Sample Location: Station 11

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47° 35' 14.82" N, 122° 22' 00.03" W

Depth Ranges:

☐ Other:

Elevation and Reference: 134 ft of water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: ☐ Alconox Wash ☐2 Tap Rinse ☐3 DI Water Rinse ☐ Other ☐ Other
(By Numerical Order) ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 90% fine sand 10% coarse sand, fine-coarse gravel, trace brown silt, light gray limestone sand and gravel trace sheen in pore-water

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5gal	1	☐ Glass ☒ Plastic ☐ Other	semivol, PCB, TOC, total Metals
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 1st - rejected - large opening in jaws (incomplete closure)
2nd - same as 1st
3rd - accepted - jaws completely closed water siphoned from top. Sediment is 6.5 in from top of sample bucket.

☐ *Continued on Back*

Signature [signature] Date 12/14/04

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520 Event: Cap Verification

Sample No.: Station 12 / VS-44
Date Collected: 12/14/04 Time: 15:40

Weather: overcast, strong wind Collector(s): JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other ______
Sample Location: Station 12

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited
Locations: 47°35' 16.35" N, 122 21 56.61" W
Depth Ranges: ______
☐ Other: ______

Elevation and Reference: 146 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab
Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other ______
Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other ______
Decon Procedure: (By Numerical Order) [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ______ ☐ Other ______ ☐ Other ______

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.):
~~500%~~ 80% coarse gravel and cobbles, ~~trace~~ 5: 20% fine gravel and coarse sand, trace wood fragments

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semivolatiles, PCB, total Metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s). ______

Photo No. ______ Roll No. ______

Comments: 1st - rejected - jaws incompletely closed
2nd - accepted - small gap in jaws - 8 in to top of sample bucket (30% recovery)
3rd - same as 2nd
4th - jaws fully closed, ~~set~~ water remaining in sample bucket ~~pa~~ drained through sample as we examined it
sample description identical to 2nd attempt.

☐ Continued on Back

Signature [signature] Date 12/14/04

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Project Name PSR

Project No. 24520 Event Cap Verification

Sample No. ~~Station 13~~ / S. / VS-43

Date Collected 12/13/04 Time 15:19

Soil/Sediment Sample Collection Form

Weather Cloudy Collector(s) JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 13

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: ~~12~~ 13 47°35'13.42"N, 122°21'55.90"W

Depth Ranges:

☐ Other:

Elevation and Reference: 86.7 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: (By Numerical Order) [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): >90% fine - coarse gravel and cobbles, ~~sand~~ <10% fine - coarse sand dark gray.

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
NA		☐ Glass ☐ Plastic ☐ Other	~~SemiVols, PCB, Total Metal, TOC~~ J.S.
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s)

Photo No. Roll No.

Comments: 1st attempt - small rocks caught in jaw. some loss of fines. less than 1/3 sample capacity collected w/ >90% med-coarse gravel and <10% fine sand.

2nd attempt good closure w/ only small opening in jaws
↳ Acceptable closure. very little loss of fines observed.
3rd attempt - large rocks caught holding jaws open

No sample taken (sample collected 12/15/04)

☐ Continued on Back

Signature [signature] Date 12/13/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name PSR
Project No. 24570 Event Cap Verification
Sample No. Station 13 / VS-43
Date Collected 12/15/04 Time 09:45
Weather Sunny, light wind Collector(s) JRS/BPM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 13

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47° 35' 13.25" N, 122° 21' 55.80" W
Depth Ranges:
☐ Other:

Elevation and Reference:

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: (By Numerical Order) 1 Alconox Wash 2 Tap Rinse 3 DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 70% fine gravel 15% coarse gravel and cobble, ~~20%~~ 5% coarse sand, 10% fine sand and brown silt 15.
light to medium gray limestone sand and gravel

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5gal	1	☐ Glass ☒ Plastic ☐ Other	Semivol, PCB, total metals, TOC
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 4th attempt - accept jaws completely closed
standing water at top of sample drains quickly through sample
1st - 3rd attempts on 12/13/04

☐ Continued on Back

Signature [signature] Date 12/15/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name PSR
Project No. 24570 Event Cap Verificat
Sample No. ~~??~~ Station 14/ VS-34
Date Collected 12/13/04 Time 10:55
Weather Cloudy Collector(s) JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other
Sample Location: ~~??~~ ~~loca~~ Station 14

Sample Composited: ☐ Horizontally Locations:
☐ Vertically Depth Ranges:
☐ Not Composited ☐ Other:

Elevation and Reference: 46 ft

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Gra
Sample Collected With: ☐ Bowl ☐ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other
Made of: ☐ Stainless Steel ☐ Steel ☐ Plastic ☐ Other
Decon Procedure: ☐ Alconox Wash ☐ Tap Rinse ☐ DI Water Rinse ☐ Other ☐ Other
(By Numerical Order) ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): Very coarse gravel, insignificant fine material. Dark gray limestone gravel

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
	N/A	☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 3 attempts made 10:45 - 11:25 → photos documenting grab attempts and water streaming from jaws as pulled up. DECONED SAMPLER ~~BETWEEN STA~~ BEFORE MOVING TO NEXT STATION BRM

NO SAMPLE COLLECTED (sample collected 12/14/04)
400lb weights added after 1st attempt to aid bucket in sampling. ☐ Continued on Back

Signature [signature] Date 12/13/04

SoilSedSmplCollForm (M) 10/97

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Soil/Sediment Sample Collection Form

Project Name: PSR
Project No.: 24520
Event: Cap verification

Sample No.: Station 15 / VS-30
Date Collected: 12/14/04
Time: 10:03

Weather: overcast, strong wind
Collector(s): JRS/BRM

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☒ Sediment ☐ Other

Sample Location: Station 15

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47°38' 06.40" N, 122° 22' 15.18" W

Depth Ranges:

☐ Other:

Elevation and Reference: 97.3 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power Grab

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: 1 Alconox Wash 2 Tap Rinse 3 DI Water Rinse ☐ Other ☐ Other ☐ Other
(By Numerical Order)

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 60% fine-medium gravel, 25% fine medium sand and ~~silt~~, 10% coarse gravel/cobbles, 5% coarse sand, trace silt (brown silt) light - medium gray limestone gravel and sand w/ trace organic debris (wood particles)

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5 gal	1	☐ Glass ☒ Plastic ☐ Other	Semi Vols, PCB, TOC, total metals
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 1st - 4th attempt → jaws held ~1/2 - 1.0 in apart by gravel - some fines remain in grab, but no water caught remaining in sampler → all water drained as pulled up. These attempts are rejected for sampling
Jaws adjusted by Bob Dickerson after 4th attempt
Attempt #5, successful w/ standing water at top removed w/ [illegible]
jaws completely closed

☐ Continued on Back

Signature Date

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Project Name PSR
Project No. 24520 Event Cap Verific

Sample No. Station4 / VS-34
Date Collected 12/14/04 Time 16:32

Soil/Sediment Sample Collection Form

Weather dark, strong wind Collector(s) JRS/BR

SAMPLE LOCATION/COMPOSITE DATA

Sample Type: ☐ Soil ☐ Sediment ☐ Other

Sample Location: station4 (2nd try)

Sample Composited: ☐ Horizontally ☐ Vertically ☐ Not Composited

Locations: 47° 35' 06.83", 122° 22' 08.85" W

Depth Ranges:

☐ Other:

Elevation and Reference: 54.3 ft water depth

SAMPLE COLLECTION DATA

Sample Collected From: ☐ Hand-Dug Hole ☐ Test Pit ☐ Boring ☐ Catch Basin/Manhole ☒ Other Power

Sample Collected With: ☐ Bowl ☒ Spoon ☐ Split Barrel ☐ Shovel ☐ Auger ☐ Other

Made of: ☒ Stainless Steel ☐ Steel ☐ Plastic ☐ Other

Decon Procedure: (By Numerical Order) [1] Alconox Wash [2] Tap Rinse [3] DI Water Rinse ☐ Other ☐ Other ☐ Other

SAMPLE DESCRIPTION (color, grain size, density, moisture, etc.): 20% cobbles, 30% coarse gravel, 45% fine-med gravel, 5% fine sand
light to medium gray limestone sand and gravel.

SIZE	QUANTITY	TYPE	LABORATORY ANALYSIS
5gal	1	☐ Glass ☒ Plastic ☐ Other	semivol, PCB, total metals, T
		☐ Glass ☐ Plastic ☐ Other	
		☐ Glass ☐ Plastic ☐ Other	

Co-Located/Duplicate Sample No(s).

Photo No. Roll No.

Comments: 4th attempt - rocks caught in jaws. incomplete closure - r
5th attempt - accept - incomplete closure, some fines observ
washing out as sample was brought out of water.
1st and 2nd attempts on 12/13/04

☐ Continued on B

Signature Date 12/14/04

Appendix G – Project Photographs

CD Only

Appendix E

Data Report: Construction and Post-Construction Monitoring of RA5 Marine Sediment Unit, PSR Superfund Site

DATA REPORT

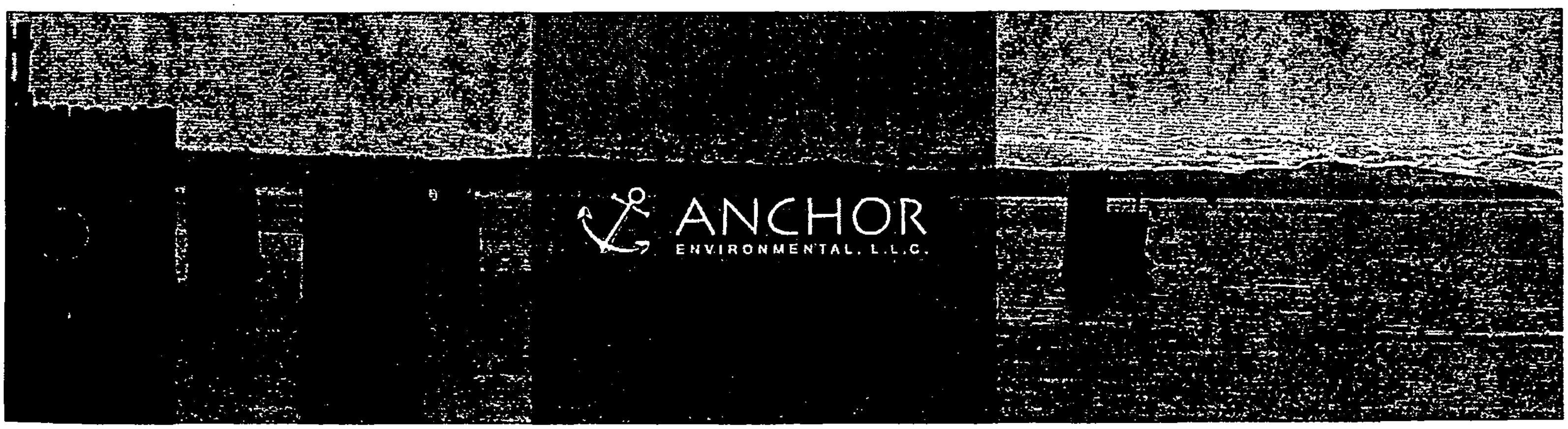
CONSTRUCTION MONITORING OF RA5 MARINE SEDIMENT UNIT

PACIFIC SOUND RESOURCES SUPERFUND SITE

Prepared for
Seattle District
U.S. Army Corps of Engineers
4735 E. Marginal Way South
Seattle, Washington 98124

Prepared by
Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

May 2005



DATA REPORT

CONSTRUCTION MONITORING OF RA5 MARINE SEDIMENT UNIT

PACIFIC SOUND RESOURCES SUPERFUND SITE

Prepared for
Seattle District
U.S. Army Corps of Engineers
4735 E. Marginal Way South
Seattle, Washington 98124

Prepared by
Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

May 2005

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1 INTRODUCTION

Under an Interagency Agreement between the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency, Region 10 (EPA), cap construction activities have been performed for Remedial Area 5 (RA5) of the Pacific Sound Resources Superfund Site (PSR). RA5 consists of sub-areas RA5a and RA5b, which are approximately 20 and 2 acres in size, respectively. These areas extend to approximately -140 to -240 feet mean lower low water (MLLW) and include slopes with approximately 4 percent to 15 percent grades. Figure 1 depicts the general location of PSR RA5.

Environmental monitoring was performed to evaluate impacts on water quality during cap material placement. After the completion of capping activities in February 2005, additional studies were conducted to assess surface sediment quality of the cap, to determine the post-construction bathymetry, and to assess the thickness and extent of capping material.

2 OVERVIEW OF MONITORING ACTIVITIES

Monitoring activities consisted of the following:

- Collecting water quality measurements to evaluate impacts on site water quality during cap construction
- Collecting and analyzing sediment grab samples to characterize surface sediment quality of the cap
- Collecting and logging through-cap cores to investigate the thickness and distribution of cap material and its physical nature
- Conducting a sub-bottom profile survey as another means of examining the thickness and distribution of cap material
- Conducting a multi-beam bathymetric survey to determine post-construction bathymetry and, through comparison with pre-construction bathymetric data, provide a third means of examining the thickness and distribution of cap material

An approved Quality Assurance Project Plan (QAPP, Anchor 2004) guided all aspects of conducting the water quality monitoring program. A Quality Assurance Project Plan Addendum (QAPPA, Anchor 2005) guided the collection, handling, and analysis of samples and cores and the performance of the sub-bottom and multi-beam bathymetric surveys.

3 CAP CONSTRUCTION MONITORING—APPROACH AND RESULTS

Individual subsections of this report summarize the approach and results for each type of monitoring activity. For brevity and where appropriate, respective subsections may refer to an appendix for complete details, rather than duplicating the information in the body of the report. Appendices consist of assembled support information for sediment grab samples and through-cap cores, and reports submitted by individual subcontractors performing water quality monitoring and acoustic surveys.

3.1 Water Quality Monitoring

Evans-Hamilton, Inc. (EHI) conducted a comprehensive water quality monitoring program during cap construction operations at RA5. The purpose of the monitoring program was to provide measurements and documentation confirming that scow cap material placement events had only temporary impacts on water quality. EHI's project report, included as Appendix A, may be consulted for complete details of the water quality monitoring program.

Monitoring consisted of real time water quality measurements of dissolved oxygen (DO) concentration, turbidity, pH, temperature, and salinity prior to and following a cap material placement event. Intensive water quality monitoring began on January 5, 2005 and continued daily through January 7, 2005. After concurrence from the USACE, a limited monitoring schedule, consisting of collecting measurements one day per week, began on January 12, and was repeated on January 21 and 27, February 2 and 8, 2005.

3.1.1 Field Monitoring Procedures

Water quality monitoring was conducted from a small boat chartered by EHI from Mullins Guide Service, Inc. or Global Diving, Inc. for this project. For safety considerations and to meet requirements for making qualitative observations, sampling was conducted during daylight hours only.

Prior to a monitoring event, EHI coordinated with the dredge operator to determine tug and scow schedules that would allow sufficient time for the field crew to mobilize the boat and gear to the site and acquire background water quality and current data before the scow's arrival at the target location. Once on site, the field crew contacted the tug operator to determine the final estimated time to site and placement, as well as the target coordinates for opening the scow. Prior to the scow's arrival, current measurements were made to determine the general direction and speed of the current, and a conductivity-temperature-depth (CTD) cast was made near the estimated target location to ascertain background water quality conditions before the cap material placement event.

After a discharge event, the scow position was recorded, and a water sampling station [referred to as the Early Warning (EW) site] was plotted at 300 feet directly down current from the target location. Two additional water sampling stations were plotted 20° left and 20° right of the current direction and 600 feet downstream of the target location. The names of the locations were determined by the order in which the sites were occupied. For example, if the monitoring station 20° to the right was occupied first, then that site was designated MS1. If a water quality parameter measured during a CTD cast failed to meet the evaluation criterion, the boat re-occupied that particular station again at specific time intervals or until conditions warranted departing the site. These conditions usually were that turbidity values fell to background levels or USACE personnel felt sufficient data had been collected. Figure 2 depicts the navigation screen and shows an example of the typical distribution of monitoring locations around the scow discharge position. Figures A-1 through A-8 in Attachment A-1 of Appendix A show the cap material placement and monitoring locations for all monitoring events.

Prior to each deployment, every CTD cast was given a unique file name identifying the date, time, and station position relative to the dredge activity. For example, "CTD_010505_600feet_MS1_1045" was taken on January 5, 2005, 600 feet downcurrent of the target coordinates, at Monitoring Station 1 (MS1), at 1045 hours. If another cast was required on the same station, the time stamp would differentiate it from the other casts made at that station. Because only one background and one early warning CTD cast were required, they are respectively identified as "Background" or "300feet_Early Warning" after the date stamp.

The real-time, or in situ, water quality sampling measurements were made in accordance with the QAPP at 1 meter below the water surface, mid-water depth, and between 1 and 5 meters above the bottom. Direct observations of the real-time numerical display were recorded on the field data sheets for the discrete depths; however, DO concentration, turbidity, temperature, and salinity data were obtained for the entire water column and extracted and post-processed to develop a comparative profile to determine if measurements exceeded water quality standard at other depths within the water column.

3.1.2 Monitoring Equipment

A Wide Area Augmentation System (WAAS)-enabled handheld Global Positioning System (GPS) linked to a notebook computer provided navigation capability. The system provided the vessel operator a real time display of the vessel position, heading, and plotted targets (sampling stations) integrated onto an electronic nautical chart of the site.

A Hydrolab® Model H20 Water Quality Multi-probe was used to obtain the in situ water quality values for DO, turbidity, salinity, pH, temperature, and depth for each cast. The real time water quality values were displayed and refreshed once every second on the computer screen where direct observations for each depth of the profile could be made.

The CTD was calibrated by EHI personnel before the start of each sampling day or when abnormal observations of the data required the parameter to be checked or corrected against known standards. All calibrations were performed according to the manufacturer's procedures using appropriate laboratory calibration standards and methods.

An RD Instruments 600 kHz Rio-Grande acoustic Doppler current profiler (ADCP) with bottom track was used to determine the current speed and direction at the target location before each monitoring event. Due to the weak and variable currents at the site, velocity was referenced to the bottom track (vessel and current speed relative to the bottom) for better accuracy. General observations of the orientation of the moored barges in the anchorage area near the target location during monitoring also provided some qualitative support for determinations of the current direction.

3.1.3 Results

Real time field observations of water quality parameters recorded at the time of sampling on the daily field logs were made by the CTD technician observing the numerical data after the values stabilized at the required depth. This approach provided the best approximate mean value for the changing parameter readings. The readings recorded by the CTD technician on the field log sheets are the values reported from the field to USACE personnel following the monitoring event. Field data logs have been included in Attachment A-2 of Appendix A.

Post-processed CTD data for each CTD cast have been extracted from the electronic record, summarized, and presented in the Water Quality Monitoring (WQM) report in Appendix A report as Tables A-1 through A-8. The values represent the mathematical mean of several readings for each parameter recorded at the respective monitoring depths.

Attachment A-3 of Appendix A contains plots of water quality parameter versus depth for all parameters and all CTD casts. Both downcasts and upcasts are included in the plots, illustrating reproducibility and consistent turbidity readings throughout the water column. In some casts, DO concentrations on the downcast appeared slightly higher than on the upcast. The DO concentration on the downcast was exaggerated just below the surface because of the lag time in temperature equilibration from the surface. In these cases, the lower value of the upcast is more accurate.

Turbidity was the only parameter to exceed water quality standards. Background turbidity was usually below 10 nephelometric turbidity units (NTU). Exceedances for turbidity were observed and reported on all monitoring days except January 7 and January 12. Except for the exceedances measured at mid-depth on January 27, all exceedances were observed at the near-bottom sampling depth.

Except for observations made on January 21, successive turbidity values collected during resampling of the stations that initially exceeded the turbidity criterion usually decreased, thereby indicating that the effects on water quality were temporary for this operation. Visual surface observations made after the scow cap material placement event occasionally indicated a small number of floating logs and localized surface turbidity that dissipated quickly.

3.1.4 Deviations from the QAPP

Due to coordination difficulties and operational requirements of the tug and scow, it was often hazardous to attempt to collect CTD data at a background station 600 feet upcurrent of the target location after the cap material placement event. Instead, background CTD data was collected at the anticipated target location before the scow occupied the site and placed the cap material. The field crew obtained target coordinates and estimated arrival time from the tug operator via VHF radio contact.

On January 5, a conflict with the chartered boat schedule arose because of the late arrival of the barge. The situation did not allow sufficient time for retesting of stations MS1 and MS2, which showed slightly elevated turbidity levels. Two additional stations located approximately 300 feet from the target location along the projected 600-foot sampling station radials were collected before the 600-foot stations were collected. These stations confirmed the local effect of the cap material and the gradual dissipation of the turbidity over the 600-foott distance.

On January 6, the field crew could not conduct further monitoring efforts beyond the second resampling due to sunset. A turbidity exceedance was recorded during the first round of sampling at stations MS1 and MS2; however, upon resampling, both stations showed significant drops in turbidity levels, although the reduced levels were still above criteria.

On January 7, the field crew collected CTD data at the two projected 600-foot sampling stations, however turbidity was lower than measured background levels. Based on currents measured the previous two days, the field crew collected CTD data at two additional 600-foot stations along different radials from the target location. Turbidity levels were elevated at these two locations. The field crew observed no surface plumes or debris immediately after the cap material placement event, and turbidity levels had returned to background levels approximately 40 minutes after the event.

On January 21, CTD data were collected at two additional stations positioned 1000 feet from the target location along the same radials as the 600-foot sampling stations. These were collected after the one-hour resampling of the stations at 600 feet showed the turbidity levels to be slowly decreasing but still exceeding the turbidity criterion. Turbidity levels were lower but still in exceedance at both 1000-foot stations.

3.2 Surface Sediment Grab Samples

Sediment grab samples were collected from the *S/V Peter R* of Marine Sampling Systems on March 8 and 9, 2005. The following sections describe the steps taken to collect surface samples for chemical analysis, the results of the sampling and analysis, and any deviations from the QAPPA.

3.2.1 Sample Collection, Processing, and Handling

Grab samples were collected for surface chemistry analysis following Puget Sound Estuary Program (PSEP 1997) protocols and as specified in the QAPPA. Horizontal positioning was determined using an onboard differential global positioning system (DGPS) based on coordinates chosen in advance of field work. Actual station positions were converted to latitude and longitude (North American Datum [NAD] 83) to the nearest 0.01 second. The accuracy of measured and recorded horizontal coordinates was within 3 meters. Table 2 presents surface sample coordinates, and Figure 3 shows the actual sampling locations.

Vertical elevation of each grab station was measured using an onboard fathometer and converted to MLLW by adding the tidal elevation. Tidal elevations were based on data from the tide prediction program "Tides and Currents for Windows™" by Nobeltec Corporation. Table 2 also includes mudline elevations for the surface sample locations.

Once on station, samples were collected from the vessel using a van Veen-type grab sampler. Location and water depths were recorded by field staff while the sampler was at depth. The sampler was then retrieved on board the vessel and sample quality was evaluated against PSEP criteria. If a sample met criteria, the 0 to 10 cm interval was collected. Sampling sediment in contact with the walls of the sampler was avoided.

Collected sediment was homogenized in a decontaminated stainless steel mixing container and placed in pre-labeled, certified pre-cleaned glass jars. All samples were kept at 4°±2°C until delivery to the lab, Columbia Analytical Services (CAS), for analysis. Details of the collection activities were recorded in the field log book and entered on surface sediment field sample collection forms (Appendix B).

Sample processing instruments, working surfaces, and any other items that were used for sampling or sample processing were decontaminated prior to use and between sampling locations in accordance with the PSEP protocols. To address the potential need to evaluate the effectiveness of decontamination procedures, a filter wipe was collected from homogenization equipment at the end of surface sampling activities. A filter blank was also collected from the same box of filters away from the project site.

All sediment remaining after sample processing was washed back into the water at the station. Any sediment spilled on the deck of the sampling vessel was washed into the surface waters in the vicinity of the sampling station.

All disposable sampling materials and personnel protective equipment used in sample processing, such as foil, gloves, and paper towels, were placed in heavy duty garbage bags or other appropriate containers.

3.2.2 Results

The results of surface chemistry are presented in the following sections. Tables 3 and 4 provide the analytical results for the sediment samples in the appropriate format for comparison with Sediment Management Standards (SMS) or Puget Sound Apparent Effects Threshold (AET) evaluation criteria, respectively. Appendix B contains field notes, surface sediment collection forms, and photographs from the sampling event. Appendix C contains chemistry data QA/QC review, analytical laboratory case narratives, and chain-of-custody forms. Appendix D contains the laboratory data sheets.

3.2.2.1 Organic Compounds

Total organic carbon (TOC) content ranged from 0.30 percent to 2.57 percent. TOC contents in samples RA5-16-GS and RA5-19A-GS were 0.49 percent and 0.30 percent, respectively. In accordance with the USACE Statement of Work (USACE 2005) AET dry weight criteria were used for evaluation of organic compounds in these two samples. All other samples fell within the standard range of 0.50 percent to 4.00 percent TOC for comparison to SMS criteria.

Concentrations of polychlorinated biphenyls (PCBs) were either very low or not detected in all samples except for one, RA5-05-GS, which exceeded SMS Sediment Quality Standards (SQS). Phenols were undetected in most samples, and the detected concentrations were low relative to screening criteria. Polyaromatic hydrocarbons (PAHs) were detected at low concentrations relative to screening criteria.

Comparison with SMS Organic Carbon Normalized Criteria

Table 3 presents the SMS organic carbon (OC) normalized SQS and Cleanup Screening Level (CSL) criteria and the OC normalized chemical analytical results for all samples within the range of 0.50 percent to 4.00 percetn.

None of the detected analyte concentrations of semi-volatile organic compounds (SVOCs) exceeded their respective SMS OC normalized criteria. For non-detected analyte concentrations, the method reporting limits (MRLs) for 2,4-dimethylphenol exceeded SQS criteria for some samples; therefore, the method detection limits (MDLs) for 2,4-dimethylphenol were entered for all samples in the table for comparison to the evaluation criterion. None of the MDLs exceeded the criterion.

As mentioned previously, sample RA5-05-GS had a total PCB concentration of 18.91 mg/kg-OC, which is higher than the SMS SQS value of 12 mg/kg-OC. This is the only station that had PCB concentrations elevated above the SQS criterion. Concentrations of all other analytes at this station were less than SQS criteria.

Comparison with Puget Sound AET Dry Weight Criteria

Table 4 presents the lowest apparent effects threshold (LAET) and second lowest apparent effects threshold (2LAET) sediment quality criteria and the dry weight (DW) chemical analytical results for samples RA5-16-GS and RA5-19A-GS. Percent TOC in these samples, 0.49 percent and 0.30 percent respectively, was outside the range of 0.50 percent to 4.00 percent, so it is appropriate to compare with AET criteria. None of the detected analyte concentrations in either of the sediment samples exceeded their respective AET criteria.

3.2.2.2 *Inorganic Compounds*

Evaluation criteria for metals are not presented on an OC normalized basis, and the same values are used for comparison with the SMS and AET criteria. In general, metals were detected in all samples; however, the concentrations were not atypically elevated, and there were no exceedances of evaluation criteria. Metals results are presented in Tables 3 and 4.

3.2.3 Deviations from the QAPP and QAPPA

After concurrence from the USACE Project Engineer, four stations were moved after encountering refusal at the initial station locations. Station RA5-14 was moved towards the west edge of area RA5b and renamed RA5-14A. All grabs at station RA5-14 consisted of large gravel and cobble. It was confirmed that a barge of gravel had been placed in this location (Bachman personal communication, March 9, 2005). Station RA5-17 was moved closer to the cap because no cap was present in the first grab at RA5-17, which contained organic leafy debris with a silt layer on top. The relocated station was renamed RA5-17A to distinguish it from the original target location. Station RA5-19 was moved closer to the cap when grabs at the target location came up consistently with wood debris. The new station was named RA5-19A. Station RA5-20 was moved closer to the cap after grabs continued to come up with debris in the jaws preventing sediment collection. The new station was named RA5-20A.

On Day 1, some samples (RA5-03, RA5-06, and RA5-11) were collected from grabs with less than 10 cm penetration. Exact sampling depths are included on Tables 3 and 4. The sandy material was difficult to penetrate with the van Veen sampler that was initially used. A heavier van Veen was rented and used on Day 2 to guarantee adequate penetration through the sand cap in deep waters.

Samples were held in cold storage at Analytical Resources, Inc. (ARI) for one week pending discussions between CAS and the USACE to finalize agreement on analytical quality assurance/quality control (QA/QC) requirements and responses regarding sample analysis. Custody was signed over to ARI while samples were held at their lab prior to shipment to CAS.

Tidal elevations were calculated after sampling, and the adjustment to yield mudline elevations relative to MLLW was made after field sampling.

3.3 Through-Cap Cores

Coring activities occurred on March 23, 24, and 25, 2005, onboard the *R/V Nancy Anne* of Marine Sampling Systems. Core logging took place offsite at ARI. The following sections describe the steps taken to collect through-cap cores for sediment characterization, the results of the characterization, and any deviations from the QAPPA.

3.3.1 Core Collection, Measurement, and Logging

To the extent possible, core locations were co-located with sediment grab sample locations occupied on March 8 and 9, 2005. Horizontal positioning procedures were the same as those followed in the grab sampling (Section 3.2.1). Figure 4 shows the actual locations where through-cap cores were collected, and Table 5 lists the coordinates. Mudline elevations were converted to MLLW by adding the tidal elevation to the water depth that was measured using an onboard fathometer. Table 5 also includes mudline elevations.

Subsurface sediment cores were collected at each location using a vibracorer. The vibracorer was allowed to penetrate to refusal or to a depth of 7 feet, which was the limit imposed by the length of the core barrels. When that depth was reached, the vibracorer was turned off and returned to the surface for removal and temporary storage of the core barrel. Immediately upon recovery, cores were inspected for native material at the bottom of the core. Cores were then cut to length, capped, and labeled. Details of the collection activities were recorded in the field log notes and entered on core collection field forms (Appendix E).

Processing occurred onshore at ARI. Cores were cut open down the length of the barrel using a circular saw. The core was then stabilized on a table and split open for visual characterization. All cores were photographed after being split open and then logged by a qualified geotechnical engineer. Details of the characterization were recorded on core logging forms (Appendix E).

After a core was logged and the cap identified, cap material was segregated from sub-cap sediments. Cap material was returned to the site. Sub-cap sediments were contained in 5-gallon buckets and held for disposal at a suitable upland location.

3.3.2 Results

To assist in the identification and thickness determination of the RA5 cap, pre-dredge characterization logs and daily dredge reports from the Lower Snohomish River Settling Basin were reviewed. This material can be characterized as dark gray, very silty sand based on a volume-weighted average of the entire dredge prism. On average, 58 percent of all sediment was finer than a 0.125 millimeter sieve (the upper limit of the very fine sand classification). Given that the water depths at RA5 exceed approximately 150 feet, it is likely that a significant portion of this dredged material would remain suspended and susceptible to transport upon discharge from a scow at the surface.

Cap material observed in cores consisted of layers of dark gray, (medium to fine) sand to sandy silt with occasional occurrences of minor constituents (e.g., shell fragments, vegetation, and wood debris). The underlying native material ranged from soft, dark olive gray, plastic silt to very dark gray to black, fine sand. Some of this material was observed to possess visible sheen and petroleum odor and was considered to be contaminated sediment. Several of the cores also contained a thin layer of light gray, fine sand. This material is assumed to be the fine-fraction fallout from the RA4 cap material. In many cases, this layer served as the defining interface between the RA5 cap material and the existing underlying sediments.

Analysis of the through-cap cores indicates that average cap thicknesses of 7.5 inches and 41 inches has been placed at the RA5a and RA5b segments, respectively. A breakdown of the estimated cap thickness by core is provided in Table 6 and illustrated on Figure 4.

3.3.3 Deviations from the QAPPA

At stations RA5-17, RA5-19, and RA5-20, cores were collected at the original location listed in the QAPPA, and therefore are not co-located with grabs from these stations. As with the subsurface grabs, station RA5-14 was relocated as station RA5-14A to avoid a gravel layer placed over the cap material.

Three of the 21 cores (RA5-01, RA5-02, and RA-06) did not meet the QAPPA penetration requirements of 40 inches or core termination into native material. On the second attempt, core RA5-01 recovered 28 inches of cap material. This core was accepted and additional attempts at the RA5-01 station were not made. Both RA5-02 and RA5-06 cores were located outside of the RA5 cap footprint, within the boundaries of the RA4 cap segment. These cores did not meet the QAPPA acceptance requirements; however, they did contain a layer of RA5 cap material over the presumed gravel layer composing the RA4 cap. The gravel contributed to difficulties in advancing the cores and led to minor cracking of the core tubes; therefore, additional attempts at these stations were not considered.

3.4 Sub-Bottom Profile and Multi-Beam Bathymetric Surveys

Golder Associates, Inc. and Chris Ransome and Associates, Inc.-Northwest (CRA–NW), respectively, conducted the sub-bottom profile (SBP) and multi-beam bathymetric (MBB) surveys. Both surveys were conducted concurrently on April 6, 2005 from the same vessel and required one work day to complete.

The objective of the SBP survey was to use a high-frequency subbottom profiler (3.5 to 10 KHz) to attempt to map the thickness of the sediment cap placed on the seabed at RA5a and RA5b. The subsurface data, depicting the cap thickness, was used to generate an isopach map (sediment thickness map) of the cap material covering RA5.

The objective of the MBB survey was to determine post-construction bathymetry, and through comparison with pre-construction MBB data obtained in 2000, generate an isopach map. Appendix F presents the survey report provided by Golder Associates and includes the isopach map generated by CRA-NW using MBB data. The following narrative has been excerpted from Appendix F, which may be consulted for additional detail.

3.4.1 Field Operations and Methods

The geophysical investigation was conducted from the *R/V Data Cat*, CRA-NW's 26-foot survey boat. The navigation system consisted of a Trimble PRO XRS differential global positioning system (DGPS) linked to a computer and operated under CRA-NW Model CATNAV hydrographic software.

The DGPS was used to determine the vessel's location in real time, and to plot the vessel's position along pre-selected survey lines. The pre-plotted survey lines and the actual survey lines traversed were displayed in real time on a video monitor. The navigation computer transmitted event marks to the geophysical recording instruments every 20 seconds in order to correlate the geophysical data with the survey vessel position during data analysis and mapping.

The SBP data were collected with a GeoAcoustics 3.5 to 10 KHz SBP system. The SBP system provided very high resolution images (0.5 feet) through fine-grained sediment and achieved a maximum of 15 to 20 feet of subsurface penetration. The data were displayed on a graphic recorder and archived on a digital acquisition system. The graphic recorder and digital acquisition system were interfaced with the navigation system to provide real time position on all archived and printed data.

The MBB data were collected with a Reson 8124 multi-beam sounding system. Typical accuracies for this technique are approximately one percent of the water depth, which translates into a range of 1.5 to 2.5 feet over the range of depths at RA5. The sounding system was integrated with the navigation system, so the result was a record of horizontal location and depth at fixed time intervals. Depth data were automatically adjusted for fluctuations of tidal elevation throughout the survey duration.

3.4.2 Survey Track Lines

The SBP and MBB data were obtained at the same time on 34 transects oriented NW-SE and 12 transects oriented SW-NE (Figure 5). The intervals between transects were approximately 50 feet and 100 feet, respectively.

3.4.3 Survey Data Analysis and Results

The results of the bathymetric survey are presented in Figure 6 (Map 2 of Appendix F). The mound to the south of RA5-17 and RA5-07 reflects the presence of a sunken barge prior to cap construction, but the height reflects the contribution from recent placement of cap material.

The SBP data were analyzed by determining what subsurface reflectors, or reflection characteristic would most likely represent cap material. SBP data from other projects were used as reference for interpretation. Cap material is general acoustically transparent (light colored image, no internal reflectors) and usually has a uniform distribution. In addition, the interpreted SBP data were correlated, where possible, with data from the through-cap cores.

Figure 7 shows the results of the interpreted SBP data (adapted from Map 3 of Appendix F). The interpreted SBP data did not detect a uniformly distributed, acoustically transparent sediment layer that would potentially represent the cap material. There were several localized patches of acoustically transparent material, 1 to 3 feet in thickness throughout the site (Inset Figure 2 of Figure 7). These are interpreted as possibly representing cap material.

The lack of geophysical evidence for the presence of uniform cap material may result from several conditions. These are:

- Behavior of the cap material during descent through the water column was different than simulated by modeling efforts
- The cap material may have acoustic properties similar to the native soil and consequently be undetectable
- The cap material may have been eroded or been transported downslope by a series of submarine slides
- A combination of all of the above

Figure 8 shows cap thickness estimates derived from the combination of pre- and post-construction MBB surveys. Cap thickness estimates inside the footprint of RA5, as derived from MBB data, appear slightly greater than indicated by data from either through-cap core logs or the SBP survey. On the basis of visual assessment of Figure 8

(MBB survey data), cap thickness is greater than 1 foot over most of the footprint. According to Figure 8, the areas where cap material thickness is greatest are outside the RA5 footprint. These areas are to the east of RA5b, between RA5b and RA5a, and southeast of RA5a all along the boundary with RA4. Core data indicate that approximately one foot of RA5 cap material overlays RA4 cap material.

According to the surveyor from CRA-NW, the error in depth measurements using acoustic sounding techniques may be approximately 1 percent of the depth. Depths in the survey footprint ranged from approximately 150 to 250 feet, so potential errors in the MBB data may range from 1.5 to 2.5 feet. Similarly, the potential errors in the year 2000 MBB survey may range from 1.5 to 2.5 feet. In the worst case, errors in estimates of cap thickness derived by differencing these two sets of data could be as large as 5 feet in depths of 250 feet.

3.4.4 Deviations from the QAPPA

Both the SBP and MBB surveys were conducted in accordance with the QAPPA with no deviations.

4 COMPARISON OF CAP THICKNESS ESTIMATES

Table 7 summarizes estimates of cap thickness derived from inspection of through-cap cores, SBP data, and MBB data. Estimates are on a point-by-point basis at each core collection location.

The average cap thicknesses at RA5a determined from core and MBB data were 0.7 feet and 1.7 feet, respectively. The thicknesses determined at RA5b were 3.5 feet and 1.5 feet, respectively, for core and MBB data. If a cap thickness of 0.5 feet is assumed at all locations where the SBP survey failed to detect cap material, then the average thicknesses at RA5a and RA5b inferred from SBP data would be 0.7 feet and 1.8 feet, respectively. Cap thickness estimates derived from cores, SBP and MBB surveys agree best at station RA5-14A.

The MBB estimates indicate two thick lenses of cap material to the south and the east of RA5b. These localized areas have a shallower slope than surrounding slope areas (see Figure 6), so material might have tended to accumulate there. SBP data hint at an accumulation near station RA5-15, but do not indicate an accumulation of material to the south of station RA5-14A.

The MBB data indicate an accumulation of material at the extreme northwest edge of the survey area, and the contours are aligned approximately with the trend in the bathymetric contours. That would hint at downhill flow and accumulation. The indication of thicker material may be an artifact stemming from the data being at the extreme edge of the survey tracklines. The anomaly in the pattern of downhill movement is the band of relatively thin material in and immediately to the northwest of RA5b. If downhill movement of material occurred, the slope may have been just adequate for material to continue downslope.

MBB survey data show a band of accumulated material, approximately 225 feet wide between 3-foot contours, lying over the northwest part of RA4 paralleling the boundary between RA5a and RA4 (see Figure 8). This may represent a combination of coarse material previously placed at RA4 overlain by RA5 cap material held in place on the slope by the coarse substrate. Because there does not appear to be a change in gradient at the boundary (Figure 6), the inference is that something southeast of the boundary is holding the RA5 material in place. Where that coarse RA4 material is not present, there is no feature to keep the RA5 material from moving downslope, and thus results in a decrease in RA5 cap thickness to the northwest. SBP survey data indicate a thickness of 1.5 feet only in the vicinity of station RA5-6, and the core data for station RA5-6 indicate a cap thickness of 0.7 feet. The three sources of cap thickness estimates do not agree well along the boundary between RA4 and RA5a.

5 SUMMARY OF CAP CONSTRUCTION MONITORING

Following is a brief summary of the results of each type of monitoring conducted during cap construction at RA5. Section 3 and the appendices provide detailed information.

5.1 Water Quality Monitoring

Water quality monitoring consisted of measurements of turbidity, DO concentration, salinity, pH, and temperature. Intensive water quality monitoring measurements were collected each day January 5, 6, and 7, 2005. With concurrence from the USACE, limited water quality monitoring began on January 12, 2005 and was repeated once per week (January 21 and 27, February 2 and 8, 2005) until construction activities ceased because of fish window timing constraints.

Turbidity was the only water quality parameter to exceed its evaluation criterion (5 NTU above background). Background turbidity values were generally less than 10 NTU. Exceedances for turbidity were observed and reported on all monitoring days except January 7 and January 12. Except for the exceedances measured at mid-depth on January 27, all exceedances were observed at the near-bottom sampling depth. The highest measured turbidity value at a range of 600 feet from the discharge location was approximately 102 NTU (MS1 on January 6, 2005). Twenty-one minutes later, turbidity had decreased to 11.8 NTU, indicating that the subsurface plume had dispersed or had passed the sampling location. Most turbidity values were within the range of approximately 5 to 40 NTU.

Except for observations made on January 21, successive turbidity values collected during resampling of the stations that initially exceeded the turbidity criterion usually decreased, thereby indicating that the effects on water quality were temporary for this operation. Visual surface observations made after the scow cap material placement event indicated localized surface turbidity that dissipated quickly.

5.2 Cap Surface Sediment Quality

Sediment grab samples were collected from the *S/V Peter R* of Marine Sampling Systems on March 8 and 9, 2005. The purpose of grab sampling was to evaluate the sediment quality in the top 10 centimeters of the recently-placed cap surface. CAS of Kelso, Washington analyzed the samples for a selected list of SMS chemicals, and the results were compared with SQS and CSL criteria (see Tables 3 and 4).

Concentrations of all metals were less than their respective criteria.

The percent TOC in two samples, RA5-16-GS and RA5-19A-GS, were was than 0.50 percent, so their respective analytical results were compared with LAET and 2LAET dw criteria, as directed in the project scope of work. None of the detected analyte concentrations in either sediment sample exceeded their respective AET criteria.

The concentration of total PCBs in sample RA5-05-GS was 18.9 mg/kg-OC, which exceeded the criterion of 12 mg/kg-OC. According to results of inspection of through-cap cores, no cap material was identified at this location, so the sample may have come from the existing surface where no cap material accumulated.

Concentrations of PAHs in all samples were below their respective OC-normalized criteria. The method reporting limits for 2,4-dimethylphenol exceeded the SQS criterion in some of the samples. When method detection limits for 2,4-dimethylphenol were inserted for all samples, there were no exceedances of the SQS criterion.

5.3 Through-Cap Cores

Coring activities occurred on March 23, 24, and 25, 2005, onboard the *R/V Nancy Anne* of Marine Sampling Systems. To the extent possible, core locations were co-located with sediment grab sample locations occupied on March 8 and 9, 2005. Core photographing and logging took place off site at ARI.

Cap material observed in cores consisted of layers of dark gray, (medium to fine) sand to sandy silt. The underlying native material ranged from soft, dark olive gray, plastic silt to very dark gray to black, fine sand. Some of this material possessed visible sheen and petroleum odor and was considered to be contaminated sediment. Several of the cores also contained a thin layer of light gray, fine sand. This material is assumed to be the fine-fraction fallout from the RA4 cap material. In many cases, this layer served as the defining interface between the RA5 cap material and the existing underlying sediments. Analysis of the through-cap cores indicates that average cap thicknesses placed at RA5a and RA5b were approximately 0.7 feet and 3.4 feet, respectively.

5.4 Sub-Bottom Profile and Multi-Beam Bathymetric Surveys

Both surveys were conducted concurrently on April 6, 2005 from the *R/V Data Cat*, CRA-NW's 26-foot survey boat. The objectives were to determine cap material thickness and distribution directly using SBP, to provide post-capping bathymetry using MBB, and to use pre- and post-capping MBB data to make a separate estimate of cap material thickness and distribution.

The interpreted SBP data did not detect a uniformly distributed, acoustically transparent sediment layer that would potentially represent the cap material. There were several localized patches of acoustically transparent material, 1 to 3 feet in thickness throughout the site. These are interpreted as possibly representing cap material.

The lack of geophysical evidence for the presence of uniform cap material may result from several conditions. These are:

- Behavior of the cap material during descent through the water column was different than simulated by modeling efforts
- The cap material may have acoustic properties similar to the native soil and consequently be undetectable
- The cap material may have been eroded or been transported downslope by a series of submarine slides
- A combination of all of the above

Cap thickness estimates inside the footprint of RA5, as derived from MBB data, appear to be greater than 1 foot, which is slightly greater than indicated by data from either through-cap core logs or the SBP survey. Areas where cap material thickness is greatest are outside the RA5 footprint. These areas are to the east of RA5b, between RA5b and RA5a, and southeast of RA5a all along the boundary with RA4.

The error in depth measurements using acoustic sounding techniques may be approximately 1 percent of the depth. Given the depth range in the survey footprint, potential errors in both the pre- and post-capping MBB data may range from 1.5 to 2.5 feet, so in the worst case, errors in estimates of cap thickness derived by differencing these two sets of data could be as large as 5 feet in depths of 250 feet.

6 REFERENCES

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TABLES

Table 1
Water Quality Monitoring Table for January 6, 2005

Scow Target: G1/G2
Dump Location: 47.58665°N, 122.37139°W
Dump Time: 16:10

Date: 1/6/2005
Scow ID: CK-7
Current: Approximately 25 cm/s @300° at 15:00

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data						
					Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	15:15	47.58828°	122.37255°	Ebb	1.0	(3.3)	7.5	7.5	30.8	7.6	8.3
					24.7	(81.0)	6.4	6.9	32.8	7.6	9.1
					48.4	(158.8)	5.5	6.4	33.1	7.6	9.5
300 ft_Early Warning	16:27	47.58701°	122.37243°	Ebb	1.0	(3.3)	7.0	7.5	32.2	7.7	8.4
					26.9	(88.3)	5.2	7.1	32.7	7.6	9.0
					53.0	(173.9)	194.2	6.2	33.0	7.6	9.4
600 ft_MS1	16:32	47.58798°	122.37308°	Ebb	1.0	(3.3)	7.7	7.5	32.0	7.7	8.4
					26.0	(85.3)	6.2	6.8	32.8	7.7	9.1
					55.2	(181.1)	**102.1**	6.3	33.1	7.6	9.4
600 ft_MS2	16:43	47.58683°	122.37393°	Ebb	1.0	(3.3)	6.5	7.7	32.1	7.7	8.2
					22.0	(72.2)	7.5	6.9	32.6	7.7	8.9
					41.6	(136.5)	**11.2**	6.3	33.0	7.7	9.4
600 ft_MS1	16:53	47.58819°	122.37282°	Ebb	1.0	(3.3)	7.8	7.5	32.0	7.7	8.4
					25.1	(82.3)	12.0	7.0	32.6	7.7	8.9
					52.8	(173.2)	**11.6**	6.2	33.2	7.6	9.7

Table 2
Surface Sediment Collection Locations and Mudline Elevations

Station ID	Date	Time	Northing	Easting	Latitude	Longitude	Mudline Elevation (feet MLLW)
RA5-01	Mar-08-2005	11:41	217758.0381	1261043.430	47°35.1951' N	122°22.2440' W	-154
RA5-02	Mar-08-2005	12:01	217753.2412	1261253.138	47°35.1950' N	122°22.1930' W	-142
RA5-03	Mar-08-2005	14:08	218050.3504	1261051.739	47°35.2432' N	122°22.2434' W	-181
RA5-04	Mar-08-2005	13:46	218046.3996	1261249.531	47°35.2432' N	122°22.1953' W	-171
RA5-05	Mar-08-2005	10:10	218054.6416	1261537.246	47°35.2455' N	122°22.1254' W	-151
RA5-06	Mar-08-2005	12:29	218036.7529	1261854.881	47°35.2436' N	122°22.0481' W	-137
RA5-07	Mar-09-2005	8:20	218352.0273	1260956.569	47°35.2925' N	122°22.2680' W	-210
RA5-08	Mar-08-2005	15:13	218345.4226	1261256.736	47°35.2924' N	122°22.1950' W	-196
RA5-09	Mar-09-2005	9:31	218352.7698	1261558.827	47°35.2946' N	122°22.1216' W	-189
RA5-10	Mar-08-2005	14:28	218362.0273	1261856.841	47°35.2971' N	122°22.0492' W	-173
RA5-11	Mar-08-2005	11:13	218359.2231	1262150.090	47°35.2976' N	122°21.9779' W	-158
RA5-12	Mar-09-2005	8:50	218652.6880	1261551.648	47°35.3439' N	122°22.1248' W	-210
RA5-13	Mar-08-2005	14:52	218647.7384	1262257.444	47°35.3454' N	122°21.9532' W	-168
RA5-14A	Mar-10-2005	16:02	218940.1920	1260978.608	47°35.3893' N	122°22.2655' W	-234
RA5-15	Mar-09-2005	13:55	218947.6173	1261337.458	47°35.3917' N	122°22.1783' W	-235
RA5-16	Mar-09-2005	14:17	219240.2329	1261056.590	47°35.4389' N	122°22.2480' W	-249
RA5-17A	Mar-10-2005	16:49	218339.8003	1260746.939	47°35.2898' N	122°22.3189' W	-200
RA5-18	Mar-09-2005	15:29	217747.7445	1260645.830	47°35.1921' N	122°22.3406' W	-157
RA5-19A	Mar-09-2005	15:06	218406.1769	1262357.120	47°35.3060' N	122°21.9278' W	-142
RA5-20A	Mar-09-2005	11:28	218442.2302	1261220.001	47°35.3082' N	122°22.2044' W	-203
RA5-21	Mar-09-2005	10:00	218653.7907	1261892.688	47°35.3452' N	122°22.0419' W	-195

Table 3
Summary of Surface Sediment Data Compared to SMS Criteria

Location ID Sample ID Sample Date Depth Interval	Sediment Management Standards SQS	 CSL	RA5-01 RA5-01-GS 3/8/2005 0-9 cm	RA5-02 RA5-02-GS 3/8/2005 0-10 cm	RA5-03 RA5-03-GS 3/8/2005 0-8 cm	RA5-04 RA5-04-GS 3/8/2005 0-10 cm	RA5-05 RA5-05-GS 3/8/2005 0-9 cm	RA5-06 RA5-06-GS 3/8/2005 0-8 cm	RA5-07 RA5-07-GS 3/8/2005 0-10 cm	RA5-08 RA5-08-GS 3/8/2005 0-9 cm	RA5-09 RA5-09-GS 3/9/2005 0-10 cm	RA5-10 RA5-10-GS 3/8/2005 0-10 cm	RA5-11 RA5-11-GS 3/8/2005 0-8 cm	RA5-12 RA5-12-GS 3/9/2005 0-10 cm	RA5-13 RA5-13-GS 3/8/2005 0-9 cm	RA5-14A RA5-14A-GS 3/9/2005 0-10 cm	RA5-15 RA5-15-GS 3/9/2005 0-9 cm	RA5-17A RA5-17A-GS 3/9/2005 0-10 cm	RA5-18 RA5-18-GS 3/9/2005 0-8 cm	RA5-20A RA5-20A-GS 3/9/2005 0-10 cm	RA5-21 RA5-21-GS 3/9/2005 0-10 cm
Conventionals (%)																					
Total solids			64	59.2	67.5	69.4	66.4	68.7	63.2	62.3	69.6	56.9	68.2	59.1	72.9	61.3	69.4	66.9	65.5	63.6	64.4
Total Organic Carbon			2.03	2.36	1.11	1.2	1.11	0.63	1.45	2.57	0.81	2.46	1.26	2.3	1.44	2.05	1.17	1.29	1.42	1.74	1.46
Metals (mg/kg)																					
Arsenic	57	93	9.33	9.89	6.92	6.6	5.97	5.47	8.63	9.12	8.23	10.5	10.9	11.7	6.92	10	5.28	6.77	7.15	8.66	8.53
Cadmium	5.1	6.7	0.178 J	0.206 J	0.144 J	0.082 J	0.149 J	0.086 J	0.177 J	0.157 J	0.107 J	0.255 J	0.158 J	0.243 J	0.092 J	0.204 J	0.086 J	0.139 J	0.157 J	0.179 J	0.198 J
Chromium	260	270	31.9	35.5	31.2	24.8	26.8	26.3	33.5	39.2	27	37.5	23.3	33.5	26	36.3	22.7	28.9	32	28.2	35.4
Copper	390	390	30.3	36.6	23.4	19.5	26.8	22	29.7	27.2	23.9	38.4	21.8	33.7	21.4	34.4	20.3	24.1	28.2	26.4	30.9
Lead	450	530	7.32 J	8.74 J	7.03 J	5.20 J	7.31 J	4.39 J	6.94 J	5.87 J	5.58 J	9.34 J	6.01 J	8.21 J	5.48 J	9.11 J	4.50 J	5.23 J	6.54 J	6.11 J	7.30 J
Mercury	0.41	0.59	0.054	0.054	0.05	0.033	0.263	0.347	0.073	0.04	0.035	0.066	0.038	0.065	0.029	0.06	0.03	0.051	0.043	0.072	0.178
Zinc	410	960	53.60 J	60.90 J	45.80 J	41 J	48.50 J	43.30 J	54.50 J	49.60 J	46.20 J	60.60 J	42 J	56.10 J	42 J	60.40 J	38.90 J	45 J	48 J	48.20 J	53.40 J
PCBs (mg/kg-OC)																					
Total PCBs (PSDDA)	12	65	0.25	0.25	0.59	1.66 U	$\boxed{18.91\ *}$	3.17 U	0.5	0.19	0.43	0.61 U	1.56 U	0.48	1.38 U	0.97 U	0.51	0.34	1.40 U	0.54	0.69
PAHs (mg/kg-OC)																					
Total LPAH	370	780	0.85	8.98	8.43	5.15	12.52	3.25	19.24	2.54	7.81	1.77	8.01	4.73	1.93	3.02	11.19	13.25	15.42	3.7	5.08
Naphthalene	99	170	0.19 J	0.63	2.25	0.91	2.88	0.68 J	2.75	0.62	0.88 J	0.30 J	0.35 J	0.95	0.30 J	0.63	1.53	0.93	0.98	1.2	0.89
Acenaphthylene	66	66	0.48 U	0.19 J	0.53 J	0.28 J	0.43 J	0.44 J	0.29 J	0.09 J	0.29 J	0.19 J	0.22 J	0.27 J	0.69 U	0.18 J	0.44 J	0.32 J	0.20 J	0.15 J	0.35 J
Acenaphthene	16	57	0.08 J	0.72	0.72 J	0.42 J	1.26	0.34 J	4	0.27 J	0.53 J	0.14 J	0.33 J	0.43	0.18 J	0.24 J	0.94	2.17	1.05	0.31 J	0.47 J
Fluorene	23	79	0.48 U	0.76	0.69 J	0.52 J	1.44	1.57 U	3.17	0.38 U	0.75 J	0.19 J	0.54 J	0.52	0.22 J	0.27 J	1.11	1.62	2.25	0.41 J	0.54 J
Phenanthrene	100	480	0.42 J	2.75	2.66	2	4.59	1.30 J	6.89	0.97	4.56	0.69	5.39	2	0.97	1.12	5.04	6.2	5.77	1.14	2.12
Anthracene	220	1200	0.15 J	3.89	1.35	1	1.89	0.47 J	2.13	0.58	0.77 J	0.24 J	1.19	0.56	0.24 J	0.58	2.13	2.01	5.14	0.45 J	0.68 J
2-Methylnaphthalene	38	64	0.48 U	0.32 J	0.33 J	0.18 J	0.86 J	1.57 U	1.17	0.11 J	0.29 J	0.15 J	0.17 J	0.24 J	0.69 U	0.18 J	0.78 J	0.56 J	0.47 J	0.22 J	0.39 J
Total HPAH	960	5300	3.88	22.83	32.25	11.5	29.81	20.63	28.27	15.71	17.9	6.17	59.04	13.13	7.08	10.92	29.23	77.2	20.14	9.31	13.9
Fluoranthene	160	1200	1.03	5.93	5.4	3	6.75	2.69	7.58	1.86	5.43	1.3	9.52	2.47	2.08	1.85	6.83	24.03	5.77	2.87	3.56
Pyrene	1000	1400	0.83	4.66	7.92	3	7.2	2.38	5.86	1.94	4.19	1.09	11.9	2.39	1.52	3.46	5.64	17.82	4.64	2.7	3.08
Benzo(a)anthracene	110	270	0.47 J	2.11	2.79	0.73 J	2.43	3.01	2.55	1.4	1.23	0.65	6.98	1.52	0.67 J	0.63	2.64	8.52	1.97	0.63	1.38
Chrysene	110	460	0.49	2.79	4.32	1.08	3.06	2.85	2.62	2.33	1.72	0.97	9.52	1.91	0.76	0.78	2.47	11.62	2.32	0.8	1.84
Total benzofluoranthenes	230	450	0.54	3.6	5.67	1.61	5.04	4.74	4.62	2.56	2.71	1.08	8.49	2.21	1.06	2.06	6.41	8.44	2.5	1.28	2.04
Benzo(a)pyrene	99	210	0.33 J	1.94	2.88	0.83	2.43	2.69	2.48	2.25	1.13 J	0.52	6.19	1.26	0.59 J	1.02	2.82	3.79	1.54	0.63	1.02
Indeno(1,2,3-cd)pyrene	34	88	0.17 J	1.01	1.53	0.50 J	1.35	1.25 J	1.24	1.05	0.75 J	0.25 J	2.93	0.6	0.34 J	0.56	1.19	1.93	0.84	0.36 J	0.52 J
Dibenzo(a,h)anthracene	12	33	0.48 U	0.22 J	0.42 J	0.83 U	0.36 J	1.57 U	0.35 J	0.85	1.22 U	0.40 U	0.95	0.16 J	0.69 U	0.17 J	0.38 J	0.55 J	0.69 U	0.57 U	0.82 U
Benzo(g,h,i)perylene	21	78	0.48 UJ	0.55 J	1.26 J	0.54 J	1.17 J	0.96 J	0.96 J	1.43 J	0.64 J	0.26 J	2.53 J	0.56 J	0.69 UJ	0.35 J	0.82 J	0.44 J	0.52 J	0.57 UJ	0.46 J
Misc (mg/kg-OC)																					
Dibenzofuran	15	58	0.48 U	0.31 J	0.51 J	0.34 J	1.26	1.57 U	2.34	0.18 J	0.54 J	0.14 J	0.20 J	0.26 J	0.69 U	0.22 J	0.94	1	0.98	0.27 J	0.37 J
Phenols (µg/kg)																					
Phenol	420	1200	13 J	22 J	8.8 J	16 J	9.2 J	30 U	30 U	49	30 U	22 J	30 U	30 U	9.0 J	33	42	23 J	21 J	30 U	28 J
2-Methylphenol	63	63	9.9 U	10 U	10 U	10 U	10 U	9.9 U	10 U	10 U	9.9 U	10 U	10 U	9.9 U	10 U	10 U	10 U	10 U	9.9 U	10 U	12 U
4-Methylphenol	670	670	16	93	8.0 J	14	10	16	20	15	9.6 J	46	14	38	13	75	12	16	30	34	34
2,4-Dimethylphenol^	29	29	8.6 UJ	9.3 UJ	8.2 UJ	8.0 UJ	8.3 UJ	8.1 UJ	8.8 UJ	8.9 UJ	8.0 UJ	9.7 UJ	8.1 UJ	9.4 UJ	7.6 UJ	9.0 UJ	8.0 UJ	8.3 UJ	8.4 UJ	8.7 UJ	8.6 UJ
Pentachlorophenol	360	690	99 U	100 U	100 U	100 U	100 U	99 U	100 U	100 U	99 U	100 U	100 U	99 U	100 U	100 U	100 U	100 U	99 U	100 U	120 U

Notes:

Bold detected

☐ exceedence

U The analyte was analyzed for, but not detected above the sample reporting limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the sample reporting limit. However, the sample reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

* The analyte was positively identified above SMS-SQS criteria.

^ The MDL for 2,4-dimethylphenol is presented here because the MRL is above the SMS criteria.

Table 4
Summary of Surface Sediment Data Compared to AET Dry Weight Criteria

Location ID / Sample ID / Sample Date / Depth Interval	LAET	2LAET	RA5-16 / RA5-16-GS / 3/9/2005 / 0-8 cm	RA5-19A / RA5-19A-GS / 3/9/2005 / 0-8 cm
Conventionals (%)				
Total Solids			**75.1**	**73.9**
Total Organic Carbon			**0.49**	**0.3**
Metals (mg/kg)				
Arsenic	57	93	**5.67**	**5.86**
Cadmium	5.1	6.7	**0.100 J**	**0.078 J**
Chromium	260	270	**23.5**	**21.4**
Copper	390	530	**18.2**	**18.1**
Lead	450	530	**6.66 J**	**8.65 J**
Mercury	0.41	0.59	**0.032**	**0.045**
Zinc	410	960	**43 J**	**44.90 J**
PCBs (µg/kg)				
Total PCBs (PSDDA)	130	1000	**61**	**22**
PAHs (µg/kg)				
Total LPAH	5200	13000	**24**	**44.8**
Naphthalene	2100	2400	**3.4 J**	**7.2 J**
Acenaphthylene	1300	1300	9.3 U	**3.5 J**
Acenaphthene	500	730	**1.8 J**	**3.9 J**
Fluorene	540	1000	9.3 U	**4.5 J**
Phenanthrene	1500	5400	**13**	**17**
Anthracene	960	4400	**5.8 J**	**8.7 J**
2-Methylnaphthalene	670	1400	9.3 U	**3.0 J**
Total HPAH	12000	17000	**141**	**180**
Fluoranthene	1700	2500	**36**	**34**
Pyrene	2600	3300	**39**	**39**
Benzo(a)anthracene	1300	1600	**12**	**14**
Chrysene	1400	2800	**17**	**17**
Total benzofluoranthenes	3200	3600	**21.8**	**34.4**
Benzo(a)pyrene	1600	3000	**9.6**	**19**
Indeno(1,2,3-cd)pyrene	600	690	**5.5 J**	**12**
Dibenzo(a,h)anthracene	230	540	9.3 U	**3.4 J**
Benzo(g,h,i)perylene	670	720	9.3 UJ	**6.9 J**
Misc SVOC (µg/kg)				
Dibenzofuran	540	700	9.3 U	**3.2 J**
Phenols (µg/kg)				
Phenol	420	1200	**13 J**	**12 J**
2-Methylphenol	63	72	9.3 U	10 U
4-Methylphenol	670	1800	**4.8 J**	10 U
2,4-Dimethylphenol^	29	72	7.4 U	7.5 U
Pentachlorophenol	360	690	93 U	100 U

Notes:

Bold = detected

LAET = lowest apparent effects threshold

2LAET = second lowest apparent effects theshold

U The analyte was analyzed for, but not detected above the sample reporting limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the sample reporting limit. However, the sample reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

^ The MDL for 2,4-dimethylphenol is presented here because the MRL is above the SMS criteria.

Table 5
Through-Cap Core Collection Locations and Mudline Elevations

Station ID	Date	Time	Northing	Easting	Latitude	Longitude	Elevation (feet MLLW)
RA5-01	Mar-23-2005	9:10	217740	1261038	47°35.1921' N	122°22.2453' W	-159
RA5-02	Mar-23-2005	11:55	217736	1261264	47°35.1922' N	122°22.1902' W	-138
RA5-03	Mar-23-2005	13:23	218032	1261047	47°35.2401' N	122°22.2445' W	-179
RA5-04	Mar-23-2005	13:56	218044	1261260	47°35.2428' N	122°22.1927' W	-167
RA5-05	Mar-23-2005	10:21	218047	1261531	47°35.2443' N	122°22.1269' W	-161
RA5-06	Mar-23-2005	15:04	218048	1261841	47°35.2454' N	122°22.0516' W	-145
RA5-07	Mar-24-2005	8:49	218344	1260942	47°35.2912' N	122°22.2716' W	-206
RA5-08[a]	Mar-24-2005	9:17	218354	1261243	47°35.2937' N	122°22.1983' W	-193
RA5-09	Mar-24-2005	9:46	218359	1261551	47°35.2956' N	122°22.1235' W	-188
RA5-10	Mar-24-2005	10:13	218348	1261847	47°35.2947' N	122°22.0516' W	-171
RA5-11	Mar-24-2005	10:34	218352	1262154	47°35.2965' N	122°21.9769' W	-157
RA5-12	Mar-24-2005	11:26	218649	1261569	47°35.3433' N	122°22.1205' W	-205
RA5-13	Mar-24-2005	11:50	218647	1262248	47°35.3452' N	122°21.9554' W	-165
RA5-14A	Mar-24-2005	14:51	218947	1260979	47°35.3904' N	122°22.2655' W	-231
RA5-15	Mar-24-2005	15:34	218953	1261360	47°35.3927' N	122°22.1729' W	-230
RA5-16	Mar-25-2005	16:04	219249	1261053	47°35.4404' N	122°22.2490' W	-246
RA5-17	Mar-23-2005	14:31	218348	1260654	47°35.2908' N	122°22.3415' W	-196
RA5-18	Mar-23-2005	11:02	217746	1260636	47°35.1917' N	122°22.3431' W	-163
RA5-19	Mar-24-2005	12:10	218448	1262574	47°35.3136' N	122°21.8752' W	-134
RA5-20	Mar-24-2005	13:53	218542	1261245	47°35.3247' N	122°22.1989' W	-206
RA5-21	Mar-24-2005	14:18	218664	1261888	47°35.3469' N	122°22.0432' W	-189

Note:

a - No measured water depth taken at this station, mudline based on project depth.

Table 6
Summary of Through-Cap Core Logging Data

Core Designation	Location	Logged Length (inches)	Estimated RA5 Cap Thickness (inches)	General Description
RA5-01	SW edge near RA4	28	28	Entire core consists of cap material
RA5-02	SW edge on RA4	38	4	Cap material is underlain by RA4 cap material
RA5-03	W edge of cap	40	5	Cap material is underlain by contaminated sediments
RA5-04	W center of cap	44	9	Cap material is underlain by native sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-05	S edge near RA4	56	0	Cap thickness cannot be determined as the upper foot of material appears contaminated
RA5-06	SE edge on RA4	22	8	Cap material is underlain by RA4 cap material
RA5-07	NW corner of cap	38	3	Cap material is underlain by contaminated sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-08	NW center of cap	53	12	Cap material is underlain by contaminated sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-09	Center of cap	50	7	Cap material is underlain by contaminated sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-10	E center of cap	50	7	Cap material is underlain by native sediments; interface is marked by a thin layer of oxidized sediment
RA5-11	SE edge near RA4	62.5	0	Cap thickness cannot be determined as the surficial material consists of RA4 cap fallout
RA5-12	E edge of cap	35	8	Cap material is underlain by native sediments
RA5-13	NE edge of cap	46	9	Cap material is underlain by native sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-14A	N section - relocated	51	45	Cap material is underlain by contaminated sediments
RA5-15	N section	67	37	Cap material is underlain by contaminated sediments
RA5-16	N of N section	44	13	Cap material is underlain by native sediments
RA5-17	NW edge outside of cap	38	7	Cap material is underlain by native sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-18	SW edge outside of cap	39.5	4	Cap material is underlain by native sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-19	E edge outside of cap	61	4	Cap material is underlain by native sediments; interface is marked by a thin layer of RA4 cap fallout
RA5-20	NW edge outside of cap	33	12	Cap material is underlain by native sediments
RA5-21	NE edge outside of cap	52	7	Cap material is underlain by native sediments; interface is marked by a thin layer of RA4 cap fallout

Notes:

RA4 cap fallout is defined as light gray, very fine sand to silt.

Contaminated sediments are defined as those presenting visible sheen and petroleum odor.

Native sediments ranged from soft, dark olive gray, plastic silt to very dark gray to black, fine sand did not appear to be adversely impacted by contamination.

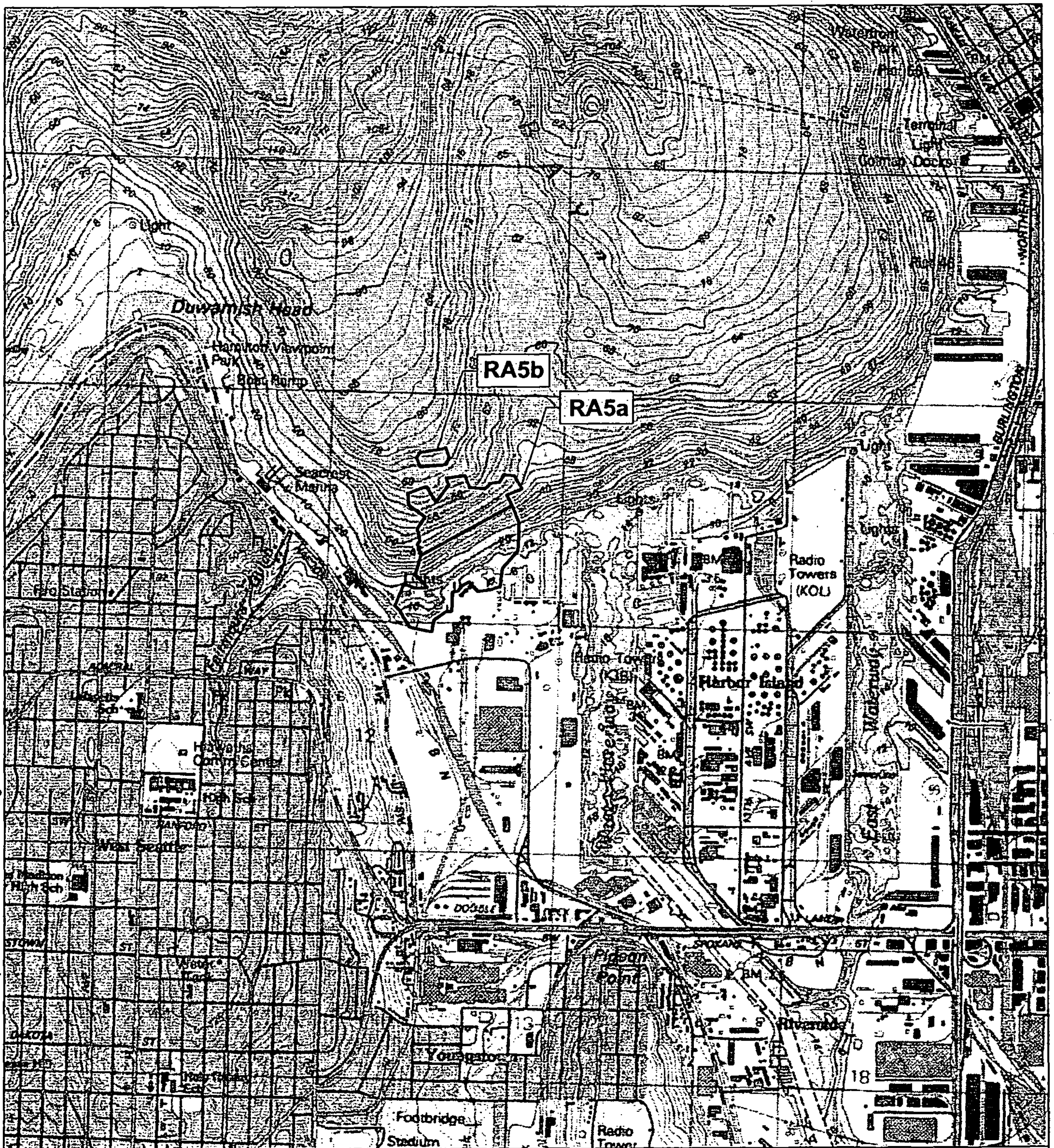
Table 7
Comparison of Cap Thickness Estimates from Through-Cap Cores, Multi-Beam Bathymetric Survey, and Sub-Bottom Profile Survey

Core Designation	Location Description	Estimated RA5 Cap Thickness (feet)		
		Through-Cap Cores	Multi-Beam Bathymetry	Sub-Bottom Profile
RA5-01	SW edge near RA4	2.3	1	NCD
RA5-02	SW edge on RA4	0.3	2.5	NCD
RA5-03	W edge of cap	0.4	1	NCD
RA5-04	W center of cap	0.8	2	NCD
RA5-05	S edge near RA4	0	1	NCD
RA5-06	SE edge on RA4	0.7	3.5	1.5
RA5-07	NW corner of cap	0.3	1	2
RA5-08	NW center of cap	1	3	NCD
RA5-09	Center of cap	0.6	2	NCD
RA5-10	E center of cap	0.6	1	NCD
RA5-11	SE edge near RA4	0	1	NCD
RA5-12	E edge of cap	0.7	1.5	NCD
RA5-13	NE edge of cap	0.8	1	NCD
RA5-14A	RA5b - relocated	3.8	2	3
RA5-15	RA5b	3.1	1	NCD
RA5-16	N of RA5b	1.1	2	NCD
RA5-17	NW edge outside of cap	0.6	1	NCD
RA5-18	SW edge outside of cap	0.3	1	NCD
RA5-19	E edge outside of cap	0.3	1	NCD
RA5-20	NW edge outside of cap	1	2	NCD
RA5-21	NE edge outside of cap	0.6	1	NCD
Average cap thickness for RA5a		**0.7**	**1.7**	**0.7**
Average cap thickness for RA5b		**3.4**	**1.5**	**1.8**

Notes:

NCD No cap material detected; assumed 0.5 feet for averaging.

FIGURES



Note: Base map prepared from Terrain Navigator Pro
USGS 7.5 minute quadrangle map of Seattle North, Washington.

0 2000
Scale in Feet

Dec 15, 2004 7:40am cdavidson K:\Jobs\020202-Seattle Corps\02020201\02020117.dwg FIG 1

Figure 1
General Location of the RA5 Marine Sediment Unit

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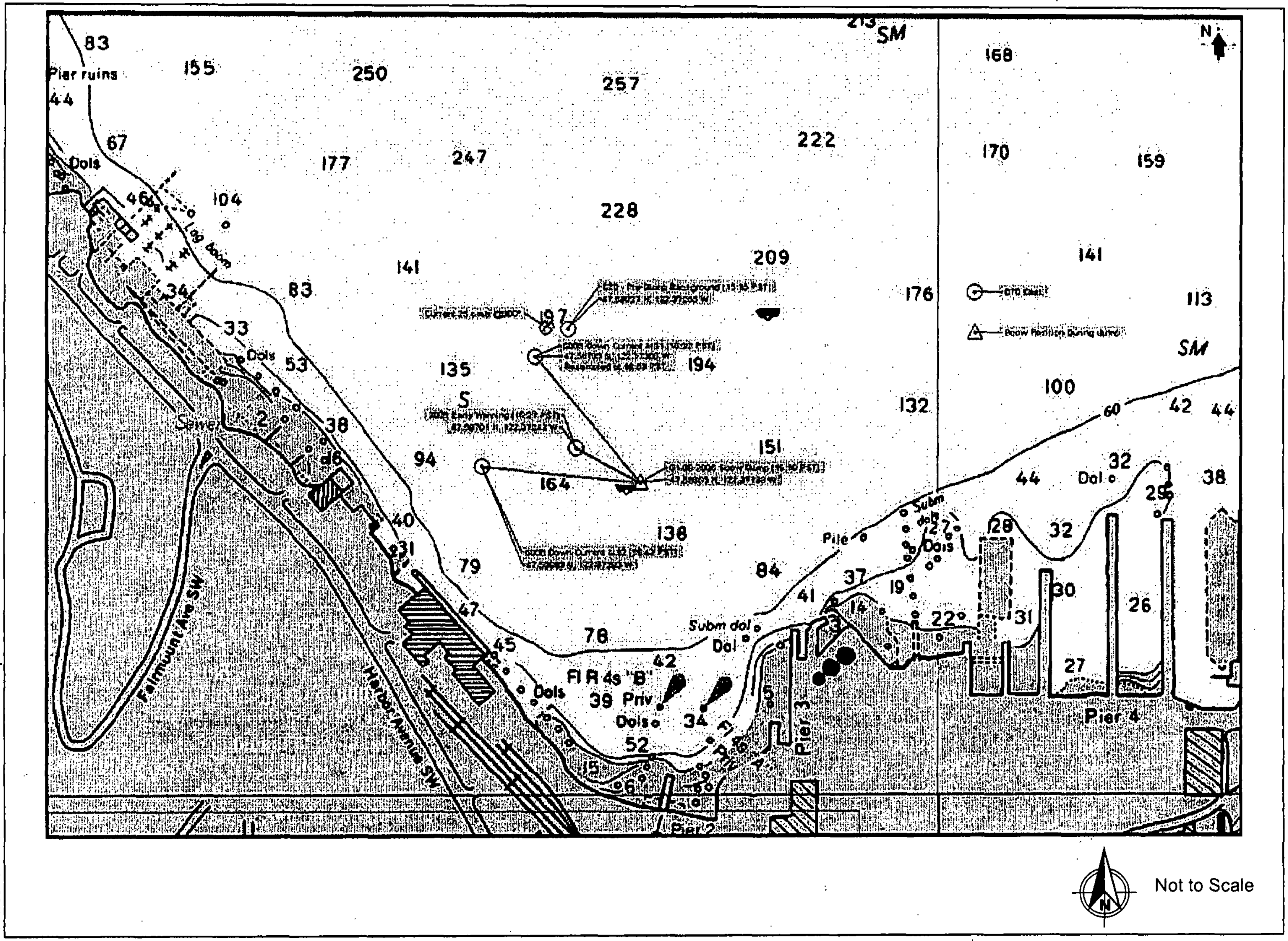

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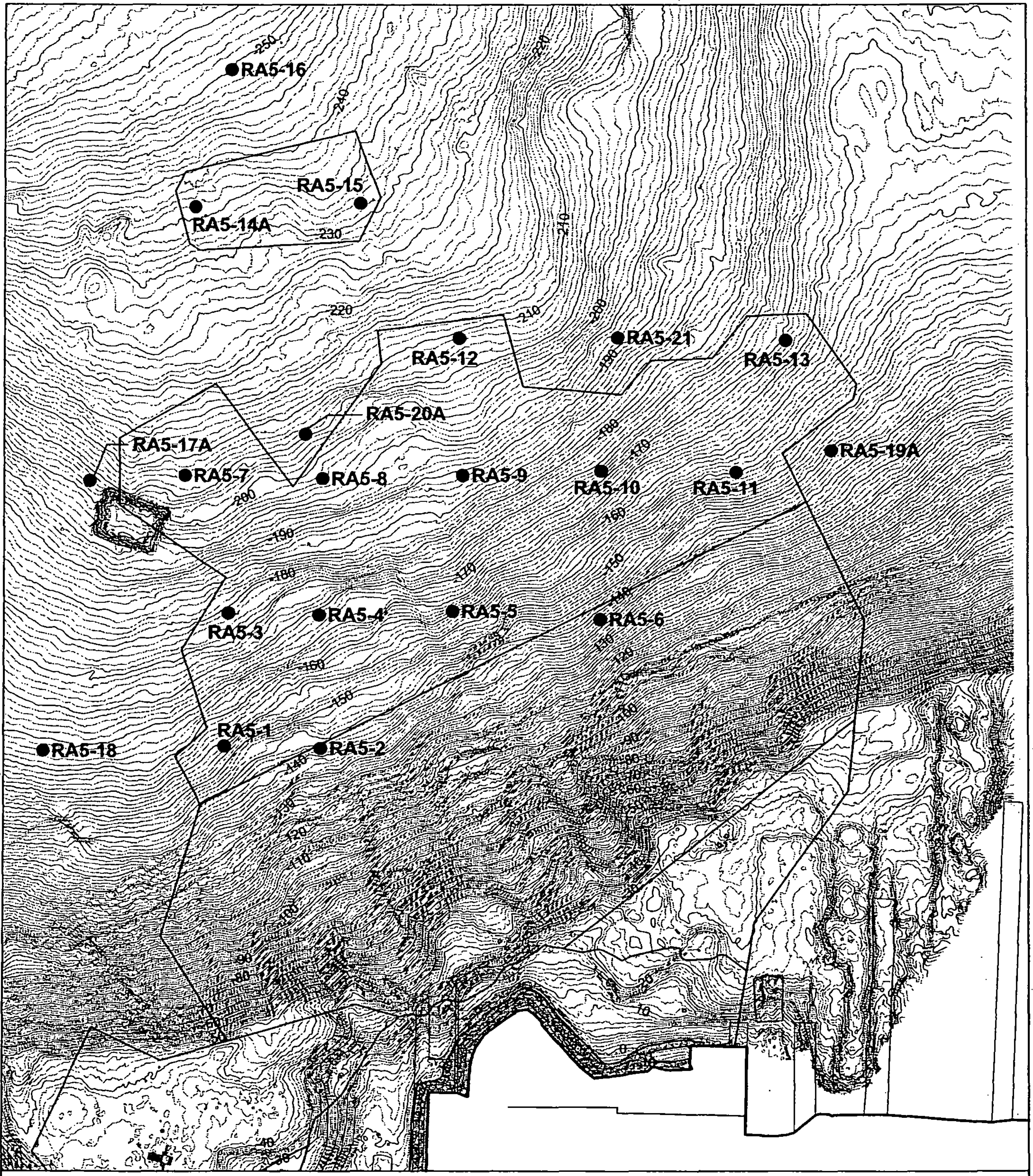
Figure 2
Representative Water Quality Monitoring Station (ribution



●RA5-5 Surface Sediment Grab Sample Location and Number

0 300
Scale in Feet

May 16, 2005 9:48am cdavidson K:\Jobs\020202-Seattle Corps\02020201\0202020125.dwg FIG 3

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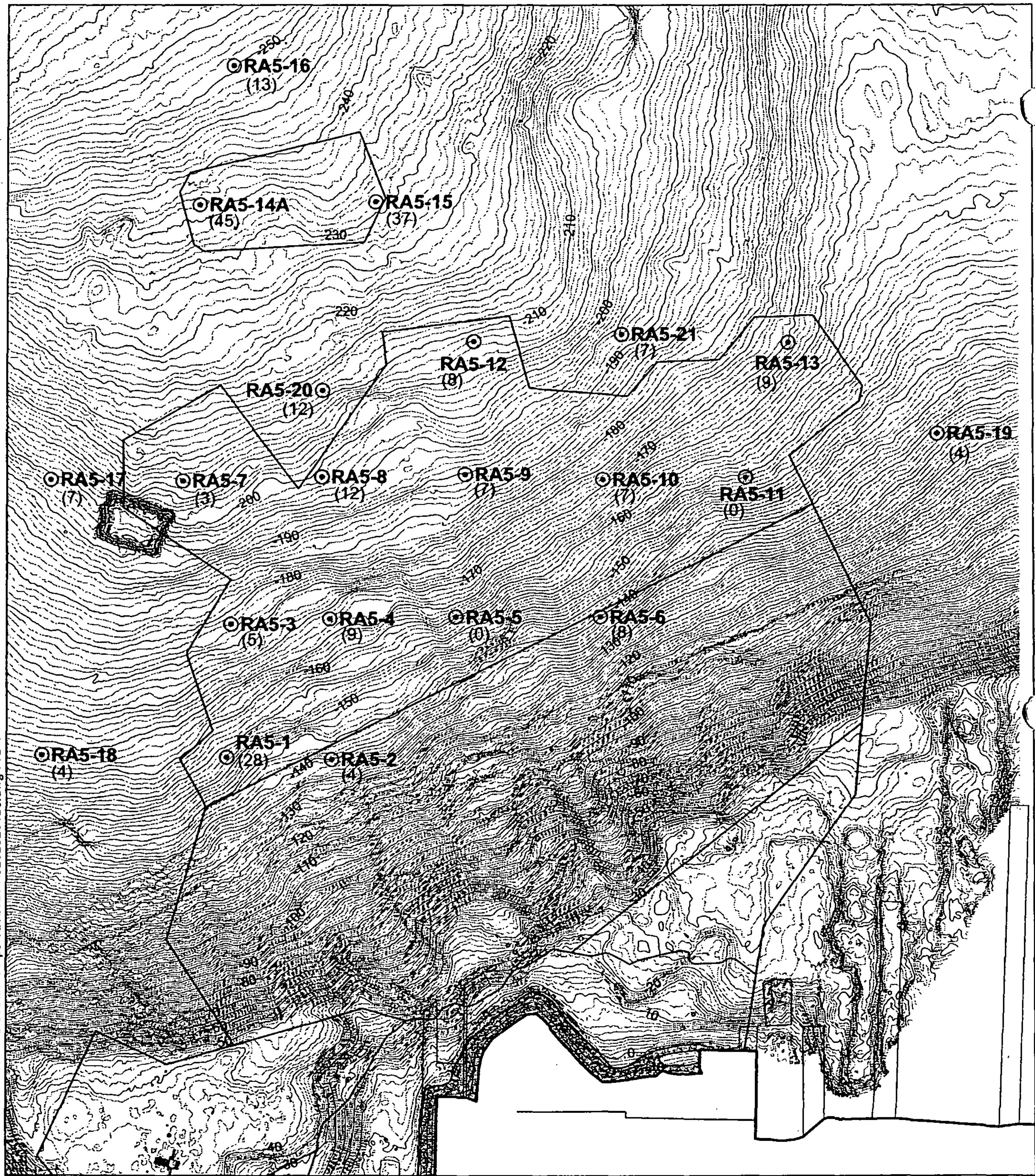
Figure 3
Locations of Surface Sediment Grab Samples at PSR RA5



⊙RA5-1 Through-Cap Core Location and Number

(12) Estimated RA5 Cap Thickness (in inches)

0 300
Scale in Feet

May 16, 2005 9:50am cdavidson K:\Jobs\020202-Seattle Corps\02020201\02020201026.dwg FIG 4

Figure 4
Locations of Through-Cap Cores at PSR RA5

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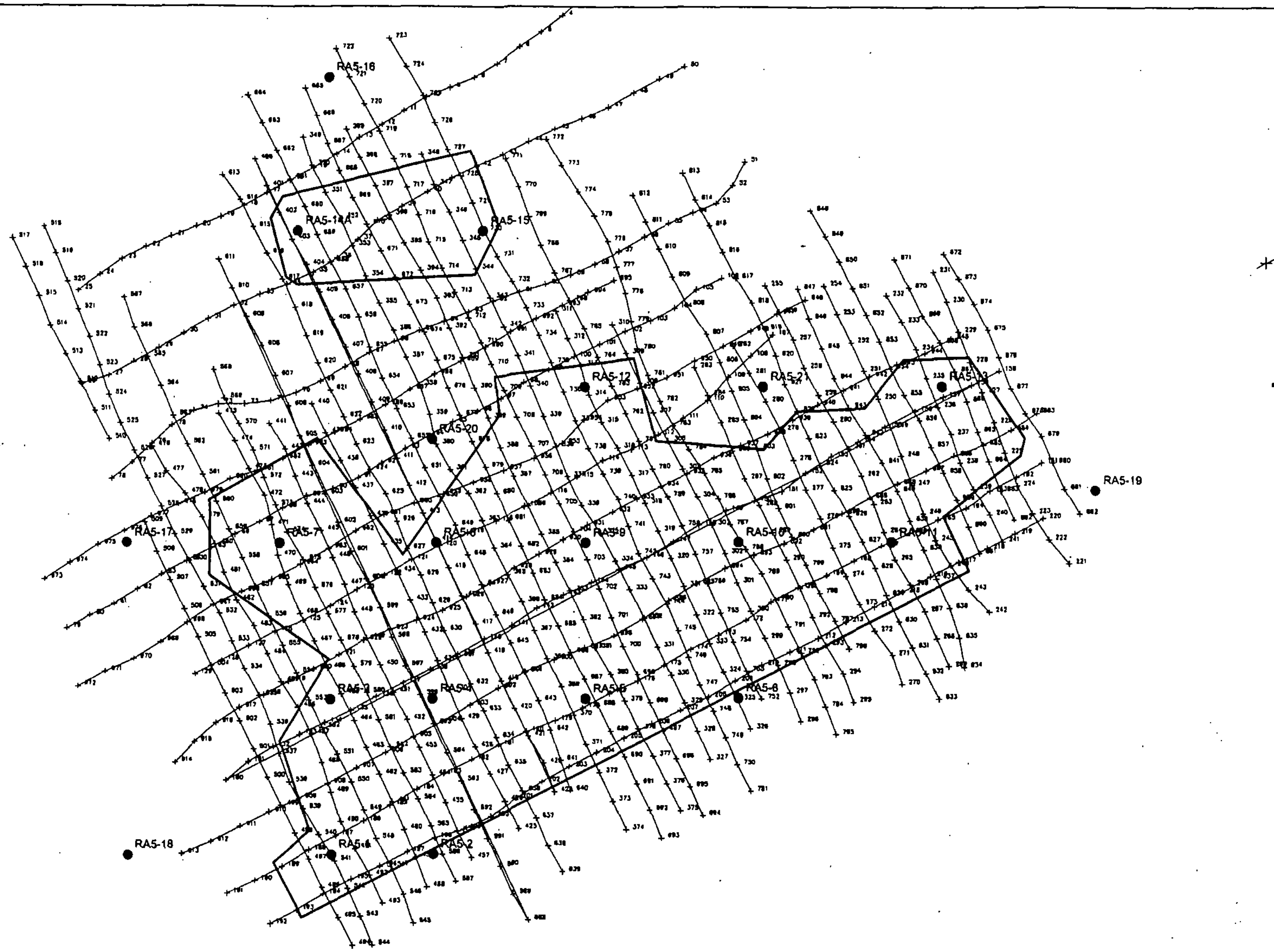

50
49
TRACKLINES AND EVENT NUMBERS

RA5-14
THROUGH CAP CORES

RA5 BOUNDARY

INSTRUMENTATION

DATASONIC SBP (3-12 KH3)
EPC MODEL 1086 GRAPHIC RECORDER
SONY MODEL 208 DIGITAL ACQUISITION
RESON MODEL 8124 MULTIBEAM (1-5° 200 KH3)
TRIMBLE AG 132

VERTICAL DATUM: MLLW
HORIZONTAL DATUM: WA STATE NORTH ZONE NAD 83 US SURVEY FEET

NOTES:

1. SURVEY DATE: APRIL 6, 2005

2. DRAWING PREPARED FROM ELECTRONIC DRAWINGS PROVIDED BY GOLDER ASSOCIATES.

0 200
Scale in Feet

May 23, 2005 11:03am cdavidson K:\Jobs\020202-Seattle Corps\02020201\0202020127.dwg FIG 5

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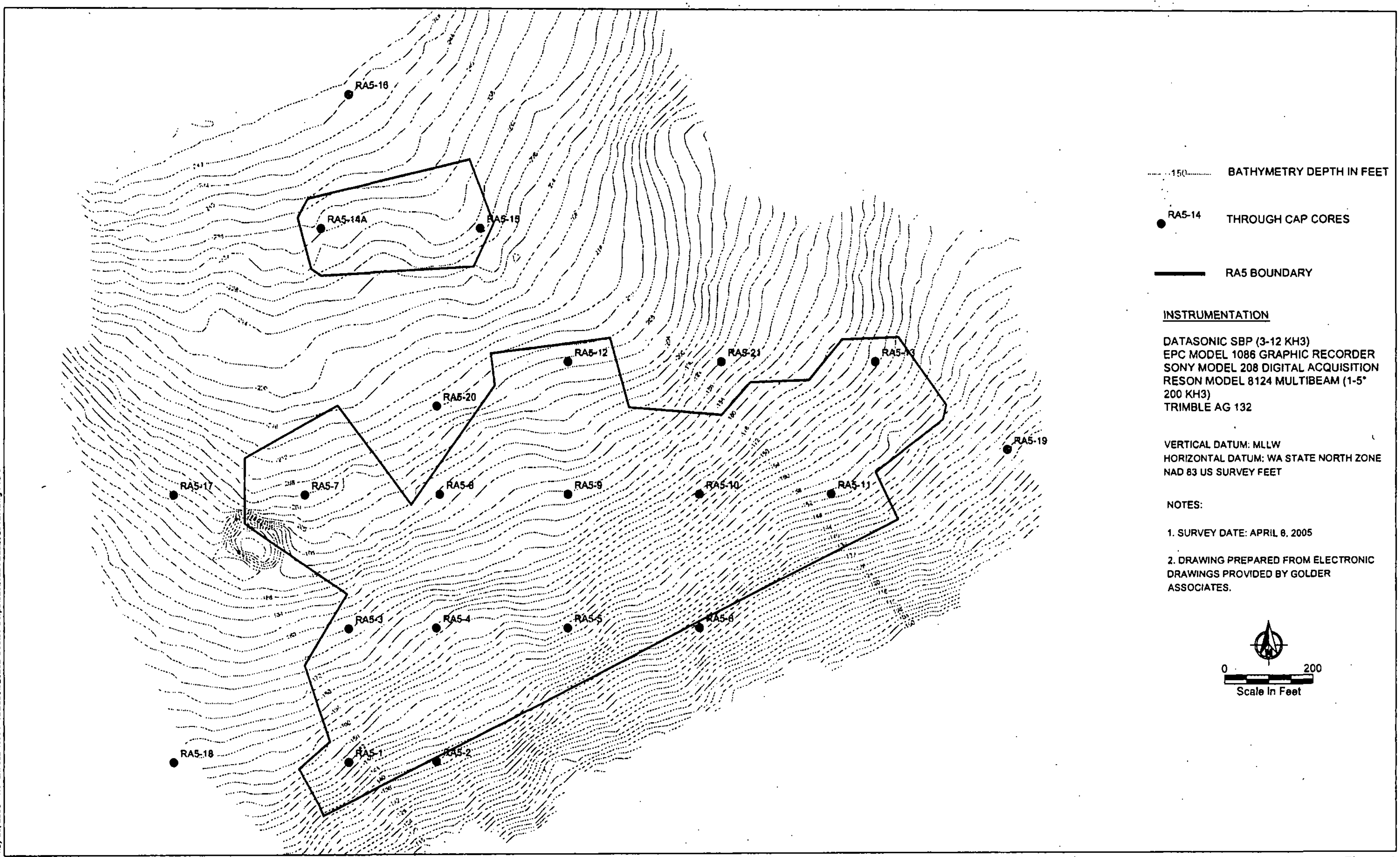
Figure 5
Tracklines for Sub-Bottom Profile and Multi-Beam Bathymetric Surveys



May 23, 2005 11:04am cdavidson K:\Jobs\020202-Seattle Corps\02020201\02020201127.dwg FIG 6

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Figure 6
Bathymetric Contours Derived from Post-Construction Multi-Beam Survey Data

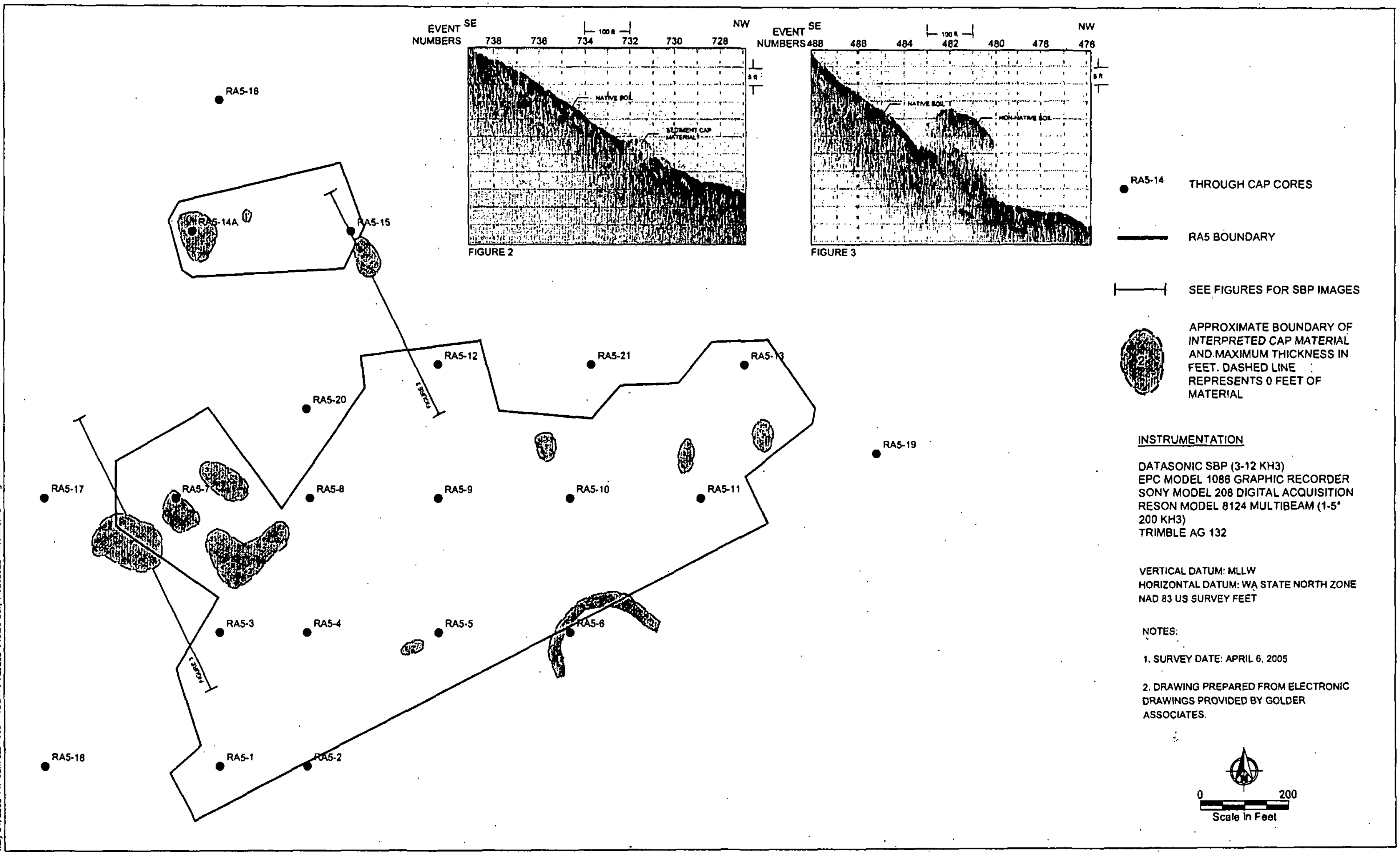

Figure 7
Cap Thickness Estimates, Sub-Bottom Profile Survey

ANCHOR ENVIRONMENTAL, L.L.C.

May 23, 2005 11:02am cdavidson K:\Jobs\020202-Seattle Corps\02020201\02020201 28.dwg FIG 8

Figure 8
Cap Thickness Estimates, Multi-Beam Bathymetric Survey

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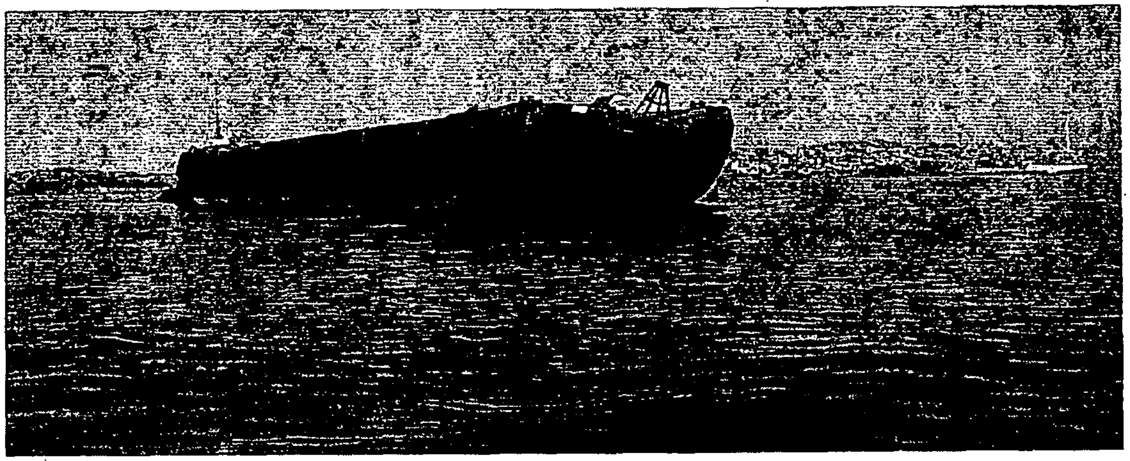
APPENDIX A
WATER QUALITY MONITORING REPORT

PSR-RA5 Material Placement

Water Quality Monitoring

CTD Data Report



April, 2005

PREPARED FOR:

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PREPARED BY:

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SEATTLE, WA 98105-4026

3.1 WATER QUALITY MONITORING

Evans-Hamilton, Inc. (EHI) conducted a comprehensive field water quality monitoring program during cap construction operations at the Pacific Sound Resources (PSR) Remedial Area 5 (RA5) site in Elliott Bay, Seattle, WA. The purpose of the monitoring program was to provide measurements and documentation confirming that scow cap material placement events had only temporary impacts on water quality. Specific monitoring activities were conducted to meet the requirements of the water quality criteria specified in the Quality Assurance Project Plan (QAPP, Anchor 2004).

Monitoring consisted of real time water quality measurements of dissolved oxygen (DO), turbidity, pH, temperature, and salinity prior to and following a cap material placement event. Three consecutive days of water quality monitoring were conducted during the first week of material placement and then once per week after that until the completion of the job in mid-February 2005. Unless otherwise noted in this document, water quality monitoring was conducted in accordance with the QAPP. Specifics involving field procedures, equipment descriptions and calibrations relating to the in-situ water quality monitoring are included herein.

3.1.1 Field Monitoring Procedures

Water quality monitoring was conducted from a small boat chartered by EHI from Mullins Guide Service, Inc. or Global Diving, Inc. for this project. The boat was set-up to accommodate a Global Positioning System (GPS), real time over-the-side (OTS) current profile data, in-situ water quality data (i.e.,CTD casts), and water grab sampling. Monitoring was conducted on January 5th, 6th, 7th, 12th, 21st, 27th, February 2nd and 8th of 2005. For safety considerations as well as requirements for making qualitative observations, sampling was conducted during daylight hours only.

Prior to a monitoring event, EHI contacted the dredge operator to determine tug and scow schedules that would allow sufficient time for the field crew to mobilize the boat and gear to the site and acquire background water quality and current data before the scow arrival at the target location. Once on site, the field crew contacted the tug operator to determine the final estimated time to site and placement, as well as the target coordinates for opening the scow. Prior to the scow's arrival, current measurements were made with an acoustic Doppler current profiler (ADCP) secured to the side of the boat to determine the general direction and velocity of the current. A CTD cast was made near the estimated target location to ascertain background water quality conditions before the cap material placement event.

The real-time, or in-situ, water quality sampling depths were made in accordance with the QAPP at 1 meter below the water surface, mid-water depth, and between 1 and 5 meters above the bottom. Direct observations of the real-time numerical display were recorded into the field data sheets for the discrete depths; however, DO, turbidity, temperature, and salinity were obtained for the entire water column and extracted and post-processed to develop a comparative profile to determine if exceedances of the water quality standards had occurred anywhere within the water column.

Upon arrival of the tug and scow, the monitoring boat was moved to a safe distance to allow the tug operator to maneuver the scow to the target position. Once the cap material placement was complete, the monitoring boat moved next to the scow and recorded the position, orientation, time, and other ancillary information (e.g., any surface evidence of dredge material). After the scow position was recorded, a water sampling station was plotted at 300 ft directly down current from the target location and is referred to as the Early Warning (EW) site. Two additional water sampling stations were plotted 20° left and 20° right of the current direction 600 ft from the target location and is referred to as Monitoring Stations 1 and 2 (MS1 and MS2, respectively). The locations of MS1 and MS2 were determined by the order of which the sites were occupied. Therefore, if the monitoring station 20° to the right was occupied first, then that site was designated MS1, and visa versa. The monitoring boat occupied each of these stations while CTD casts and, if needed, water samples were taken. If a water quality parameter failed to meet WAC criteria, the boat re-occupied that 600 ft station again at specific time intervals or until conditions warranted departing the site. These conditions usually were that turbidity values fell to background levels or Corps personnel felt sufficient data had been collected. Figures 1 through 8 in Attachment A-1 are a capture of the navigation screen and show the scow cap material placement locations and associated sampling stations for each monitoring day.

3.1.2 EQUIPMENT

NAVIGATION

A Wide Area Augmentation System (WAAS)-enabled handheld GPS was secured to the boat near the ADCP current meter or near the CTD when the current meter was not in use. An output National Marine Electronics Association (NMEA) data stream from the GPS was linked to a notebook computer running CHARTVIEW navigation software. This provided the vessel operator a real time display of the vessel position, heading, and plotted targets (sample stations) integrated onto an electronic nautical chart of the site.

HYDROLAB® H20 MULTIPROBE (CTD)

A Hydrolab® Model H20 Water Quality Multiprobe was used to obtain the in-situ water quality values for DO, turbidity, salinity, pH, temperature, and depth for each cast. The output from the CTD was interfaced into the serial communication port of a notebook computer running HyperTerminal communication software. The real time water quality values were displayed and refreshed once every second on the computer screen where direct observations for each depth of the profile could be made. CTD data for each profile cast was simultaneously recorded into its own data file to be directly imported into a Microsoft Excel spreadsheet macro to produce X,Y graphic representations of the cast profile for each parameter following each field effort.

Hydrolab® recording units:

Time:	Local (Pacific Standard Time), military format (HH:mm:ss), synchronized to GPS clock
Temperature:	Degrees centigrade (°C)
Conductivity:	Millimhos/cm
Salinity:	Parts per thousand (ppt)
DOsat:	Dissolved oxygen (% saturation)
DO:	Milligrams/liter (mg/l)
Turbidity:	Nephelometric turbidity units (NTU)
Depth:	Meters (m)
Battery:	Volts (v)

The CTD was calibrated by EHI personnel before the start of each sampling day or when abnormal observations of the data required the parameter to be checked or corrected against known standards. All calibrations were performed according to the manufacturer's procedures using the following laboratory calibration standards and methods:

(1) Salinity - HACH 53ms/cm (35.0 ppt) Conductivity Standard, LOT A3255, exp.SEP-08.
(2) pH – HACH pH7 ±0,02 CAT. 22835-56, LOT A3340, exp. DEC-05.
 pH – HACH pH10 ±0,02 CAT. 22836-56, LOT A3330, exp. NOV-05.
(3) Turbidity – AMOCO CLEAR 50 NTU, LOT 09HL50 exp. MAR-04.
 Filtered distilled water (0 NTU) for zero reference.
(4) Dissolved Oxygen – Real time barometric pressure (converted to mm of mercury) from the nearest weather station (Boeing Field) was obtained and input to the CTD to perform an air calibration on the DO system. The saturation value in milligrams per liter of zero chlorinity water from the 1985 Standards Methods for the Examination of Water and Wastewater at the probe sensor temperature was entered as the calibration standard for the standard flow

membrane. As an example, 10.084 mg/l would be input to the probe if the sensor temperature within the calibration cup was stable at 15.0 °C at the ambient barometric pressure.

(5) Time – Synchronized to GPS time and adjusted to Pacific Standard Time prior to each event.

(6) Depth - checked at the water surface to be recording 0.0 meters, and at 10.0-meter cable mark at depth.

Before each CTD cast, the recorded time was synchronized to the GPS time, and the CTD sensors were allowed to equilibrate to the water before recording the profile.

CURRENT METER

An RD Instruments 600 kHz Rio-Grande acoustic Doppler current profiler (ADCP) with bottom track was used to determine the current speed and direction at the target location before each monitoring event. The instrument was mounted on a pivot arm that extended over the side of the boat that allowed the ADCP to be lifted clear of the water when not in use. Due to the weak and variable currents at the site, velocity was referenced to the bottom track (vessel and current speed relative to the bottom) for better accuracy. Several current profiles in the shallower water slightly south of the site were taken. Station positions were based on the depth-averaged speed and current direction determined from the profiles.

General observations of the orientation of the moored barges in the anchorage area near the target location during monitoring also provided some qualitative support for determinations of the current direction.

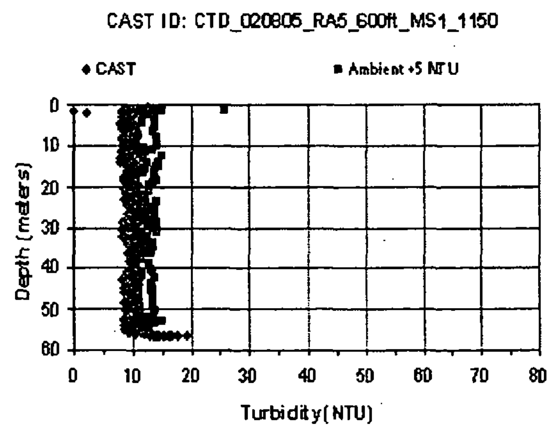
3.1.3 RESULTS

Water Quality – CTD Observations

Prior to each deployment, every CTD cast was given a unique filename identifying the date, time, and station position relative to the dredge activity. For example, "CTD_010505_600ft_MS1_1045" was taken on January 5, 2005, 600-feet down current of the target coordinates, at station Monitoring Station 1 (MS1), at 1045hrs. If another cast was required on the same station, the time stamp would differentiate it from the other casts made at that station. Because only one background and one early warning CTD cast were required, they are respectively identified as "Background" or "300ft_Early Warning" after the date stamp.

Although some parameters such as temperature and pH remain relatively stable throughout the water column, turbidity and DO may vary significantly in the dynamic environment with each update. Real time field observations of water quality parameters recorded at the time of sampling onto the daily field logs were made by the CTD technician observing the updating numerical data after the values stabilized at the required depth. This approach provided the best approximate mean value for the changing parameter readings. The readings recorded by the CTD technician onto the field log sheets are the values reported from the field to Corps personnel following the monitoring event. Field data logs have been included in Attachment 2. Processed CTD data have been summarized and presented in this report as Tables A-1 through A-8 for each location on their respective monitoring day. The values represent the mathematical mean of several readings for each parameter recorded at the respective monitoring depths.

A plot of reading versus depth (X,Y plot) for each cast illustrates the range of values observed for each parameter through the water column. The example to the right, taken from Attachment 3, illustrates that although the mean value of the parameter (green points) might not exceed the permitted limit of ambient plus 5 NTU (red points), some values might fall above that limit. In this example, higher values were initially observed before the values decreased and stabilized, resulting in a reported mean value of



10.4 NTU at 55.1 meters depth. Background turbidity was usually below 10 NTU. Turbidity was the only parameter to exceed water quality standards. Detailed CTD data including X,Y plots of the parameter data are included in Attachment 3. Both the downcast and upcast of the CTD are included in the plots illustrating duplicity and consistent turbidity readings throughout the water column. In some casts, the downcast for DO appeared slightly higher than the upcast, exaggerated just below the surface. This is due to a lag time in temperature equilibration from the surface, and in these cases, the lower value of the upcast is more accurate.

Exceedances for turbidity were observed and reported on all monitoring days except January 7th and January12th. In most cases, except for January 27th, the exceedance was observed in the near-bottom record and was usually limited to 5 to 10 meters from the bottom. Elevated turbidity was also observed at the mid-water depth on January 27th. Except for observations made on January 21st, CTD data collected during re-sampling of the stations that exceeded the turbidity criterion usually exhibited a reduction in turbidity, thereby indicating the effects on water quality were temporary for this operation. Visual surface observations made after the scow cap material placement event occasionally indicated 3 to 4 floating logs and localized surface turbidity that dissipated quickly.

3.1.4 DEVIATIONS FROM THE QAPP

Due to co-ordination difficulties and operational requirements of the tug and scow, it was often hazardous to attempt to collect CTD data at a background station, 600 ft up current of the target location after the cap material placement event. Instead, background CTD data was collected at the anticipated target location before the scow occupied the site and placed the cap material. The field crew obtained target co-ordinates and estimated arrival time from the tug operator via VHF radio contact.

On January 5th, a conflict with the chartered boat schedule arose because of the late arrival of the barge. The situation did not allow sufficient time for re-testing of stations MS1 and MS2, which showed slightly elevated turbidity levels. Two additional stations located approximately 300 ft from the target location along the projected 600 ft sampling station radials were collected before the 600 ft stations were collected. These confirmed the local effect of the cap material and the gradual dissipation of the turbidity over the 600 ft distance.

On January 6th, the field crew could not conduct further monitoring efforts beyond the second re-sampling due to sunset. A turbidity exceedance was recorded during the first round of sampling at stations MS1 and MS2; however, upon re-sampling, both stations showed significant drops in turbidity levels, although the reduced levels were still above criteria.

On January 7th, the field crew collected CTD data at the two projected 600 ft sampling stations, however turbidity was lower than measured background levels. Based on currents measured the previous two days, the field crew collected CTD data at two additional 600 ft stations along different radials from the target location. Turbidity levels were elevated at these two locations. The field crew observed no surface plumes or debris immediately after the cap material placement event, and turbidity levels had quickly returned to background levels approximately 40 minutes after the event.

On January 21st, CTD data were collected at two additional stations positioned 1000 ft from the target location along the same radials as the 600 ft sampling stations. These were collected after the 1-hour re-sampling of the stations at 600 ft showed the turbidity levels to be slowly decreasing but still exceeding the turbidity criterion. Turbidity levels were lower but still in exceedance at both 1000 ft stations.

Scow Target: G9
Dump Location: 47.58949°N, 122.36522°W
Dump Time: 9:09

Date: 1/5/2005
Scow ID: DS-5
Current: Variable (approximately 5 cm/s @283°) at 08:30

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data: Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	8:42	47.58948°	122.37317°	Flood	1.0	(3.3)	4.5	7.2	31.8	7.6	9.1
					27.0	(88.6)	3.3	6.4	32.3	7.5	9.4
					53.5	(175.5)	3.4	6.1	33.0	7.5	9.7
300 ft_Early Warning	9:18	47.58923°	122.36553°	Flood	1.0	(3.3)	13.5	7.2	31.7	7.6	9.0
					27.0	(88.6)	3.4	6.4	32.6	7.6	9.4
					52.9	(173.6)	84.9	6.3	32.8	7.5	9.5
300 ft_MS1	9:35	47.58929°	122.36523°	Flood	1.0	(3.3)	6.3	7.9	32.0	7.6	8.9
					25.5	(83.7)	3.3	7.0	32.3	7.6	9.2
					50.0	(164.0)	15.5	6.1	32.8	7.5	9.7
300 ft_MS2	9:48	47.58946°	122.36558°	Flood	1.0	(3.3)	11.4	7.9	31.7	7.5	8.5
					26.6	(87.3)	4.2	6.5	32.2	7.6	9.2
					52.1	(170.9)	29.4	6.3	33.0	7.5	9.6
600 ft_MS1	10:00	47.58894°	122.36542°	Flood	1.0	(3.3)	6.8	7.8	31.5	7.6	8.9
					24.5	(80.4)	5.2	6.5	32.9	7.6	9.4
					48.0	(157.5)	**11.3**	6.0	33.0	7.5	9.7
600 ft_MS2	10:13	47.58542°	122.35955°	Flood	1.0	(3.3)	9.6	8.6	32.0	7.6	8.4
					27.5	(90.2)	4.8	6.3	32.7	7.6	9.5
					54.0	(177.2)	**14.5**	6.0	32.9	7.6	9.7

Table A-1. Station and CTD summary for January 5th, 2005 (Turbidity exceedances in bold type)

Scow Target: G1/G2
Dump Location: 47.58665°N, 122.37139°W
Dump Time: 16:10

Date: 1/6/2005
Scow ID: CK-7
Current: Approximately 25 cm/s @300° at 15:00

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data: Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	15:15	47.58828°	122.37255°	Ebb	1.0	(3.3)	7.5	7.5	30.8	7.6	8.3
					24.7	(81.0)	6.4	6.9	32.8	7.6	9.1
					48.4	(158.8)	5.5	6.4	33.1	7.6	9.5
300 ft_Early Warning	16:27	47.58701°	122.37243°	Ebb	1.0	(3.3)	7.0	7.5	32.2	7.7	8.4
					26.9	(88.3)	5.2	7.1	32.7	7.6	9.0
					53.0	(173.9)	194.2	6.2	33.0	7.6	9.4
600 ft_MS1	16:32	47.58798°	122.37308°	Ebb	1.0	(3.3)	7.7	7.5	32.0	7.7	8.4
					26.0	(85.3)	6.2	6.8	32.8	7.7	9.1
					55.2	(181.1)	**102.1**	6.3	33.1	7.6	9.4
600 ft_MS2	16:43	47.58683°	122.37393°	Ebb	1.0	(3.3)	6.5	7.7	32.1	7.7	8.2
					22.0	(72.2)	7.5	6.9	32.6	7.7	8.9
					41.6	(136.5)	**11.2**	6.3	33.0	7.7	9.4
600 ft_MS1	16:53	47.58819°	122.37282°	Ebb	1.0	(3.3)	7.8	7.5	32.0	7.7	8.4
					25.1	(82.3)	12.0	7.0	32.6	7.7	8.9
					52.8	(173.2)	**11.6**	6.2	33.2	7.6	9.7

Table A-2. Station and CTD summary for January 6th, 2005 (Turbidity exceedances in bold type)

Scow Target: G5/F5
Dump Location: 47.58695°N, 122.36840°W
Dump Time: 11:17

Date: 1/7/2005
Scow ID: CK-7
Current: Weak and variable (approximately 10 cm/s @195°)

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data						
					Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	10:20	47.59074°	122.37038°	Flood	1.0	(3.3)	5.5	7.5	32.1	7.7	8.3
					29.1	(95.5)	8.1	6.5	33.2	7.7	9.5
					57.1	(187.3)	9.3	5.8	33.4	7.7	9.7
300 ft_Early Warning	11:30	47.58583°	122.36828°	Flood	1.0	(3.3)	6.4	7.5	32.0	7.7	8.3
					12.8	(42.0)	5.9	6.9	32.8	7.7	8.9
					24.7	(81.0)	5.9	6.6	33.0	7.7	9.2
600 ft_MS1	11:35	47.58557°	122.36917°	Flood	1.0	(3.3)	6.1	7.4	32.4	7.7	8.5
					11.0	(36.1)	5.2	7.1	32.7	7.7	8.8
					21.0	(68.9)	5.5	6.9	33.0	7.7	9.1
600 ft_MS2	11:50	47.58543°	122.36787°	Flood	1.0	(3.3)	5.1	7.5	31.7	7.7	8.3
					5.0	(16.4)	5.0	7.3	32.5	7.7	8.6
					8.5	(27.9)	5.7	7.4	32.6	7.7	8.8
Dump site re-check (Partial)	11:55	47.58673°	122.36795°	Flood	1.0	(3.3)	7.1	7.4	32.2	7.7	8.4
					18.6	(61.0)	5.7	6.8	33.0	7.7	9.1
					36.2	(118.8)	9.3	6.3	33.3	7.7	9.6
300 ft_Early Warning[1]	12:10	47.58585°	122.3683°	Flood/Slack	1.0	(3.3)	6.0	-	-	-	-
					13.0	(42.7)	7.0	-	-	-	-
					24.0	(78.7)	9.0	-	-	-	-
600 ft_MS1b	12:20	47.58833°	122.36913°	Flood/Slack	1.0	(3.3)	5.5	7.4	32.2	7.7	8.4
					30.9	(101.4)	5.5	6.3	33.2	7.7	9.5
					60.8	(199.5)	12.7	6.4	33.4	7.7	9.7
600 ft_MS2b	12:30	47.58762°	122.37058°	Slack	1.0	(3.3)	5.5	7.4	32.3	7.7	8.5
					29.6	(97.1)	6.0	6.5	33.2	7.7	9.4
					58.2	(190.9)	9.6	5.8	33.4	7.7	9.7

[1] File not recorded. Turbidity results from field logs

Table A-3. Station and CTD summary for January 7th, 2005

Scow Target: D5/D6
Dump Location: 47.58924°N, 122.36894°W
Dump Time: 12:44

Date: 1/12/2005
Scow ID: DS-5
Current: Variable (approximately 20 cm/s @300°) at 1200

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data						
					Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	12:10	47.59028°	122.37085°	Slack	1.0	(3.3)	11.4	6.7	32.2	7.6	9.1
					33.1	(108.6)	9.1	6.3	33.6	7.6	9.1
					64.9	(212.9)	11.6	5.9	34.2	7.6	9.2
300 ft_Early Warning	12:55	47.58917°	122.37044°	Slack/Ebb	1.0	(3.3)	13.1	6.7	32.6	7.6	9.2
					31.7	(104.0)	7.6	6.7	32.9	7.7	9.0
					62.4	(204.7)	30.1	5.8	33.6	7.6	9.2
600 ft_MS1	13:10	47.58918°	122.37185°	Slack/Flood	1.0	(3.3)	7.4	6.6	32.8	7.7	9.2
					33.0	(108.3)	8.5	6.5	33.2	7.7	9.0
					65.3	(214.2)	9.7	6.0	33.7	7.6	9.2
600 ft_MS2	13:20	47.59019°	122.37090°	Slack/Flood	1.0	(3.3)	7.9	6.8	32.6	7.7	9.1
					34.0	(111.5)	8.0	6.5	33.1	7.7	9.0
					67.0	(219.8)	9.9	5.8	33.8	7.6	9.2

Table A-4. Station and CTD summary for January 12th, 2005

Scow Target: F7
Dump Location: 47.58908°N, 122.36561°W
Dump Time: 14:17

Date: 1/21/2005
Scow ID: DS-5
Current: Variable (approximately 5 cm/s @300°) at 1030

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data: Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	10:37	47.58930°	122.36912°	Flood	1.0	(3.3)	10.3	7.1	32.4	7.6	8.9
					36.0	(118.1)	9.1	6.3	34.7	7.6	8.9
					70.9	(232.6)	12.0	5.9	34.9	7.5	8.7
300 ft_Early Warning	14:31	47.58928°	122.36772°	Slack/Ebb	1.0	(3.3)	11.5	6.8	33.2	7.6	9.0
					32.3	(106.0)	10.0	6.5	33.7	7.6	9.0
					63.6	(208.7)	29.3	6.1	34.5	7.6	8.9
600 ft_MS1	14:42	47.58018°	122.36820°	Slack/Ebb	1.0	(3.3)	10.4	6.9	32.8	7.6	8.9
					33.8	(110.9)	8.9	6.5	34.1	7.6	8.9
					66.6	(218.5)	**37.5**	6.0	34.1	7.6	8.9
600 ft_MS2	14:50	47.58912°	122.36912°	Ebb	1.0	(3.3)	8.6	7.0	33.2	7.6	9.1
					33.5	(109.9)	8.7	6.4	34.0	7.6	8.9
					66.0	(216.5)	**27.7**	5.8	34.4	7.6	8.9
600 ft_MS1	14:57	47.59017°	122.36828°	Ebb	1.0	(3.3)	10.5	6.9	33.4	7.6	9.0
					33.5	(109.9)	9.0	6.4	34.8	7.6	8.9
					66.9	(219.5)	**36.9**	5.9	34.8	7.6	8.9
600 ft_MS2	15:05	47.58915°	122.36900°	Ebb	1.0	(3.3)	8.1	7.0	33.4	7.6	9.0
					33.7	(110.6)	8.9	6.5	34.5	7.6	8.9
					66.5	(218.2)	**23.6**	5.9	34.2	7.6	8.9
600 ft_MS1	15:15	47.59023°	122.36828°	Ebb	1.0	(3.3)	10.0	6.9	32.7	7.6	8.9
					34.0	(111.5)	8.4	6.4	34.5	7.6	8.9
					66.9	(219.5)	**27.2**	5.8	34.7	7.6	8.9
600 ft_MS2	15:22	47.59133°	122.36905°	Ebb	1.0	(3.3)	12.9	7.1	32.3	7.6	9.0
					33.2	(108.9)	10.8	6.5	34.8	7.6	8.9
					65.4	(214.6)	**21.1**	5.9	34.5	7.6	8.9
600 ft_MS1	15:45	47.59065°	122.37340°	Ebb	1.0	(3.3)	10.7	6.9	32.5	7.6	8.9
					33.7	(110.6)	7.1	6.3	34.4	7.6	8.9
					66.4	(217.8)	**27.9**	6.1	34.0	7.6	8.9
600 ft_MS2	15:50	47.58900°	122.36900°	Ebb	1.0	(3.3)	9.5	7.0	32.7	7.6	9.0
					32.8	(107.6)	10.3	6.5	34.4	7.6	8.9
					64.6	(211.9)	**25.9**	5.8	34.9	7.6	8.9
1000 ft_MS2	16:00	47.58927°	122.37067°	Ebb	1.0	(3.3)	11.9	7.6	31.9	7.6	9.1
					35.0	(114.8)	8.2	6.1	34.6	7.6	8.9
					69.1	(226.7)	**17.2**	5.7	34.9	7.6	8.9
1000 ft_MS1	16:05	47.59092°	122.36922°	Ebb	1.0	(3.3)	7.5	6.7	33.9	7.6	9.0
					36.8	(120.7)	9.2	6.4	34.9	7.6	8.9
					72.7	(238.5)	**20.2**	5.5	34.2	7.6	8.9

Table A-5. Station and CTD summary for January 21st, 2005 (Turbidity exceedances in bold type)

Scow Target: G1/G2
Dump Location: 47.58823°N, 122.37052°W
Dump Time: 10:42

Date: 1/27/2005
Scow ID: DS-5
Current: Weak and variable (approximately 10cm/s @270°)

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data: Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	10:10	47.58829°	122.36880°	Ebb	1.0	(3.3)	5.5	7.1	33.5	7.6	8.8
					22.5	(73.8)	5.2	6.5	34.5	7.7	8.8
					44.1	(144.7)	7.2	6.3	34.6	7.6	8.8
300 ft_Early Warning	11:10	47.58623°	122.37173°	Ebb	1.0	(3.3)	6.3	7.6	31.3	7.7	8.8
					24.5	(80.4)	5.6	6.9	34.6	7.6	8.9
					48.0	(157.5)	26.3	6.0	34.5	7.6	8.9
600 ft_MS1	11:20	47.58681°	122.37279°	Ebb	1.0	(3.3)	5.8	7.5	31.9	7.6	8.8
					26.4	(86.6)	5.4	6.6	34.4	7.7	8.8
					51.7	(169.6)	**35.6**	6.1	34.7	7.6	8.9
600 ft_MS2	11:35	47.58577°	122.37285°	Ebb	1.0	(3.3)	5.1	7.5	32.1	7.7	8.8
					22.4	(73.5)	6.0	6.7	34.1	7.6	8.9
					43.8	(143.7)	10.7	6.4	34.5	7.6	8.9
600 ft_MS1	11:40	47.58672°	122.37275°	Ebb	1.0	(3.3)	4.4	7.5	31.9	7.7	8.8
					26.5	(86.9)	**11.1**	6.5	34.6	7.7	8.9
					52.0	(170.6)	**12.4**	6.3	34.9	7.6	8.9
600 ft_MS1	11:55	47.58691°	122.37282°	Ebb	1.0	(3.3)	6.4	7.4	31.5	7.7	8.8
					20.6	(67.6)	6.8	6.6	34.4	7.7	8.8
					40.1	(131.6)	**21.4**	6.4	34.7	7.6	8.8
600 ft_MS1	12:20	47.58687°	122.37273°	Slack	1.0	(3.3)	6.4	7.4	32.0	7.7	8.8
					25.8	(84.6)	**22.5**	6.5	34.4	7.7	8.9
					50.6	(166.0)	**21.3**	6.2	34.5	7.6	8.8
600 ft_MS1	12:40	47.58678°	122.37271°	Slack	1.0	(3.3)	5.4	7.9	32.3	7.6	8.8
					26.0	(85.3)	**18.1**	6.5	34.4	7.6	8.9
					51.1	(167.7)	**19.9**	6.2	34.7	7.6	8.8
600 ft_MS1	12:55	47.58676°	122.37286°	Slack	1.0	(3.3)	5.6	7.9	29.8	7.5	9.1
					26.0	(85.3)	**13.8**	6.5	34.3	7.6	8.9
					51.1	(167.7)	**17.0**	6.1	34.5	7.6	8.8

Table A-6. Station and CTD summary for January 27th, 2005 (Turbidity exceedances in bold type)

Scow Target: B2
Dump Location: 47.58953°N, 122.37042°W
Dump Time: 14:26

Date: 2/2/2005
Scow ID: DS-5
Current: Weak and variable (approximately 10cm/s to 15 cm/s @275°)

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data: Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	14:16	47.58888°	122.36826°	Ebb	1.0	(3.3)	5.6	7.2	32.3	7.6	9.1
					29.8	(97.8)	10.3	6.6	34.4	7.5	8.7
					58.5	(191.9)	13.3	6.1	34.6	7.5	8.7
300 ft_Early Warning	14:55	47.58963°	122.37154°	Ebb	1.0	(3.3)	9.7	6.9	33.1	7.6	9.0
					35.4	(116.1)	6.8	6.6	34.4	7.6	8.7
					69.8	(229.0)	51.6	6.2	34.5	7.5	8.7
600 ft_MS1	15:05	47.58910°	122.37288°	Ebb	1.0	(3.3)	6.6	6.8	33.3	7.6	9.0
					33.4	(109.6)	11.1	6.5	34.4	7.6	8.7
					66.0	(216.5)	**48.8**	6.1	34.6	7.5	8.7
600 ft_MS2	15:12	47.59027°	122.37261°	Ebb	1.0	(3.3)	5.5	6.9	33.4	7.6	8.9
					38.5	(126.3)	9.1	6.6	34.5	7.6	8.7
					76.1	(249.7)	**64.5**	6.1	34.5	7.5	8.7
600 ft_MS1	15:20	47.58901°	122.37271°	Ebb	1.0	(3.3)	5.2	6.8	33.5	7.6	8.9
					33.0	(108.3)	7.6	6.6	34.5	7.6	8.7
					64.9	(212.9)	**25.9**	6.0	34.6	7.6	8.7
600 ft_MS2	15:32	47.59023°	122.37253°	Ebb	1.0	(3.3)	8.6	8.6	32.0	7.6	9.1
					38.4	(126.0)	9.0	6.6	34.5	7.6	8.7
					75.7	(248.4)	**39.0**	6.1	34.6	7.6	8.7
600 ft_MS1	15:50	47.58908°	122.37267°	Ebb	1.0	(3.3)	7.9	7.5	32.1	7.6	9.2
					33.2	(108.9)	7.5	6.6	34.3	7.6	8.7
					65.3	(214.2)	15.2	6.1	34.5	7.6	8.7
600 ft_MS2	15:55	47.59028°	122.37263°	Ebb	1.0	(3.3)	7.7	8.0	32.7	7.6	9.0
					38.6	(126.6)	7.5	6.5	34.4	7.6	8.7
					76.3	(250.3)	**23.4**	6.4	34.7	7.6	8.7
600 ft_MS1	16:13	47.58918°	122.37261°	Ebb	1.0	(3.3)	7.8	6.8	33.7	7.6	8.9
					38.2	(125.3)	7.3	6.5	34.4	7.6	8.7
					75.3	(247.0)	**23.6**	5.8	34.7	7.6	8.7

Table A-7. Station and CTD summary for February 2nd, 2005 (Turbidity exceedances in bold type)

Scow Target: E1
Dump Location: 47.58768°N, 122.37138°W
Dump Time: 11:14

Date: 2/8/2005
Scow ID: CK-7
Current: Weak and variable (approximately 10cm/s to 20 cm/s @310°)

Station	Time (PST)	Latitude (DD.ddddd° N)	Longitude (DDD.dddd° W)	Tide	Processed CTD Data: Depth Meters	(feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
Background	11:10	47.58776°	122.37090°	Ebb/Slack	1.0	(3.3)	10.0	7.3	33.0	7.6	8.6
					27.1	(88.9)	9.0	6.7	34.4	7.6	8.7
					53.2	(174.5)	7.3	6.7	34.4	7.6	8.7
300 ft_Early Warning	11:40	47.58830°	122.37237°	Slack/Flood	1.0	(3.3)	9.6	7.3	33.0	7.7	8.6
					31.4	(103.0)	10.6	6.7	34.4	7.7	8.7
					61.8	(202.8)	158.7	6.4	34.5	7.6	8.7
600 ft_MS1	11:50	47.58827°	122.37362°	Slack/Flood	1.0	(3.3)	9.1	7.3	33.2	7.7	8.6
					28.3	(92.8)	10.6	6.8	34.4	7.7	8.6
					55.6	(182.4)	10.6	6.5	34.5	7.7	8.7
600 ft_MS2	12:05	47.58913°	122.37265°	Slack/Flood	1.0	(3.3)	10.7	7.4	32.5	7.7	8.4
					35.1	(115.2)	10.4	6.7	34.4	7.7	8.7
					68.0	(223.1)	**27.1**	6.4	34.5	7.6	8.7
600 ft_MS2	12:20	47.58914°	122.37263°	Flood	1.0	(3.3)	9.3	7.1	33.2	7.7	8.6
					34.5	(113.2)	10.6	6.9	34.5	7.7	8.7
					68.0	(223.1)	**14.5**	6.4	34.5	7.7	8.7

Table A-8. Station and CTD summary for February 8th, 2005 (Turbidity exceedances in bold type)

ATTACHMENT A-1

PSR-RA5

WATER QUALITY MONITORING

MONITORING STATIONS

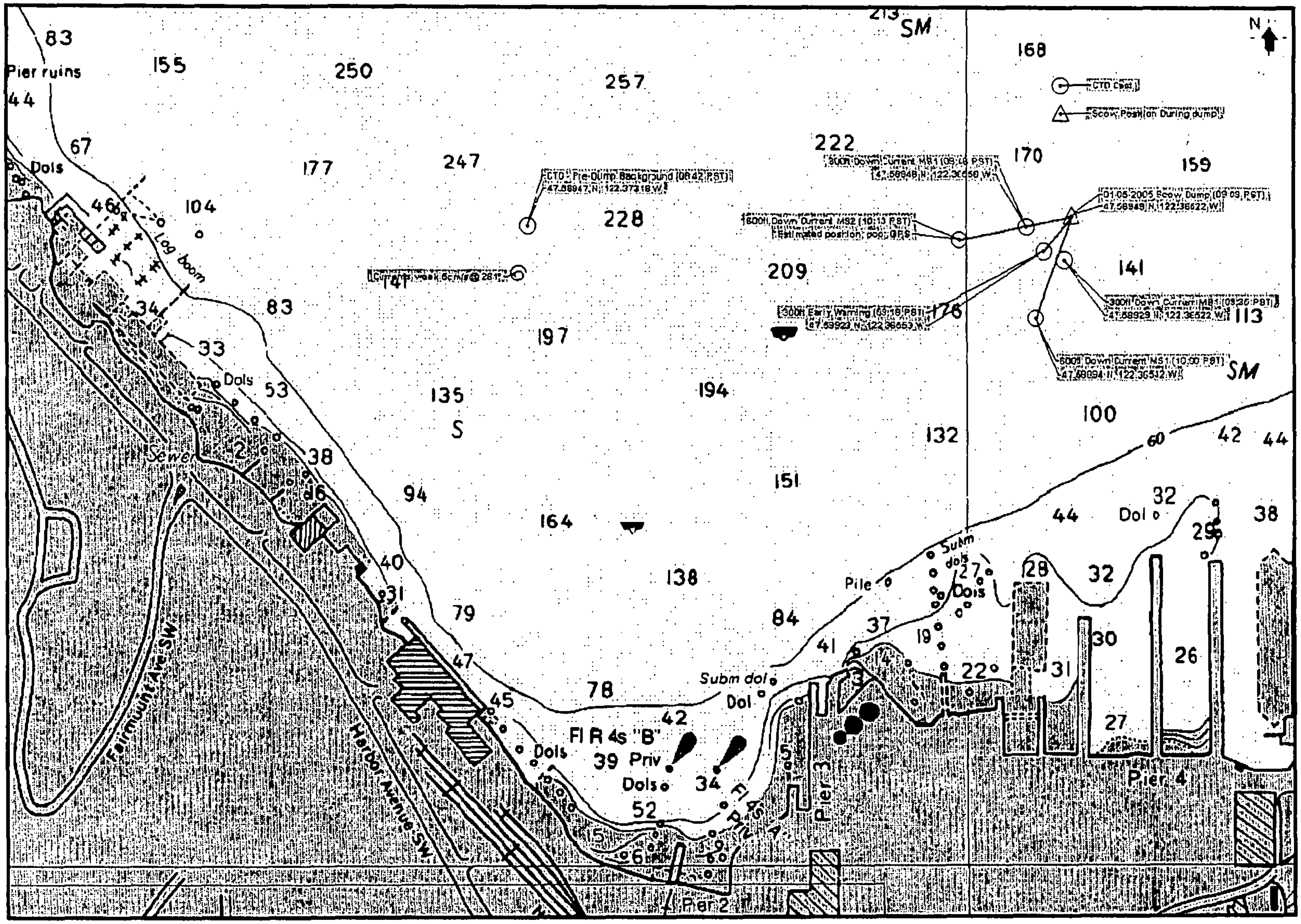


Figure A-1. Monitoring stations on January 5th, 2005

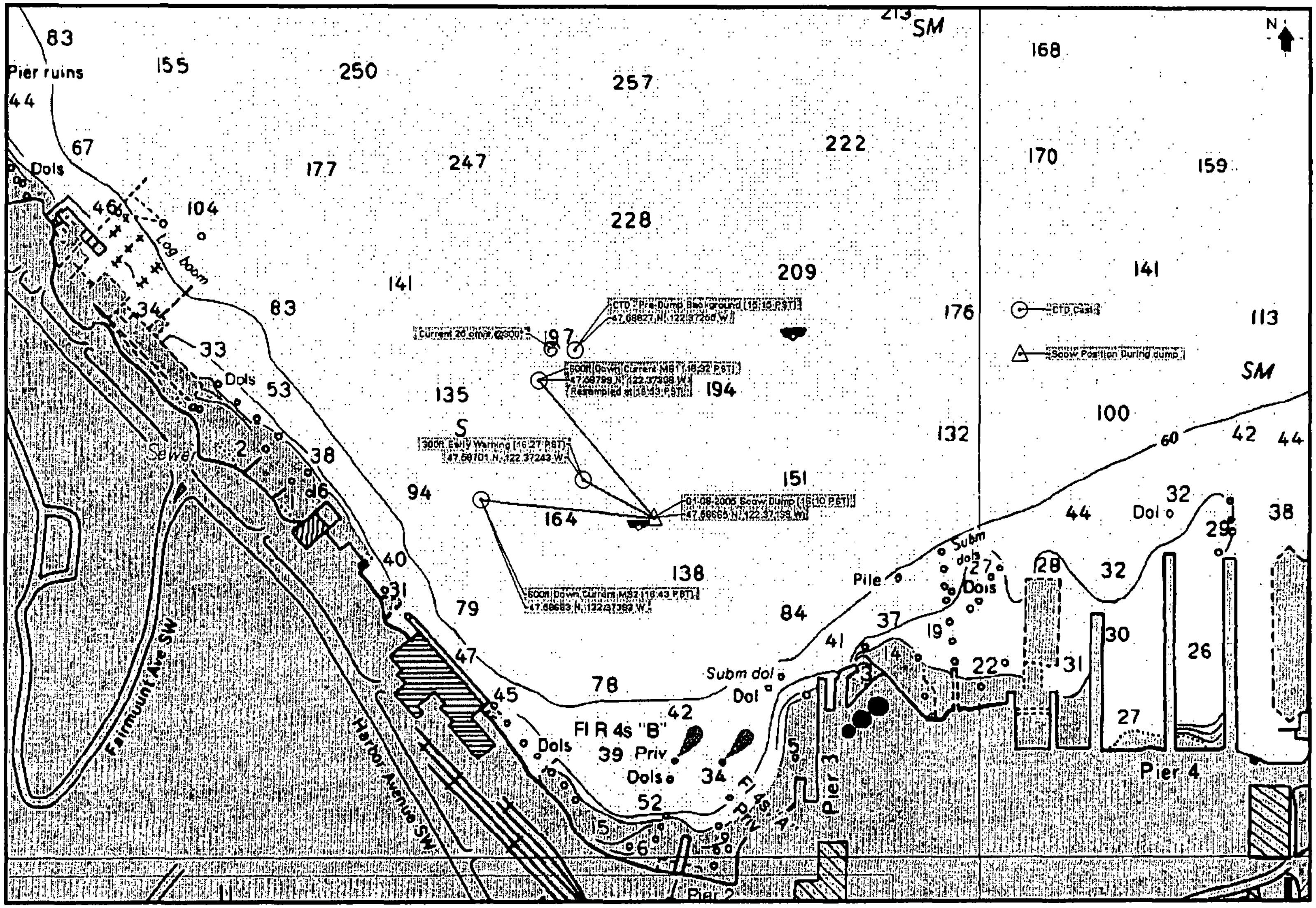


Figure A-2. Monitoring stations on January 6th, 2005

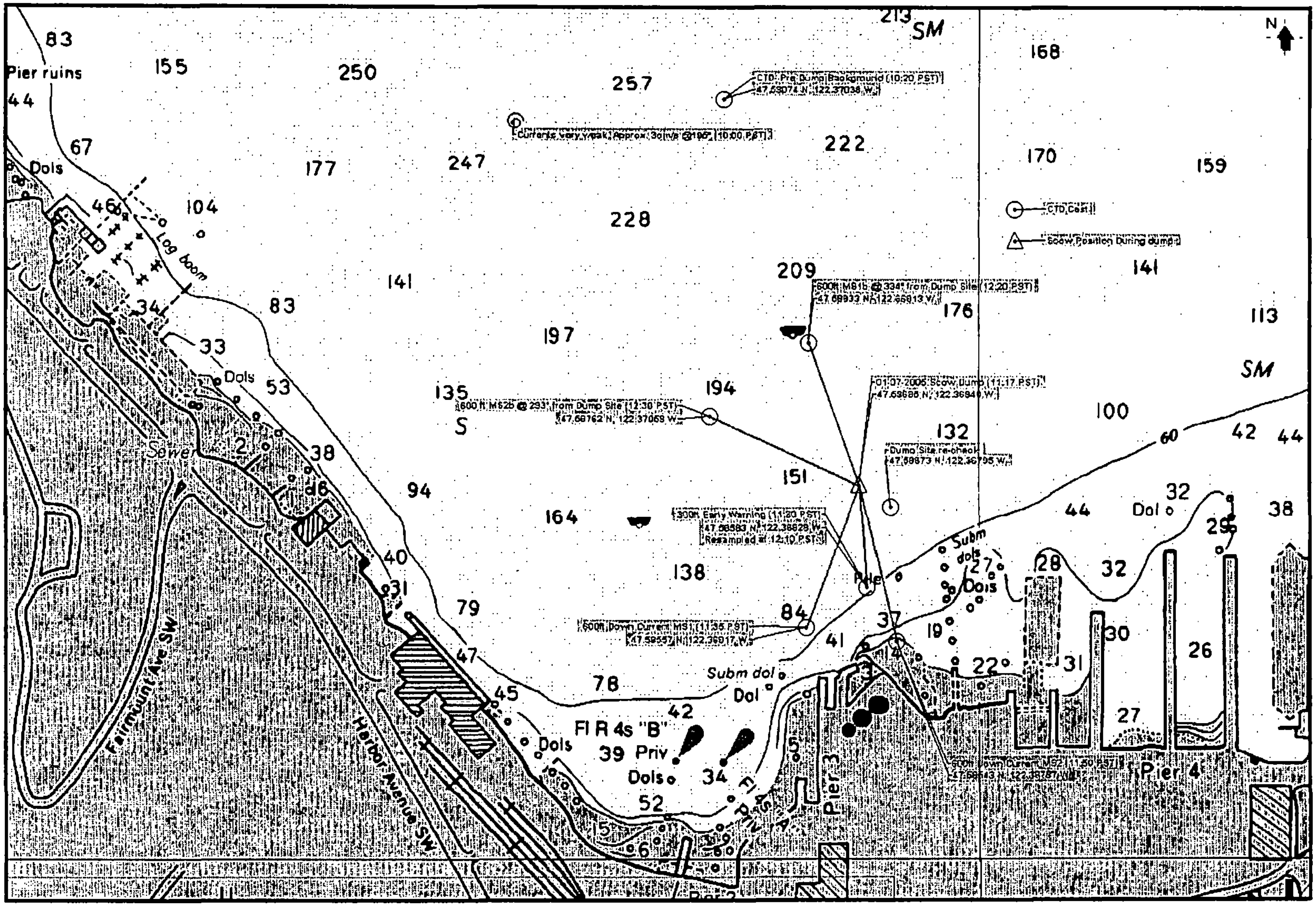


Figure A-3. Monitoring stations on January 7th, 2005

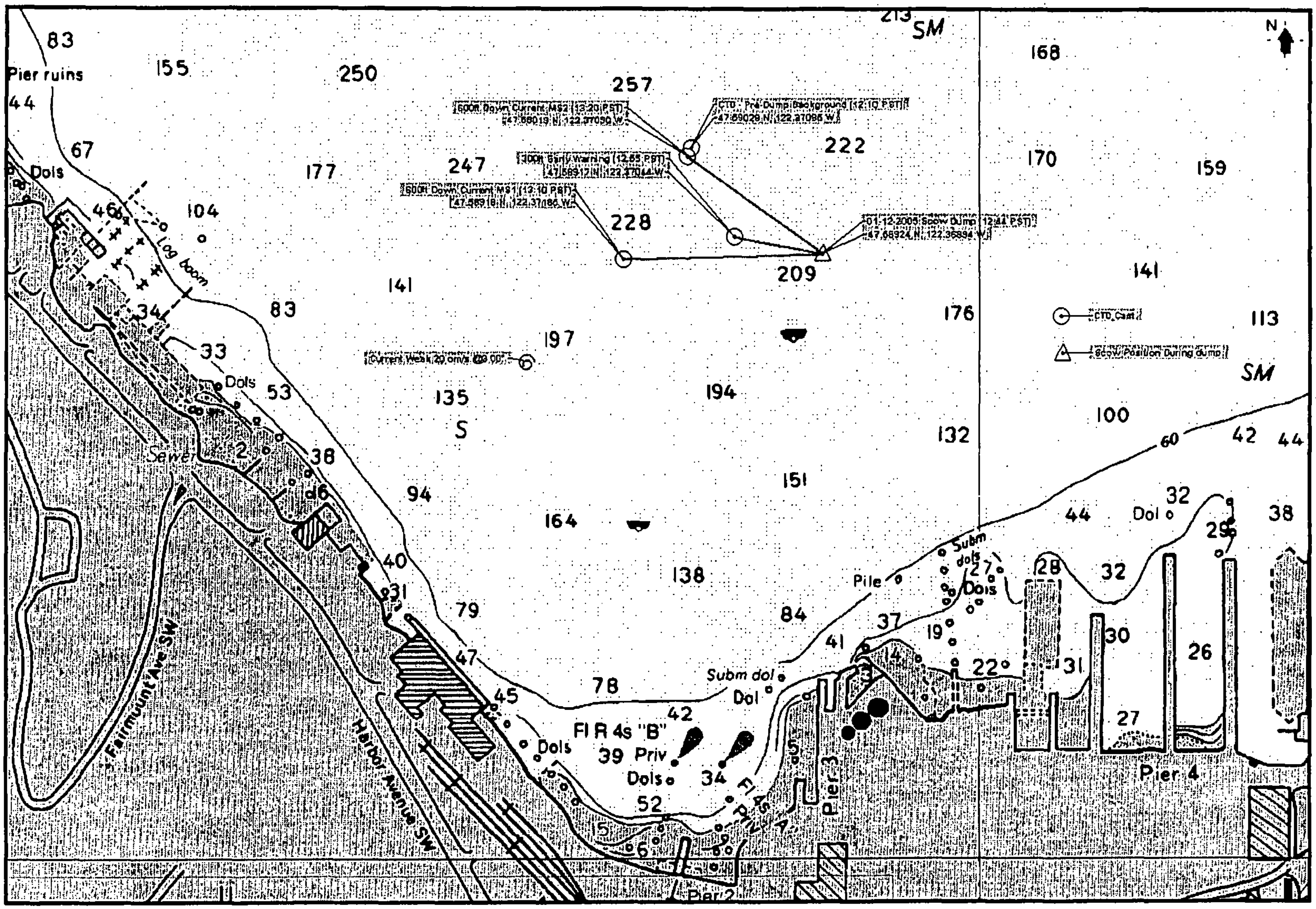


Figure A-4. Monitoring stations on January 12th, 2005

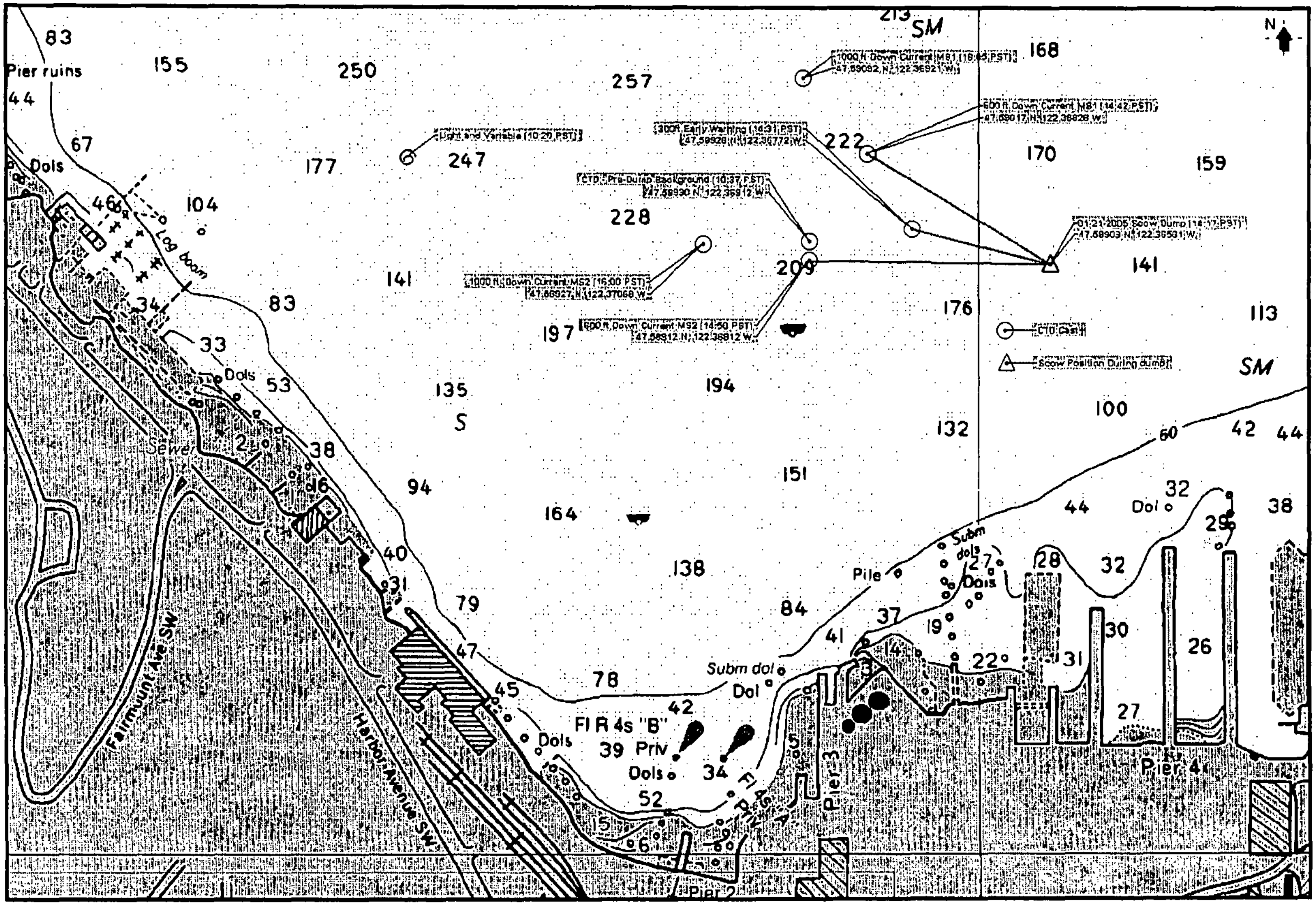


Figure A-5. Monitoring stations on January 21st, 2005

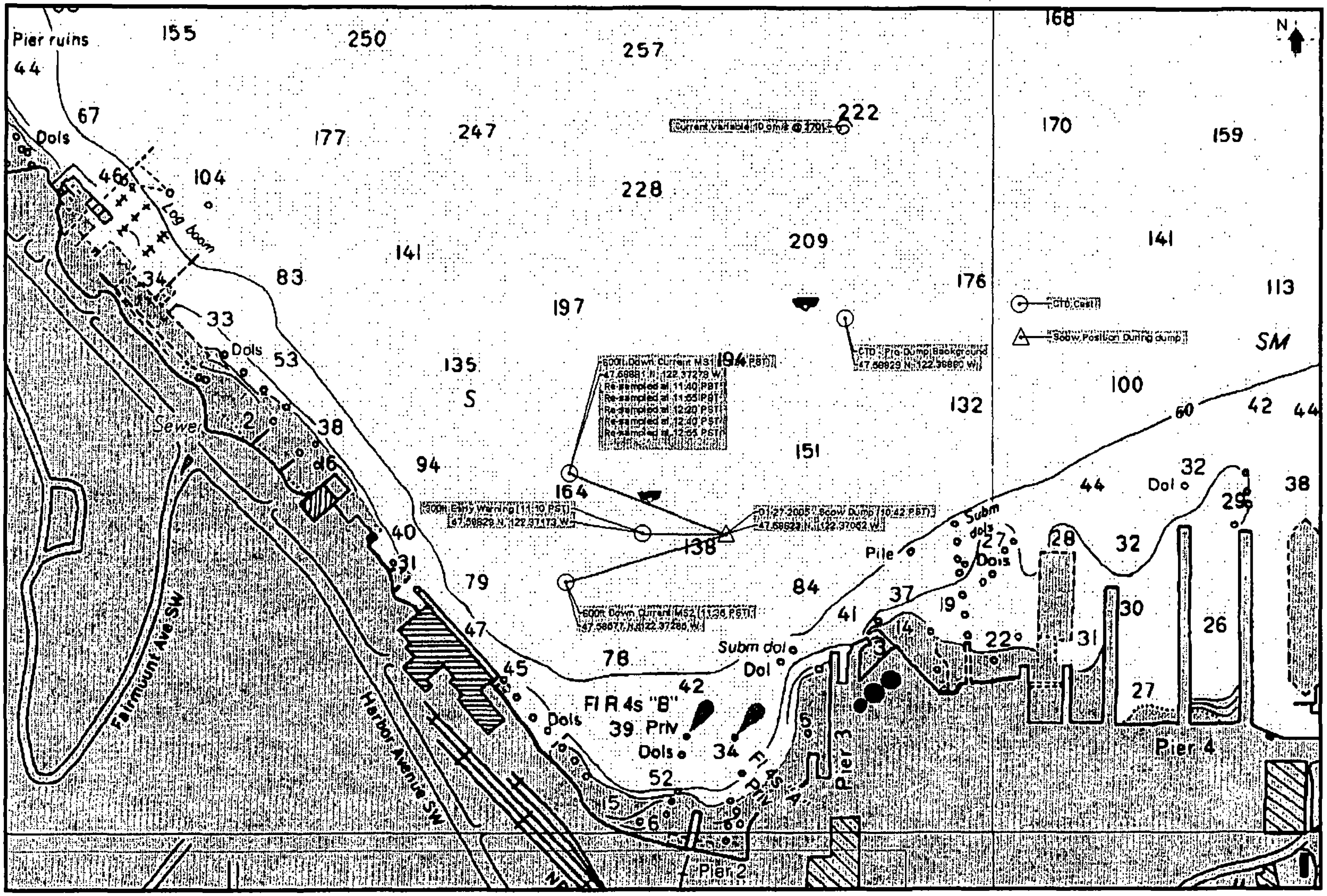


Figure A-6. Monitoring stations on January 27th, 2005

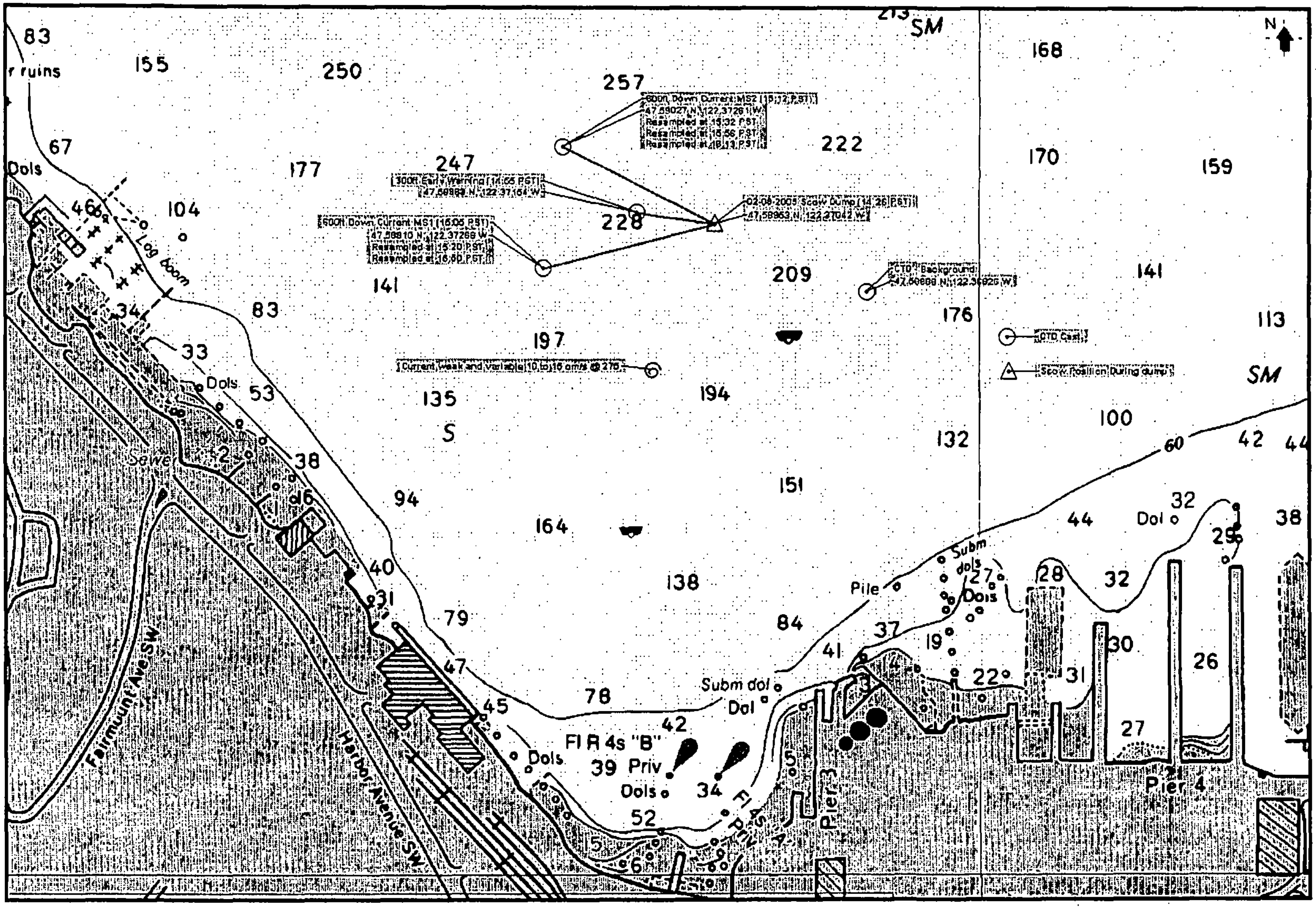


Figure A-7. Monitoring stations on February 2nd, 2005

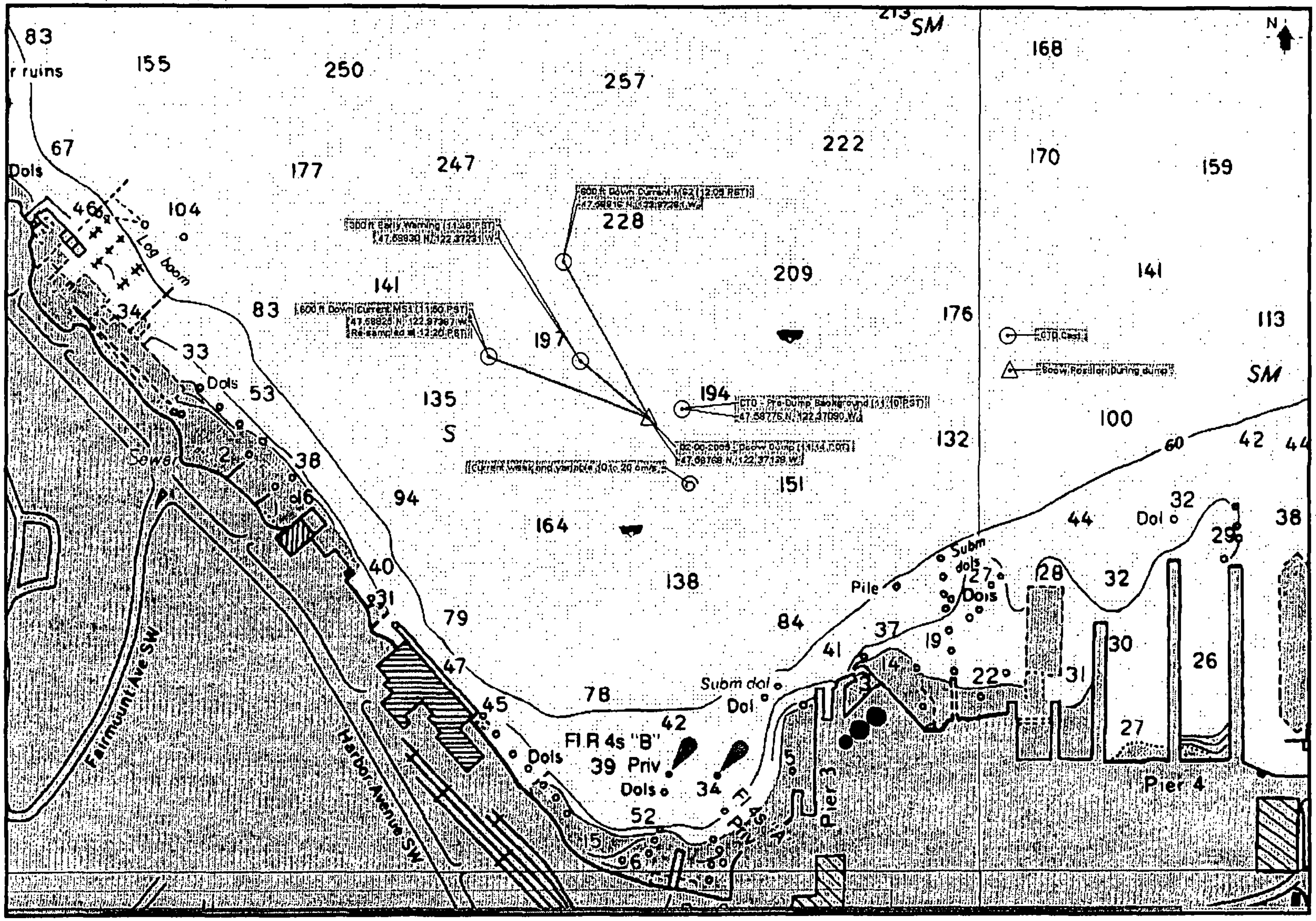


Figure A-8. Monitoring stations on February 8th, 2005

ATTACHMENT A-2

PSR-RA5

WATER QUALITY MONITORING

FIELD DATA LOGS

1-5/1

WATER QUALITY MONITORING
FIELD LOG
RA5 Marine Sediment Construction

Project: PSR RA5 Date: 1/5/05
Project No.: 5259 Location: RA5

Instrument Type: Hydrolab H2O Personnel: C Coomes; K Smith, D Mullins
Serial No.: 24473

Site Conditions
Weather and Sky: Clear Cold N wind
Water Conditons: ripples

Site Locations

	Latitude	Longitude	Speed (m/s)	Direction (°T)
Water currents:	47° 35.369'	122° 22.39'	.05 m/s	283 °M

Scow Target Location:
Scow ID: 5 Time (local): Aiming for target G
Scow Start: ~~47° 35' 22.18~~ 122° 21.0' 54.78" 0909
Scow End:

Visual Observations: 3-4 logs @ surface from scow / fast release

Up Current Monitoring Position (600 ft)
Time (local): 0842 Latitude: 47° 35.369' Longitude: 122° 22.39'

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
53.9	52.9	9.73	7.51	33.0	5.99	3.8	
	25.9	9.22	7.56	32.5	6.98	4.4	
	1.0	8.94	7.58	31.2	7.29	[illegible]	

Early Warning Monitoring Location (300 ft down current)
Time (local): 0918 Latitude: 47° 35' 21.22" Longitude: 122° 21' 55.90"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
53.2	52.8	9.45	7.50	32.8	6.29	106.0	end location 47° 35.371 122° 21.990
	27.0	9.44	7.55	32.4	6.46	3.4	
	0.9	8.98	7.58	31.6	7.21	13.8	

Turbid water as pass through to Early Warning site

1-5/2

Down Current Monitoring Location 1 (~~600~~ 300 ft)
Time (local): 0935 Latitude: 47° 35' 21.45" Longitude: 122° 21' 54.84"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
50.3	49.5	9.65	7.54	32.8	6.09	21.0		
	22.7	9.19	7.58	32.9	6.77	4.5		
	0.8	9.17	7.59	31.8	7.04	4.8		

Comments:

Down Current Monitoring Location 2 (~~600~~ 300 ft)
Time (local): 0948 Latitude: 47° 35' 22.06" Longitude: 122° 21' 56.09"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
53.1	51.9	9.61	7.53	32.6	6.20	22.6		
	26.0	9.20	7.58	32.5	6.59	4.9		
	0.8	9.06	7.57	31.6	7.14	11.1		

Comments: End @ 47° 35.384'
122° 21.947'

~~15 minute retake at~~ Down Current Monitoring Location 600 ft - Site 1
Time (local): 1000 Latitude: 47° 35' 20.19" Longitude: 122° 21' 55.52"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
49.0	48.3	9.69	7.54	33.0	6.08	10.2		
	24.3	9.33	7.58	32.7	6.47	5.4		
	0.7	9.02	7.59	32.7	6.98	4.6		

Comments: End cast @ 47° 35.20'
122° 21.553'

~~30 minute retake at~~ Down Current Monitoring Location 600 ft - Site 2
Time (local): 1013 Latitude: 47° 35.125' Longitude: 122° 21.573'

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
55.0	54.1	9.70	7.55	32.8	6.01	15.1		
	25.2	9.30	7.59	32.5	6.59	4.8		
	0.8	9.03	7.60	31.9	7.08	8.8		

Comments:

1-6/1

Lg Ob

WATER QUALITY MONITORING
FIELD LOG
RA5 Marine Sediment Construction

Project: RA5 | Date: 1/6/05
Project No.: 5259 | Location: Elliott Bay

Instrument Type: H2O | Personnel: C Commas K Smith
Serial No.:

Site Conditions
Weather and Sky: Overcast lt rain wind ~north
Water Conditions: Sm chop Ebb

Site Locations — Latitude / Longitude / Speed (cm/s) / Direction (°T)
Water currents: 47° 35.2968 122° 22.3532 .25 m/s 300 0302

Scow Target Location:
Scow ID: CK7
Time (local): 2302 (0302 PST) 1610
Scow Start: 47° 35' 11.93"
Scow End: 122° 22' 16.99"
Doors on bottom only open ~3'
Visual Observations: Full draft = 16.5' open = ~3.5'

Up Current Monitoring Position (600 ft) – Background
Time (local): 0302 Latitude: 47°35.2968 Longitude: 122° 22.35332'

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
48.9	45.0	9.49	7.59	33.1	6.42	5.8	
	22.4	9.11	7.62	32.7	6.93	6.6	
	1.0	8.34	7.63	30.6	7.58	7.5	

Early Warning Monitoring Location (300 ft down current)
Time (local): 1627 Latitude: 47° 35' 13.23' Longitude: 122° 22' 20.76"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
54.0	52.7	9.40	7.59	33.1	6.20	243	End 47° 35' 13.84'
	25.7	9.01	7.66	32.8	6.76	5.8	122° 22' 20.55
	0.9	8.44	7.68	32.2	7.51	7.2	

See some discolor in H2O - but light fading

1-6/2

Down Current Monitoring Location 1 (600 ft)
Time (local): 1632 Latitude: 47° 35' 16.73" Longitude: 122° 22' 23.08"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
56.3	55.1	9.44	7.63	33.1	6.23	102.0	✓	
	26.2	9.06	7.67	32.8	6.79	6.1		
	1.0	8.46	7.68	32.0	7.50	7.9		

Comments: End 47° 35' 16.59"
122° 22' 23.14"

Down Current Monitoring Location 2 (600 ft)
Time (local): 1643 Latitude: 47° 35' 12.58" Longitude: 122° 22' 26.14"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
43.1	41.5	9.43	7.65	33.1	6.33	10.4		
	22.8	8.90	7.68	32.6	6.80	7.6		
	1.0	8.16	7.70	32.1	7.72	6.4		

Comments: End 47° 35' 12.64"
122° 22' 26.85"

5 minute retake at Down Current Monitoring Location 600-1
Time (local): 1653 Latitude: 47° 35' 17.48" Longitude: 122° 22' 22.16"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
50.8	41.0	9.56	7.65	33.2	6.22	9.3		
	25.0	8.90	7.68	32.6	7.03	12.2		
	0.7	8.44	7.69	32.0	7.50	7.7		

Comments: 47° 35' 20.04"
122° 22' 24.19"

30 minute retake at Down Current Monitoring Location ______
Time (local): ______ Latitude: ______ Longitude: ______

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample

Comments:

1-7/1

WATER QUALITY MONITORING FIELD LOG
RA5 Marine Sediment Construction

Project: RA5 Date: 1/7/05
Project No.: 52-59 Location:

Instrument Type: H20 Personnel: O'Connor K. Saund
Serial No.: Boat · Bill

Site Conditions
Weather and Sky: Overcast
Water Conditons: Calm Flood

Site Locations Latitude Longitude Speed (~~cm/s~~) Direction (°T)
Water currents: 47° 35.535 122° 22.3618' .031 m/s 195° 0952

Scow Target Location: 47° 35.2682 122° 22.0962 = 65F5
Scow ID: CK7 Time (local):
Scow Start: 11:17 Start draft: 18
Scow End: 47 35.217 122 22.109 11:18 end draft: 4

Visual Observations: no debris observed / no turbidity seen

Up Current Monitoring Position (600 ft)
Time (local): 1020 Latitude: 47° 35' 26.69" Longitude: 122° 22' 17.37"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
57.9	55.8	9.41	7.65	33	5.78	9.3	
	29.5	9.55	7.67	33.2	6.31	6.2	
	1	8.34	7.71	32.1	7.56	5.7	

Early Warning Monitoring Location (300 ft down current)
Time (local): 11:36 Latitude: 47 35.15 Longitude: 122 22.097

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
25.6	24.0	9.08	7.68	32.9	6.64	5.6	
	13	8.87	7.70	32.7	7.08	6.9	
	1	8.33	7.71	31.9	7.52	6.4	

Down Current Monitoring Location 1 (600 ft)

Time (local): 11:35 Latitude: 47° 35.184' N Longitude: 122° 22.150' W

Bottom Depth (m)	Depth (m)	Temp. (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
20.6	19.8	9.01	7.69	32.9	6.99	5.9	N	N
	10.1	8.83	7.70	32.7	7.09	5.4	N	N
	1	8.55	7.71	32.4	7.58	6.4	N	N

Comments:

Down Current Monitoring Location 2 (600 ft)

Time (local): 11:50 Latitude: 47° 35.126 Longitude: 122° 22.972

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
9.4	8.1	8.74	7.70	32.6	7.29	5.8	N	N
	5.2	8.62	7.70	32.5	7.35	5.2	N	N
	1	8.20	7.71	31.6	7.53	5.2	N	N

Comments: turbidity measurements very low, so heading over to dump site to check levels

~~15 minute retake at Down Current Monitoring Location~~ ⇒ dump site check

Time (local): 11:55 Latitude: 47 35.204 N Longitude: 122 22.077 W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
37.2	35.0	9.59	7.66	33.2	5.99	8.3	N	N
	18.							

Comments: stopped due to ~~cable~~ getting caught in prop while re-positioning

~~30 minute retake at~~ Down Current Monitoring Location Early warning #2

Time (local): 1210 Latitude: 47 35 151 Longitude: 122 22.794

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
25.	24	9.33				~9		
	13					~7		
	1					~6		

Comments:

___~~minute retake at~~ Down Current Monitoring Location #1 ⇒ 600m @ 334° from Dump Site
Time (local): 1220 Latitude: 47 35.295 Longitude: 122 22.148

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
61.8	60.0	9.66	7.66	33.3	6.30	15.4	N	N
	29.4	9.43	7.68	33.2	6.32	5.3	N	N
	1	8.42	7.72	32.2	7.55	5.6	N	N

Comments:

___~~minute retake at~~ Down Current Monitoring Location #2 600m @ 293 from Dump Site
Time (local): 12:30 Latitude: 47.35.257 Longitude: 122 22.235

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
59.2	58.0	9.66	7.65	33.4	5.81	10.0	N	N
	29.0	9.44	7.68	33.1	6.32	5.2	N	N
	1	8.47	7.72	32.3	7.47	5.6	N	N

Comments:

___minute retake at Down Current Monitoring Location ________
Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample

Comments:

___minute retake at Down Current Monitoring Location ________
Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample

Comments:

1/12-1
Check-Sp 0/8

WATER QUALITY MONITORING
FIELD LOG
RA5 Marine Sediment Construction

Project: PSR 5
Project No.: 5259
Date: 1/12/2005
Location: WWSW

Instrument Type: Hydrolab H2O
Serial No.: 24473
Personnel: Karl S, Kevin S
Dave Mullins

Site Conditions
Weather and Sky: cloudy
Water Conditons: slightly choppy ; low Tide @ 1230

Site Locations

	Latitude	Longitude	Speed (cm/s)	Direction (°T)
Water currents:	47° 35.41697	122° 22.251	~36 cm/s	300°

Scow Target Location: 47° 35' 21.27" 122° 22' 08.18"
(True) Heading: 060

Aiming for B5-08
Scow ID: DS 5
Scow Start: 14.25
Scow End: ~3.0
Time (local): 2044 32 UTC = 12:44:32 Local PST

Visual Observations:

Up Current Monitoring Position (600 ft) Background
Time (local): 12:10 Latitude: 47° 35.41697' Longitude: 122° 22.251'

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
65.8	64.5	9.19	7.61	33.3	5.80	10.1	
	32.6	9.07	7.64	33.6	6.30	8.9	
	1.0	9.09	7.63	32.2	6.72	11.3	

Early Warning Monitoring Location (300 ft down current)
Time (local): ______ Latitude: 47° 35' 21.02" Longitude: 122° 22' 13.57"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
63.6	61.9	9.19	7.63	33.0	5.82	30.1	
	31.0	9.08	7.65	33.4	6.35	9.1	
	1.2	9.17	7.63	3.2	6.71	13.4	

Down Current Monitoring Location 1 (600 ft)

Time (local): 1310 Latitude: 47° 35' 21.66" Longitude: 122° 22' 18.66"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
66.3	64.8	9.18	7.64	34.2	5.91	9.9	N	N
	33.3	9.03	7.66	33.1	6.46	8.2	N	N
	1.0	9.18	7.65	33.0	4.62	7.8	N	N

Comments:

Down Current Monitoring Location 2 (600 ft)

Time (local): 1320 Latitude: 47° 35' 24.36" Longitude: 122 22' 15.35

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
68.0	67.2	9.20	7.64	33.1	5.79	9.2	N	N
	33.9	9.03	7.67	33.1	6.41	7.9	N	N
	1.0	9.09	7.66	32.5	6.76	6.8	N	N

Comments: @ surface, bubble from jet caused elevated turb.

15 minute retake at Down Current Monitoring Location ________

Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample

Comments:

30 minute retake at Down Current Monitoring Location ________

Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample

Comments:

Pg 1/4
Sm fld - slack - Lg Ebb

WATER QUALITY MONITORING FIELD LOG
RA5 Marine Sediment Construction

Project: Anchor
Project No.: 5259
Date: 1/21/05
Location: RA5
Instrument Type: H2O
Serial No.:
Personnel: C Coomes K Sowers · D. Mullens - boat

Site Conditions
Weather and Sky: ~~fog~~ very foggy
Water Conditons: Calm
Small flood tide

Site Locations Latitude Longitude Speed (m/s) Direction (°T) 205 - 340
Water currents: 47° 35.408 122° 22.502 .05 variable !!
Scow Target Location: F9 47° 35.327 122° 21.996 47° 35.20.688 300°
Scow ID: DS5 210° heading
Time (local): 122° 21 56.197 ~~1027 01~~ 1317
Scow Start: 15' closed
Scow End: 3' open
~~close 15 draft~~ open
Visual Observations: Surface H2O very turbid / During dump turbidity at surface

Up Current Monitoring Position (600 ft) – Background
Time (local): 1637 Latitude: 47° 35.3578 Longitude: 122° 22.147

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
71.8	70.7	8.73	7.53	34.5	5.92	11.6	filename: 1040
~~36.1~~	36.1	8.91	7.56	35.1	6.27	8.6	
	1.0	8.95	7.59	32.5	7.06	10.2	

H2O very slack - surface turbid at dump time

Early Warning Monitoring Location (300 ft down current)
Time (local): 1431 Latitude: 47° 35.357 Longitude: 122° 22.063

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
64.6	63.6	8.92	7.56	34.2	6.10	22.6	filename: 1430 Saw a few 43 NTU near Bottom on upcast
	32.0	8.95	7.60	34.0	6.42	10.5	
	1.0	8.95	7.61	33.1	6.83	11.7	

2/4 16.6
13.6
15.2

Down Current Monitoring Location 1 (600 ft)

Time (local): 1442 Latitude: 47° 35.451 Longitude: 122° 22.092

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
67.6	66.1	8.91	7.56	35.1	5.9	35.3	E	
	33.1	8.93	7.61	34.0	6.32	7.6		
	1.0	8.93	7.62	32.5	6.93	10.5		

Comments:
filename = 1441-600-1

Down Current Monitoring Location 2 (600 ft)

Time (local): 1450 Latitude: 47° 35.347 Longitude: 122° 22.147

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
67.0	65.9	8.90	7.56	34.2	5.80	24.4	E	
	33.4	8.93	7.62	34.1	6.31	6.9		
	0.9	9.04	7.63	33.3	6.91	9.4		

Comments:
filename 1450-600-2

15 minute retake at Down Current Monitoring Location 600-1a

Time (local): 1457 Latitude: 35° 35.410 Longitude: 122° 22.097

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
67.9	66.1	8.91	7.56	34.9	5.91	29.6	E	
	33.8	8.93	7.62	34.6	6.36	7.8		
	1.0	8.81	7.62	32.2	6.94	9.8		

Comments:
filename: 1457 600-1a

~~30~~ 15 minute retake at Down Current Monitoring Location 600-2a

Time (local): 1505 Latitude: ~~35~~ 35.349 Longitude: 122° 22.146

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
67.5	66.2	8.90	7.57	35.3	5.88	23.7	E	
	33.5	8.92	7.62	34.6	6.32	8.2		
	1.0	9.00	7.63	33.7	6.91	7.4		

Comments:
1505-6002a

Down Current Monitoring Location 1 (600 ft) 600-1b
Time (local): 1515 Latitude: ~~47~~° 35.414 Longitude: 122° 22.097

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
67.9	65.1	8.91	7.57	34.1	5.88	20.7	E	
	34.0	8.93	7.62	34.4	6.34	8.2		
	1.0	8.77	7.63	31.5	6.96	8.8		

Comments:
1515_600-1b

Down Current Monitoring Location 2 (600 ft) 600_2b
Time (local): 1522 Latitude: 47° 35.348 Longitude: 122° 22.143

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
66.4	65.0	8.90	7.58	34.7	5.84	25.5	E	
	33.0	8.92	7.62	34.7	6.32	9.1		
	1.0	8.97	7.61	33.2	7.06	10.6		

Comments:
1522-600-2b
Call to Br[illegible] Measure @ both 600' sites & then 1000 ft [illegible]

~~15~~ 60 minute retake at Down Current Monitoring Location 600-1c
Time (local): 1545 Latitude: 47° 35.439 Longitude: 122° 22.40~~4~~

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
67.4	66.4	8.90	7.57	34.1	5.89	21.6	E	
	33.2	8.92	7.62	34.0	6.27	7.5		
	1.0	8.96	7.65	32.7	6.87	9.6		

Comments:
1545_600_1c

~~30~~ 60 minute retake at Down Current Monitoring Location 600_2c
Time (local): 1550 Latitude: 47° 35.340 Longitude: 122° 22.14

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
65.6	63.8	8.90	7.57	34.7	5.88	20.5	E	
	33.0	8.93	7.62	34.0	6.29	9.8		
	1.0	8.97	7.64	32.5	6.87	8.7		

Comments:
1550_600-2c

2.1000-2

Down Current Monitoring Location ~~1~~ (~~600~~ ft)
Time (local): 1600 Latitude: ~~38~~ 47° 35.356 Longitude: 122° 22.240

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
70.1	69.2	8.88	7.58	34.8	5.68	18.7	E	
	~~35.1~~	~~8.92~~	~~7L~~					

Comments: 1000 ft. beyond dump site along 600-2 line

Down Current Monitoring Location 2 (~~600 ft~~) 1000'
Time (local): 1605 Latitude: 47° 35.455 Longitude: 122° 22.153

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
73.7	72.7	8.88	7.59	34.9	5.79	18.2	E	

Comments: 1000 ft beyond dump site along 600-1 line

15 minute retake at Down Current Monitoring Location ________
Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample

Comments:

30 minute retake at Down Current Monitoring Location ________
Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample

Comments:

1/27 - 1

Sm Ebb

WATER QUALITY MONITORING
FIELD LOG
RA5 Marine Sediment Construction

Project: ~~5259~~ Anchor
Project No.: 5259
Instrument Type: H2O
Serial No.:

Date: 1/27/05
Location: RA5
Personnel: C Coomes K Sawers Brent - Global

Site Conditions

Weather and Sky: Partial cloudy - chance of rain
Water Conditons: Calm

Site Locations

	Latitude	Longitude	Speed (cm/s)	Direction (°T)
Water currents:	47° 35' 23.46	122' 22' 07.94"	10 cm/s	270

Scow Target Location: Between G1 & G2 — heading = ^
Scow ID: RS5
Scow Start: 16ft - ~19ft (bow & stern) 15ft
Scow End: ~~5~~ 4ft
Time (local): 10:40 ~ dump time

47° 35' 10.43" N 122° 22' 13.87" W

Visual Observations: no surface debris observed

Up Current Monitoring Position (600 ft)

Time (local): ~~0959~~ 1010 Latitude: 47 35' 17.84" N Longitude: 122° 22' 07.68" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
44.8	42.6	8.89	7.63	34.6	6.22	8.9	
	21.3	8.80	7.65	34.4	6.64	5.7	
	1	8.86	7.65	32.2	6.96	5.9	

Early Warning Monitoring Location (300 ft down current)

Time (local): 11:10 Latitude: 47° 35' 10.43" N Longitude: 122° 22' 18.22" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
49.0	47.0	8.85	7.62	34.7	6.18	34.7	
	23.9	8.86	7.65	33.7	6.63	6.5	
	1	8.76	7.68	31.7	7.57	5.2	

1/27 - 2

Down Current Monitoring Location 1 (600 ft)

Time (local): 11:20 Latitude: 47° 35' 12.51" N Longitude: 122° 22' 22.05" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
52.6	51.2	8.86	7.62	34.1	6.09	33.5	Y	N * [illegible] turbidity in bottom 2.5 meters
	25.3	8.84	7.65	33.7	6.59	5.1	N	
	1	8.76	7.67	32.8	7.35	5.9	N	

Comments:

Down Current Monitoring Location 2 (600 ft)

Time (local): 1135 Latitude: 47° 35' 08.78" N Longitude: 122° 22' 22.27" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
44.8	43.6	8.85	7.63	34.0	6.36	11.2	N	N
	21.1	8.87	7.65	34.9	6.79	5.8	N	N
	1	8.76	7.68	34.6	7.60	5.1	N	N

Comments:

15 minute retake at Down Current Monitoring Location 600-1

Time (local): 1140 Latitude: 47° 35' 12.32" N Longitude: 122° 22' 21.89" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
52.4	51.4	8.85	7.64	34.3	6.28	15.4	Y	N
	25.3	8.85	7.65	33.9	6.37	11.5	Y	N
	1	8.80	7.69	31.3	7.49	5.4	N	N

Comments:

30 minute retake at Down Current Monitoring Location 600-1

Time (local): 11:55 Latitude: 47° 35' 12.89" N Longitude: 122° 22' 22.16" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
41.1	38.6	8.85	7.64	34.1	6.23	16.7	Y	N
	20.0	8.84	7.66	34.9	6.64	5.9	N	N
	1	8.79	7.67	31.0	7.38	5.7	N	N

Comments:

45 minute retake at Down Current Monitoring Location 6(D) - 1
Time (local): 1220 Latitude: 47° 35' 12.72" N Longitude: 122° 22' 21.82" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
51.5	49.8	8.84	7.64	34.4	6.15	23.1	Y	N
	25.1	8.85	7.65	35.0	6.52	21.9	Y	N
	1	8.77	7.68	31.8	7.35	6.4	N	N

Comments:

1h ~~minute~~ retake at Down Current Monitoring Location 6(D) - 1
Time (local): 1240 Latitude: 47° 35' 12.39" N Longitude: 122° 22' 21.74" W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
52.1	49.7	8.84	7.64	34.8	6.12	12.6	N	N

Comments:

75 minute retake at Down Current Monitoring Location 6(D) - 1
Time (local): 1255 Latitude: 47° 35' 12.32" Longitude: 122° 22' 22.28"

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
52.0	49.6	8.84	7.64	34.2	6.33	13.5*	~~13.5~~ N	N

Comments: Turbidity measurements @ bottom fluctuated up & down, but settled at approximately (average) 13.5 NTU

___ minute retake at Down Current Monitoring Location ___
Time (local): ___ Latitude: ___ Longitude: ___

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample

Comments:

2/2 - 1

WATER QUALITY MONITORING
FIELD LOG
RA5 Marine Sediment Construction

Project: 5259-Anchor Date: 02/02/2005
Project No.: 5259 Location:

Instrument Type: Hydrolab #20 Personnel: Carol ~~John~~ C[illegible]
Serial No.: 24473 [illegible]
[illegible] - Global

Site Conditions
Weather and Sky: clear sunny [illegible] = 772.42 mmHg
Water Conditons: flat; a lot of barge traffic

Site Locations

	Latitude	Longitude	Speed (cm/s)	Direction (°T)
Water currents:	47.58814°N	122.37133°W	10-15 cm/s	275°

Scow Target Location: 47.58953°N, 122.37042°W
Scow ID: DS5

		Time (local):
Scow Start:	Draft = 14	14:26
Scow End:	Draft = 13.5	14:27

Visual Observations: ~~None~~ No sediment - 3 logs on surface

Up Current Monitoring Position (600 ft)
Time (local): 14:16 Latitude: 47.5888°N Longitude: 122.36826°W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
59.6	58.3	8.73	7.52	34.5	6.19	13.5	
	30.8	8.71	7.54	34.4	6.43	11.2	
	1.1	9.19	7.57	32.2	7.16	6.8	

Early Warning Monitoring Location (300 ft down current)
Time (local): 1455 Latitude: 47.58963°W Longitude: 122.37154°W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
70.8	68.3	8.72	7.55	34.5	6.21	53.7	
	34.9	8.71	7.59	34.4	6.59	6.8	
	1	9.0	7.60	33.0	6.92	9.3	

Down Current Monitoring Location 1 (600 ft)
Time (local): 1505 Latitude: 47.58910° N Longitude: 122.37 268' W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
67.0	65.1	8.72	7.55	34.5	6.12	42.8	Y	N
	32.4	8.70	7.60	34.4	6.38	9.1	N	N
	1.1	8.94	7.61	33.4	6.85	5.9	N	N

Comments: Elevated turbidity seen from 60m to bottom (bottom 7m)

Down Current Monitoring Location 2 (600 ft)
Time (local): 1512 Latitude: 47.59027° N Longitude: 122.37261° W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
77.1	75.1	8.72	7.54	34.6	6.02	38.0	Y	N
	37.3	8.70	7.60	34.4	6.49	9.0	N	N
	1.1	8.93	7.61	33.3	6.90	5.6	N	N

Comments: Elevated Turbidity seen from 68m to bottom (bottom 9m)

15 minute retake at Down Current Monitoring Location 600-1
Time (local): 1520 Latitude: 47.58901° N Longitude: 122.37271° W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
65.8	63.3	8.72	7.58	34.6	6.22	~~[illegible]~~	18.2 N	

Comments:

~~20~~ 15 minute retake at Down Current Monitoring Location 600-2
Time (local): 1532 Latitude: 47.59023 Longitude: 122.37253°

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
76.7	73.2	8.72	7.57	34.6	6.14	28.4	Y	

Comments: Exceedance in bottom 10 m

~~30~~ 15 minute retake at Down Current Monitoring Location 600-1
Time (local): 1549 Latitude: 35.58908 Longitude: 122.37267

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
66.3	63.3	8.71	7.60	34.5	6.22	14.6	N	

Comments:

20 minute retake at Down Current Monitoring Location 600-2
Time (local): 1556 Latitude: 35.59028 Longitude: 122.37263

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
77.3	74.3	8.72	7.57	34.6	6.04	24.5	Y	

Comments: Exceedance bottom 15m

~~20~~ 25 minute retake at Down Current Monitoring Location 600-2
Time (local): 1613 Latitude: 35.59018 Longitude: 122.37261

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample
76.3	73.4 ~~8.70~~	8.70 ~~7.58~~	7.58	34.6	5.97	21.8	Y	

Comments: Exceedance bottom 10 m

__minute retake at Down Current Monitoring Location ______
Time (local): ______ Latitude: ______ Longitude: ______

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedanc	TSS Sample

Comments:

2/8 - 1

WATER QUALITY MONITORING FIELD LOG
RA5 Marine Sediment Construction

Project: ARMOR - PSRS
Project No.: 5259.11
Date: 02-08-04
Location: Elliot Bay

Instrument Type: HYDROLAB H20
Serial No.: 24473
Personnel: Karl Sturtz, Kevin Smith

Site Conditions
Weather and Sky: Clear & Sunny
Water Conditons: Calm

Site Locations — Latitude / Longitude / Speed (cm/s) / Direction (°T)

Water currents: slack 47.58705° N, 122.37079° W — weak & variable ~10 cm/s — ~310°
Scow Target Location: E / 47.58768° N 122°37140° W — & heading = 150° T
Scow ID: EC-7
Time (local):
Scow Start: draft = 18 — 11:14 start
Scow End: draft = 4

Visual Observations: None: scow fully closed for return

Up Current Monitoring Position (600 ft)
Time (local): 1110   Latitude: 47.58776 N   Longitude: 122.37090 W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
54.1	52.9	8.68	7.59	34.9	6.55	8.4	
	29.0	8.67	7.61	34.4	6.70	9.0	
	1.0	8.55	7.63	33.1	7.38	9.7	

Early Warning Monitoring Location (300 ft down current)
Time (local): 11:46   Latitude: 47.58830° N   Longitude: 122.37237° W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Comments
63.0	60.1	8.68	7.58	34.5	6.40	82.7	
	31.0	8.66	7.65	34.4	6.77	10.6	
	1.0	8.59	7.67	32.9	7.40	10.5	

Down Current Monitoring Location 1 (600 ft)
Time (local): 1150 Latitude: 47.58827° N Longitude: 122.37362° W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
56.6	55.1	8.68	7.65	34.5	6.51	10.4	N	N
	28.5	8.65	7.66	34.4	6.81	10.4	N	N
	1.0	8.57	7.67	33.2	7.36	8.9	N	N

Comments:

Down Current Monitoring Location 2 (600 ft)
Time (local): 1205 Latitude: 47.58913° N Longitude: 122.37265° W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
69.4	67.3	8.68	7.63	34.5	6.37	18.2	Y	N
	35.1	8.66	7.67	34.4	6.63	10.2	N	N
	1.0	8.31	7.68	32.5	7.42	10.5	N	N

Comments:

15 minute retake at Down Current Monitoring Location 600-2
Time (local): 1220 Latitude: 47.58914° N Longitude: 122.37263° W

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample
69.0	67.5	8.66	7.45	34.5	6.33	11.7	N	N

Comments:

30 minute retake at Down Current Monitoring Location ________
Time (local): ________ Latitude: ________ Longitude: ________

Bottom Depth (m)	Depth (m)	Temp (°C)	pH	Salinity (ppt)	DO (mg/L)	Turbidity (NTU)	Exceedance	TSS Sample

Comments:

ATTACHMENT A-3

PSR-RA5

WATER QUALITY MONITORING

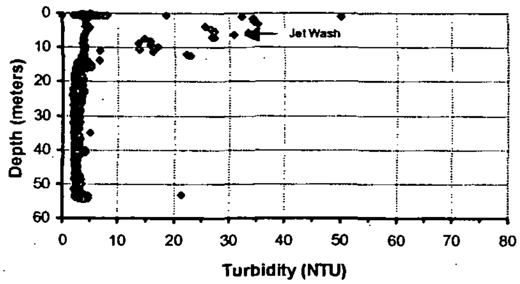
CTD PROFILES

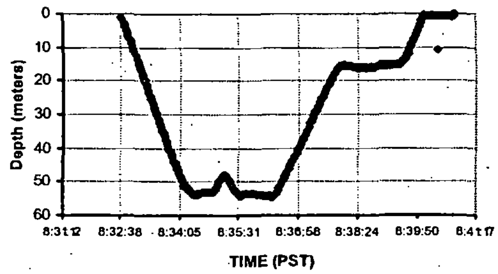
DATE: 1/5/2005

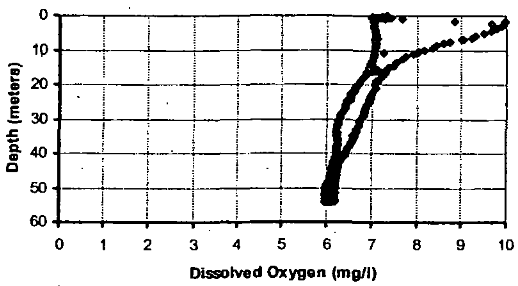
CAST ID: CTD_010505_RA5_Background

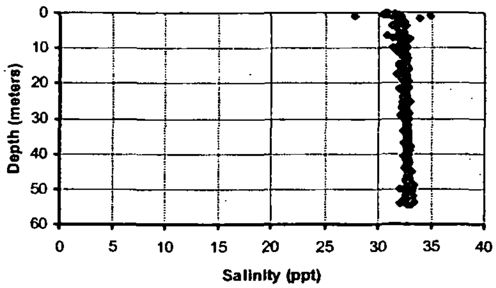
Start Time: 8:32:39
Duration(min): 8.15
Samples: 489
Tide: FLOOD

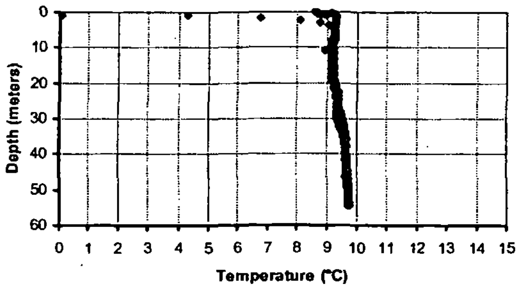
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	4.5	7.15	31.8	7.58	9.13
27 (88.6)	3.3	6.41	32.3	7.54	9.41
53.5 (175.5)	3.4	6.09	33.0	7.51	9.73

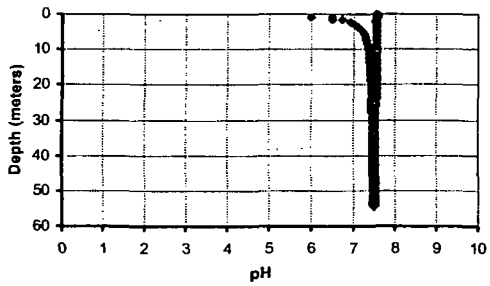










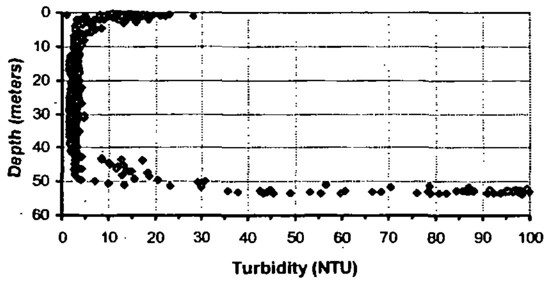


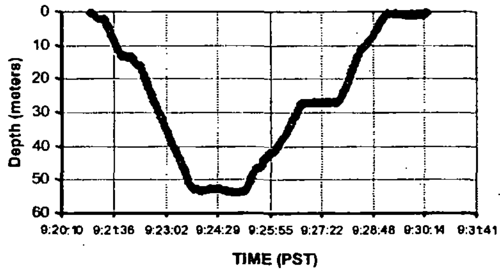
DATE: 1/5/2005

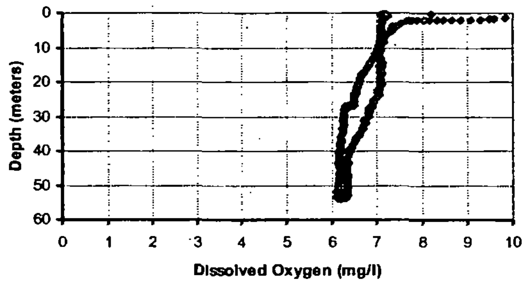
CAST ID: CTD_010505_RA5_300ft_Early Warning

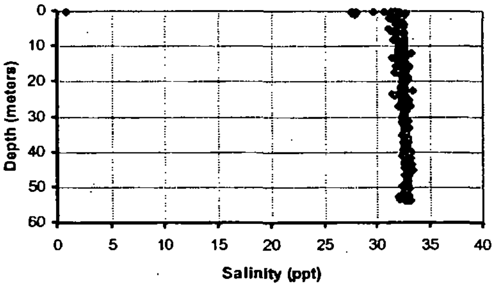
Start Time: 9:20:56
Duration(min): 9.40
Samples: 564
Tide: FLOOD

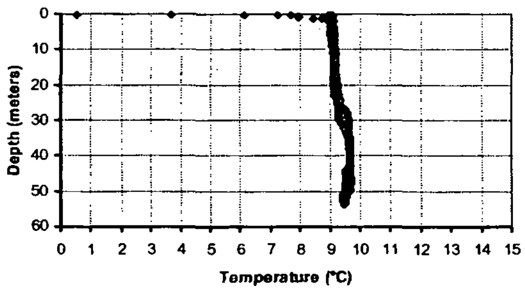
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	13.5	7.20	31.7	7.57	8.99
27 (88.6)	3.4	6.43	32.6	7.55	9.41
52.9 (173.6)	84.9	6 30	32.8	7.50	9.47

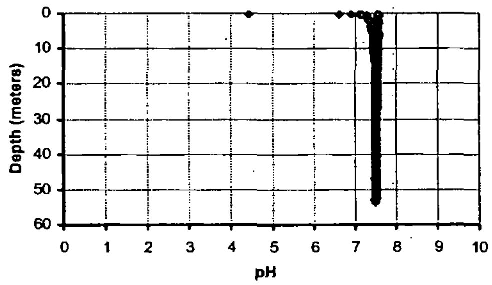










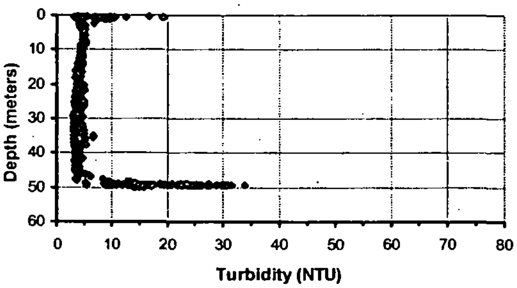


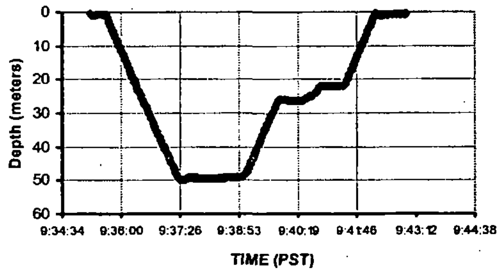
DATE: 1/5/2005

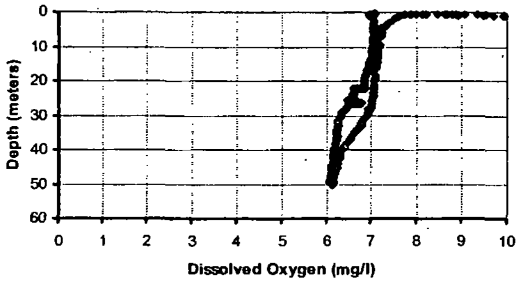
CAST ID: CTD_010505_RA5_300ft_MS1_0935

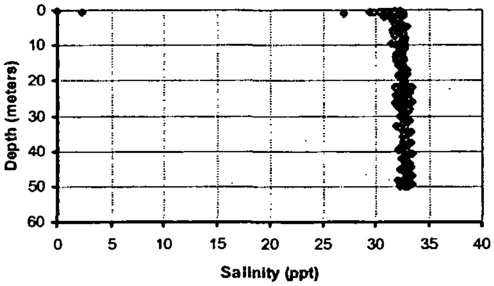
Start Time: 9:35:15
Duration(min): 7.75
Samples: 465
Tide: FLOOD

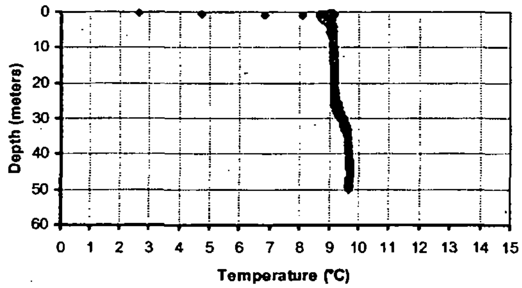
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.3	7.89	32.0	7.56	8.94
25.5 (83.7)	3.3	7.02	32.3	7.56	9.19
50 (164.0)	15.5	6.13	32.8	7.53	9.67

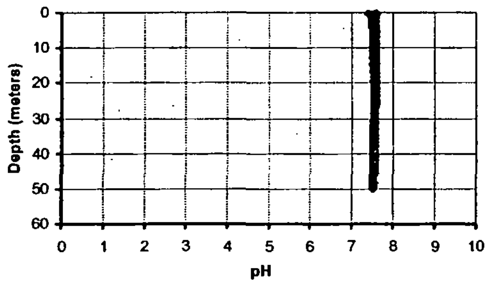










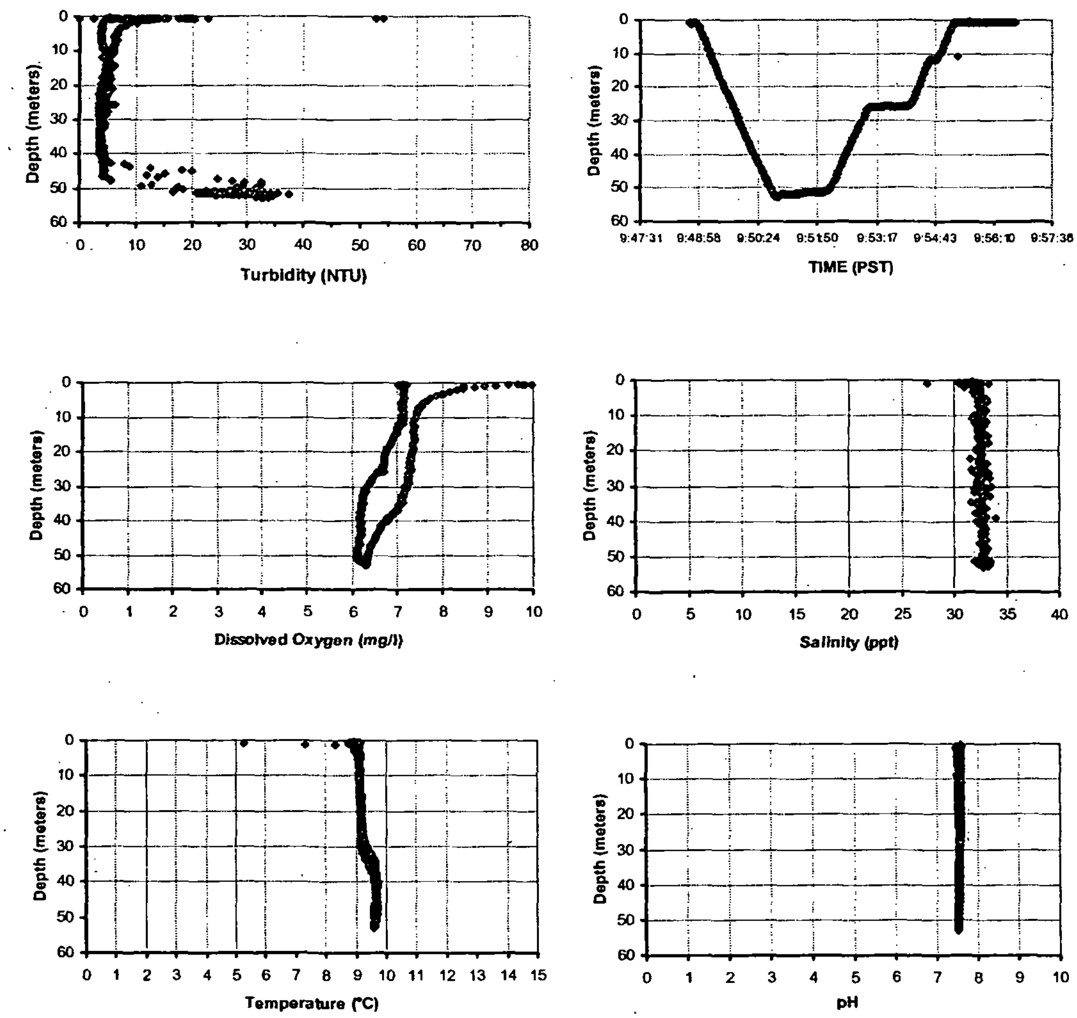


DATE: 1/5/2005

CAST ID: CTD_010505_RA5_300ft_MS2_0948

Start Time: 9:48:44
Duration(min): 7.98
Samples: 479
Tide: FLOOD

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	11.4	7.93	31.7	7.55	8.48
26.6 (87.3)	4.2	6.54	32.2	7.58	9.22
52.1 (170.9)	29.4	6.30	33.0	7.54	9.63

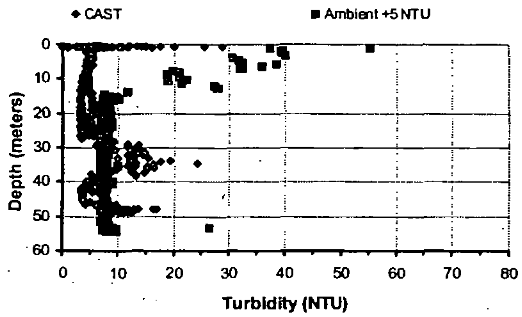


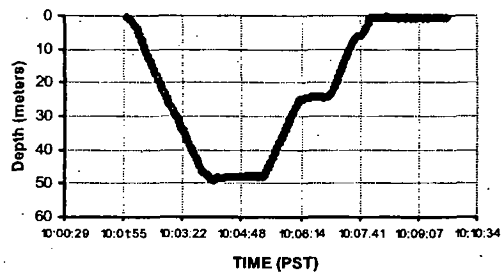
DATE: 1/5/2005

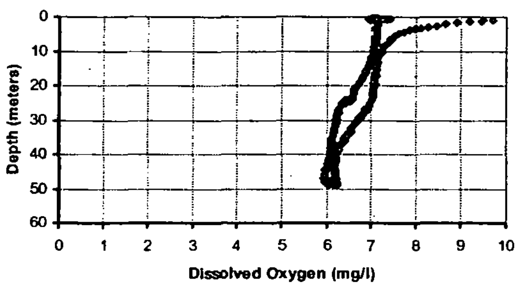
CAST ID: CTD_010505_RA5_600ft_MS1_1000

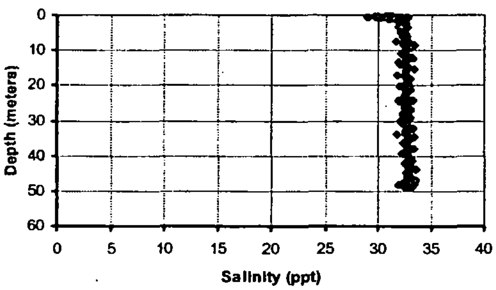
Start Time: 10:02:00
Duration(min): 7.85
Samples: 471
Tide: FLOOD

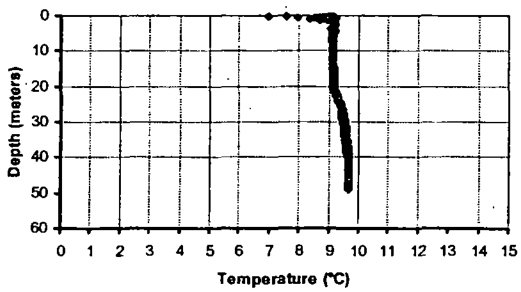
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.8	7.78	31.5	7.56	8.88
24.5 (80.4)	5.2	6.45	32.9	7.57	9.36
48 (157.5)	11.3	6.04	33.0	7.54	9.69

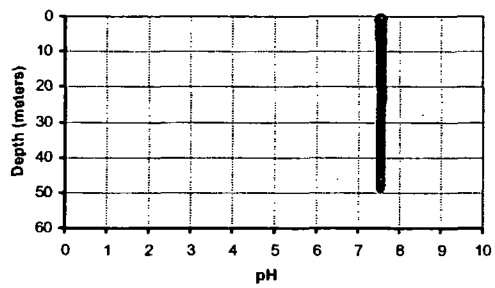










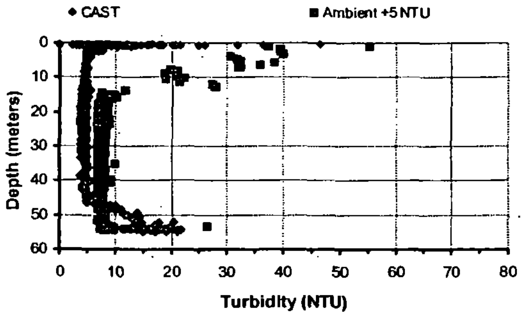


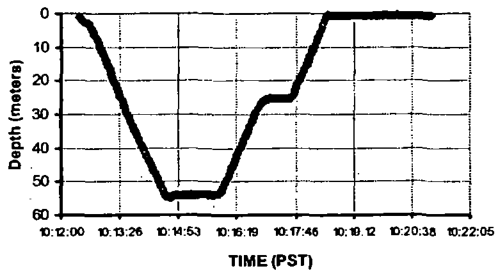
DATE: 1/5/2005

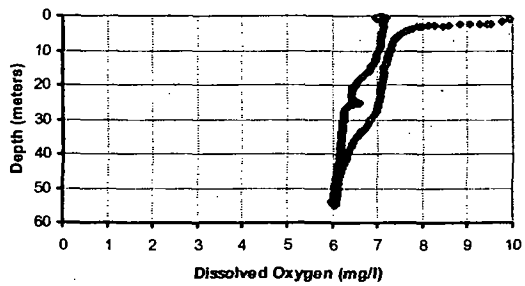
CAST ID: CTD_010505_RA5_600ft_MS2_1013

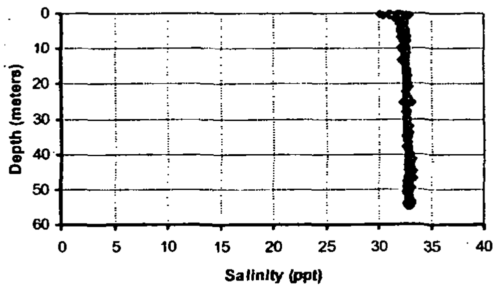
Start Time: 10:12:27
Duration(min): 8.73
Samples: 524
Tide: FLOOD

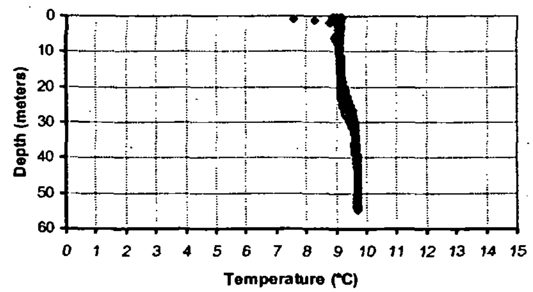
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	9.6	8.57	32.0	7.58	8.36
27.5 (90.2)	4.8	6.29	32.7	7.58	9.54
54 (177.2)	14.5	6.02	32.9	7.55	9.70

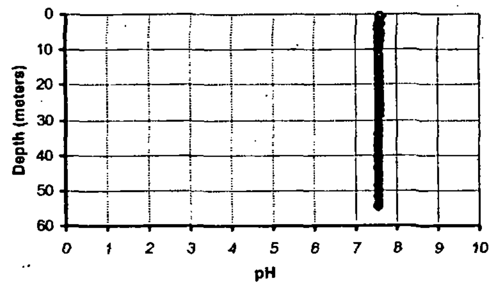










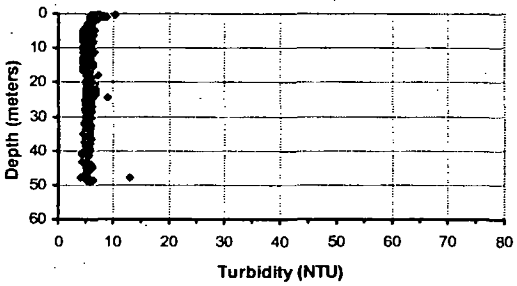


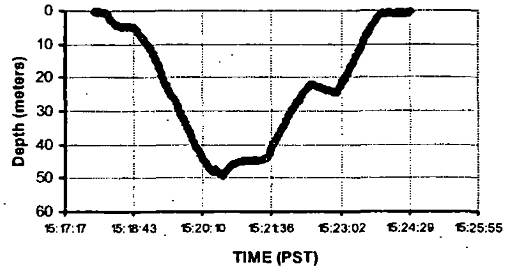
DATE: 1/6/2005

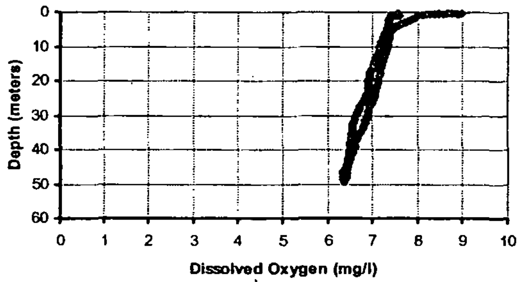
CAST ID: CTD_010605_RA5_Background

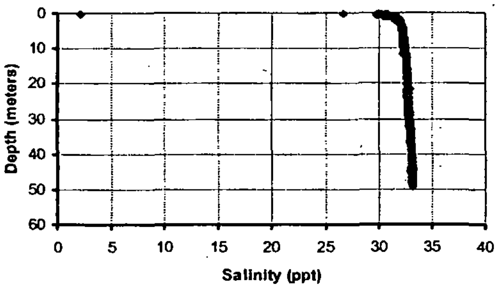
Start Time: 15:17:54
Duration(min): 6.63
Samples: 398
Tide: EBB

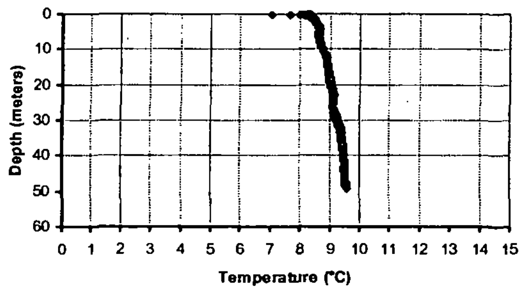
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.5	7.54	30.8	7.62	8.33
24.7 (81.0)	6.4	6.85	32.8	7.62	9.09
48.4 (158.8)	5.5	6.39	33.1	7.59	9.51

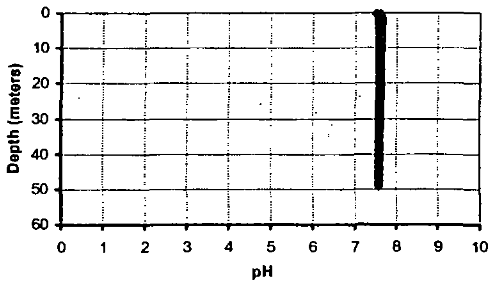










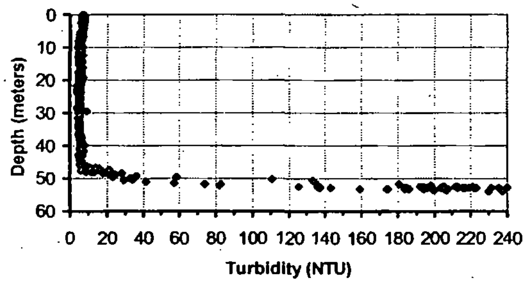


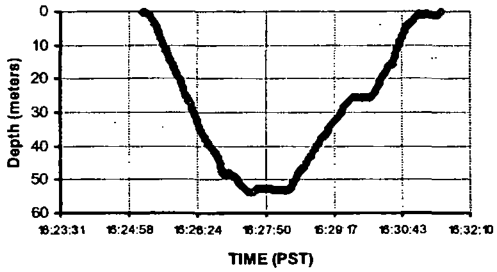
DATE: 1/6/2005

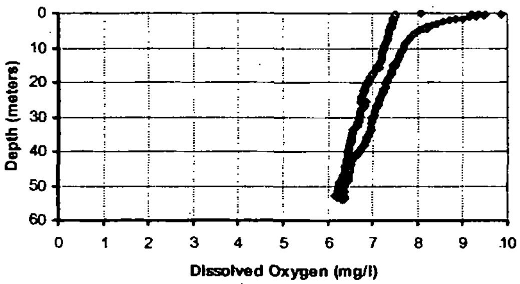
CAST ID: CTD_010605_RA5_300ft_EW_1627

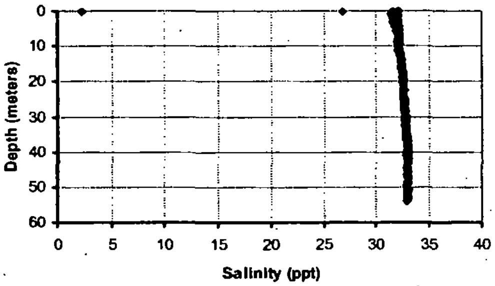
Start Time: 16:25:15
Duration(min): 6.32
Samples: 379
Tide: EBB

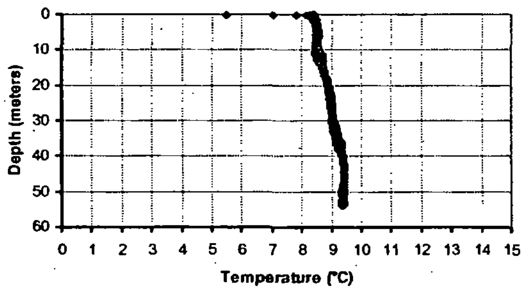
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.0	7.50	32.2	7.68	8.42
26.9 (88.3)	5.2	7.11	32.7	7.64	9.01
53 (173.9)	194.2	6.24	33.0	7.60	9.38

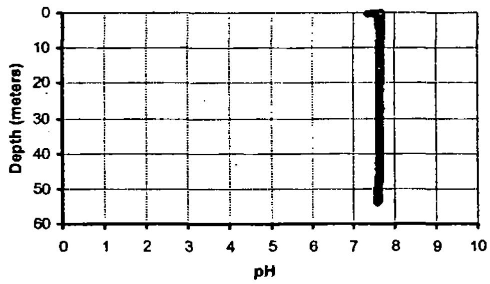










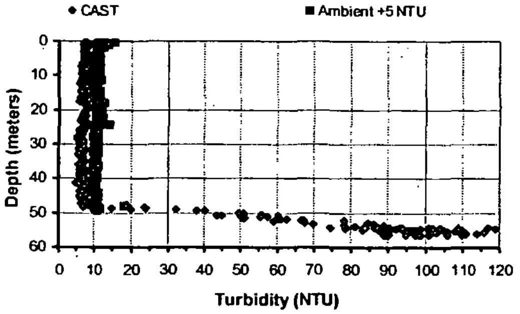


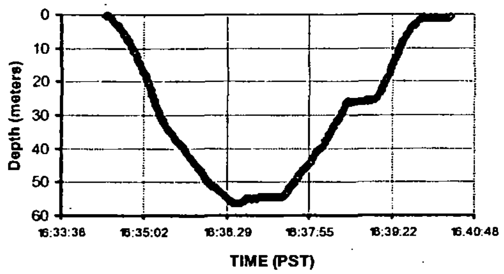
DATE: 1/6/2005

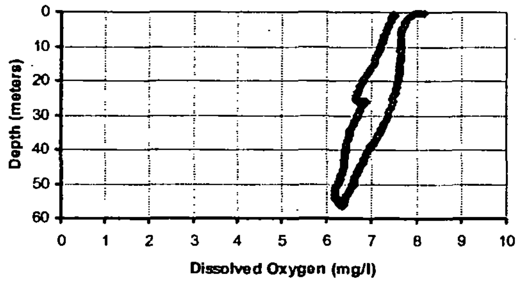
CAST ID: CTD_010605_RA5_600ft_MS1_1637

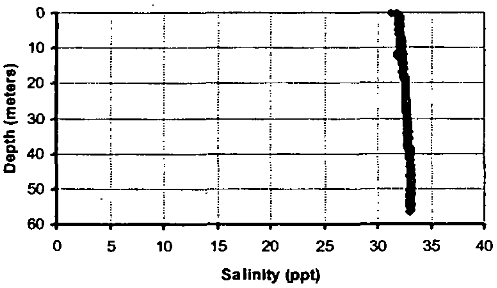
Start Time: 16:34:22
Duration(min): 6.05
Samples: 363
Tide: EBB

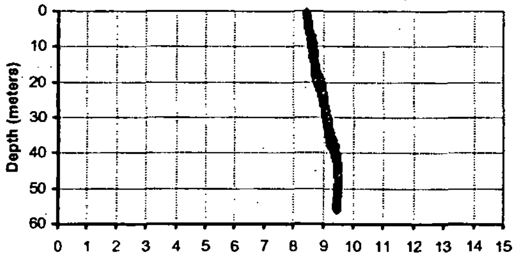
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.7	7.50	32.0	7.68	8.44
26 (85.3)	6.2	6.82	32.8	7.67	9.06
55.2 (181.1)	102.1	6.27	33.1	7.63	9.44

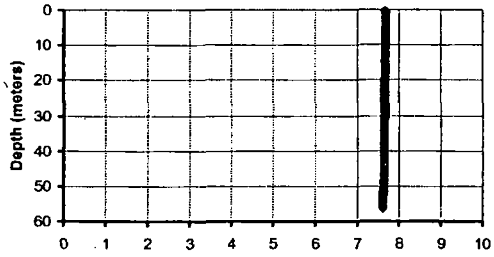










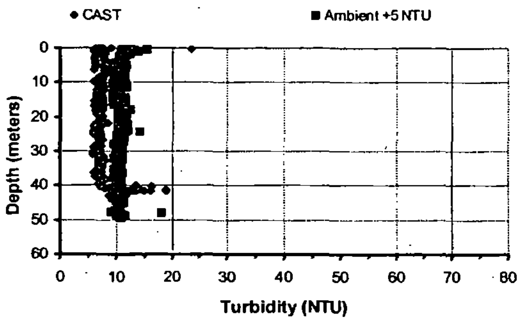


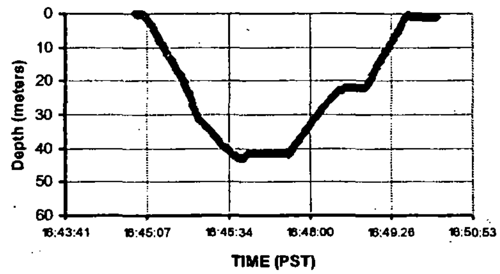
DATE: 1/6/2005

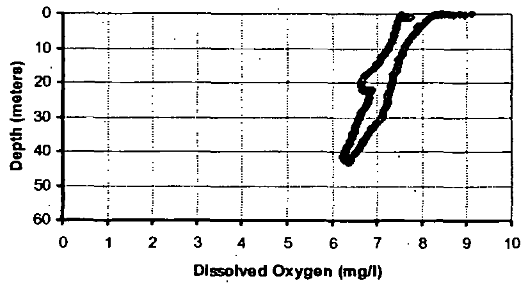
CAST ID: CTD_010605_RA5_600ft_MS2_1645

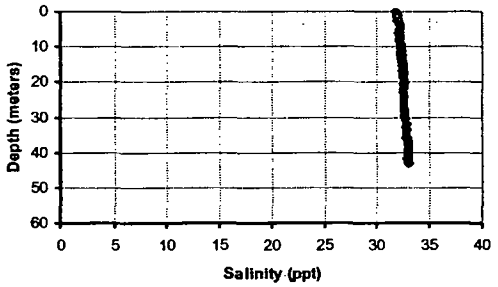
Start Time: 16:44:54
Duration(min): 5.37
Samples: 322
Tide: EBB

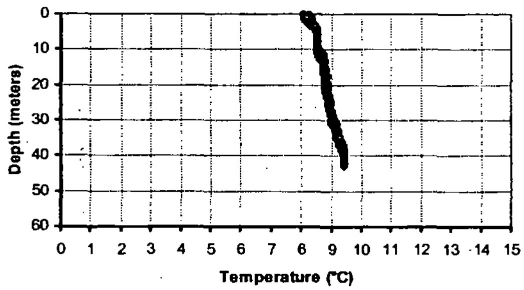
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.5	7.73	32.1	7.70	8.18
22 (72.2)	7.5	6.86	32.6	7.68	8.90
41.6 (136.5)	11.2	6.30	33.0	7.65	9.43

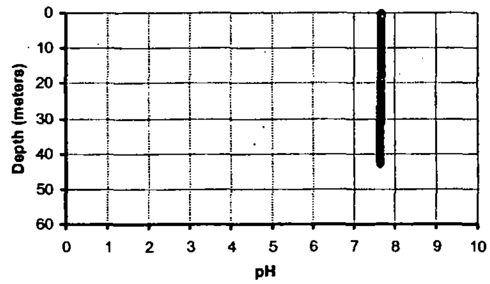










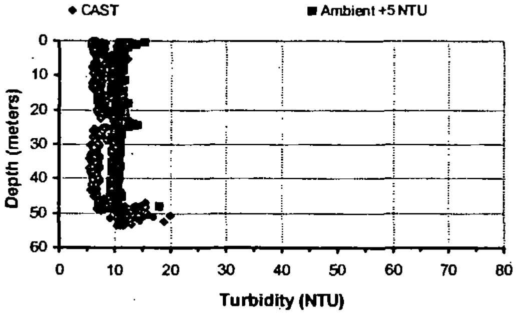


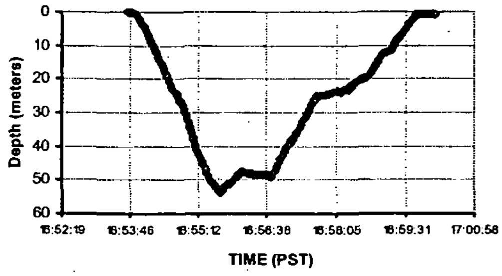
DATE: 1/6/2005

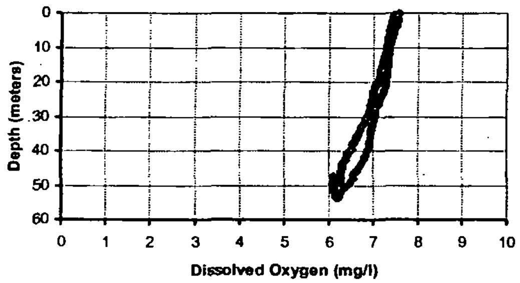
CAST ID: CTD_010605_RA5_600ft_MS1_1653

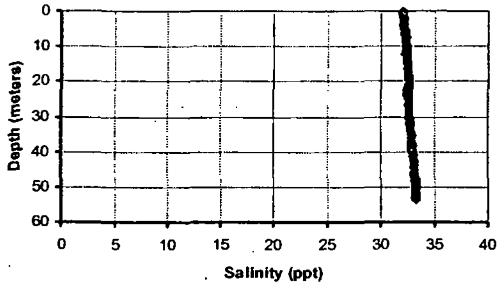
Start Time: 16:53:42
Duration(min): 6.48
Samples: 389
Tide: EBB

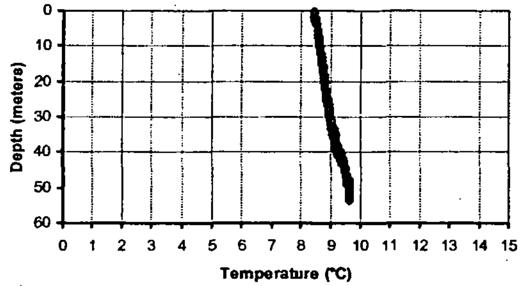
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.8	7.50	32.0	7.68	8.44
25.1 (82.3)	12.0	7.02	32.6	7.68	8.90
52.8 (173.2)	11.6	6.15	33.2	7.64	9.65

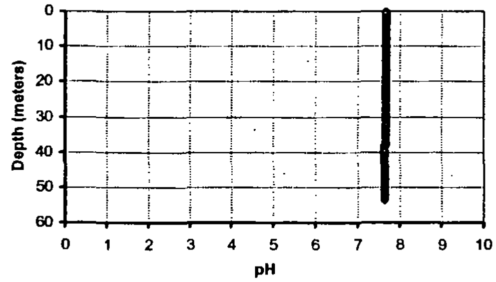










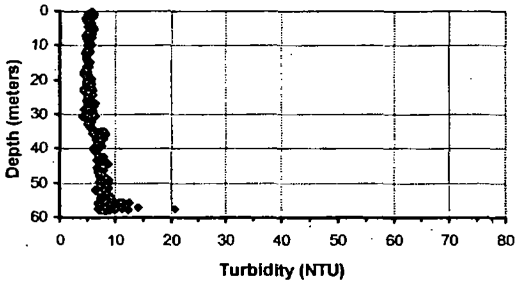


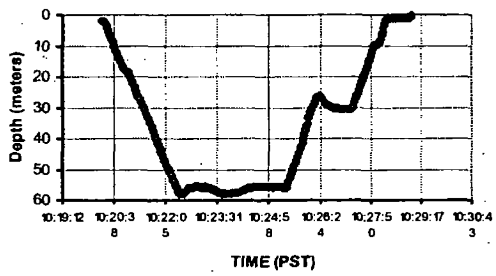
DATE: 1/7/2005

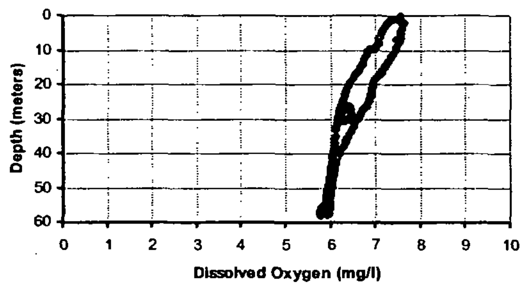
CAST ID: CTD_010705_RA5_Background

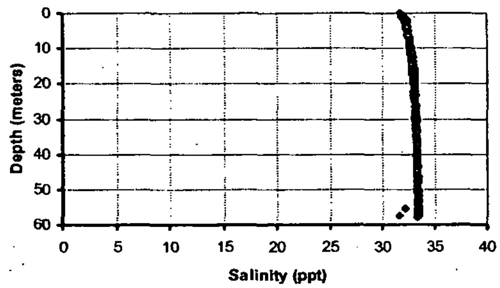
Start Time: 10:20:18
Duration(min): 8.73
Samples: 524
Tide: FLOOD

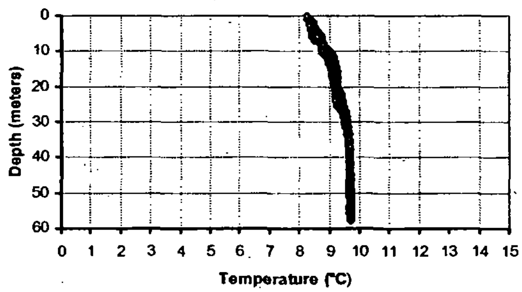
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.5	7.53	32.1	7.71	8.34
29.1 (95.5)	6.1	6.47	33.2	7.67	9.49
57.1 (187.3)	9.3	5.83	33.4	7.65	9.70

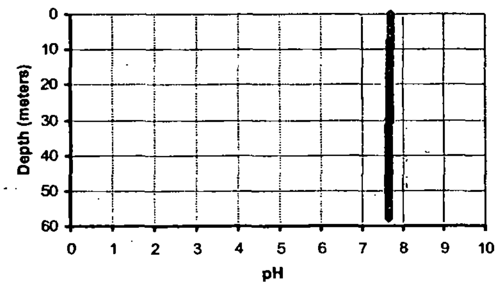










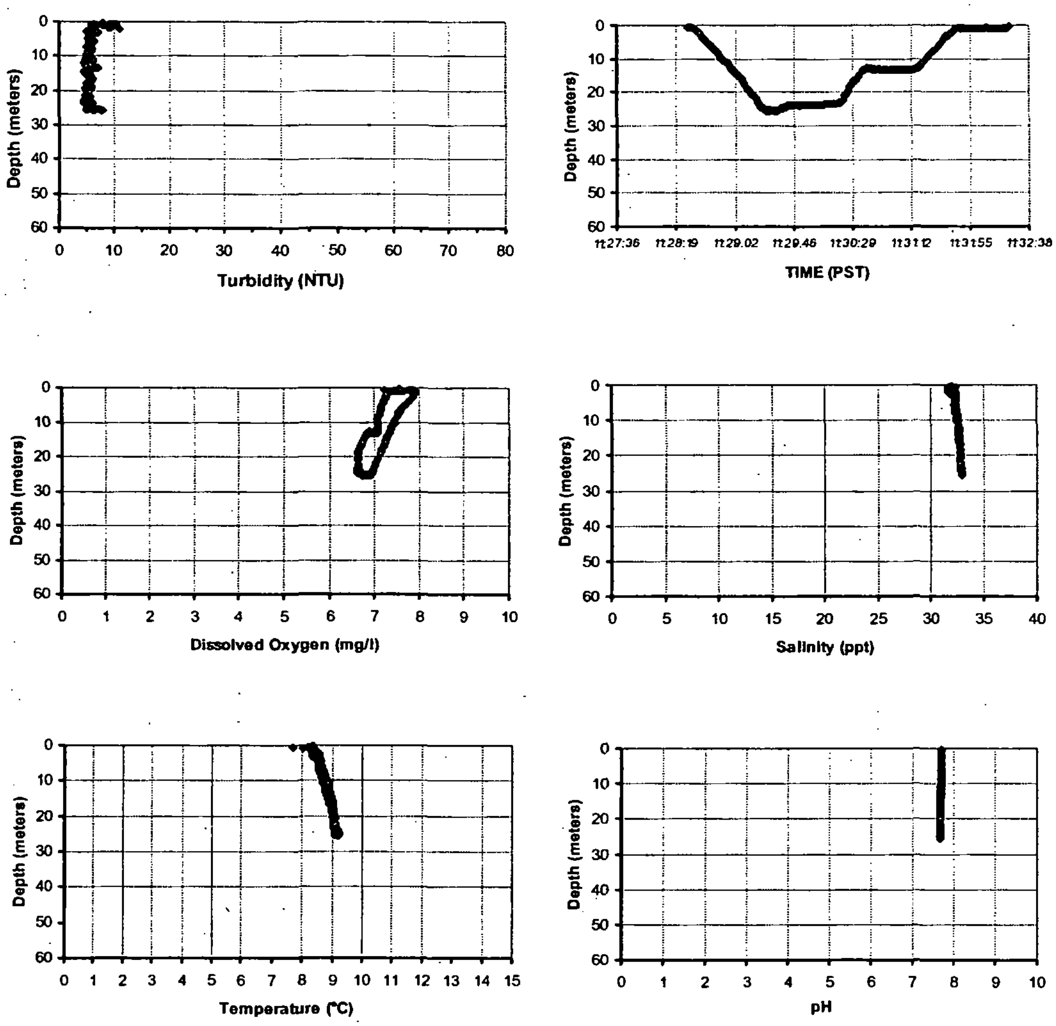


DATE: 1/7/2005

CAST ID: CTD_010705_RA5_300ft Early Warning

Start Time: 11:28:28
Duration(min): 3.95
Samples: 237
Tide: FLOOD

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.4	7.52	32.0	7.71	8.34
12.8 (42.0)	5.9	6.88	32.8	7.70	8.88
24.7 (81.0)	5.9	6.64	33.0	7.68	9.20

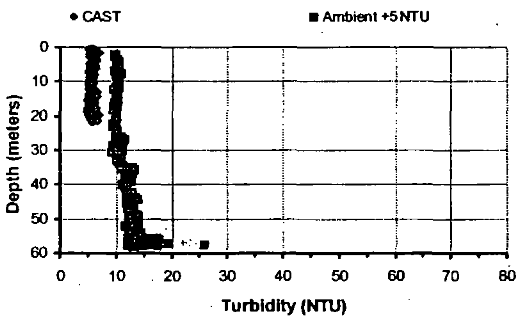


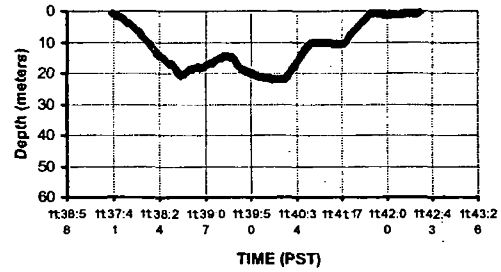
DATE: 1/7/2005

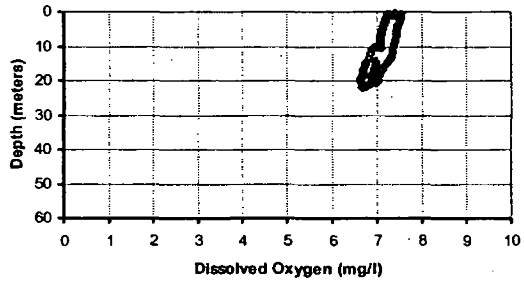
CAST ID: CTD_010705_RA5_600ft_MS1_1135

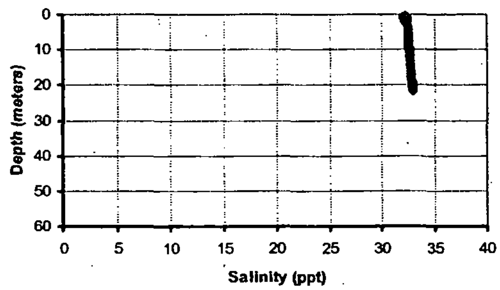
Start Time: 11:37:40
Duration(min): 4.87
Samples: 292
Tide: FLOOD

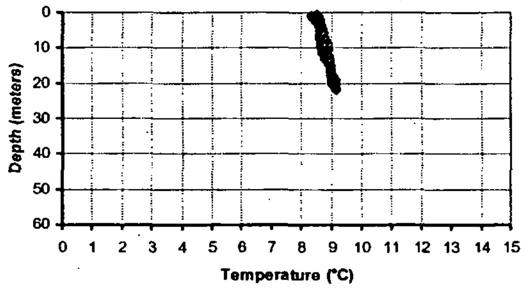
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.1	7.36	32.4	7.71	8.53
11 (36.1)	5.2	7.05	32.7	7.70	8.85
21 (68.9)	5.5	6.85	33.0	7.68	9.12

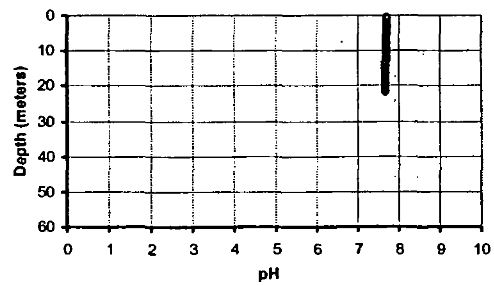










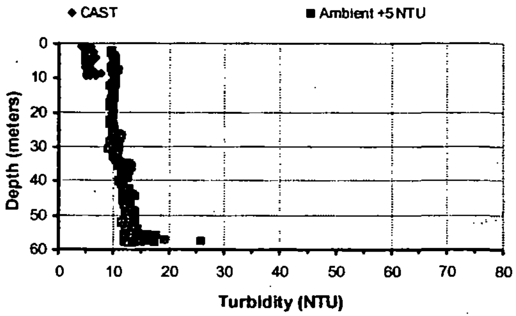


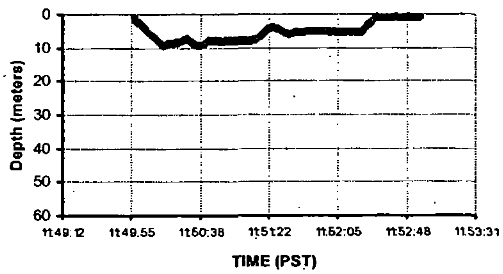
DATE: 1/7/2005

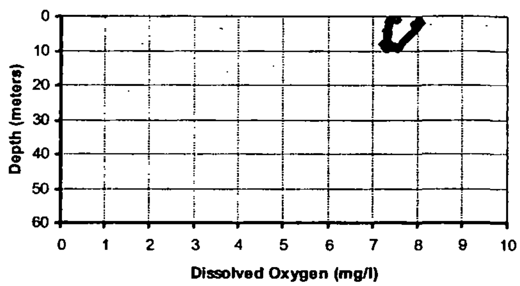
CAST ID: CTD_010705_RA5_600ft_MS2_1150

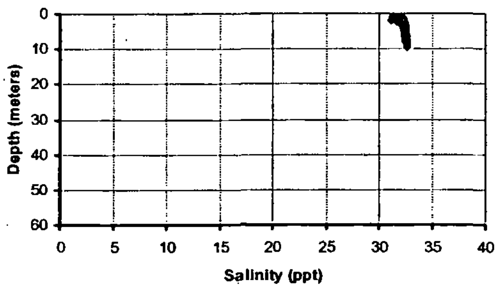
Start Time: 11:49:57
Duration(min): 3.02
Samples: 181
Tide: FLOOD

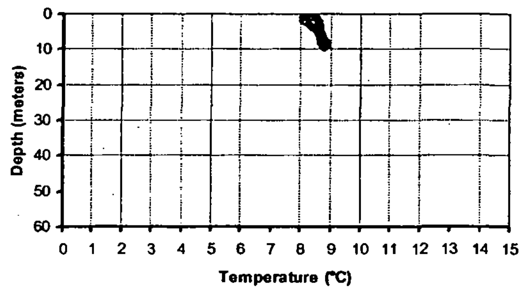
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.1	7.51	31.7	7.71	8.27
5 (16.4)	5.0	7.32	32.5	7.71	8.57
8.5 (27.9)	5.7	7.42	32.6	7.69	8.79

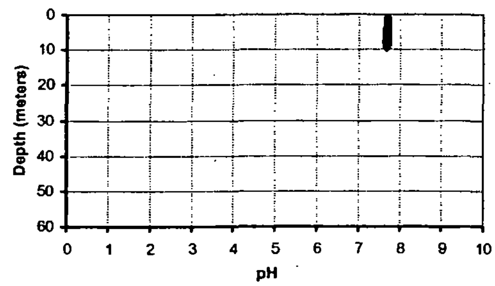








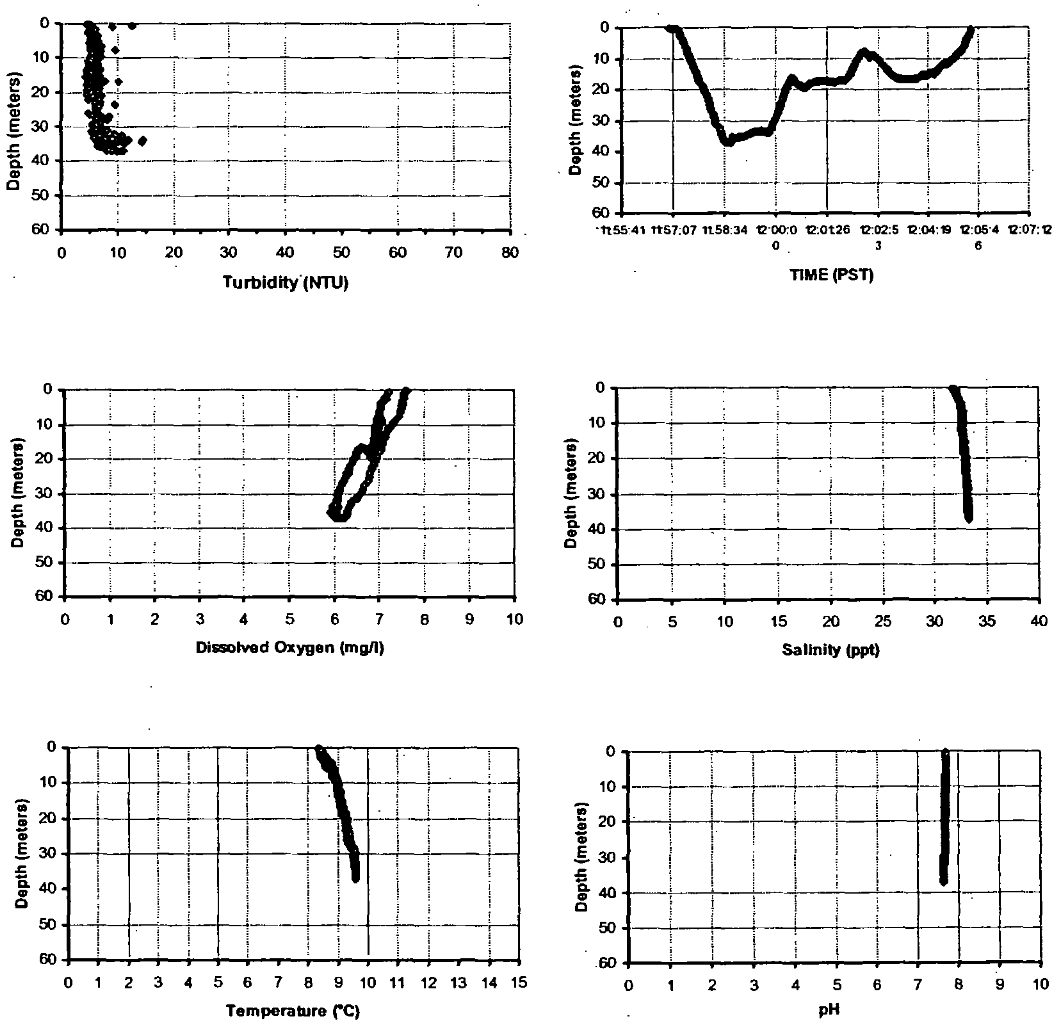




CAST ID: CTD_010705_RA5_Dump Site re-check

Start Time: 11:57:01
Duration(min): 8.57
Samples: 514
Tide: FLOOD

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.1	7.40	32.2	7.71	8.45
18.6 (61.0)	5.7	6.81	33.0	7.70	9.15
36.2 (118.8)	9.3	6.30	33.3	7.66	9.60

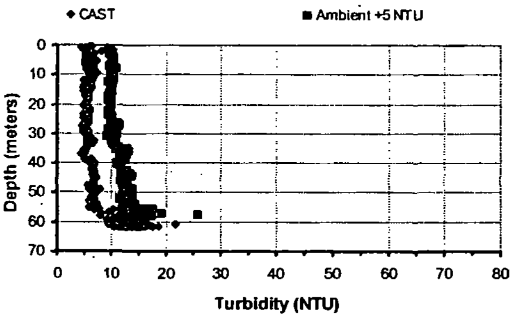


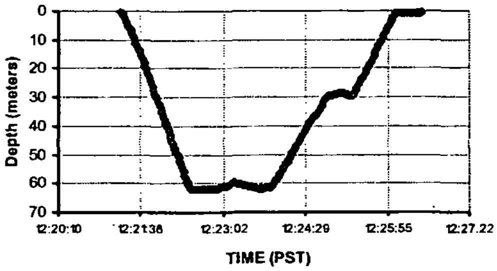
DATE: 1/7/2005

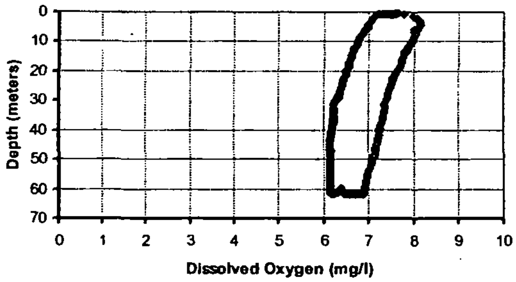
CAST ID: CTD_010705_RA5_600ft_MS1b_1220

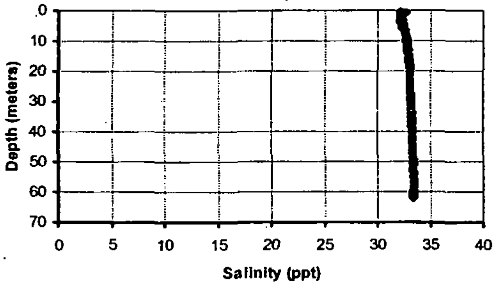
Start Time: 12:21:15
Duration(min): 5.30
Samples: 318
Tide: FLOOD/SLACK

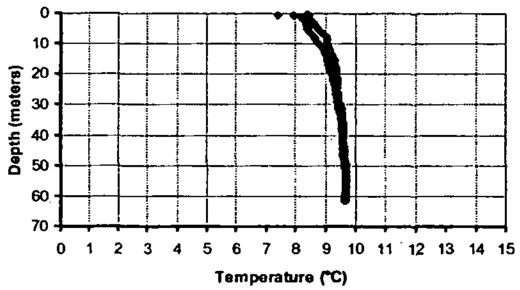
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.5	7.43	32.2	7.72	8.41
30.9 (101.4)	5.5	6.27	33.2	7.67	9.55
60 8 (199.5)	12.7	6.36	33.4	7.66	9.66

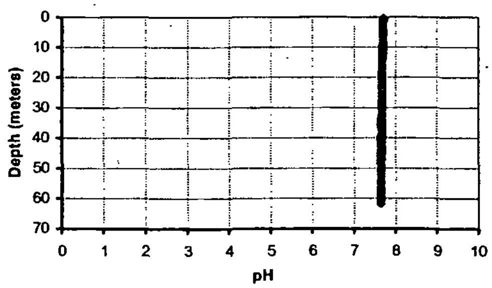










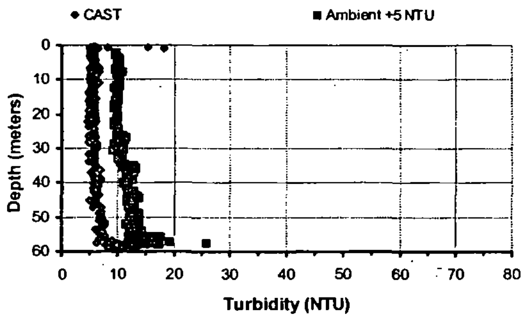


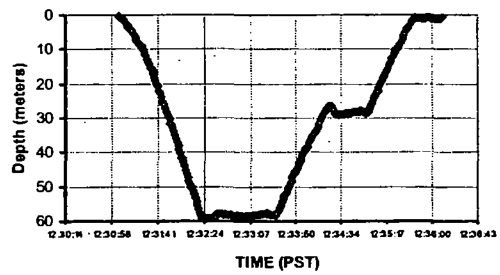
DATE: 1/7/2005

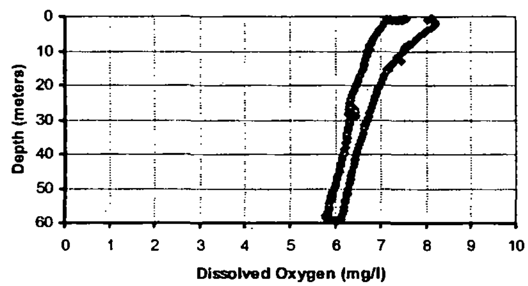
CAST ID: CTD_010705_RA5_600ft_MS2b_1230

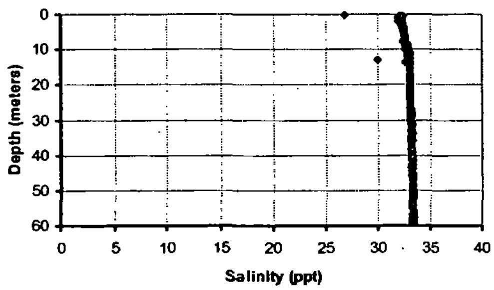
Start Time: 12:31:04
Duration(min): 5.12
Samples: 307
Tide: SLACK

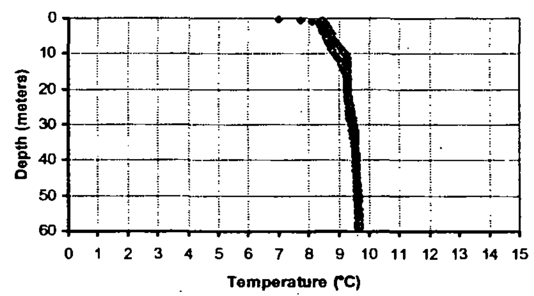
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.5	7.44	32.3	7.72	8.47
29.6 (97.1)	6.0	6.53	33.2	7.68	9.45
58.2 (190.9)	9.6	5.83	33.4	7.65	9.66

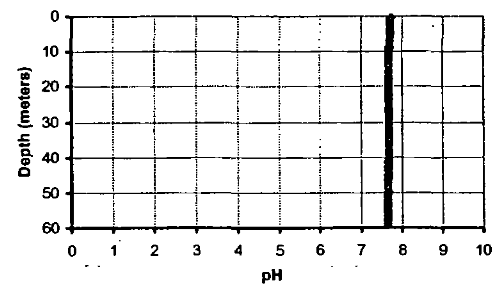










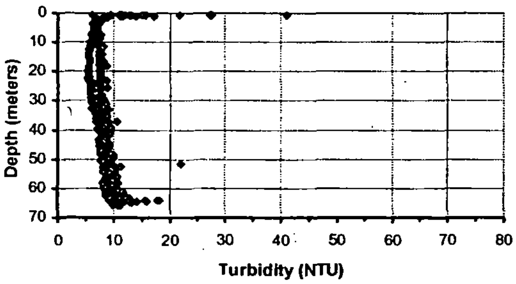


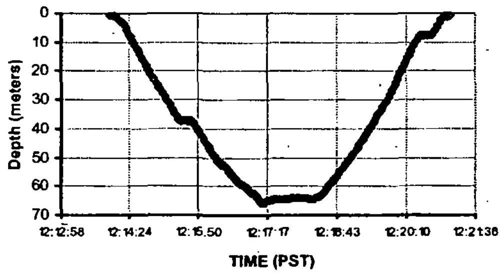
DATE: 1/12/2005

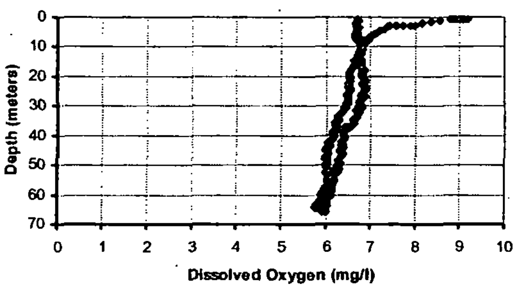
CAST ID: CTD_011205_RA5_Background

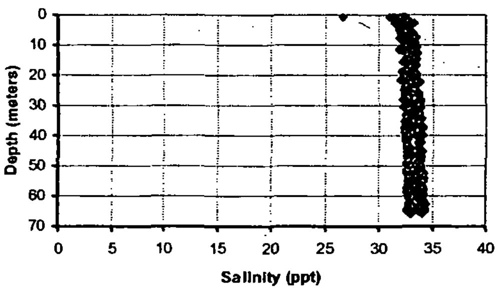
Start Time: 12:13:59
Duration(min): 7.12
Samples: 427
Tide: EBB/SLACK

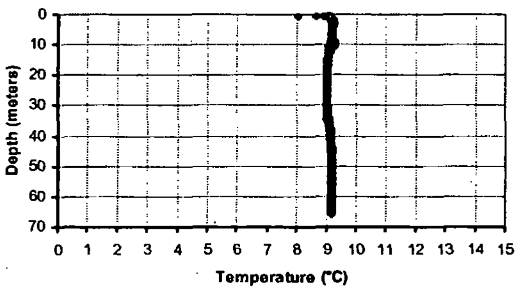
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	11.4	6.72	32.2	7.63	9.08
33.1 (108.6)	9.1	6.28	33.6	7.64	9.07
64.9 (212.9)	11.6	5.92	34.2	7.61	9.19

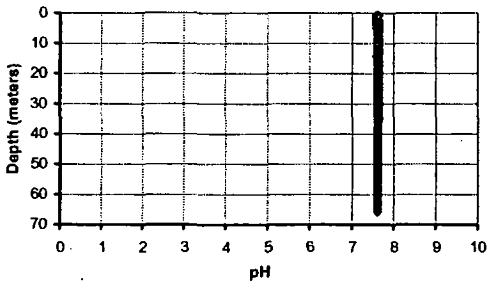










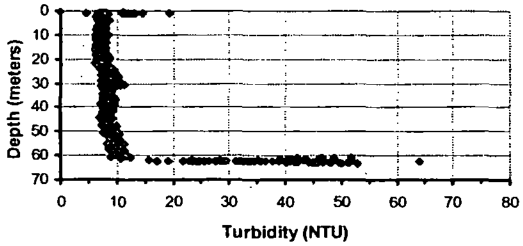


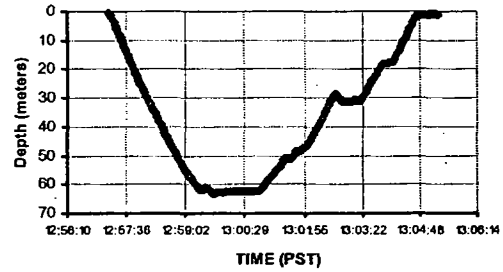
DATE: 1/12/2005

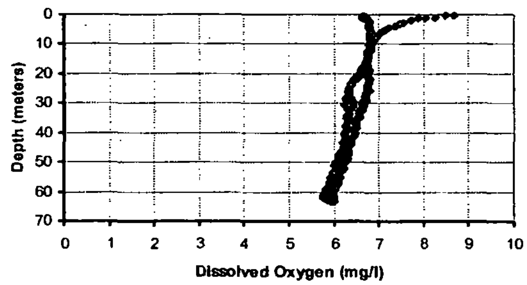
CAST ID: CTD_011205_RA5_300ft_EW_1255

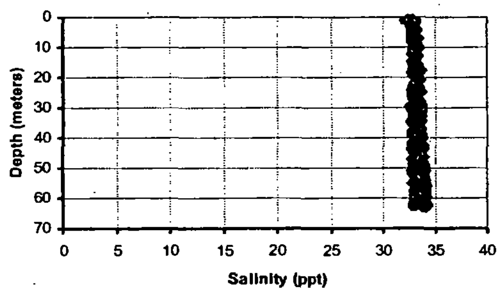
Start Time: 12:57:10
Duration(min): 8.13
Samples: 488
Tide: EBB

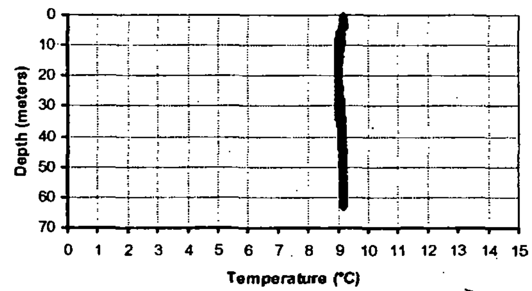
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	13.1	6.69	32.6	7.64	9.16
31.7 (104.0)	7.6	6.65	32.9	7.65	9.02
62.4 (204.7)	30.1	5.84	33.6	7.63	9.18

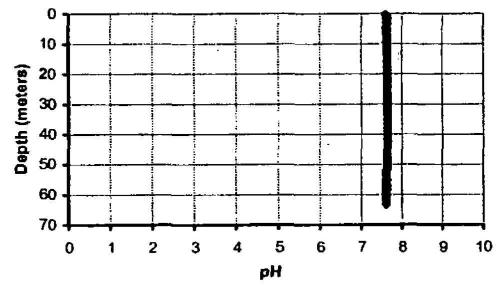










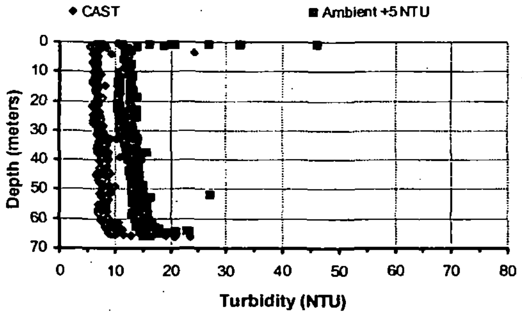


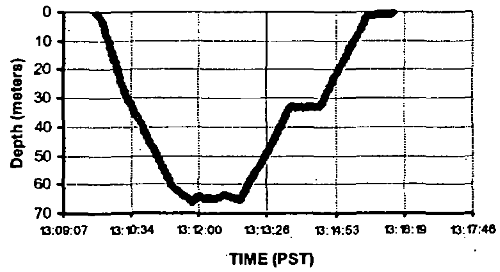
DATE: 1/12/2005

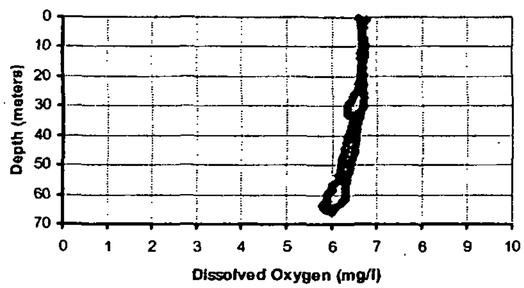
CAST ID: CTD_011205_RA5_600ft_MS1_1310

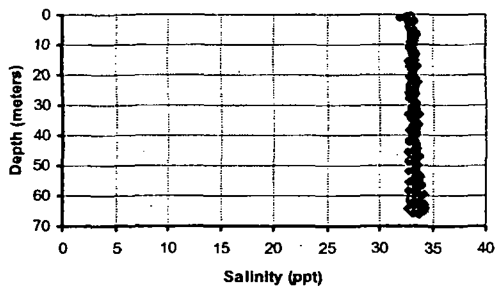
Start Time: 13:09:49
Duration(min): 6.30
Samples: 378
Tide: SLACK/FLOOD

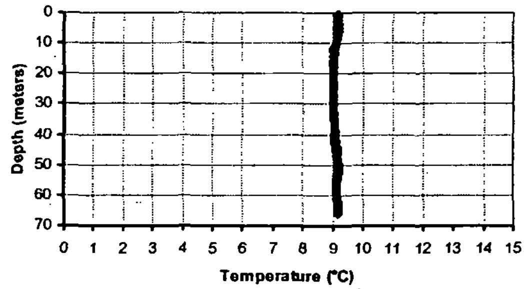
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.4	6.62	32.8	7.65	9.18
33 (108.3)	8.5	6.47	33.2	7.66	9.03
65.3 (214.2)	9.7	6.01	33.7	7.64	9.19

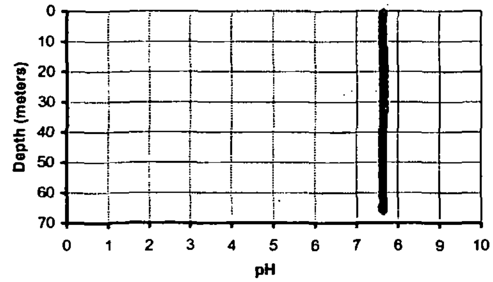










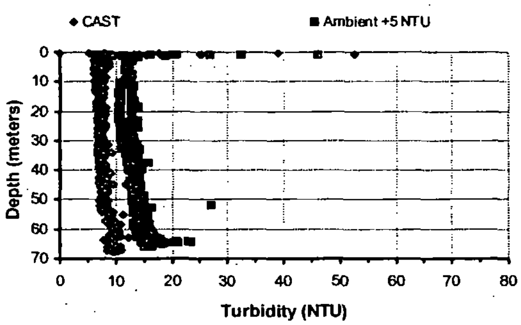


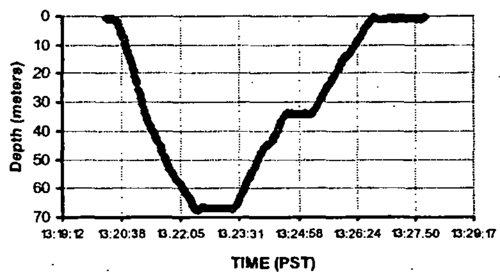
DATE: 1/12/2005

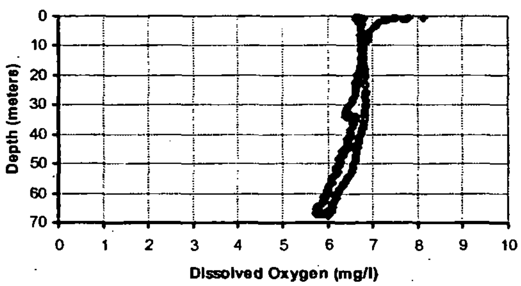
CAST ID: CTD_011205_RA5_600ft_MS2_1320

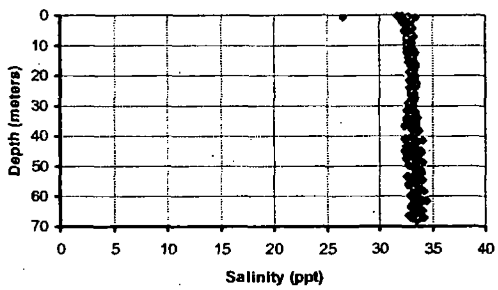
Start Time: 13:20:17
Duration(min): 7.85
Samples: 471
Tide: SLACK/FLOOD

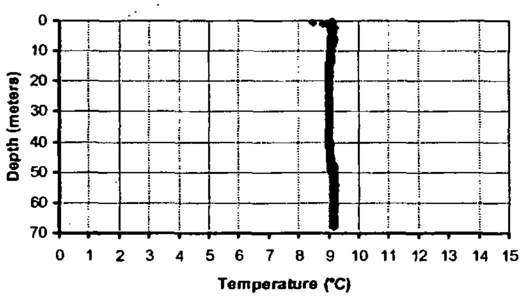
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.9	6.84	32.6	7.66	9.08
34 (111.5)	8.0	6.49	33.1	7.67	9.03
67 (219.8)	9.9	5.76	33.8	7.64	9.20

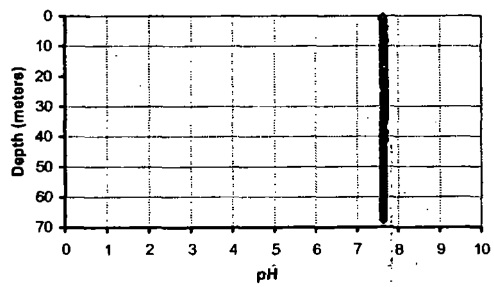










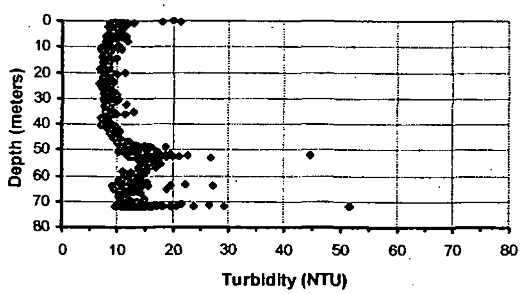


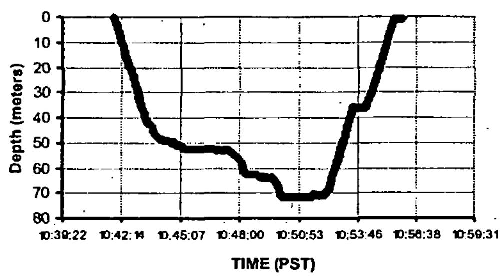
DATE: 1/21/2005

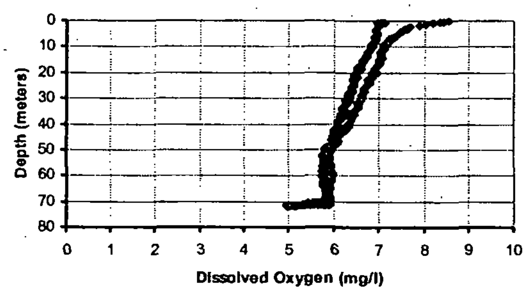
CAST ID: CTD_012105_RA5_Background_1040

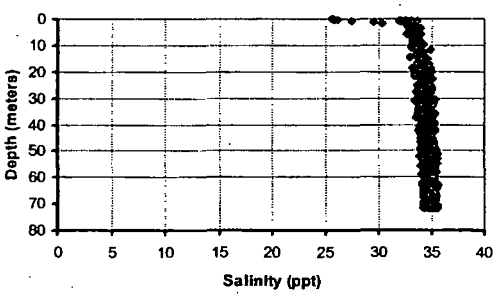
Start Time: 10:41:51
Duration(min): 14.17
Samples: 850
Tide: FLOOD

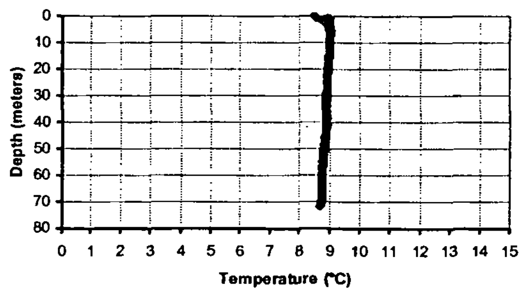
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	10.3	7.10	32.4	7.59	8.94
36 (118.1)	9.1	6.31	34.7	7.56	8.91
70.9 (232.6)	12.0	5.86	34.9	7.53	8.73

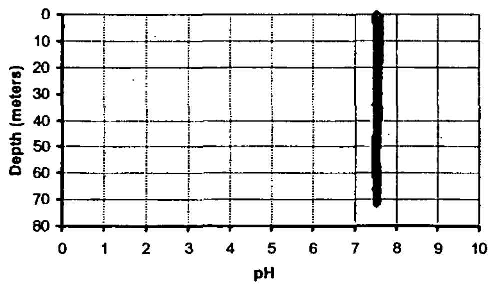










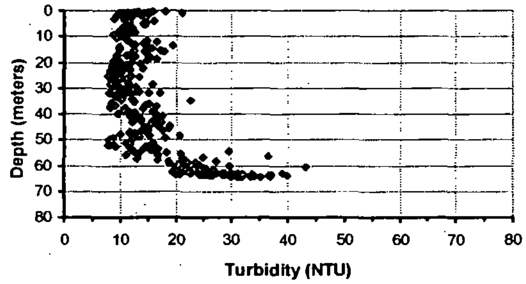


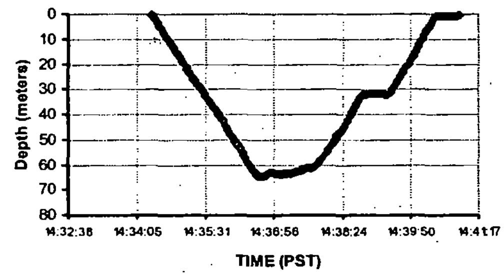
DATE: 1/21/2005

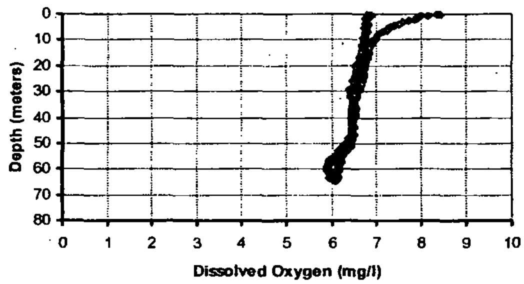
CAST ID: CTD_012105_RA5_300ft_1431

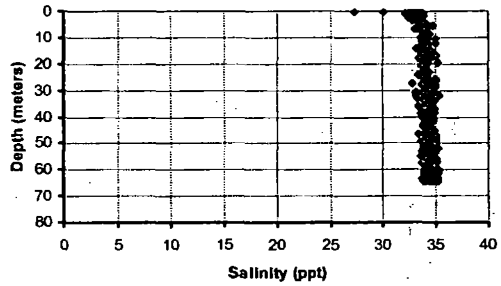
Start Time: 14:34:23
Duration(min): 6.52
Samples: 391
Tide: FLOOD

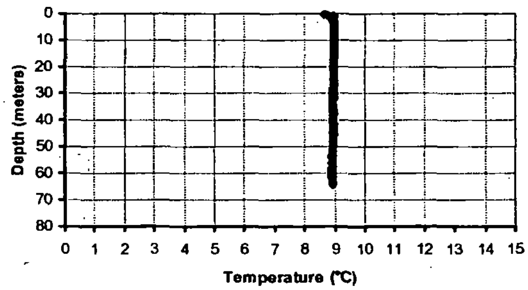
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	11.5	6.83	33.2	7.61	8.95
32.3 (106.0)	10.0	6.45	33.7	7.60	8.96
63.6 (208.7)	29.3	6.07	34.5	7.56	8.93

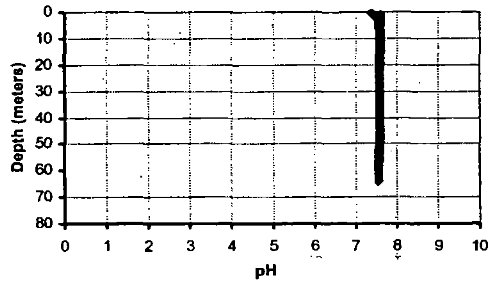










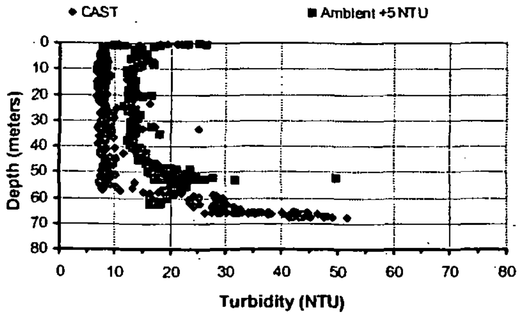


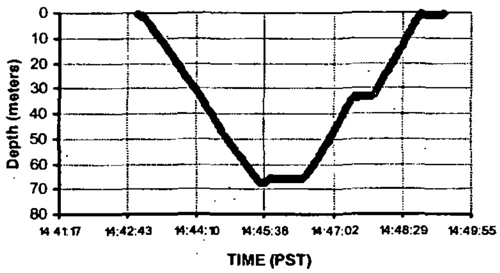
DATE: 1/21/2005

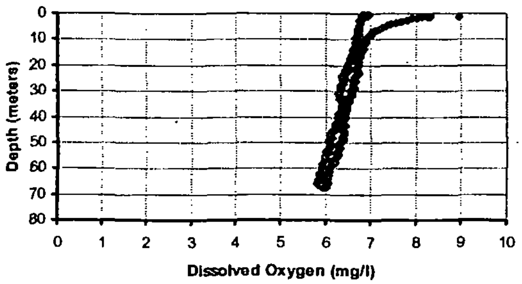
CAST ID: CTD_012105_RA5_600ft_MS1_1442

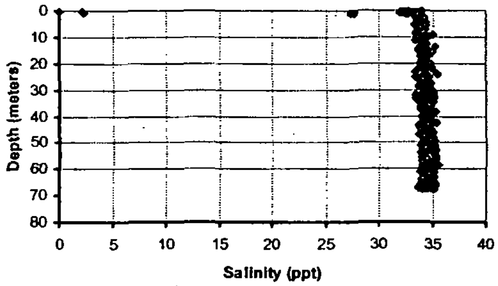
Start Time: 14:42:56
Duration(min): 6.43
Samples: 386
Tide: EBB

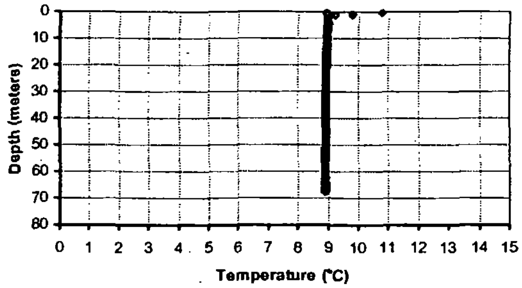
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	10.4	6.89	32.8	7.62	8.94
33.8 (110.9)	8.9	6.46	34.1	7.61	8.93
66.6 (218.5)	37.5	6.03	34.1	7.56	8.91

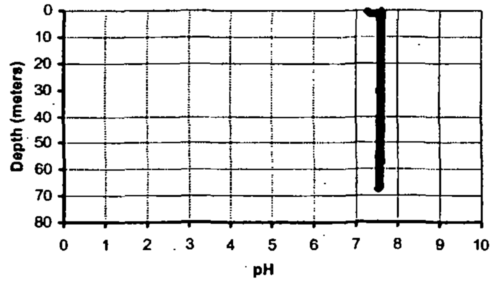










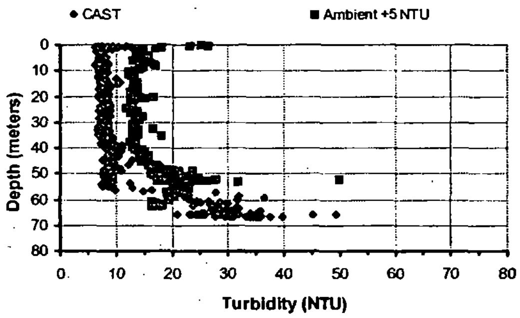


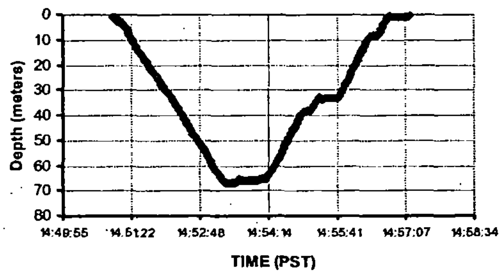
DATE: 1/21/2005

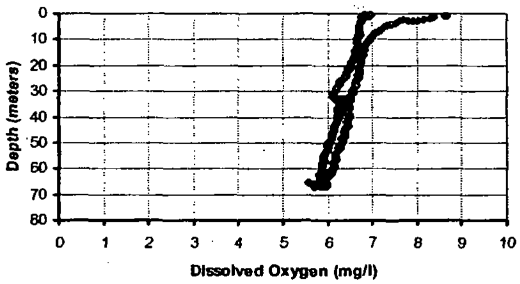
CAST ID: CTD_012105_RA5_600ft_MS2_1450

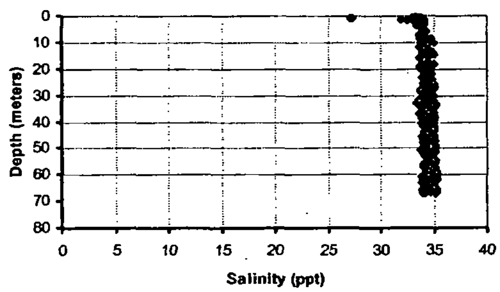
Start Time: 14:50:59
Duration(min): 6.27
Samples: 376
Tide: EBB

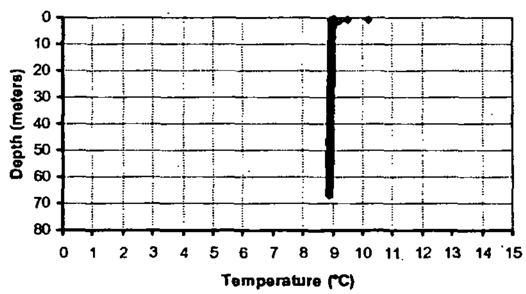
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	8.6	6.99	33.2	7.62	9.06
33.5 (109.9)	8.7	6.44	34.0	7.62	8.92
66 (216.5)	27.7	5.80	34.4	7.56	8.90

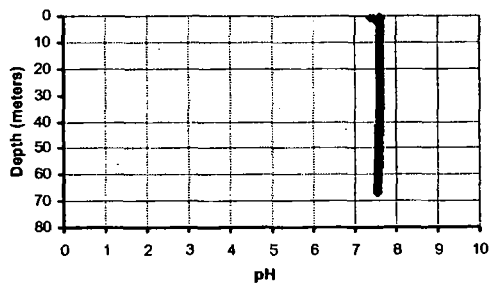










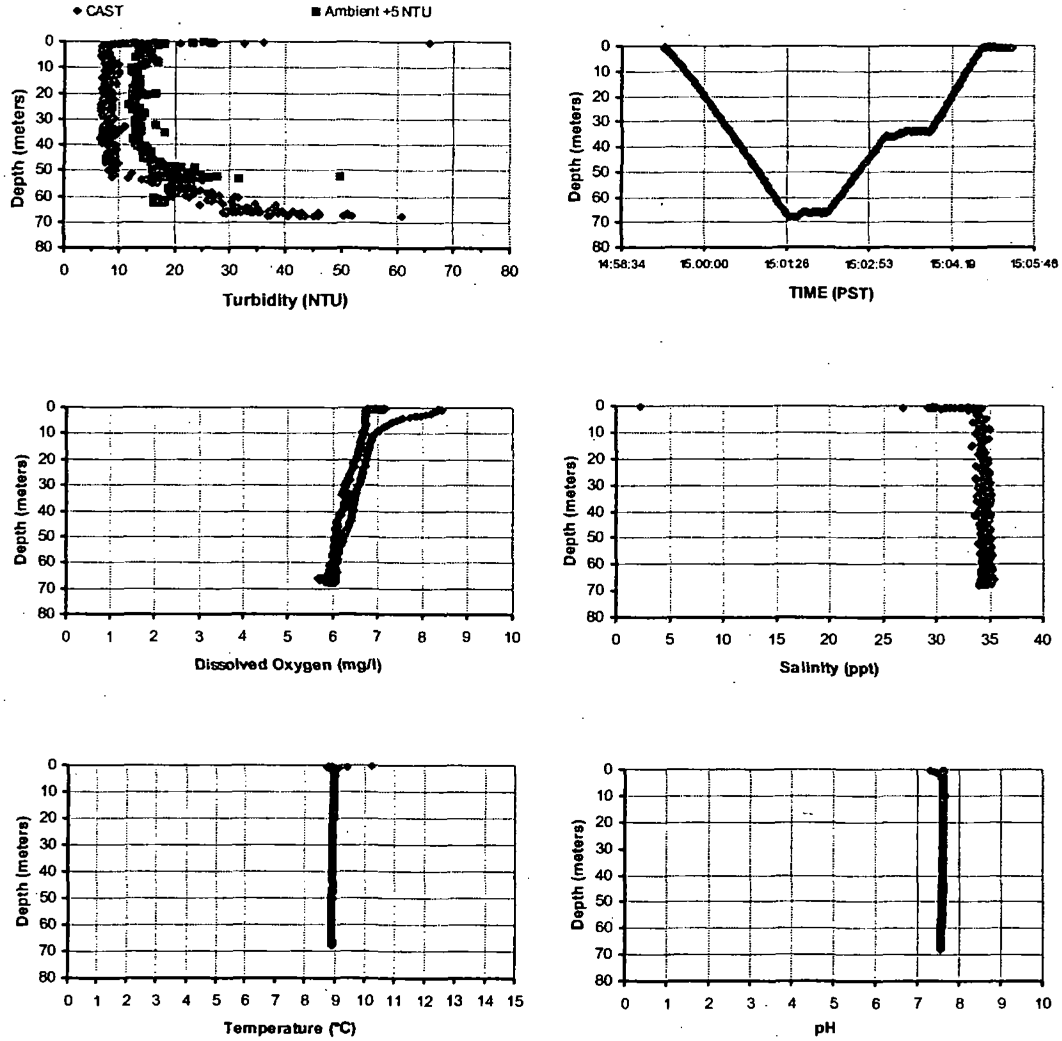


DATE: 1/21/2005

CAST ID: CTD_012105_RA5_600ft_MS1a_1457

Start Time: 14:59:18
Duration(min): 6.08
Samples: 365
Tide: EBB

Depth Meters	(Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1	(3.3)	10.5	6.94	33.4	7.62	8.96
33.5	(109.9)	9.0	6.36	34.8	7.62	8.93
66.9	(219.5)	36.9	5.90	34.8	7.56	8.91

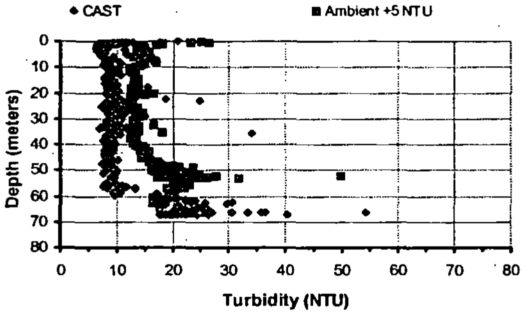


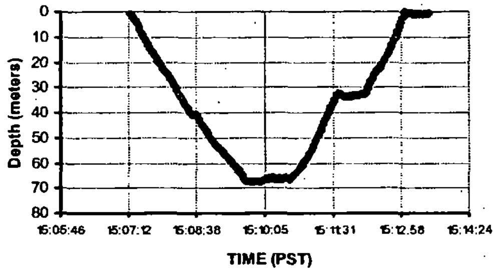
DATE: 1/21/2005

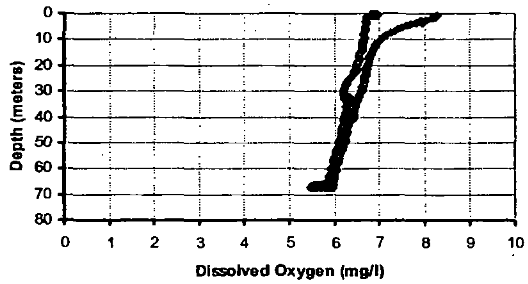
CAST ID: CTD_012105_RA5_600ft_MS2a_1505

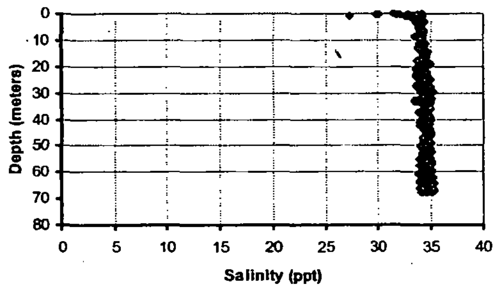
Start Time: 15:07:14
Duration(min): 6.33
Samples: 380
Tide: EBB

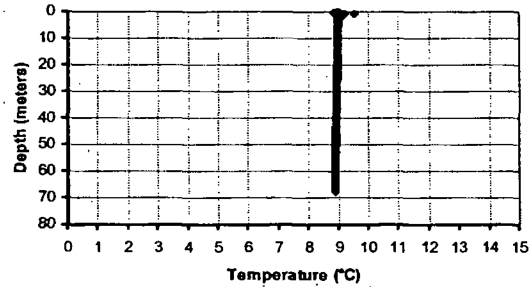
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	8.1	7.00	33.4	7.63	9.05
33.7 (110.6)	8.9	6.46	34.5	7.62	8.93
66.5 (218.2)	23.6	5.89	34.2	7.57	8.91

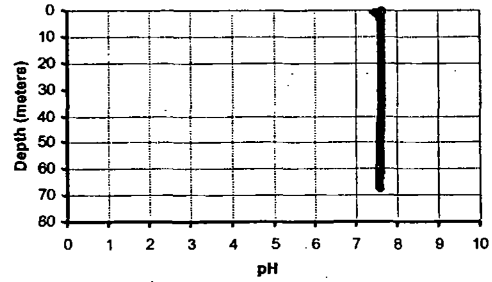










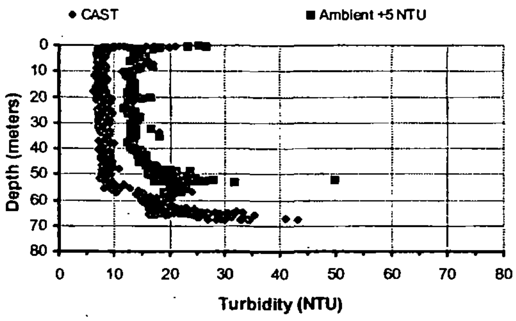


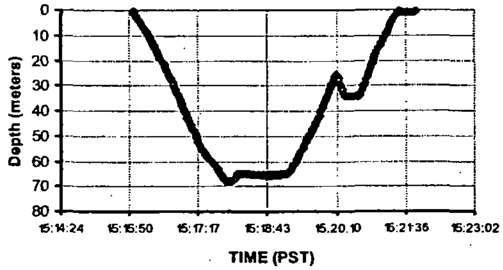
DATE: 1/21/2005

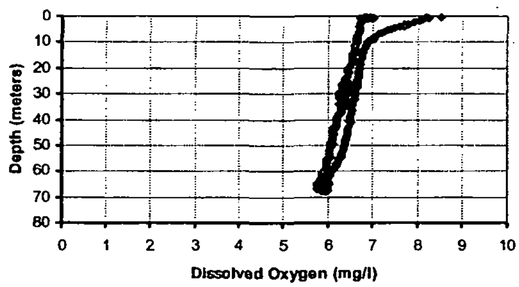
CAST ID: CTD_012105_RA5_MS1b_1515

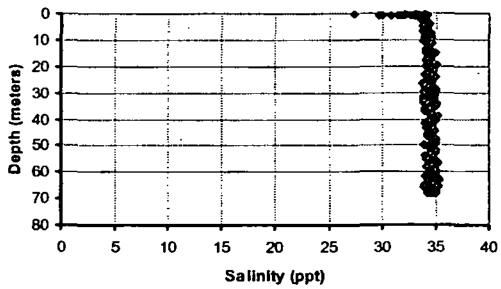
Start Time: 15:15:54
Duration(min): 5.93
Samples: 356
Tide: FLOOD

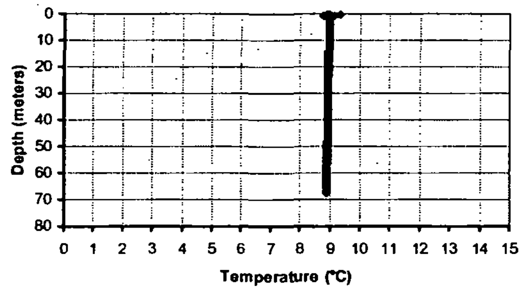
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	10.0	6.90	32.7	7.63	8.90
34 (111.5)	8.4	6.44	34.5	7.62	8.92
66.9 (219.5)	27.2	5.79	34.7	7.56	8.91

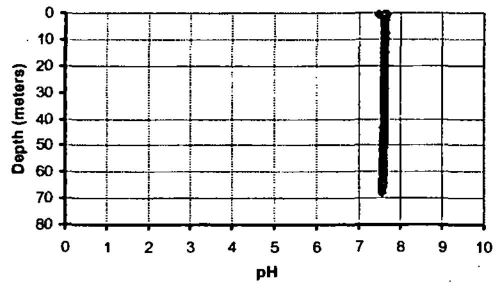










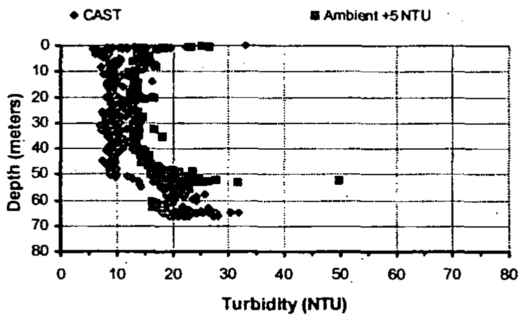


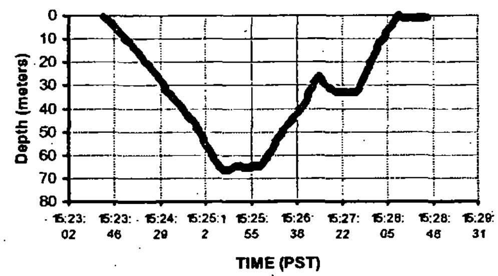
DATE: 1/21/2005

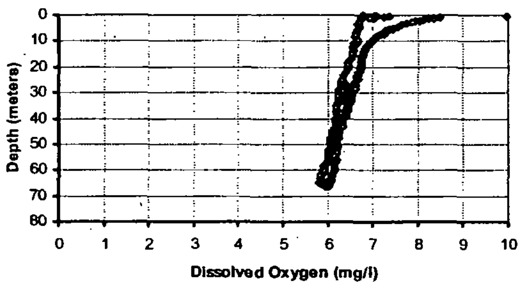
CAST ID: CTD_012105_RA5_MS2b_1523

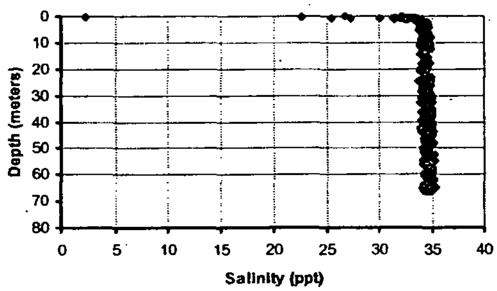
Start Time: 15:23:35
Duration(min): 5.12
Samples: 307
Tide: FLOOD

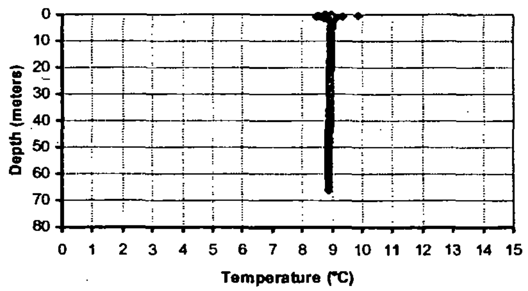
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	12.9	7.09	32.3	7.62	8.97
33.2 (108.9)	10.8	6.51	34.8	7.63	8.92
65.4 (214.6)	21.1	5.90	34.5	7.58	8.91

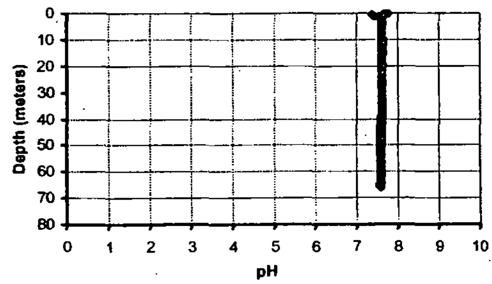










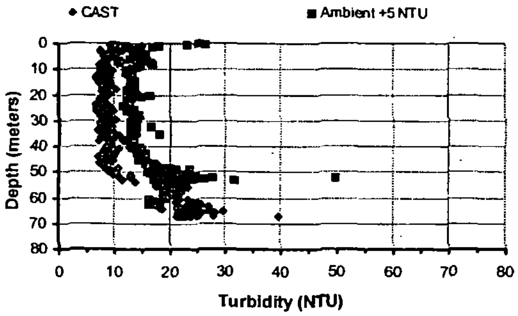


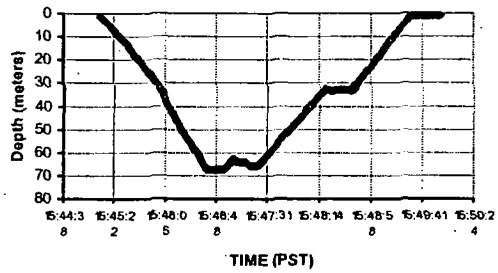
DATE: 1/21/2005

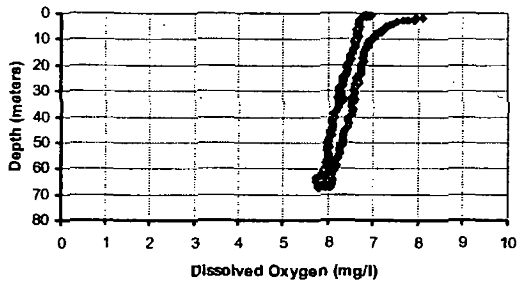
CAST ID: *CTD_012105_RA5_600ft_MS1c_1545*

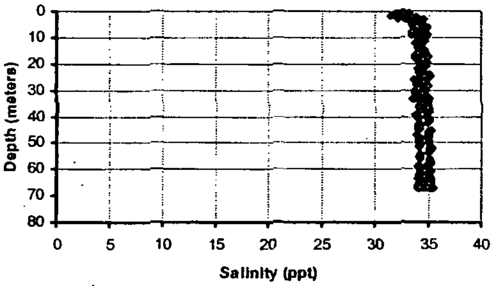
Start Time: 15:45:10
Duration(min): 4.78
Samples: 287
Tide: FLOOD

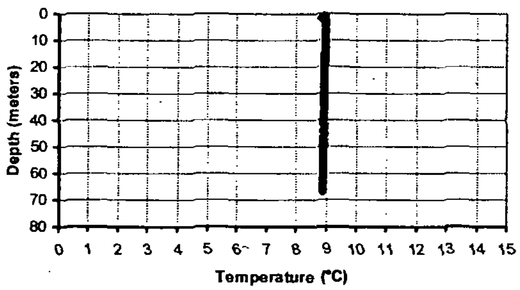
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
.1 (3.3)	10.7	6.90	32.5	7.64	8.93
33.7 (110.6)	7.1	6.32	34.4	7.62	8.92
66.4 (217.8)	27.9	6.10	34.0	7.57	8.90

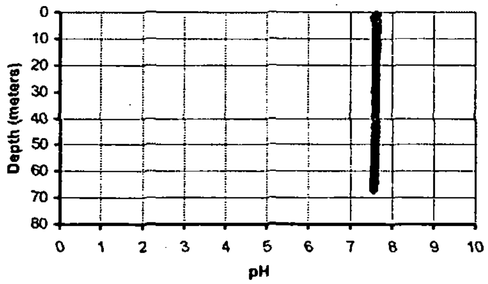










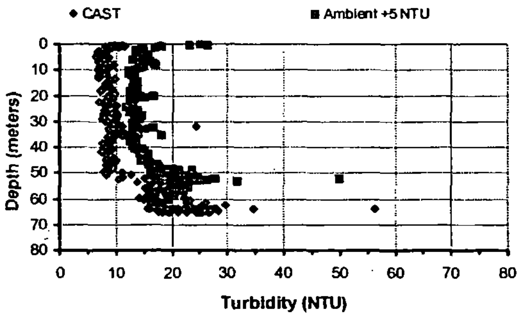


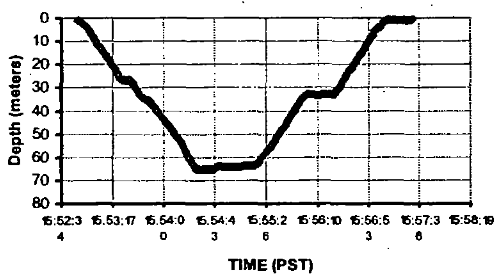
DATE: 1/21/2005

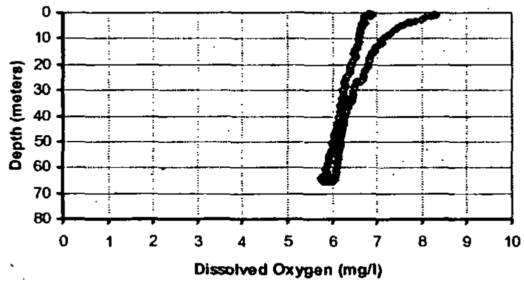
CAST ID: CTD_012105_RA5_600ft_MS2c_1550

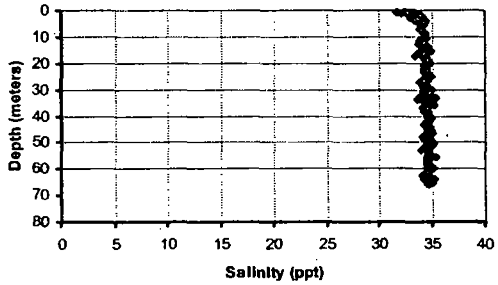
Start Time: 15:52:48
Duration(min): 4.73
Samples: 284
Tide: FLOOD

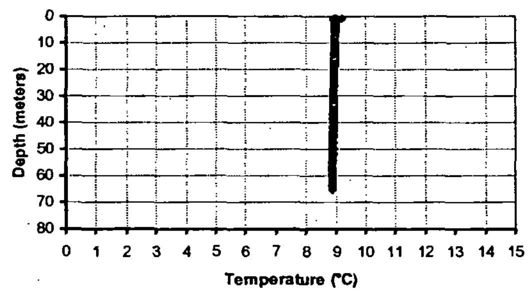
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	9.5	6.98	32.7	7.63	8.97
32.8 (107.6)	10.3	6.47	34.4	7.63	8.92
64.6 (211.9)	25.9	5.76	34.9	7.57	8.90

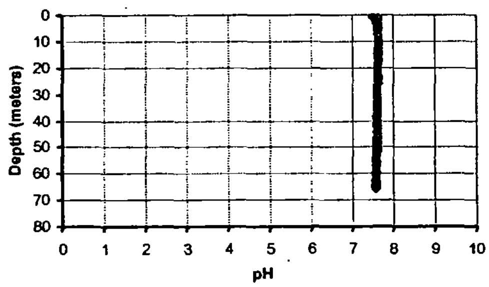










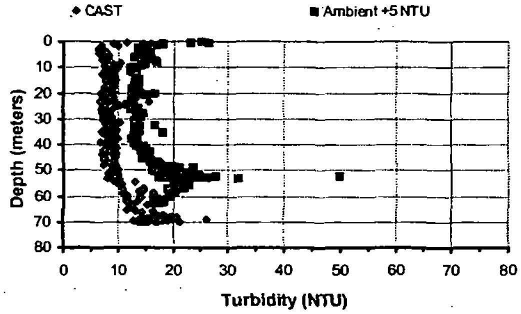


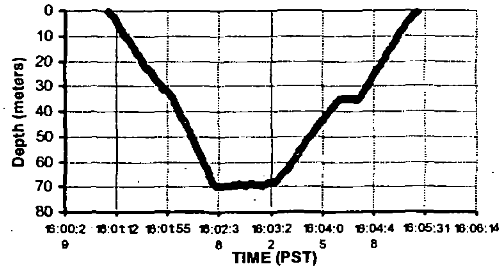
DATE: 1/21/2005

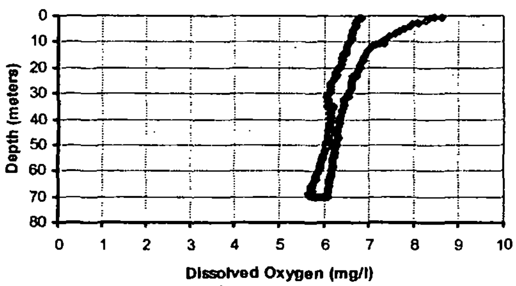
CAST ID: CTD_012105_RA5_1000ft_MS2_1600

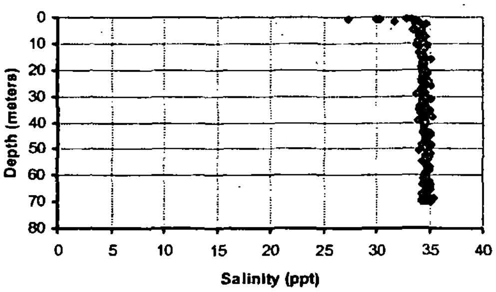
Start Time: 16:01:05
Duration(min): 4.35
Samples: 261
Tide: EBB

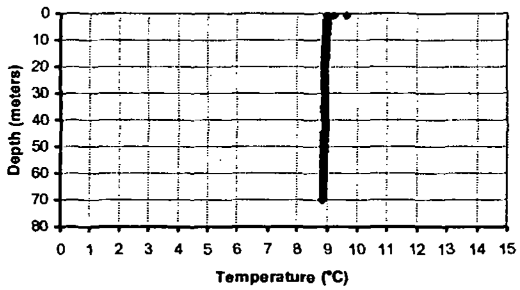
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	11.9	7.58	31.9	7.57	9.11
35 (114.8)	8.2	6.10	34.6	7.61	8.92
69.1 (226.7)	17.2	5.68	34.9	7.58	8.88

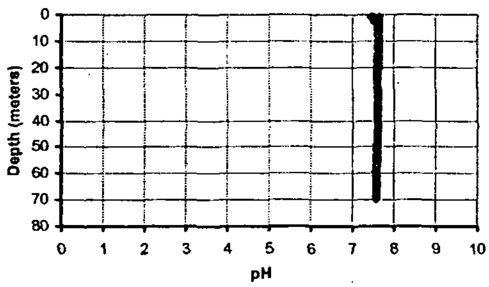










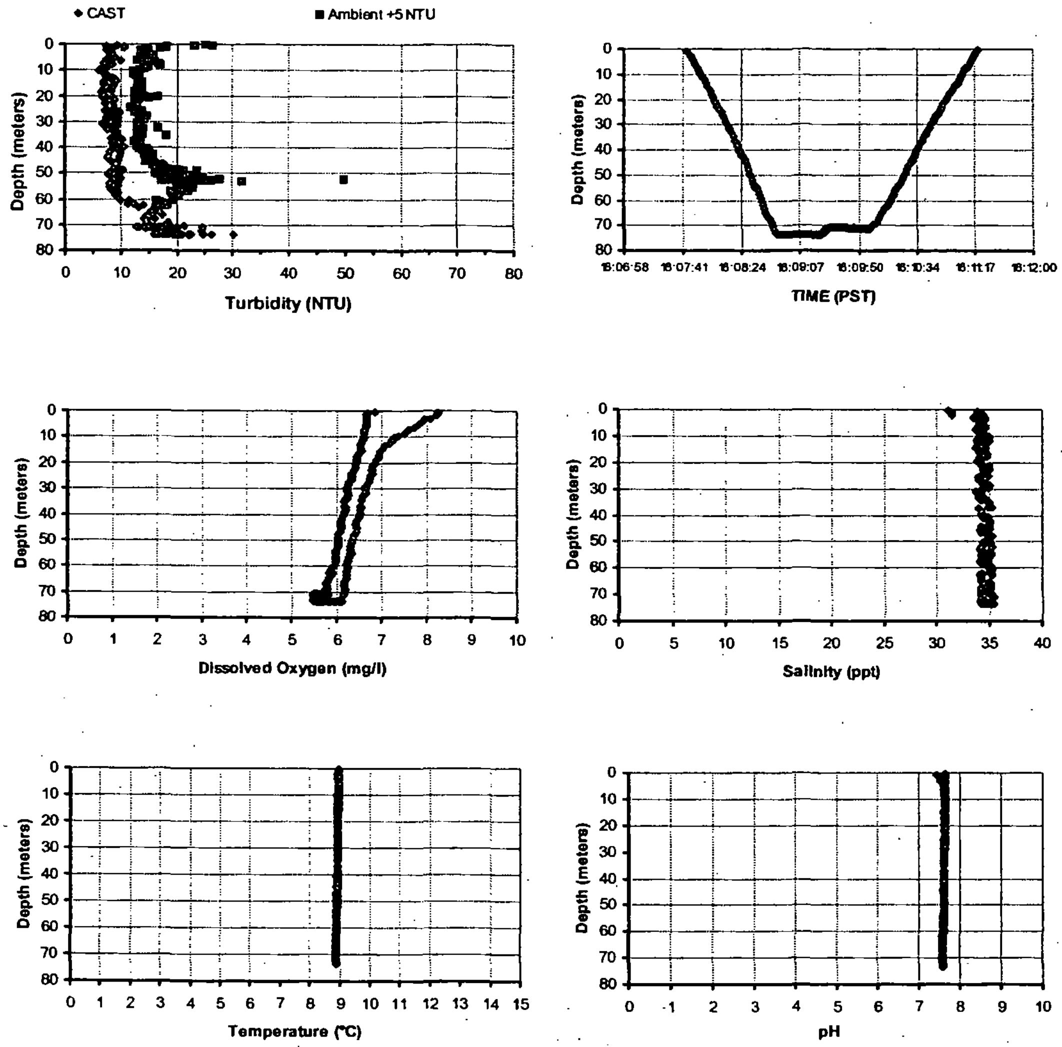


DATE: 1/21/2005

CAST ID: CTD_012105_RA5_1000ft_MS1_1605

Start Time: 16:07:43
Duration(min): 3.63
Samples: 218
Tide: EBB

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.5	6.69	33.9	7.64	8.98
36.8 (120.7)	9.2	6.35	34.9	7.63	8.92
72.7 (238.5)	20.2	5.50	34.2	7.58	8.89

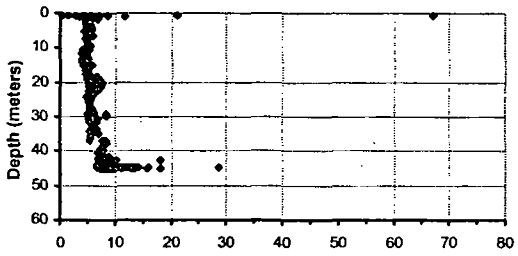


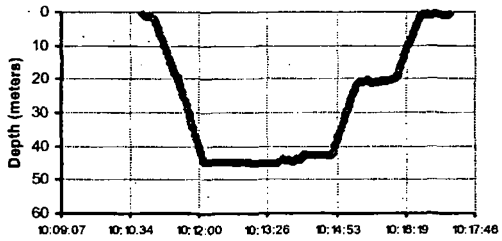
DATE: 1/27/2005

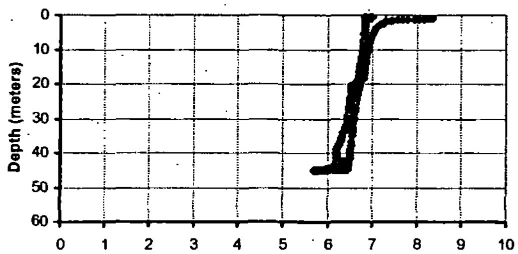
CAST ID: CTD_012705_RA5_Background

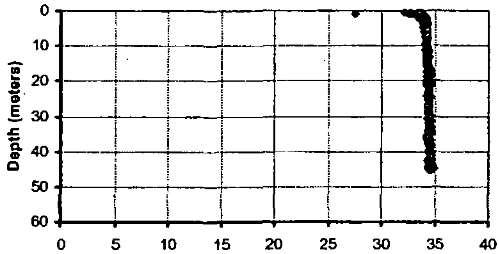
Start Time: 10:10:49
Duration(min): 6.45
Samples: 387
Tide: EBB

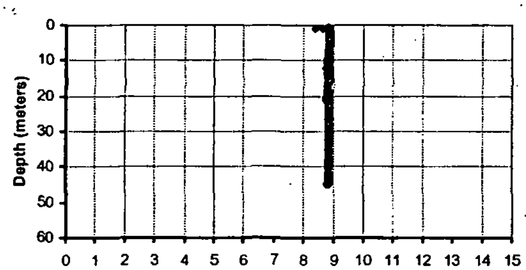
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.5	7.07	33.5	7.63	8.85
22.5 (73.8)	5.2	6.53	34.5	7.65	8.84
44.1 (144.7)	7.2	6.30	34.6	7.63	8.84

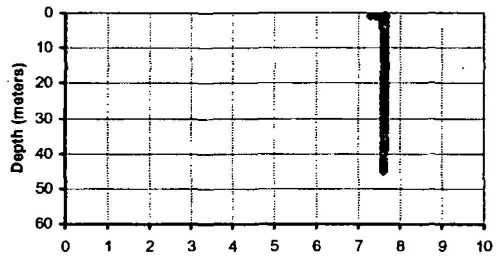










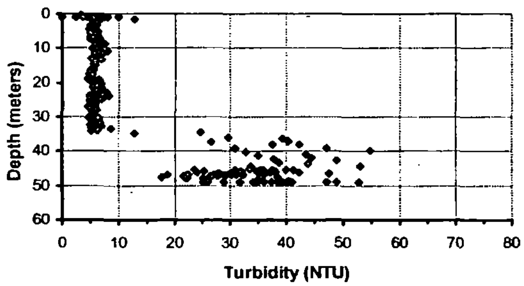


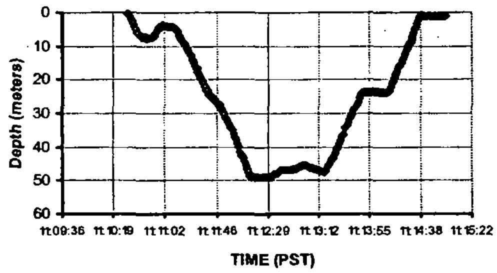
DATE: 1/27/2005

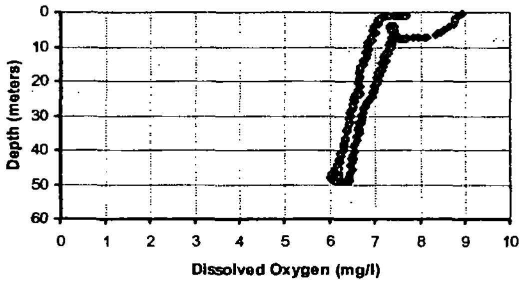
CAST ID: CTD_012705_RA5_300ft_EW

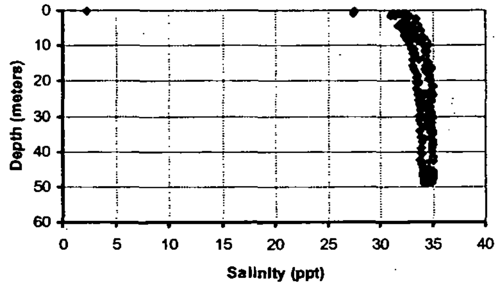
Start Time: 11:10:31
Duration(min): 4.50
Samples: 270
Tide: EBB

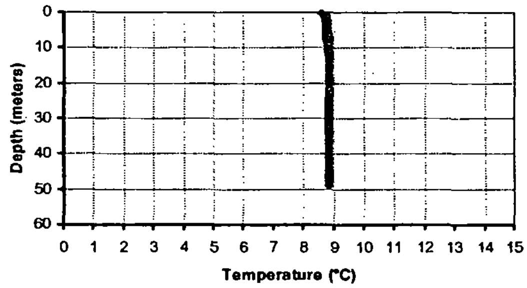
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.3	7.57	31.3	7.66	8.75
24.5 (80.4)	5.6	6.92	34.6	7.63	8.87
48 (157.5)	26.3	6.04	34.5	7.61	8.86

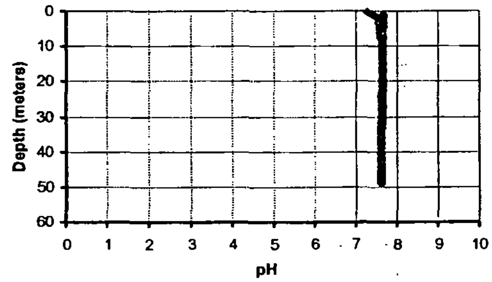










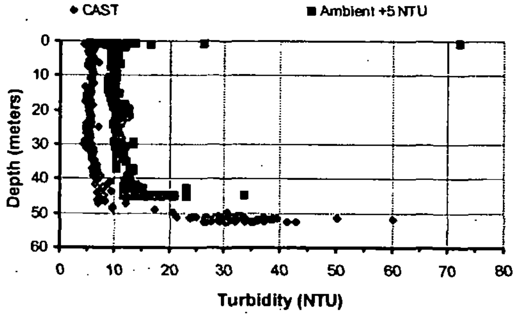


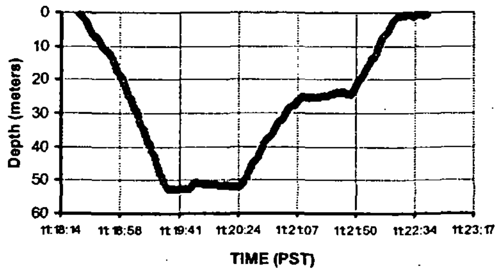
DATE: 1/27/2005

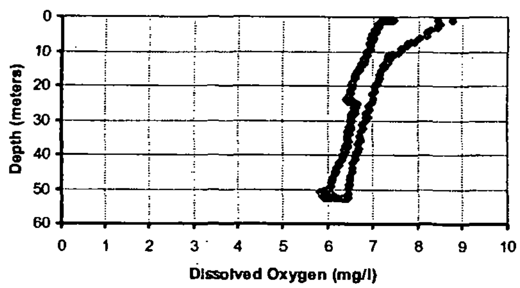
CAST ID: CTD_012705_RA5_600ft_1120

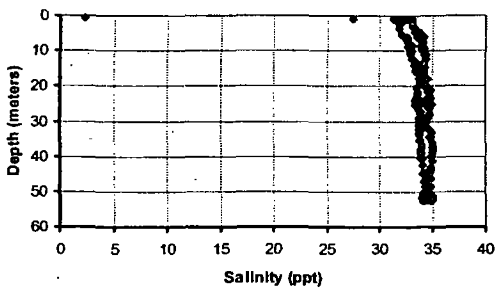
Start Time: 11:18:28
Duration(min): 4.27
Samples: 256
Tide: EBB

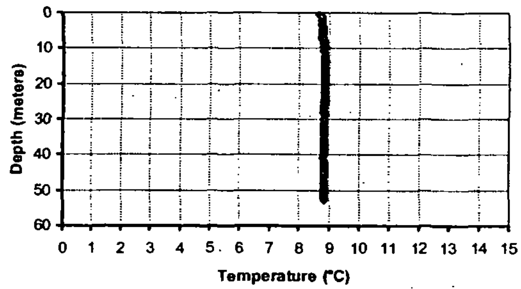
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.8	7.53	31.9	7.62	8.76
26.4 (86.6)	5.4	6.60	34.4	7.65	8.83
51.7 (169.6)	35.6	6.11	34.7	7.62	8.86

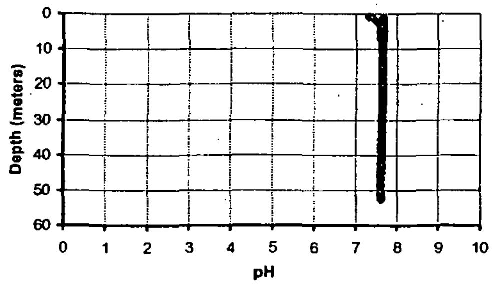










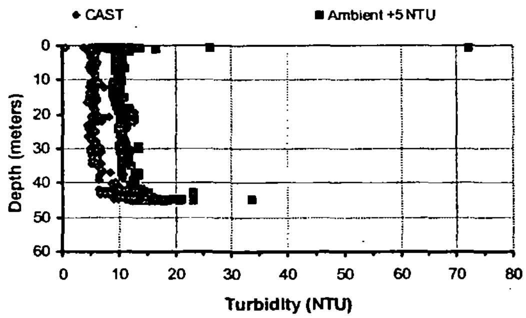


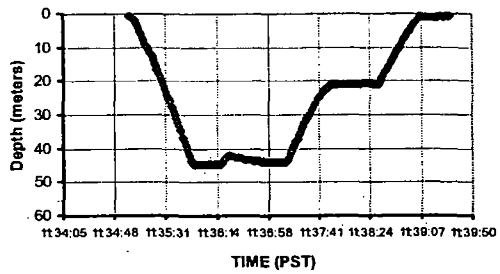
DATE: 1/27/2005

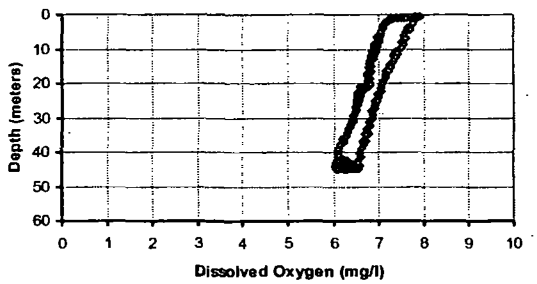
CAST ID: CTD_012705_RA5_600ft_MS2_1135

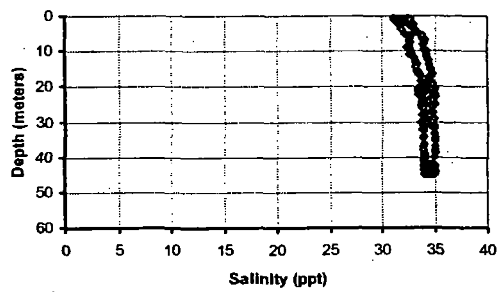
Start Time: 11:35:00
Duration(min): 4.55
Samples: 273
Tide: FLOOD

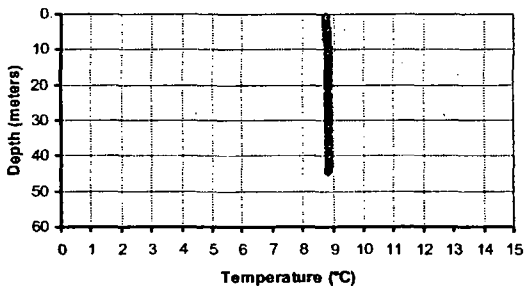
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.1	7.52	32.1	7.68	8.76
22.4 (73.5)	6.0	6.72	34.1	7.65	8.86
43.8 (143.7)	10.7	6.37	34.5	7.64	8.85

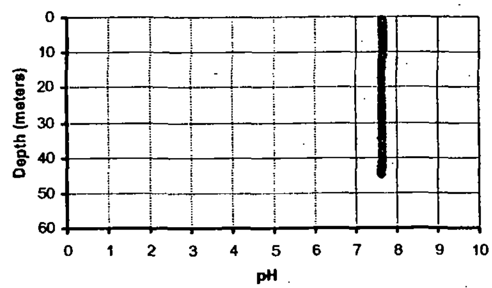










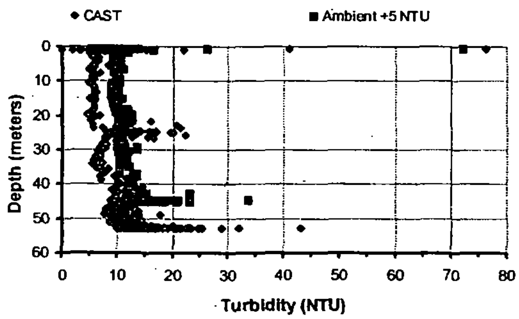


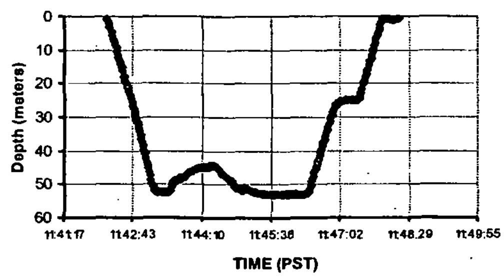
DATE: 1/27/2005

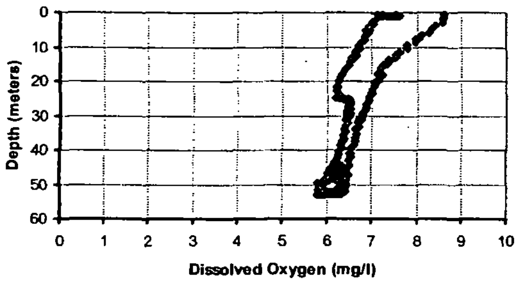
CAST ID: CTD_012705_RA5_600ft_MS1_1140

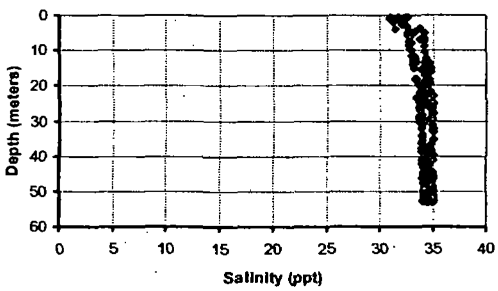
Start Time: 11:42:11
Duration(min): 6.12
Samples: 367
Tide: EBB

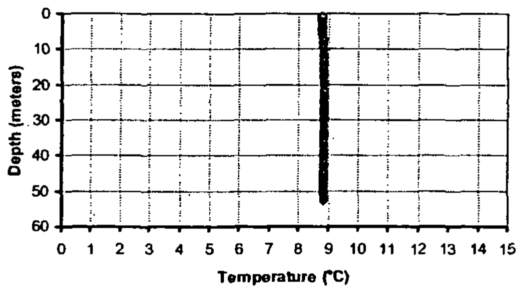
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	4.4	7.53	31.9	7.69	8.81
26.5 (86.9)	11.1	6.52	34.6	7.65	8.86
52 (170.6)	12.4	6.29	34.9	7.64	8.85

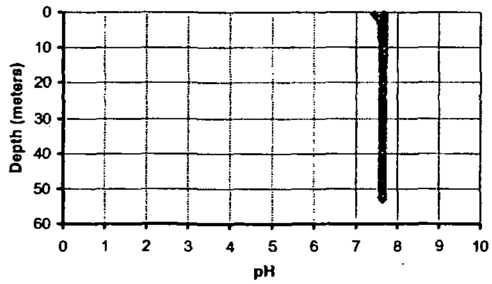










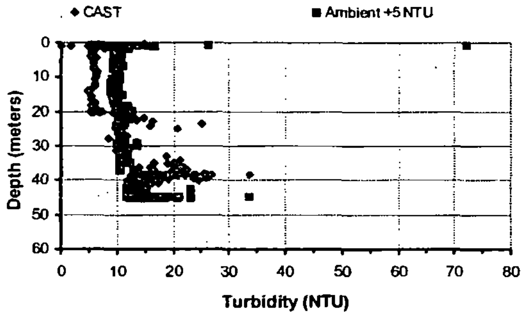


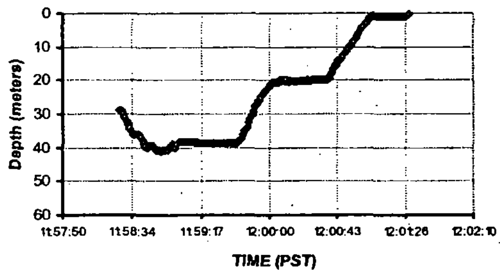
DATE: 1/27/2005

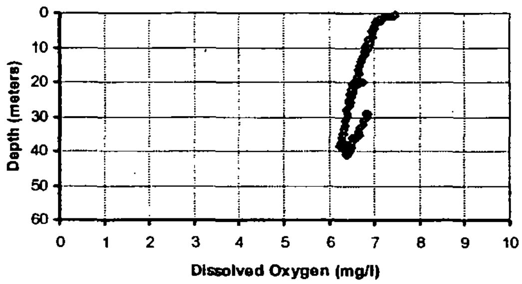
CAST ID: CTD_012705_RA5_600ft_MS1_1155

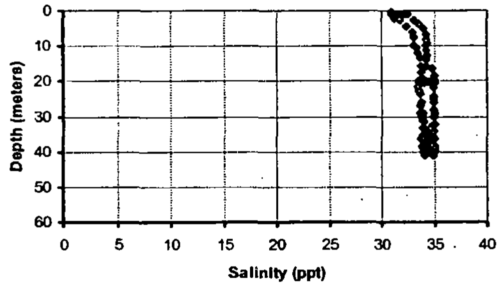
Start Time: 11:58:26
Duration(min): 3.07
Samples: 184
Tide: EBB

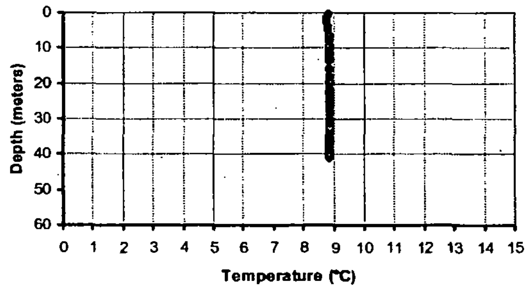
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.4	7.39	31.5	7.67	8.80
20.6 (67.6)	6.8	6.55	34.4	7.65	8.84
40.1 (131.6)	21.4	6.39	34.7	7.64	8.84

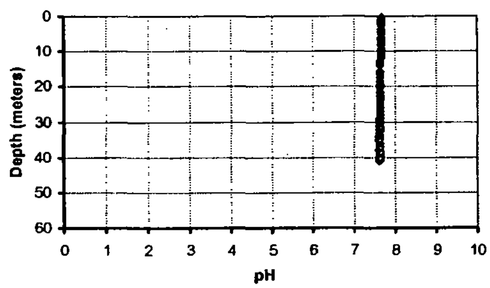










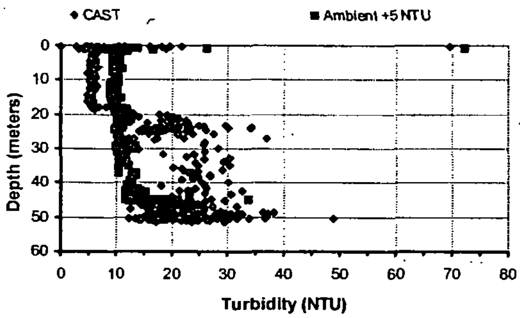


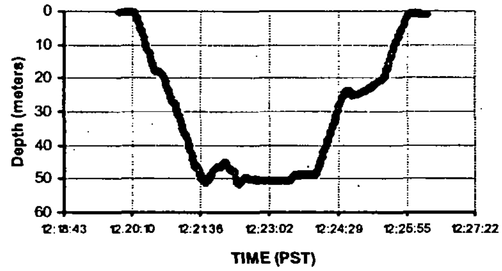
DATE: 1/27/2005

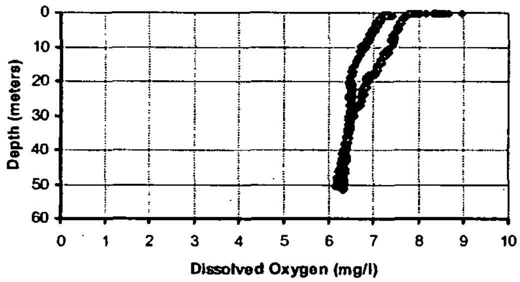
CAST ID: CTD_012705_RA5_600ft_MS1_1220

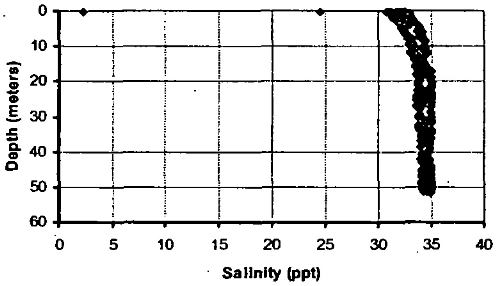
Start Time: 12:19:53
Duration(min): 6.50
Samples: 390
Tide: SLACK

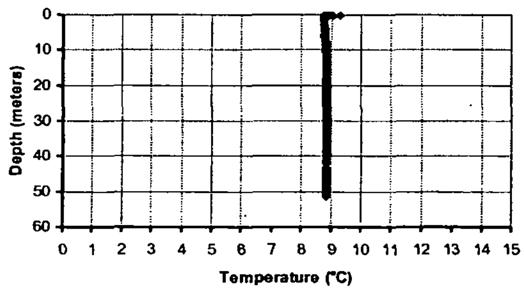
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	6.4	7.39	32.0	7.67	8.77
25.8 (84.6)	22.5	6.50	34.4	7.65	8.86
50.6 (166.0)	21.3	6.18	34.5	7.64	8.84

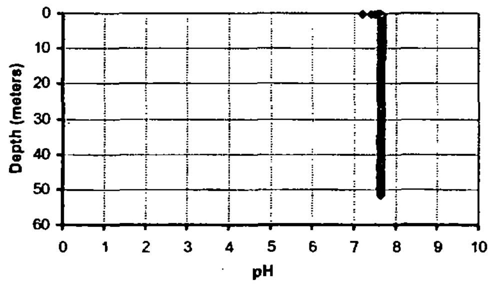










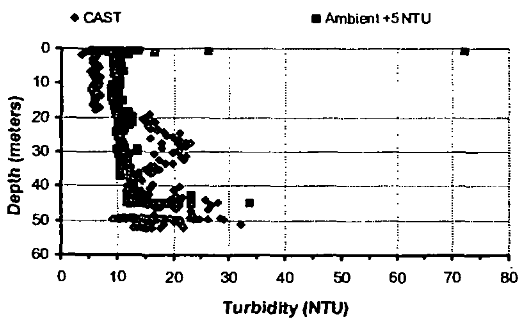


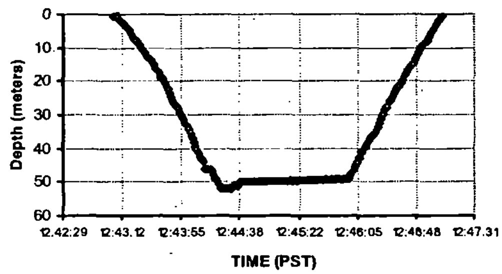
DATE: 1/27/2005

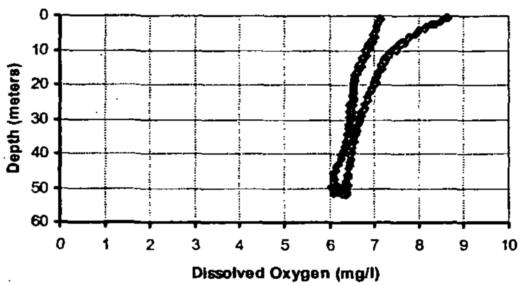
CAST ID: CTD_012705_RA5_MS1_1240

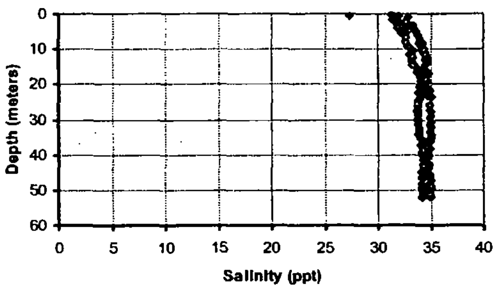
Start Time: 12:43:06
Duration(min): 4.05
Samples: 243
Tide: SLACK

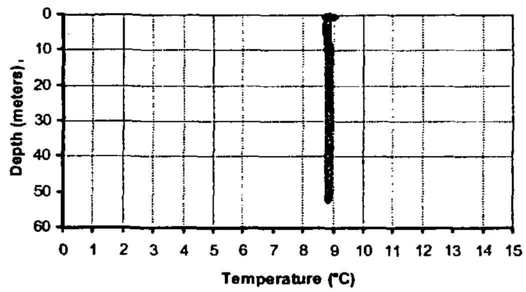
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.4	7.85	32.3	7.62	8.82
26 (85.3)	18.1	6.49	34.4	7.64	8.85
51.1 (167.7)	19.9	6.23	34.7	7.64	8.84

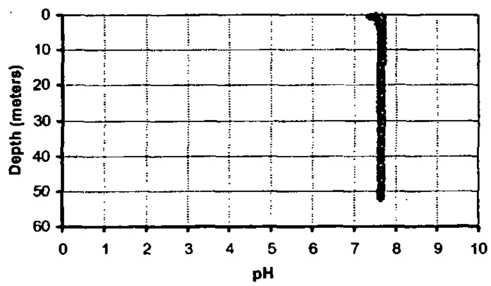










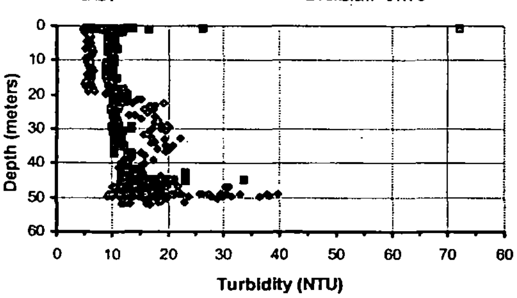


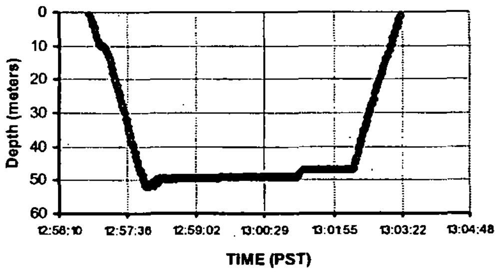
DATE: 1/27/2005

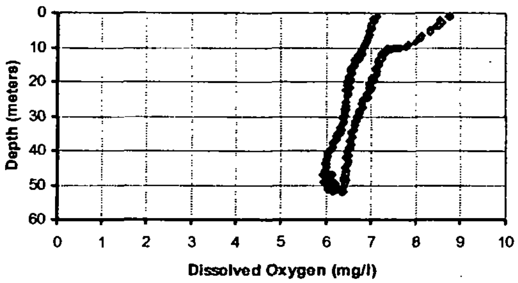
CAST ID: CTD_012705_RA5_600ft_MS1_1255

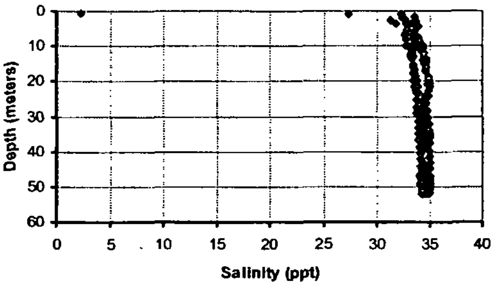
Start Time: 12:56:48
Duration(min): 6.55
Samples: 393
Tide: SLACK

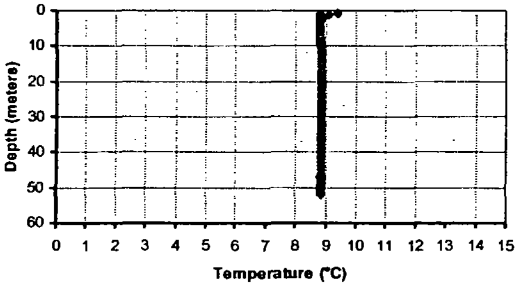
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.6	7.93	29.8	7.50	9.09
26 (85.3)	13.8	6.45	34.3	7.64	8.85
51.1 (167.7)	17.0	6.14	34.5	7.64	8.84

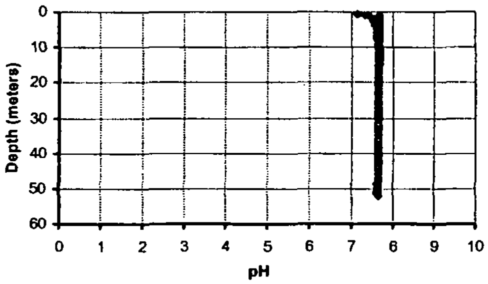










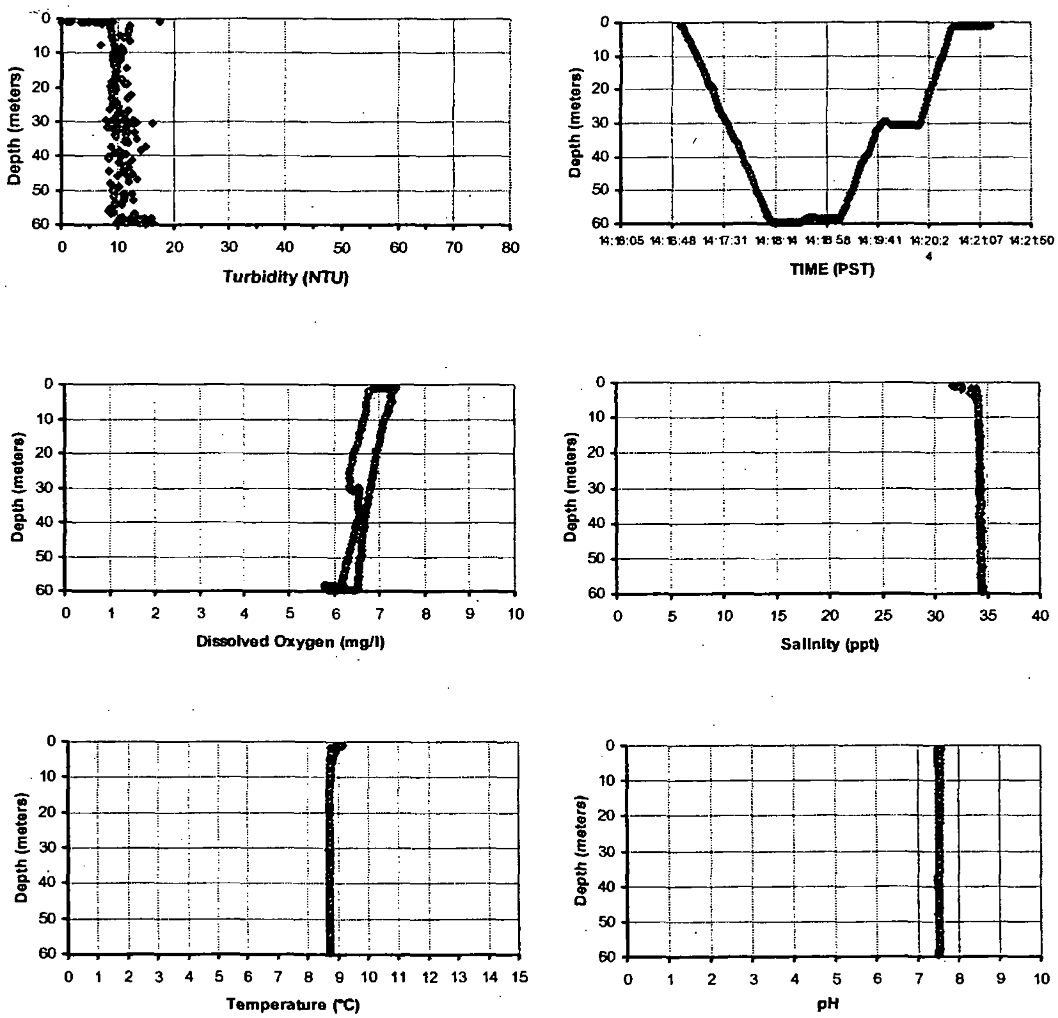


DATE: 2/2/2005

CAST ID: CTD_020205_RA5_Background

Start Time: 14:16:55
Duration(min): 4.38
Samples: 263
Tide: EBB

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.6	7.17	32.3	7.57	9.14
29.8 (97.8)	10.3	6.61	34.4	7.53	8.71
58.5 (191.9)	13.3	6.10	34.6	7.52	8.73

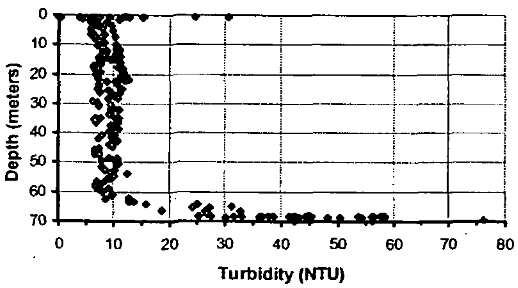


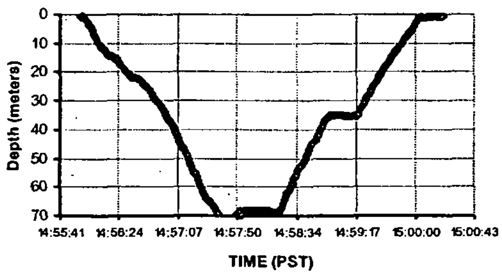
DATE: 2/2/2005

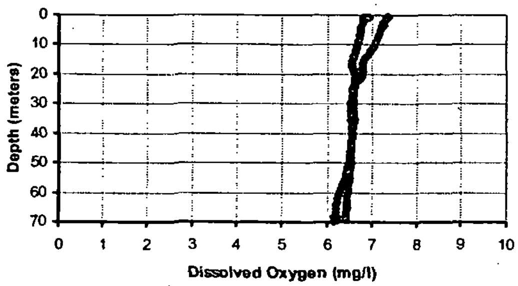
CAST ID: CTD_020205_RA5_300ft_EW

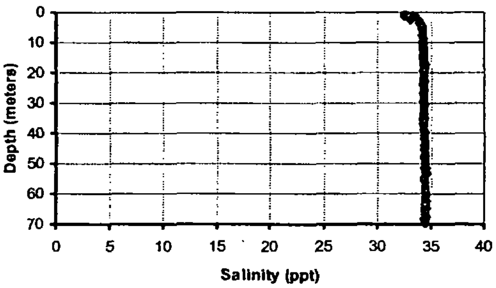
Start Time: 14:55:56
Duration(min): 4.43
Samples: 266
Tide: EBB

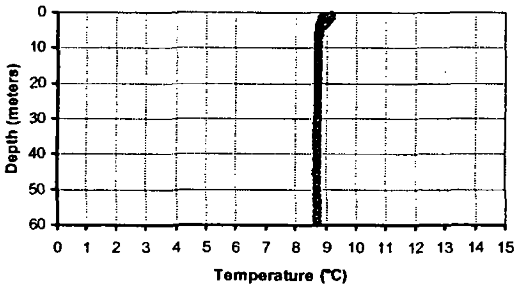
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	9.7	6.93	33.1	7.61	9.02
35.4 (116.1)	6.8	6.58	34.4	7.59	8.71
69.8 (229.0)	51.6	6.16	34.5	7.53	8.73

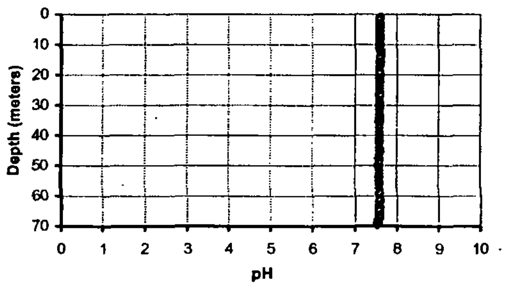










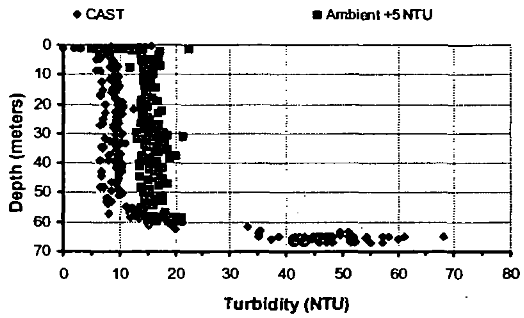


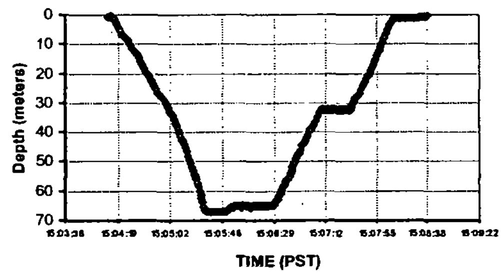
DATE: 2/2/2005

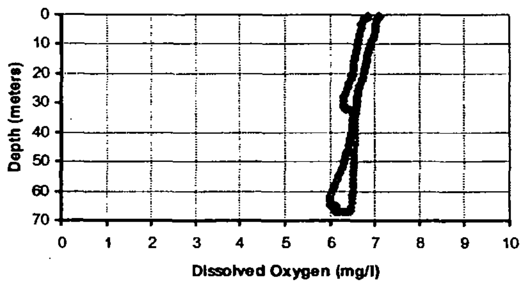
CAST ID: CTD_020205_RA5_600ft_MS1_1505

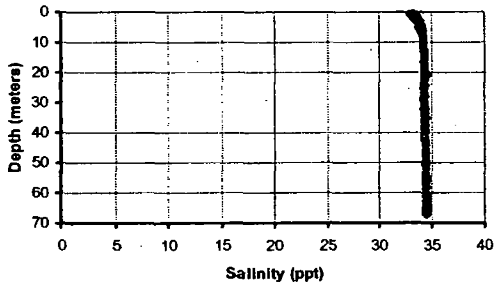
Start Time: 15:04:11
Duration(min): 4.48
Samples: 269
Tide: EBB

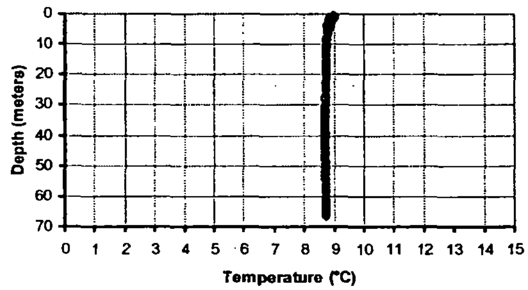
Depth Meters	(Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1	(3.3)	6.6	6.84	33.3	7.61	8.96
33.4	(109.6)	11.1	6.52	34.4	7.60	8.70
66	(216.5)	48.8	6.13	34.6	7.55	8.72

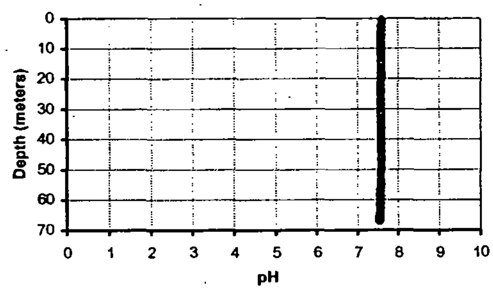










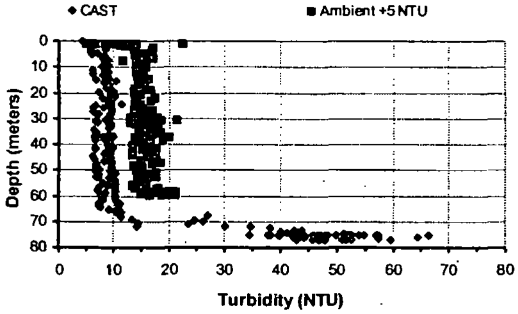


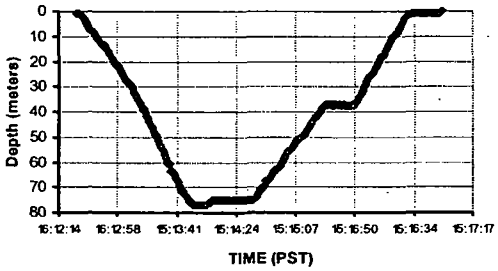
DATE: 2/2/2005

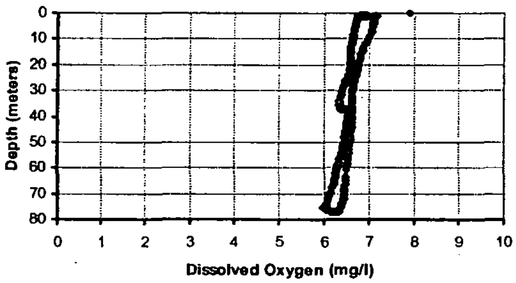
CAST ID: CTD_020205_RA5_600ft_MS2_1512

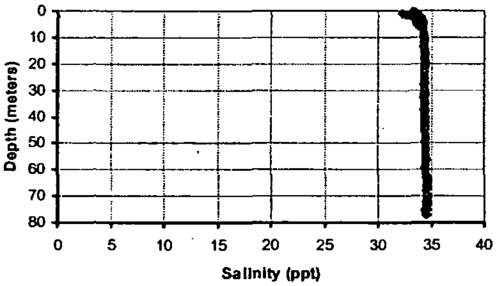
Start Time: 15:12:28
Duration(min): 4.45
Samples: 267
Tide: EBB

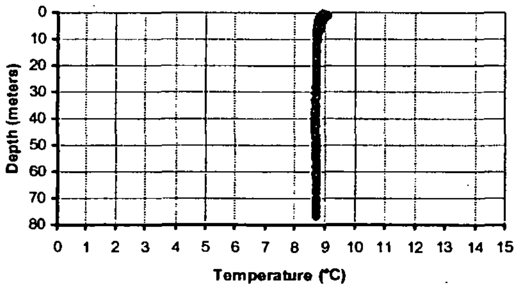
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	5.5	6.92	33.4	7.61	8.93
38.5 (126.3)	9.1	6.58	34.5	7.60	8.71
76.1 (249.7)	64 5	6.07	34.5	7.54	8.73

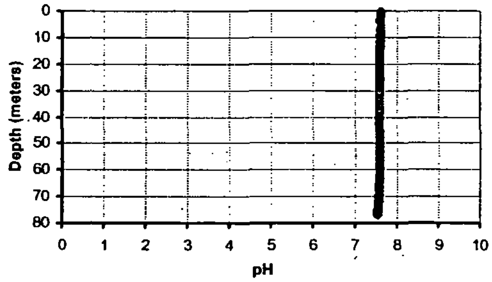










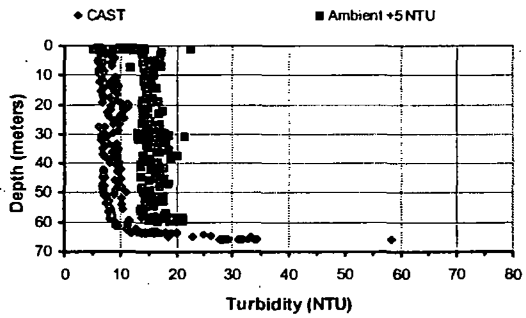


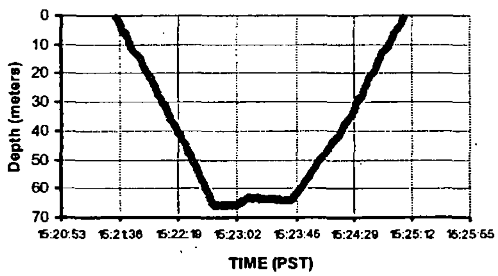
DATE: 2/2/2005

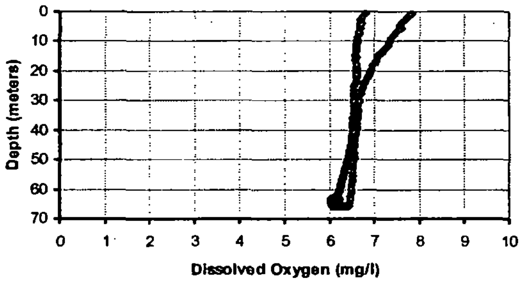
CAST ID: CTD_020205_RA5_600ft_MS1_1520

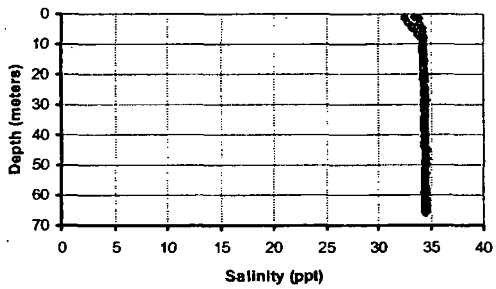
Start Time: 15:21:33
Duration(min): 3.57
Samples: 214
Tide: EBB

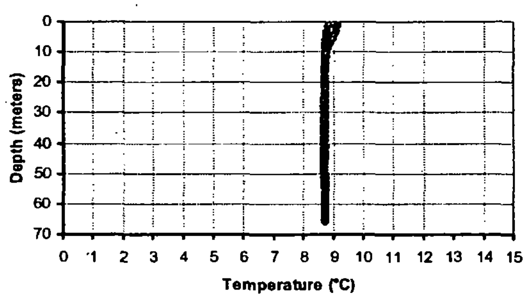
Depth Meters	(Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1	(3.3)	5.2	6.79	33.5	7.62	8.87
33	(108.3)	7.6	6.64	34.5	7.60	8.71
64.9	(212.9)	25.9	6.05	34.6	7.55	8.72

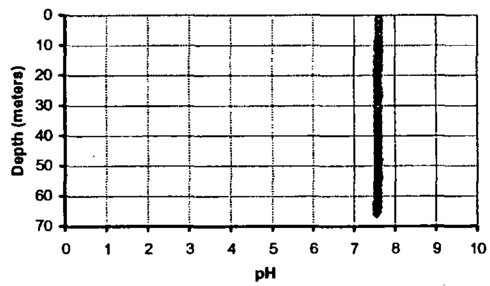










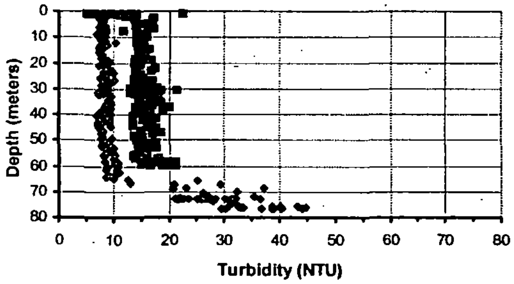


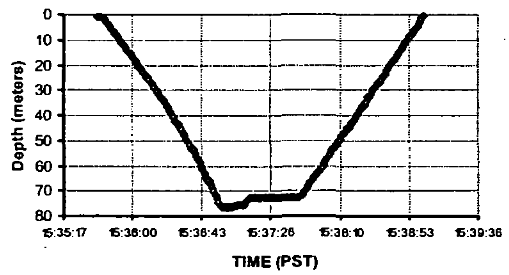
DATE: 2/2/2005

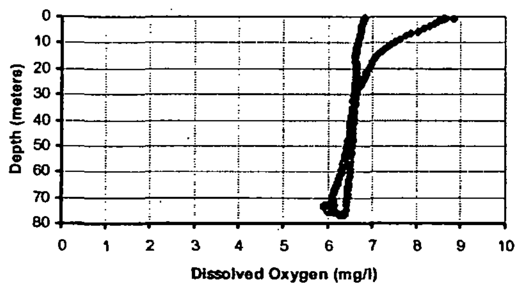
CAST ID: CTD_020205_RA5_600ft_MS2_1532

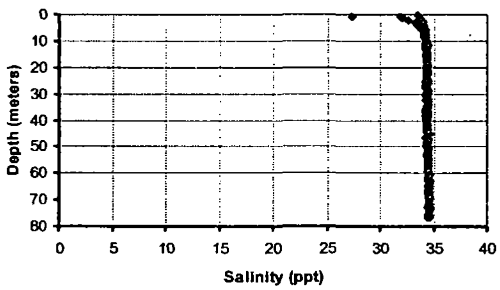
Start Time: 15:35:38
Duration(min): 3.42
Samples: 205
Tide: EBB

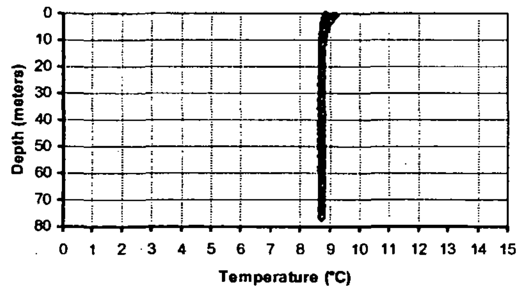
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	8.6	8.64	32.0	7.62	9.11
38.4 (126.0)	9.0	6.59	34.5	7.61	8.70
75.7 (248.4)	39.0	6.09	34.6	7.56	8.72

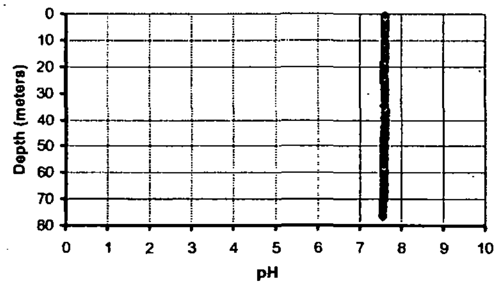










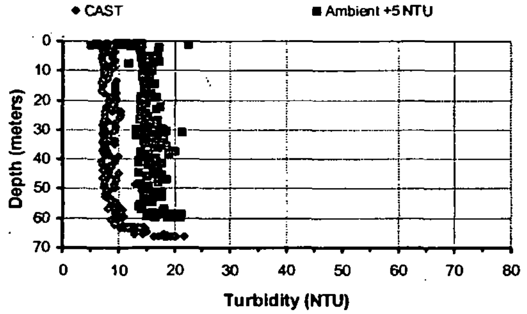


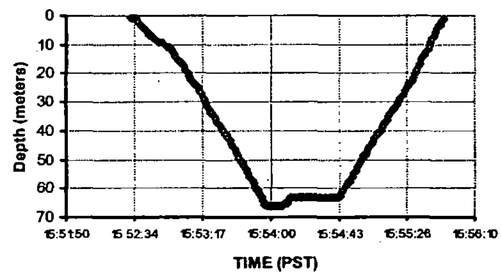
DATE: 2/2/2005

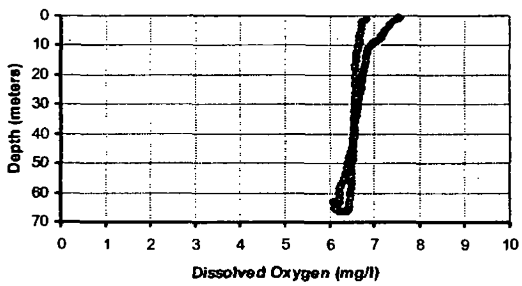
CAST ID: CTD_020205_RA5_MS1_1550

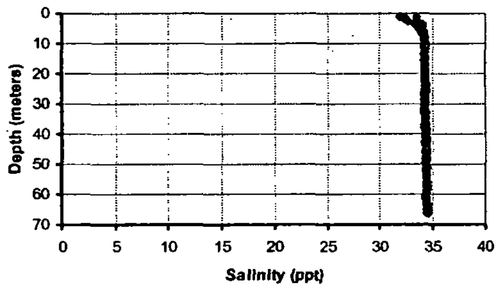
Start Time: 15:52:31
Duration(min): 3.33
Samples: 200
Tide: EBB

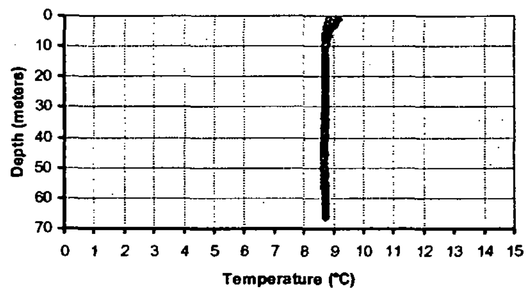
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.9	7.51	32.1	7.64	9.16
33.2 (108.9)	7.5	6.58	34.3	7.61	8.70
65.3 (214.2)	15.2	6.14	34.5	7.57	8.72

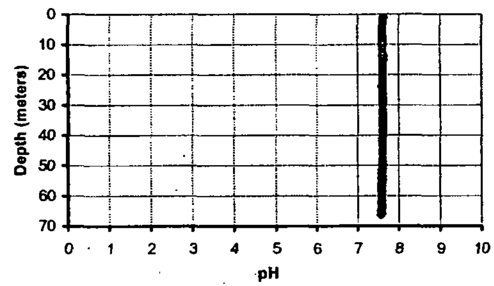










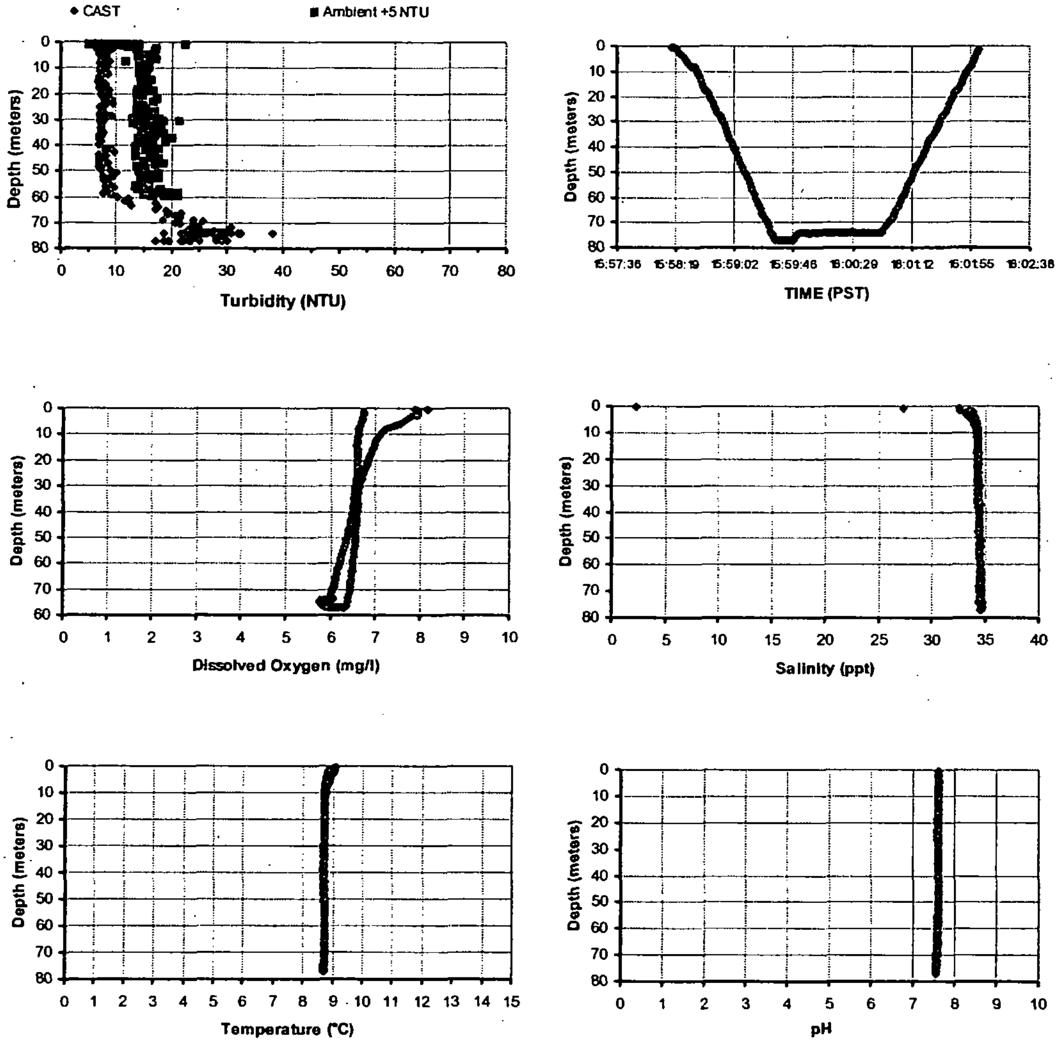


DATE: 2/2/2005

CAST ID: CTD_020205_RA5_600ft_MS2_1555

Start Time: 15:58:16
Duration(min): 3.78
Samples: 227
Tide: EBB

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	7.7	7.95	32.7	7.63	9.03
38.6 (126.6)	7.5	6.51	34.4	7.63	8.70
76.3 (250.3)	23.4	6.37	34.7	7.57	8.72

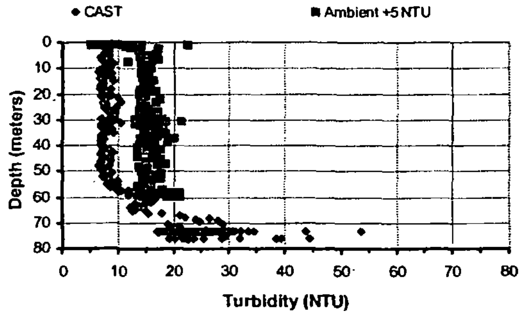


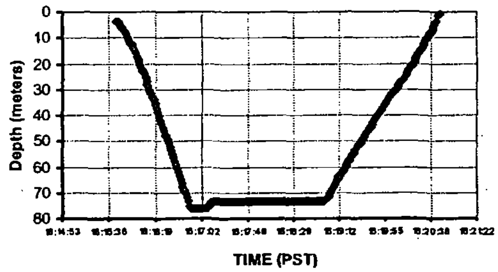
DATE: 2/2/2005

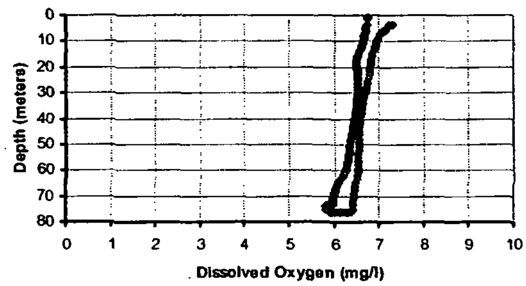
CAST ID: CTD_020205_RA5_600R_MS2_1613

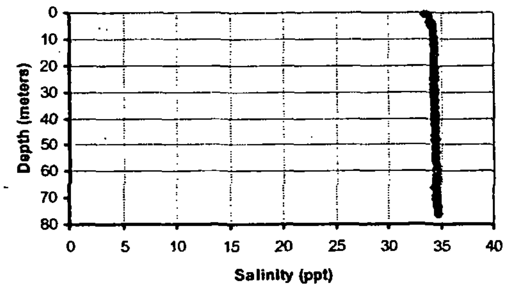
Start Time: 16:15:43
Duration(min): 5.08
Samples: 305
Tide: EBB

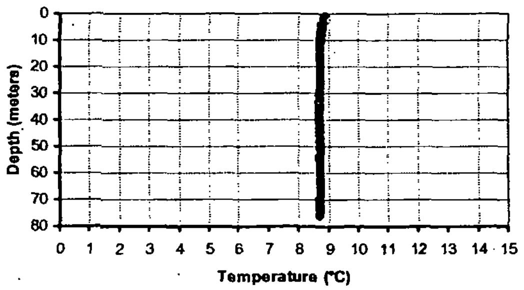
Depth Meters	(Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1	(3.3)	7.8	6.77	33.7	7.63	8.86
38.2	(125.3)	7.3	6.48	34.4	7.62	8.70
75.3	(247.0)	23.6	5.83	34.7	7.58	8.68

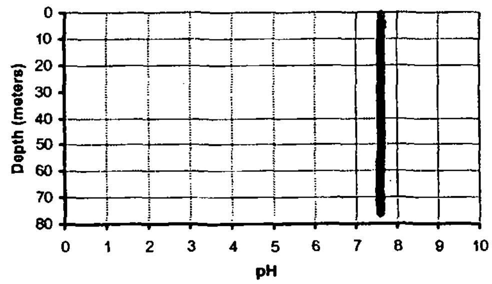










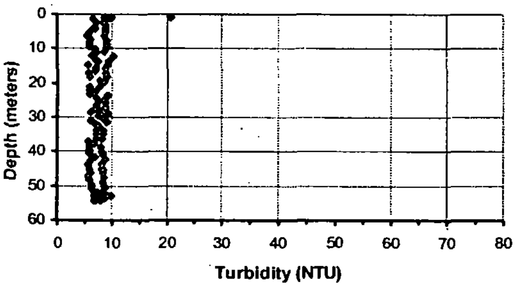


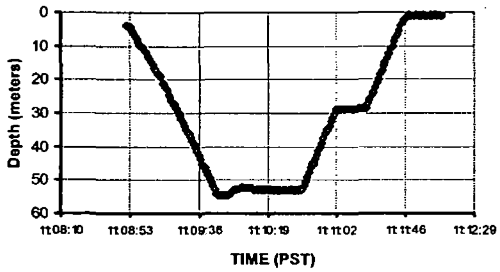
DATE: 2/8/2005

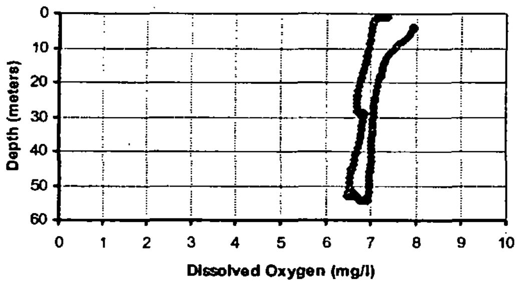
CAST ID: CTD_020805_RA5_Background

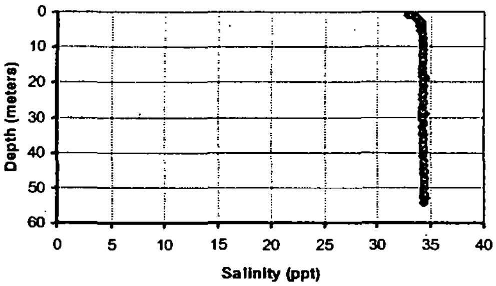
Start Time: 11:08:50
Duration(min): 3.33
Samples: 200
Tide: FLOOD

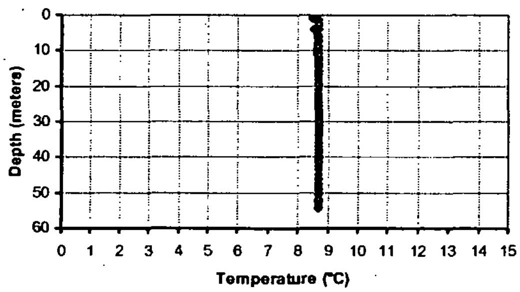
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	10.0	7.29	33.0	7.63	8.55
27.1 (88.9)	9.0	6.70	34.4	7.61	8.67
53.2 (174.5)	7.3	6.68	34.4	7.58	8.68

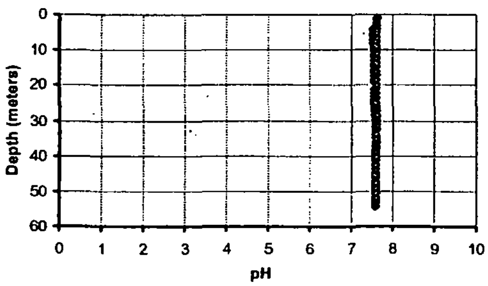










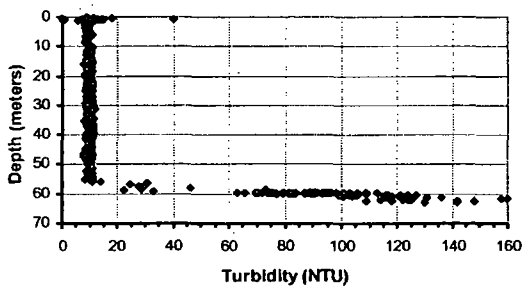


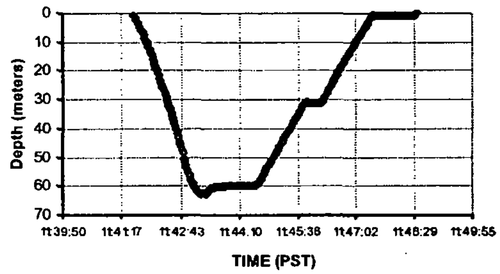
DATE: 2/8/2005

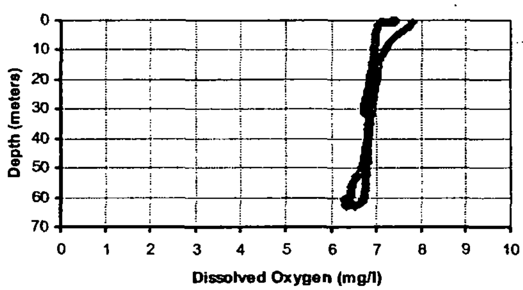
CAST ID: CTD_020805_RA5_300ftEW

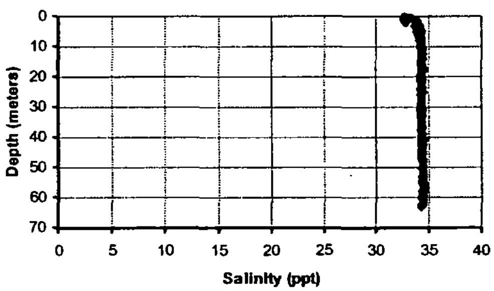
Start Time: 11:41:35
Duration(min): 7.02
Samples: 421
Tide: FLOOD

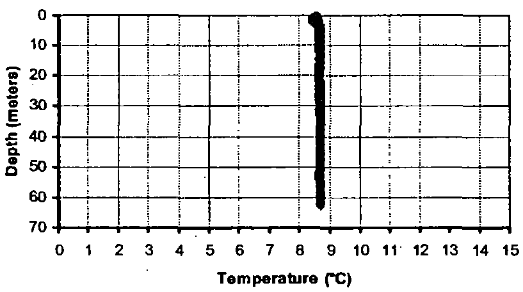
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	9.6	7.35	33.0	7.67	8.58
31.4 (103.0)	10.6	6.73	34.4	7.65	8.67
61.8 (202.8)	158.7	6.42	34.5	7.56	8.69

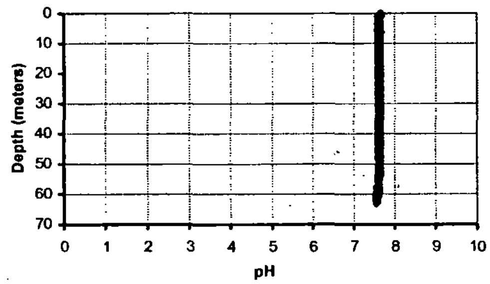










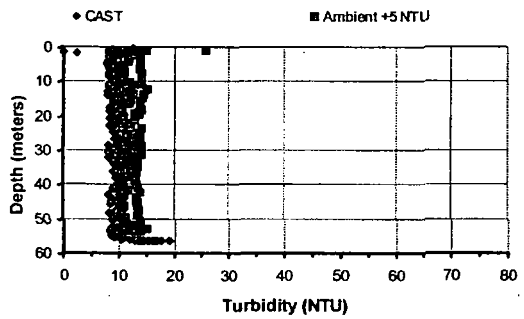


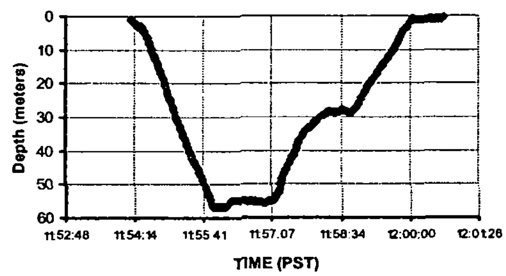
DATE: 2/8/2005

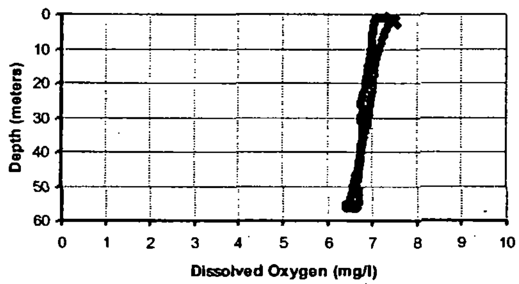
CAST ID: CTD_020805_RA5_600ft_MS1_1150

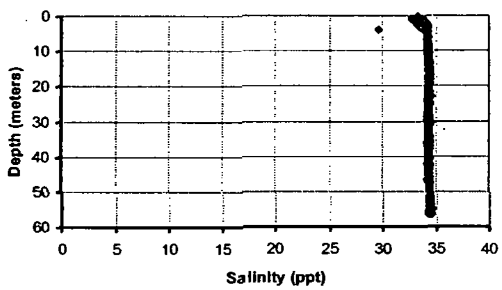
Start Time: 11:54:10
Duration(min): 6.57
Samples: 394
Tide: FLOOD

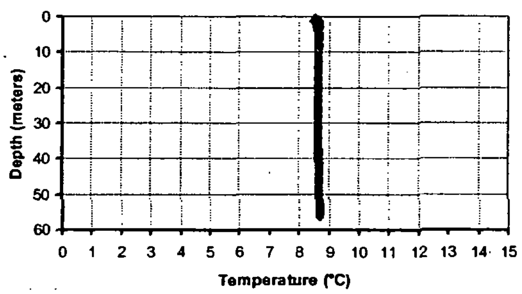
Depth Meters	(Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1	(3.3)	9.1	7.29	33.2	7.67	8.56
28.3	(92.8)	10.6	6.80	34.4	7.66	8.65
55.6	(182.4)	10.6	6.51	34.5	7.65	8.68

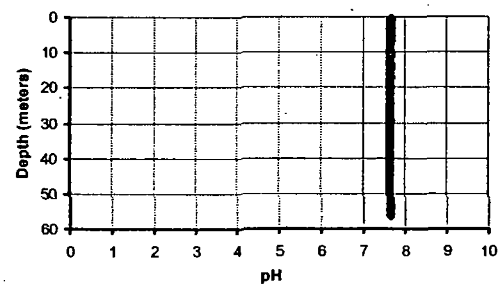










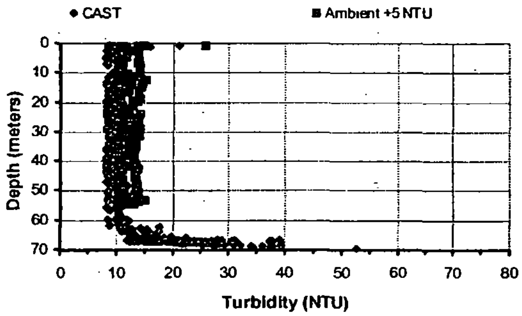


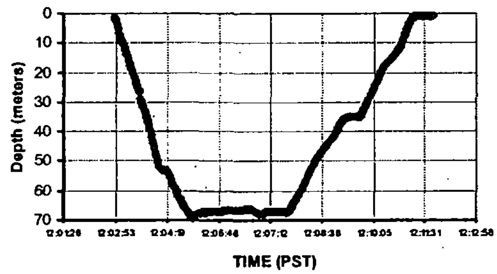
DATE: 2/8/2005

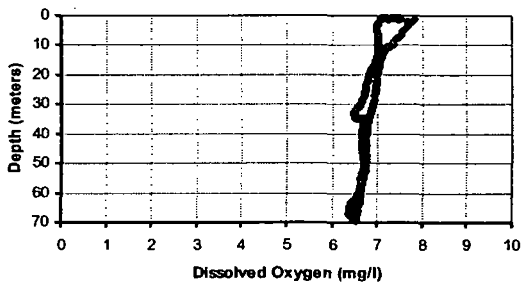
CAST ID: CTD_020805_RA5_600ft_MS2_1205

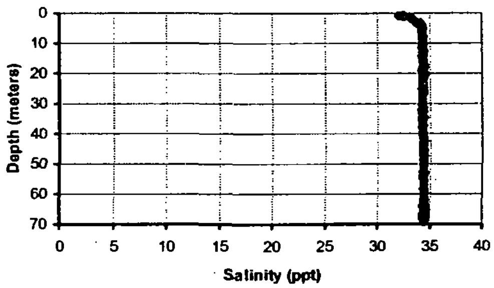
Start Time: 12:02:51
Duration(min): 8.95
Samples: 537
Tide: FLOOD

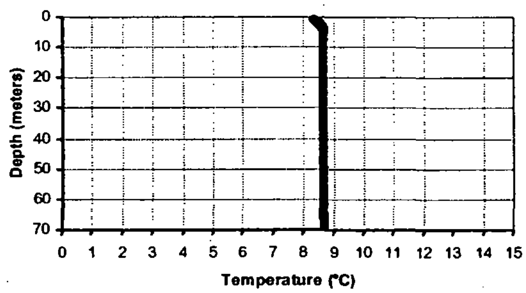
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1 (3.3)	10.7	7.42	32.5	7.68	8.39
35.1 (115.2)	10.4	6.70	34.4	7.67	8.66
68 (223.1)	27.1	6.44	34.5	7.63	8.68

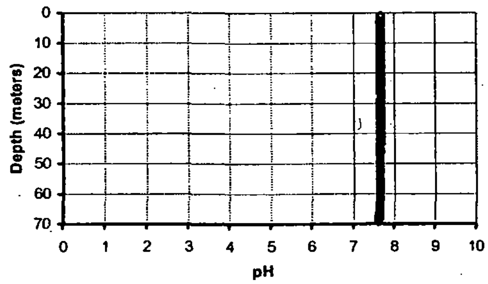










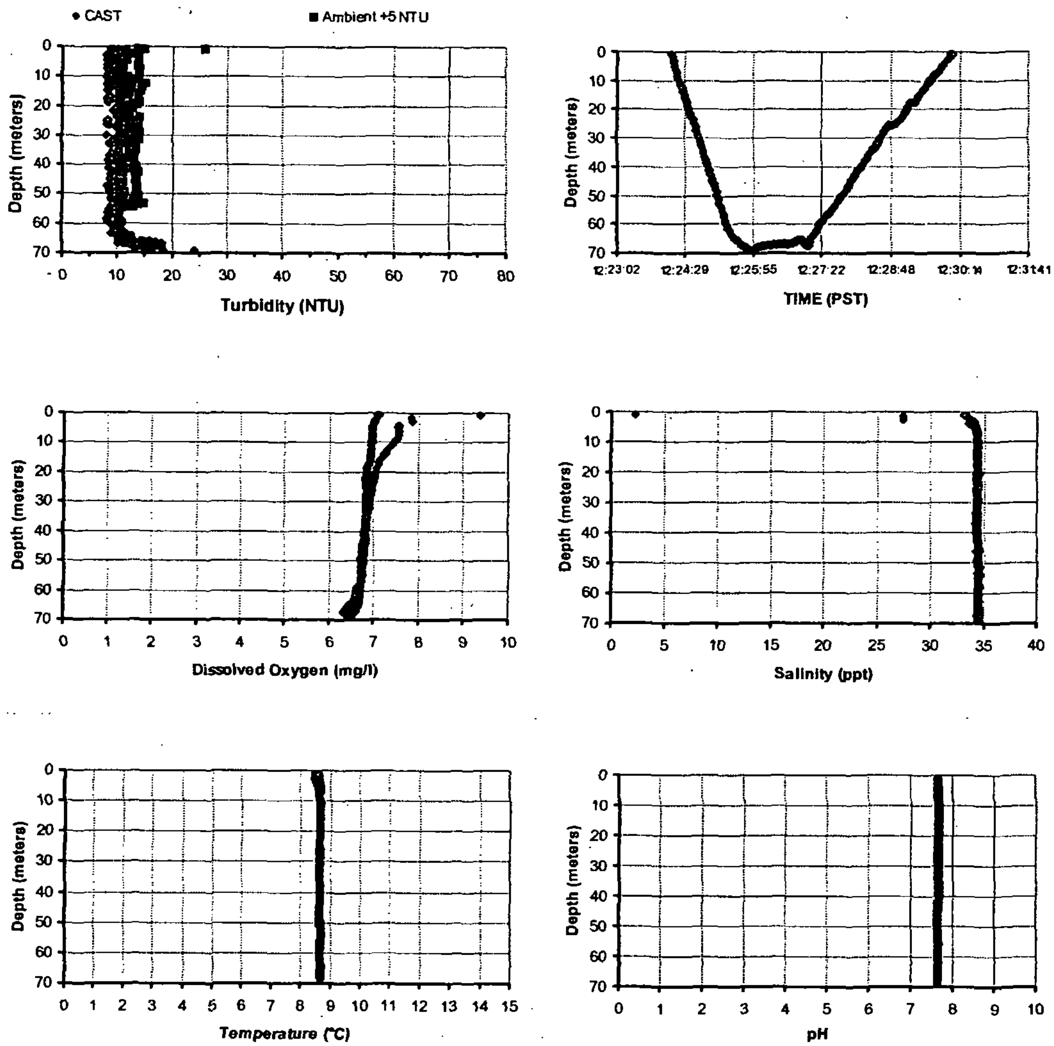


DATE: 2/8/2005

CAST ID: CTD_020805_RA5_600ft_MS2_1220

Start Time: 12:24:12
Duration(min): 5.90
Samples: 354
Tide: FLOOD

Depth Meters	(Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	pH	Temperature (°C)
1	(3.3)	9.3	7.10	33.2	7.68	8.58
34.5	(113.2)	10.6	6.87	34.5	7.65	8.66
68	(223.1)	14.5	6.38	34.5	7.65	8.67



APPENDIX B

SURFACE SEDIMENT QUALITY: FIELD LOG NOTES, SURFACE SEDIMENT COLLECTION FORMS, AND PHOTOGRAPHS

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

Name Anchor Environmental LLC

Address 1423 3rd Ave, Ste 300
Seattle, WA 98101

Phone 206.287.9130

Project US Army Corps of Engineers
Pacific Sound Resources RA5
#020202-01 BG 11 Task 1

CONTENTS

8 March 05 - Day 1 Log

07:45 Arrived @ Don Armeni Boat Ramp
Met Dale Dickinson on SV Peter R
Loaded Boat

0815 H&S Mtg
Dale discussed boat safety
Katherine discussed work zones & chem

Field Crew
Dale Dickinson - Skipper
Katherine D'Orazio - Field Lead
Bryan Patterson - Sampler

Weather -
Sunny, light breeze, ~50°F

PPE Level D Modified
- waterproof rain gear
- hard hats
- eye protection
- gloves
- PFDs
- steel toe boots

KD

8 Mar 05

0845 Left dock for PSR RAS
(Southwest Elliott Bay)

0900 RAS-9-g1 196 FSW (electronic depths)
47° 35.2432' N 122° 22.1277' W
REJECT - INSUFF MTRL.

0912 9-g2 196 FSW REJECT - INSUFF MTRL
47° 35.2445' N 122° 22.1292' W

0923 9-g3 197 FSW REJECT - DEBRIS IN JAW
47° 35.2930' N 122° 22.1271' W

0929 9-g4 197 FSW REJECT - DEBRIS
47° 35.2918' N 122° 22.1222' W

0935 KD called Dennis Hanzlick to discuss difficulty in getting good grabs (10 cm penetration & jaws fully closed)
~DH recommended moving to stations in shallower water & accepting shallow penetration if otherwise good (~7-8 cm)

1001 RAS-5-g1 157 FSW ACCEPT
47° 35.2455' N 122° 22.1254' W

DD

8 MARCH, 2005

1044 RAS-11-g1 164 FSW REJECT-INSUFF MTRL
47°35.2954'N 122°21.9812'W

1056 11-g2 165 FSW REJECT-INSUFF MTRL
~~1056~~ 47°35.2985'N 122°21.9812'W

1106 11-g3 164 FSW REJECT-INSUFF MTRL
47°35.2964'N 122°21.9804'W

1113 11-g4 165 FSW ACCEPT
47°35.2976'N 122°21.9779'W

1134 RAS-1-g1 162 FSW REJECT-INSUFF MTRL
47°35.1938'N 122°22.2422'W

1141 1-g2 162 FSW ACCEPT
47°35.1951'N 122°22.2440'W

1201 RAS-2-g1 150 FSW ACCEPT
47°35.1950'N 122°22.1930'W

1230 RAS-6-g1 146 FSW ACCEPT
47°35.2436'N 122°22.0481'W

1255-1325 LUNCH BREAK

DD

8 MARCH, 2005

1339 RAS-4-g1 179 FSW REJECT-INSUFF
47°35.2455'N 122°22.1932'W

1347 ~~RA~~ 4-g2 181 FSW ACCEPT
47°35.2432'N 122°22.1953'W
LAB QA/QC STATION -- EXTRA VOLUME COLLECTED

1409 RAS-3-g1 191 FSW ACCEPT
47°35.2432'N 122°22.2434'W

1429 RAS-10-g1 183 FSW ACCEPT
47°35.2971'N 122°22.0492'W

1452 RAS-13-g1 178 FSW ACCEPT
47°35.3454'N 122°21.9532'W

1514 RAS-8-g1 206 FSW ACCEPT
47°35.2934'N 122°22.1950'W

1530 END SAMPLING OPS; HEAD FOR RAMP

1542 ARRIVE RAMP, OFF LOAD SAMPLES

1600 End of Day

DD

8 March 05

1945 picked up extra VanVeen from Michael Kyte

KD

9 March 05

0730 Met at Don Armeni Boat Launch
Switched out to Kyte VanVeen

0800 H&S Mtg.
Crew: Dale Dickinson - skipper
Katherine D'Orazio - lead
Bryan Patterson

Weather: overcast, calm, ~55°F

0807 left dock for 1st station of the day

0808 Called Dennis for extra jars

0820 RAS-7-g1 217 FSW ACCEPT
47°35.2925'N 122°22.2680'W

DD

9 MARCH, 2005

0850 RAS-12-g1 216 FSW ACCEPT
47°35.3439'N 122°22.1248'W

0856 - 0912 ROUND TRIP TO RAMP FOR SAMPLE JAR PICK UP

0924 RAS-9-g5 194 FSW REJECT-DIS
47°35.2952'N 122°22.1247'W

0931 RAS-9-g6 194 FSW ACCEPT
~~47 45~~°35.2946'N 122°22.1216'W
KD 3/10/05

0958 RAS-21-g1 200 FSW REJECT-FAIL
47 ~~45~~°35.3459'N 122°22.0402'W
KMD 3/10/05

1001 RAS-21-g2 200 FSW ACCEPT
47 ~~45~~°35.3452'N 122°22.0419'W
KMD 3/10/05

1028 RAS-20-g1 218 FSW REJECT-1.M
47 ~~45~~°35.3252'N 122.22.1985'W
KMD 3/10/05

1039 RAS-20-g2 218 FSW REJECT-DIST
47 ~~45~~°35.3261'N 122°22.1961'W
KMD 3/10/05

DD

9 MARCH, 2005

1047 RA5-20-g3 218 FSW REJECT-DEBRIS
47 ~~45~~° 35.3254'N 122°22.1968'W
KMD 3/10/05

1055 RA5-20-g4 218 FSW REJECT-WASH
47 ~~45~~° 35.3220'N 122°22.1998'W
KMD 3/10/05

TELEPHONE ~~AFTER~~ DISCUSSION WITH DENNIS HANZLICK.

1121 RA5-20A-g1 209 FSW REJECT-FAIL
47 ~~45~~° 35.3089'N 122°22.2080'W
KMD 3/10/05

1129 RA5-20A-g2 208 FSW ACCEPT
47 ~~45~~° 35.3082'N 122°22.2044'W
KMD 3/10/05

~~1155~~-1225 LUNCH BREAK

1242 RA5-14-g1 238 FSW REJECT-WASH
47 ~~45~~° 35.3890'N 122°22.2436'W
KMD 3/10/05

1304 RA5-14-g2 241 FSW REJECT-LM
47 ~~45~~° 35.3913'N 122°22.2458'W
KMD 3/10/05

1315 RA5-14-g3 244 FSW REJECT-WASH
47 ~~45~~° 35.3930'N 122°22.2420'W
KMD 3/10/05

DD

9 MARCH, 2005

1326 RA5-14-g4 241 FSW REJECT-ROCK
47°35.3912'N 122°22.2367'W

1340 RA5-15-g1 243 FSW REJECT ~~ACCEPT~~
47°35.3935'N 122°22.1730'W

1356 RA5-15-g2 244 FSW ACCEPT
47°35.3917'N 122°22.1783'W

1418 RA5-16-g1 259 FSW ACCEPT
47°35.4389'N 122°22.2480'W

Call from B. Brehman RE: RA5-14
move W (or SW or NW) at least
100 ft. [NEW COORDS = 76' W]
14A 47°35.3910'N 122°22.2664'W

1442 RA5-19-g1 144 FSW REJECT-WOOD
47°35.3118'N 122°~~21~~.8828'W

1449 RA5-19-g2 142 FSW REJECT-WOOD
47°35.3152'N 122°21.8783'W

DD

9 MARCH, 2005

1455	RA5-19-g3	139 FSW	REJECT-WOOD
	47°35.3139'N	122°21.8765'W	
1506	RA5-19A-g1	152 FSW	ACCEPT
	47°35.3060'N	122°21.9278'W	
1529	RA5-18-g1	168 FSW	ACCEPT
	47°35.1921'N	122°22.3406'W	
1553	RA5-14A-g1	246 FSW	REJECT-WOOD
	47°35.3909'N	122°22.2636'W	
1602	RA5-14A-g2	245 FSW	ACCEPT
	47°35.3893'N	122°22.2655'W	
1626	RA5-17-g1	209 FSW	REJECT ~~ACCEPT~~
	47°35.2931'N	122°22.3387'W	
1649	RA5-17A-g1.	210 FSW	ACCEPT
	47°35.2898'N	122°22.3189'W	

1710 END SAMPLING OPS; HEAD FOR RAMP

1718 ARR AT RAMP, OFFLOAD SAMPLES AND EQUIPMENT

AD

9 March 05

1730 End of Day KD

KDOrazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 1

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Anchor
Station Coordinates: N / Lat 47° 35.1951'N Weather: Sunny, light breeze, warm
E / W / Long. 122°22.2440'W
Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-1GS Comments: 3 jars filled from grab #2
Analysis: TOC / Metals / PCB / SVOC Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 162' Penetration/Sampled Depth: 3/0 cm Time: 1134
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none H2S	none
		slight Petroleum	slight
Subsurface:	Subsurface:	moderate other:	moderate
		strong	heavy
		overwhelming	

Additional Comments: large gravel

Grab Number: 2 Water Depth: 162' Penetration/Sampled Depth: 11/9 cm Time: 1141
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface: sand w/ silt	Surface: brown	none H2S	none
		slight Petroleum	slight
Subsurface: sand	Subsurface: olive grey	moderate other:	moderate
		strong	heavy
		overwhelming	

Additional Comments: shells & gravel, pockets of clay

Grab Number: ___ Water Depth: ___ Penetration/Sampled Depth: ___ Time: ___
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none H2S	none
		slight Petroleum	slight
Subsurface:	Subsurface:	moderate other:	moderate
		strong	heavy
		overwhelming	

Additional Comments:

Grab Number: ___ Water Depth: ___ Penetration/Sampled Depth: ___ Time: ___
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none H2S	none
		slight Petroleum	slight
Subsurface:	Subsurface:	moderate other:	moderate
		strong	heavy
		overwhelming	

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 2

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R — Sampling Method: Van Veen - Anchor

Station Coordinates: N (Lat) 47° 35.1950'N — Weather: Sunny, light breeze, warm

E/W (Long.) 122° 22. 1930'W

Datum: NAD 83 / WGS 84 — Zone: — — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-2-GS — Comments: 3 jars filled from 1st grab

Analysis: TOC / Metals / PCB / SVOC Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 150 Penetration/Sampled Depth: 12/10 cm Time: 12:01

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: SAND	Surface: tr. brown spots on	none	H2S	none
		slight	Petroleum	slight
Subsurface: clayey SAND (fine to med)	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: organic debris (leafy),

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K. D'Orazio

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 8 **March 05**
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** **RA5-3**

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen – Anchor
Station Coordinates: N / Lat 47°35.2432'N Weather: sunny, breezy, warm
E / W / Long 122°22.2434'W
Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R
Sample Number: RA5-3-GS Comments: 3 jars filled from 1st grab
Analysis: TOC / Metals / PCB / SVOC Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 191' Penetration/Sampled Depth: 9/8 cm Time: 14:09
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

K 8MAY

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5-4

Sampling Crew:	Katherine D'Orazio, Bryan Patterson, Dale Dickinson		
Sampling Vessel:	S/V Peter R	Sampling Method:	Van Veen – Anchor
Station Coordinates:	N / Lat. 47° 35. 2432' N	Weather:	partly cloudy, breezy
	E / W / Long. 122° 22. 1953' W		
Datum:	NAD 83 / WGS 84 Zone: –	GPS:	Trimble DGPS on SV Peter R
Sample Number:	RA5-4GS	Comments:	collected double volume for lab QA/QC (not a FD)
Analysis:	TOC / Metals / PCB / SVOC Archive (Circle Appropriate Analyses)		5 jars filled from 2nd grab

Grab Number: 1 Water Depth: 179' Penetration/Sampled Depth: 4 / 0 cm Time: 13 39
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: 2 Water Depth: 181' Penetration/Sampled Depth: 10 / 10 cm Time: 13 47
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
Silty SAND	brown	slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
SAND	olive grey	strong		heavy
		overwhelming		

Additional Comments: Shells, woody debris ~~eol~~

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

KDOrazio

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5- 5

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R Sampling Method: Van Veen - Anchor

Station Coordinates: N / Lat. 47° 35.2455' N Weather: Sunny w/ some clouds light breeze

E / W / Long. 122° 22.1254' W

Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-5GS Comments: No archive sample taken at this station.

Analysis: TOC / Metals / PCB / SVOC ~~2 jars~~ (KD)

(Circle Appropriate Analyses)

2 jars filled

Grab Number: 1 Water Depth: 157' Penetration/Sampled Depth: 11/9 cm Time: 1001

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight - penny sized bubble
Subsurface: fine to med SAND	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: some pockets of lt grey to white sand subsurf

~~Grab Number:~~ Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

K. D'Orazio

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 6

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R — Sampling Method: Van Veen - Anchor

Station Coordinates: N (Lat.) 47°35.2436' N — Weather: sunny, breezy 5-10 kt wind warm

E / W (Long.) 122°22.0481' W

Datum: NAD 83 / WGS 84 — Zone: ✓ — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-6GS — Comments:

Analysis: TOC / Metals / PCB / SVOC

(Circle Appropriate Analyses)

3 jars filled from 1st grab.

Grab Number: 1 Water Depth: 146' Penetration/Sampled Depth: 9/8 cm Time: 12:30

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

KDO

Additional Comments:

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 **March 05**
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 7

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Kyte
Station Coordinates: N / Lat 47°35.2925'N Weather: overcast, light breeze, cool
E / W / Long 122°22.2680'W
Datum: NAD 83 / WGS 84 Zone: GPS: Trimble DGPS on SV Peter R
Sample Number: RA5-7GS Comments: * Switched to M. Kyte's Van Veen which is heavier.
Analysis: TOC / Metals / PCB / SVOC Archive
(Circle Appropriate Analyses)
3 jars filled from 1st grab

Grab Number: 1 Water Depth: 217' Penetration/Sampled Depth: 13/10 cm Time: 0820
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: Silty SAND	Surface: (very thin) brown	none	H2S	none
		slight	Petroleum	slight - 2 sm bubbles
Subsurface: Silty clayey SAND pockets	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: shells, fibers, organic debris

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K. D'Orazio

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: KD'Orazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 8 **March 05**
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** **RA5-** 8

Sampling Crew: *Katherine D'Orazio, Bryan Patterson, Dale Dickinson*

Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Anchor

Station Coordinates: N / Lat. 47°35.2924'N Weather: sunny, warm, breezy

E / W / Long. 122°22.1950'W

Datum: NAD 83 / WGS 84 Zone: GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-8GS Comments:

Analysis: TOC / Metals / PCB / SVOC Archive

(Circle Appropriate Analyses)

3 jars filled from 1st grab

Grab Number: 1	Water Depth: 206'	Penetration/Sampled Depth: 11/9 cm	Time: 15:14
Bioassay / Chemistry (circle)	AVS/SEM; Total Sulfides; VOC Sample (circle)	ACCEPT	
Sediment Type:	**Sediment Color:**	**Sediment Odor:**	**Sheen:**
Surface: not distinct →	Surface:	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface: med SAND w/ abundant	Subsurface: olive grey		

Additional Comments: organic debris @ depth & some shells

Grab Number:	Water Depth:	Penetration/Sampled Depth:	Time:
Bioassay / Chemistry (circle)	AVS/SEM; Total Sulfides; VOC Sample (circle)		
Sediment Type:	**Sediment Color:**	**Sediment Odor:**	**Sheen:**
Surface:	Surface:	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface:	Subsurface:		

Additional Comments:

Grab Number:	Water Depth:	Penetration/Sampled Depth:	Time:
Bioassay / Chemistry (circle)	AVS/SEM; Total Sulfides; VOC Sample (circle)		
Sediment Type:	**Sediment Color:**	**Sediment Odor:**	**Sheen:**
Surface:	Surface:	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface:	Subsurface:		

K. D'Orazio

Additional Comments:

Grab Number:	Water Depth:	Penetration/Sampled Depth:	Time:
Bioassay / Chemistry (circle)	AVS/SEM; Total Sulfides; VOC Sample (circle)		
Sediment Type:	**Sediment Color:**	**Sediment Odor:**	**Sheen:**
Surface:	Surface:	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface:	Subsurface:		

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5- 9

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R | Sampling Method: Van Veen - Anchor

Station Coordinates: N (Lat) —

E / W (Long.) —

Datum: NAD 83 / WGS 84 | Zone: — | GPS: Trimble DGPS on SV Peter R

Weather: sunny, light breeze

Sample Number: ~~RA5-9GS~~ NO SAMPLE

Analysis: TOC / Metals / PCB / SVOC (Circle Appropriate Analyses)

NO Sample!

Comments: 4 attempts w/ refusal, decision was made to move to another station until a different sampler can be obtained.

Grab Number: 1 Water Depth: 196' Penetration/Sampled Depth: 6/0 cm Time: 859

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface: silty SAND	Surface: brown	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface: fine to med SAND	Subsurface: dk olive grey		

Additional Comments: organic debris subsurface

Grab Number: 2 Water Depth: 196' Penetration/Sampled Depth: 8/0 cm Time: 912

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface: silty SAND	Surface: brown	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface: fine to med SAND	Subsurface: olive grey		

Additional Comments: penetration too shallow, some winnowing is occurring from organic debris

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Grab Number: 3 Water Depth: 197' Penetration/Sampled Depth: 6/0 cm Time: 923

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface: silty SAND	Surface: brown	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface: fine to med SAND	Subsurface: olive grey		

Additional Comments: heavily winnowed, shallow penetration, organic debris in jaws

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Grab Number: 4 Water Depth: 197' Penetration/Sampled Depth: 8/0 cm Time: 929

Bioassay / ~~Chemistry~~ (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface: silty SAND	Surface: brown	none / slight / moderate / strong / overwhelming; H2S / Petroleum / other:	none / slight / moderate / heavy
Subsurface: fine to med SAND	Subsurface: olive grey		

Additional Comments: 50% organic debris, heavy winnowing

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5-9X RD

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson	
Sampling Vessel: S/V Peter R	Sampling Method: Van Veen - Kyte
Station Coordinates: N / Lat 47°35.2946'N	Weather: overcast, light breeze, cool
E / W / Long 122°22.1216'W	
Datum: NAD 83 / WGS 84 Zone: —	GPS: Trimble DGPS on S/V Peter R
Sample Number: RA5-9GS	Comments: tried this station yesterday 4 times, 2nd grab today was successful
Analysis: TOC / Metals / PCB / SVOC Archive (Circle Appropriate Analyses)	
3 jars filled from 6th grab.	

Grab Number: #5 Water Depth: 194' Penetration/Sampled Depth: — Time: 0924
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	~~H2S~~	~~none~~
~~silty SAND~~	~~brown~~	slight ~~very~~	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
~~SAND~~	~~olive grey~~	strong		heavy
		overwhelming		

Additional Comments: debris in jaws, sample winnowed

Grab Number: 6 Water Depth: 194' Penetration/Sampled Depth: 12/10 cm Time: 0931
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	~~none~~	H2S	~~none~~
silty SAND	brown	slight - very	Petroleum	slight - appeared w/ homogenization
Subsurface:	Subsurface:	moderate	other:	moderate
SAND	olive grey	strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K. D'Orazio

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 10

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Anchor
Station Coordinates: N (Lat) 47°35.2971'N Weather: Sunny w/ some clouds, breezy
E / W / (Long) 122°22.0492'W Warm ~60+°F
Datum: (NAD 83) / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-10GS Comments: 3 jars filled from 1st grab
Analysis: ~~TOC / Metals / PCB / SVOC~~ - Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 183' Penetration/Sampled Depth: 13/10 cm Time: 14:29
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: spotty tr silt	Surface: spotty tr. brown	none	H2S	none
Subsurface: silty SAND w/ pockets of clay	Subsurface: olive grey	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: organic (woody) debris

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5- 11

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R | Sampling Method: Van Veen - Anchor

Station Coordinates: N / Lat 47° 35.2976 'N | Weather: sunny, light breeze, ~55°F

E / W / Long 122° 21.9779 'W

Datum: NAD 83 / WGS 84 | Zone: — | GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-11G5 | Comments: 3 jars filled from 4th grab

Analysis: TOC / Metals / PCB / SVOC Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 164' Penetration/Sampled Depth: 6/0 cm Time: 10:44
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: SAND w/silt	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: abundant organic (woody) debris

Grab Number: 2 Water Depth: 165' Penetration/Sampled Depth: 6/0 cm Time: 10:56
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: SAND w/ silt	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: abundant organic debris

Grab Number: 3 Water Depth: 164' Penetration/Sampled Depth: — Time: 11:06
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: NO sediment, organic debris only

Grab Number: 4 Water Depth: 165' Penetration/Sampled Depth: 10/6 cm Time: 11:13
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: SAND w/ silt	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND pocket of clay	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: shells & organic debris

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5- 12

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R Sampling Method: Van Veen – Kyte

Station Coordinates: N / Lat. 47°35. 3439'N Weather: Overcast, light breeze, cool

E / W / Long 122°22. 1247'W

Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-12GS Comments: 3 jars filled from 1st grab.

Analysis: TOC / Metals / PCB / SVOC Archive

(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 216' Penetration/Sampled Depth: 13/10 cm Time: 0850

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: tr brown	none	H2S	none
Subsurface: silty SAND, then CLAY, then SAND w/ fibers	Subsurface: olive gry, then dk grey	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: sample has distinct layering sand (0-4 cm), silty CLAY w/ sand (4-8 cm) then silty SAND w/ organic fibers @ depth

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

KDO 3/9/05

Additional Comments:

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 8 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5-13

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R Sampling Method: Van Veen - Anchor

Station Coordinates: N / Lat. 47°35.3454' N Weather: partly cloudy w/ breeze ~60°F

E / W / Long. 122°22.~~1930~~9532' N

Datum: NAD 83 / WGS 84 Zone: GPS: Trimble DGPS on Peter R

Sample Number: RA5-13GS Comments: 3 jars filled from 1st grab

Analysis: TOC / Metals / PCB / SVOC / Archive

(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 178' Penetration/Sampled Depth: 11/9 cm Time: 14:52

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: not distinct	Surface: not distinct	none	H2S	none
		slight	Petroleum	slight
Subsurface: med SAND w/ shells	Subsurface: olive gray	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: some organic debris, tr. clay

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

KD 3/8/05

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5-14

Sampling Crew:	Katherine D'Orazio, Bryan Patterson, Dale Dickinson		
Sampling Vessel:	*S/V Peter R*	Sampling Method:	Van Veen - Kyte
Station Coordinates:	N / Lat.	Weather:	overcast, breezy, cool
	E / W / Long.		
Datum:	~~NAD 83~~ / WGS 84	Zone: —	GPS: Trimble DGPS on SV Peter R
Sample Number:	~~RA5-14GS(K0)~~	Comments:	No sample attainable at this station. Moved station towards edge of cap (westward) after discussing with Brenda Bachman (USACE).
Analysis:	TOC / Metals / PCB / SVOC (Circle Appropriate Analyses) NO Sample		

Grab Number: 1 Water Depth: 238' Penetration/Sampled Depth: 10 / 0 cm Time: 1242
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none; slight; moderate; strong; overwhelming; H2S; Petroleum; other:	none; slight; moderate; heavy
Subsurface: Coarse SAND to gravel w/ clay inclusions	Subsurface:		

Additional Comments: Sample winnowed

Grab Number: 2 Water Depth: 241' Penetration/Sampled Depth: 6 / 0 cm Time: 1304
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none; slight; moderate; strong; overwhelming; H2S; Petroleum; other: creosote	none; slight; moderate; heavy – 2 large slicks visible after dumping material on tray
Subsurface: Coarse SAND to gravel	Subsurface: dk grey		

Additional Comments: winnowed, some cobble

Grab Number: 3 Water Depth: 244' Penetration/Sampled Depth: — Time: 1315
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none; slight; moderate; strong; overwhelming; H2S; Petroleum; other:	none; slight; moderate; heavy
Subsurface:	Subsurface:		

Additional Comments: Cobble in jaws, no sample

Grab Number: 4 Water Depth: 241' Penetration/Sampled Depth: — Time: 1326
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:	Sheen:
Surface:	Surface:	none; slight; moderate; strong; overwhelming; H2S; Petroleum; other:	none; slight; moderate; heavy
Subsurface:	Subsurface:		

Additional Comments: Rock in jaws
moved slightly east towards center of cap

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5-14a

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R*
Sampling Method: Van Veen - Kyte
Station Coordinates: N (Lat) 47°35.3809'N
E/W (Long) 122°22.2655'W
Weather: partly cloudy, light breeze, cool
Datum: NAD 83 / WGS 84 Zone: —
GPS: Trimble DGPS on SV Peter R
Sample Number: RA5-14A-GS
Comments: 3 jars filled from 2nd grab.
Analysis: TOC / Metals / PCB / SVOC / Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 24.1 Penetration/Sampled Depth: ______ Time: 15 53
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: WOOD in JAWS

Grab Number: 2 Water Depth: 24.5 Penetration/Sampled Depth: 13 / 10 cm Time: 1602
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: silty SAND w/ organics	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

KDO

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K DOrazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5- 15

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R — Sampling Method: Van Veen - Kyte

Station Coordinates: N / Lat 47°35.3917'N — Weather: mostly cloudy, breezy, cool

E / W Long 122°22.1783'W

Datum: NAD 83 / WGS 84 — Zone: — — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-15GS — Comments: 2 jars filled from 2nd grab

Analysis: TOC / Metals / PCB / SVOC / Archive

(Circle Appropriate Analyses) — Archive, TOC & Metals in one 16-oz. jar

Grab Number: 1 Water Depth: 243' Penetration/Sampled Depth: 6/5 Time: 13:40

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: shallow penetration

Grab Number: 2 Water Depth: 244' Penetration/Sampled Depth: 10/9 cm Time: 1356

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none — few bubbles developed when homogenized
Subsurface: 0-6 Sand	Subsurface: olive gray	slight	Petroleum	slight
6-10 silty sand w/ org.		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: organic debris (leafy)

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

KD'Orazio

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 16

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Kyte
Station Coordinates: N (Lat.) 47°35.4389'N Weather: cloudy, breezy, cool
E/W (Long.) 122°22.2480'W
Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-16GS Comments: 2 jars filled from 1st grab.
Analysis: TOC / Metals / PCB / SVOC / Archive Archive, TOC, & Metals in one 16oz jar
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 259' Penetration/Sampled Depth: 10 / 8 cm Time: 1418
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: Silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: 0-7 SAND	Subsurface: 0-7 olive grey	moderate	other:	moderate
7-10 SiltySAND	7-10 dk grey	strong		heavy
		overwhelming		

Additional Comments: w/ organics & shells, 1 pc of woody debris

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K. DOrazio

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. DOrazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 9 **March 05**
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** **RA5-** 17 & RA5-17A

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Kyte
Station Coordinates: N / Lat. 47°35.2898' N Weather: partly cloudy, calm, cool
E / W / Long. 122°22.3189' W
Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-17A-GS Comments: 3 jars filled from 1st grab at station RA5-17A (last sample - no more field sheets)
Analysis: TOC / Metals / PCB / SVOC / Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 209' Penetration/Sampled Depth: 9/0 Time: 1626
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: silt over organic leafy debris, no cap, moved to Station 17a 2

Grab Number: 1 Water Depth: 210' Penetration/Sampled Depth: 12/10 cm Time: 16:49
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: sand	Subsurface: dk olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K DOrazio

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. DOrazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 9 **March 05**
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5- 18

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: S/V Peter R
Sampling Method: Van Veen - Kyte
Station Coordinates: N/Lat. 47°35.1921'N
E/W/Long. 122°22.3406'N
Weather: overcast, breezy, cool
Datum: NAD 83 / WGS 84 Zone: -
GPS: Trimble DGPS on SV Peter R
Sample Number: ~~RA5-18GS~~
Analysis: TOC / Metals / PCB / SVOC / Archive
(Circle Appropriate Analyses)
Comments: 2 jars filled from 1st grab
Archive, TOC, & Metals in one 16oz jar

Grab Number: 1 Water Depth: 168' Penetration/Sampled Depth: 10/8 cm Time: 15:29
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
Subsurface: SAND silty SAND w/	Subsurface: olive grey	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: organics

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K D 9/05

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K DOrazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: 9 March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5- 19

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson

Sampling Vessel: S/V Peter R
Sampling Method: Van Veen - Kyte

Station Coordinates: N (Lat.) —
E / W (Long) —
Weather: partly cloudy, breezy, cool

Datum: NAD 83 / WGS 84
Zone: —
GPS: Trimble DGPS on SV Peter R

Sample Number: —

Analysis: TOC / Metals / PCB / SVOC
(Circle Appropriate Analyses)

NO Sample

Comments: 3 attempts w/ refusal → choose to relocate station halfway to cap.

Grab Number: 1 Water Depth: 144' Penetration/Sampled Depth: — Time: 1442

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: large (6 inch) piece of wood

Grab Number: 2 Water Depth: 142' Penetration/Sampled Depth: — Time: 1449

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: wood in jaws

Grab Number: 3 Water Depth: 139' Penetration/Sampled Depth: — Time: 1455

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: woody debris

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

K DOrazio

Recorded by: K DOrazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 9 **March 05**
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5-19a

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen – Kyte
Station Coordinates: N / Lat. 47°35.3060'N Weather: overcast, light breeze, mild (on the cold side ~50°F)
E / W / Long. 122°22.9278'W
Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on S/V Peter R

Sample Number: RA5-19A-GS Comments: RA5-19 was woody debris. This station is half way to closest on cap sample.
Analysis: TOC / Metals / PCB / SVOC / Archive
(Circle Appropriate Analyses)
2 jars filled from 1st grab.

Grab Number: 1 Water Depth: 152' Penetration/Sampled Depth: 10/8 cm Time: 1506
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
Subsurface: SAND	Subsurface: olive grey	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
Subsurface:	Subsurface:	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
Subsurface:	Subsurface:	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

KD 3/9/05

Additional Comments:

Grab Number: Water Depth: Penetration/Sampled Depth: Time:
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
Subsurface:	Subsurface:	slight	Petroleum	slight
		moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K DOrazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** RA5-20

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: *S/V Peter R* Sampling Method: Van Veen - Kyte
Station Coordinates: N / Lat. —— Weather: overcast, breezy, cool
E / W / Long. ——
Datum: NAD 83 / WGS 84 Zone: —— GPS: Trimble DGPS on SV Peter R

Sample Number: —— Comments: 4 attempts w/ refusal -> moved station halfway to cap
Analysis: TOC / Metals / PCB / SVOC
(Circle Appropriate Analyses)

No Sample

Grab Number: 1 Water Depth: 218' Penetration/Sampled Depth: 5 / 0 cm Time: 1028
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: penetration too shallow - sand w/ woody debris & shells

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Grab Number: 2 Water Depth: 218' Penetration/Sampled Depth: —— Time: 1039
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: beer can in jaws, no sediments just debris

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Grab Number: 3 Water Depth: 218' Penetration/Sampled Depth: —— Time: 1047
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: debris jaws, sample fell exiting water

Grab Number: 4 Water Depth: 218' Penetration/Sampled Depth: —— Time: 1055
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: debris in jaws

Recorded by: K. D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date: 9 March 05
Shipping Date: March 05

Project Name: USACE/PSR RA5 **Project No:** 020202-01BG11 **Station ID:** RA5-20a

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: S/V Peter R Sampling Method: Van Veen – Kyte
Station Coordinates: N / Lat. 47° 35.3082'N Weather: overcast, breezy, cool
E / W Long. 122°22.2044'W
Datum: NAD 83 / WGS 84 Zone: — GPS: Trimble DGPS on SV Peter R

Sample Number: RA5-20A-GS Comments: Station halfway to cap edge from RA5-20
Analysis: ~~TOC~~ / Metals / PCB / SVOC / Archive ~~(Circle Appropriate Analyses)~~
3 jars filled from 2nd grab

Grab Number: 1 Water Depth: 209' Penetration/Sampled Depth: — Time: 11:21
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: did not trip - chain caught

Grab Number: 2 Water Depth: 208' Penetration/Sampled Depth: 12/10 cm Time: 11:29
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND w/ some silt @ depth	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: shells & organics, S.

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

KD 3/9/05

Grab Number: ____ Water Depth: ____ Penetration/Sampled Depth: ____ Time: ____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K D'Orazio

ANCHOR ENVIRONMENTAL, L.L.C. **Surface Sediment Field Sample Record**

Collection Date: 9 **March 05**
Shipping Date: March 05

Project Name: *USACE/PSR RA5* **Project No:** *020202-01BG11* **Station ID:** **RA5-** 21

Sampling Crew: Katherine D'Orazio, Bryan Patterson, Dale Dickinson
Sampling Vessel: S/V Peter R — Sampling Method: Van Veen - Kute
Station Coordinates: N / Lat 47°35.3452' N — Weather: overcast, breezy, cool
E / W / Long 122°22.0419' W
Datum: NAD 83 / WGS 84 — Zone: — — GPS: Trimble DGPS on SV Peter R
Sample Number: RA5-21GS — Comments: 3 jars filled from 2nd grab
Analysis: TOC / Metals / PCB / SVOC / Archive
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 200' Penetration/Sampled Depth: — Time: 958
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) REJECT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: did not close properly

Grab Number: 2 Water Depth: 200' Penetration/Sampled Depth: 11/10 cm Time: 1001
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle) ACCEPT

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface: silty SAND	Surface: brown	none	H2S	none
		slight	Petroleum	slight
Subsurface: SAND w/ organic debris & pockets	Subsurface: olive grey	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments: of silty clay, some shells & rocks

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

KD'Orazio

Grab Number: ______ Water Depth: ______ Penetration/Sampled Depth: ______ Time: ______
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:
Surface:	Surface:	none	H2S	none
		slight	Petroleum	slight
Subsurface:	Subsurface:	moderate	other:	moderate
		strong		heavy
		overwhelming		

Additional Comments:

Recorded by: K. D'Orazio

APPENDIX C

SURFACE SEDIMENT QUALITY: CHEMISTRY DATA QA/QC REVIEW, ANALYTICAL LABORATORY CASE NARRATIVES, AND CHAIN-OF-CUSTODY FORMS

COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Anchor Environmental	**Service Request No.:**	K2501854
Project:	USACE-PSR RA5	**Date Received:**	3/16/05
Sample Matrix:	Sediment		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for samples designated for Tier III validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Twenty-three sediment samples were received for analysis at Columbia Analytical Services on 3/16/05. No discrepancies were noted upon initial sample inspection. All samples were received in good condition and consistent with the accompanying chain of custody. The samples for analysis were stored in a refrigerator at 4°C upon receipt at the laboratory. The samples for archive were stored frozen at –20°C upon receipt at the laboratory.

General Chemistry Parameters

No anomalies associated with the analysis of these samples were observed.

Total Metals

No anomalies associated with the analysis of these samples were observed.

PCB Aroclors by EPA Method 8082

Elevated Method Detection Limits:
The detection limit is elevated for several analytes in samples RA5-10-GS, RA5-11-GS, RA5-12-GS, RA5-14A-GS, RA5-18-GS, and RA5-20A-GS. The chromatogram indicated the presence of non-target background components. The matrix interference prevented adequate resolution of the target compounds at the reporting limit. The results are flagged to indicate the matrix interference.

Aroclor Identification:
Three Aroclors were identified in sample RA5-16-GS: Aroclor 1248, Aroclor 1254, and Aroclor 1260. When mixtures of PCB Aroclors are present in a sample, correct identification and quantitative analysis of the individual Aroclors can be subjective. In particular, when mixtures are present, differentiating Aroclor 1242 from Aroclor 1248 can be difficult.

A review of the sample chromatograms indicated the presence of PCB patterns that spanned the entire elution range from Aroclor 1248 through the end of Aroclor 1260. Based on individual PCB peaks in the early portion of the chromatogram, Aroclor 1248 was identified and quantitated. Aroclor 1260 was identified based on the presence of PCB peaks eluting late in the chromatogram. The remainder of the PCB pattern was identified as Aroclor 1254 because PCB peak height in the middle of the chromatogram was larger than could be attributed to either Aroclor 1248 or Aroclor 1260.

When Aroclor mixtures are present in a sample, care is taken to minimize the possibility of double-counting PCBs. Analytical peaks are selected based on the best resolution possible for that particular sample. However, when a mixture of Aroclors 1248, 1254, and 1260 are present in a sample, the potential exists for a high bias from contribution of one Aroclor to another due to common peaks or peaks that cannot be completely resolved.

Approved by [signature] **Date** 4/15/05

Sample Confirmation Notes:
The confirmation comparison criteria of 40% difference for Aroclor 1254 was exceeded in sample RA5-16-GS. The lower of the two values was reported because of an apparent interference on the alternate column that produced the higher value.

For analytes flagged JP, the confirmation comparison criteria are not applicable because at least one of the values is below the Method Reporting Limit (MRL).

Continuing Calibration Verification Exceptions:
The primary evaluation criterion was exceeded for the following analytes in Continuing Calibration Verification (CCV) 0328F016, 0328F027: Aroclor 1016, Aroclor 1260. In accordance with CAS standard operating procedures, the alternative evaluation specified in the EPA method was performed using the average percent recovery of all analytes in the verification standard. The standard meets the alternative evaluation criteria.

No other anomalies associated with the analysis of these samples were observed.

Semivolatile Organic Compounds by EPA Method 8270C

Lab Control Sample Exceptions:
The spike recoveries of Benzo (g, h, i) perylene were outside control criteria in Laboratory Control samples KWG0504420-3 and KWG0504420-4. Recoveries in the associated replicate matrix spike sample analyses were acceptable and no further corrective action was taken. The data is flagged to indicate the problem.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for Benzo (g, h, i) perylene in the replicate Laboratory Control Sample (LCS) analyses (KWG0504420-3 and KWG0504420-4) was outside control criteria. Recoveries in the associated replicate matrix spike sample analyses were acceptable and no further corrective action was taken. The data is flagged to indicate the problem.

Initial Calibration Exceptions:
The primary evaluation criterion was exceeded for the following analytes in Initial Calibration (ICAL) ID CAL4337: Phenol, Benzoic Acid, 4-Nitrophenol, 2, 3, 4, 6-Tetrachlorophenol, 2-Methyl-4, 6-dinitrophenol. In accordance with CAS standard operating procedures, the alternative evaluation specified in the EPA method was performed using the mean Relative Standard Deviation (RSD) of all analytes in the calibration. The result of the mean RSD calculation was 7.4%. The calibration meets the alternative evaluation criteria. Note that CAS/Kelso policy does not allow the use of averaging if any analyte in the ICAL exceeds 30% RSD.

No other anomalies associated with the analysis of these samples were observed.

Approved by ________ Date 4/15/05

Columbia Analytical Services INC.
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CHAIN OF CUSTODY

1317 South 13th Ave. • Kelso, WA 98626 • (360) 577-7222 • (800) 695-7222x07 • FAX (360) 636-1068

SR#: ______

 COC #: ______

PROJECT NAME: USACE Pacific Sound Resources RAS
PROJECT NUMBER: 020202-01 BG 11
PROJECT MANAGER: Dennis Hanzlick
COMPANY/ADDRESS: Anchor Environmental LLC
1423 3rd Ave, Suite 300
CITY/STATE/ZIP: Seattle, WA 98101
E-MAIL ADDRESS: dhanzlick@anchorenv.com
PHONE #: 206.287.9130 FAX#: 206.287.9131
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625 ☐ 8270 ☒ 8270LL ☐	Volatile Organics 624 ☐ 8260 ☐	Hydrocarbons (*see below) Gas ☐ Diesel ☐ Oil ☐	Fuel Fingerprint (FIQ) ☐ NW-HCID Screen ☐	Oil & Grease/TRPH 1664 HEM ☐ 1664 SGT ☐	PCB's Aroclors ☒ Congeners ☐	Pesticides/Herbicides 608 ☐ 8081A ☐ 8141A ☐ 8151A ☐	Chlorophenolics - 8151M Tri ☐ Tetra ☐ PCP ☐	PAHS 8310 ☐ SIM ☐	Metals, Total or Dissolved (See list below)	Cyanide ☐ Hex-Chrom ☐	pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS (circle)	NH3-N, COD, Total-P, TKN, TOC, DOC (circle) NO2+NO3	TOX 9020 ☐ AOX 1650 ☐ 506 ☐	TOC 9060 ☒	Archive			REMARKS
RAS-1-GS	3/8/05	11:41		SE	3	X					X				X					X	X			
RAS-2-GS	3/8/05	12:01		SE	3	X					X				X					X	X			
RAS-3-GS	3/8/05	14:09		SE	3	X					X				X					X	X			
RAS-4-GS	3/8/05	13:47		SE	*5	X					X				X					X	X			QA/QC
RAS-5-GS	3/8/05	10:01	X	SE	2	X					X				X					X				No Archive Jar
RAS-6-GS	3/9/05	12:36		SE	3	X					X				X					X	X			
RAS-7-GS	3/9/05	8:20		SE	3	X					X				X					X	X			
RAS-8-GS	3/8/05	15:14		SE	3	X					X				X					X	X			
RAS-9-GS	3/9/05	9:31		SE	3	X					X				X					X	X			
RAS-10-GS	3/8/05	14:29		SE	3	X					X				X					X	X			

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required

___ II. Report Dup., MS, MSD as required

X III. Data Validation Report (includes all raw data)

___ IV. CLP Deliverable Report

X V. EDD

INVOICE INFORMATION

P.O. #: ✓
Bill To: ✓

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.

___ 5 Day

X Standard (10-15 working days)

___ Provide FAX Results

___ Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER:______ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:
*on sample RAS-5 GS please archive any remaining sediment from analyzed jars, no archive jar was collected.

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Katherine DiMaggio	3/10/05 14:30	[illegible]	3/10/05 1430				
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
Katherine DiMaggio	Anchor Env.	[illegible]	[illegible]				
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Std.	Page: 1 of 3	
ARI Client Company: Anchor Environmental	Phone: 206.287.9130	Date: 3/15/05	Ice Present?
Client Contact: Dennis Hanzlick / Katherine D'Orazio		No. of Coolers:	Cooler Temps:
Client Project Name: USACE-PSR RA5			
Client Project #: 020202 01 BG 11	Samplers: KDO, BP		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	TOC 9060	SVOC 8270	PCB Aroclor 8082	Metals	Archive				Notes/Comments: Metals = As, Cd, Cr, Cu, Pb, Zn, Hg
RA5-1-GS	3/8/05	11:41	SE	3	X	X	X	X	X				
RA5-2-GS	3/8/05	12:01		3	X	X	X	X	X				
RA5-3-GS	3/8/05	14:09		3	X	X	X	X	X				
RA5-4-GS	3/8/05	13:47		5	X	X	X	X	X				QA/QC
RA5-5-GS	3/8/05	10:01		2	X	X	X	X					No Archive Jar
RA5-6-GS	3/8/05	12:30		3	X	X	X	X	X				
RA5-7-GS	3/9/05	8:20		3	X	X	X	X	X				
RA5-8-GS	3/8/05	15:14		3	X	X	X	X	X				
RA5-9-GS	3/9/05	9:31		3	X	X	X	X	X				
RA5-10-GS	3/8/05	14:29	SE	3	X	X	X	X	X				

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Katherine D'Orazio	(Signature)	(Signature)	(Signature)
	Printed Name: Katherine D'Orazio	Printed Name:	Printed Name:	Printed Name:
	Company: Anchor Env.	Company:	Company:	Company:
	Date & Time: 3/15/05 15:15	Date & Time:	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

[redacted]mbia Analytical Services INC.
An Employee - Owned Company

CHAIN OF C[redacted]STODY

SR#: [redacted]

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PAGE 2 OF 3 COC #

PROJECT NAME USACE - Pacific Sound Resources RA5
PROJECT NUMBER C2C202-01 BG11
PROJECT MANAGER Dennis Hanzlick
COMPANY/ADDRESS Anchor Environmental LLC
1423 3rd Ave, Suite 300.
CITY/STATE/ZIP Seattle, WA 98101
E-MAIL ADDRESS dhanzlick@anchorenv.com
PHONE # 206.287.9130 FAX# 206 287 9131
SAMPLER'S SIGNATURE

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☒ 8270LL☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Fuel Fingerprint (FIQ)☐ NW-HCID Screen☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCB's Aroclors☒ Congeners☐	Pesticides/Herbicides 608☐ 8081A☐ 8141A☐ 8151A☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	PAHS 8310☐ SIM☐	Metals (Total or Dissolved) (See list below) X	Cyanide☐	Hex-Chrom☐	pH, Cond, Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS (circle)	NH3-N, COD, Total-P, TKN, TOC, DOC (circle) NO2+NO3	TOX 9020☐ AOX 1650☐ 506☐	TOC 9060☒	Archive			REMARKS
RA5-11-GS	3/8/05	11:13		SE	3	X					X				X						X	X			
RA5-12-GS	3/9/05	8:50		SE	3	X					X				X						X	X			
RA5-13-GS	3/8/05	14:52		SE	3	X					X				X						X	X			
RA5-14A-GS	3/9/05	16:02		SE	3	X					X				X						X	X			
RA5-15-GS	3/9/05	13:56		SE	2	X					X				X						X	X			
RA5-16-GS	3/9/05	14:18		SE	2	X					X				X						X	X			
RA5-17A-GS	3/9/05	16:49		SE	3	X					X				X						X	X			
RA5-18-GS	3/9/05	15:29		SE	2	X					X				X						X	X			
RA5-19A-GS	3/9/05	15:06		SE	2	X					X				X						X	X			
RA5-20A-GS	3/9/05	11:29		SE	3	X					X				X						X	X			

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
X III. Data Validation Report (includes all raw data)
___ IV. CLP Deliverable Report
X V. EDD

INVOICE INFORMATION

P.O. # ______
Bill To: ______

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 Day
X Standard (10-15 working days)
___ Provide FAX Results

______
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER:______ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Katherine DiMarco 3/10/05 14:30	[illegible]		
Signature Date/Time	Signature Date/Time	Signature Date/Time	Signature Date/Time
Katherine DiMarco Anchor Env	[illegible]		
Printed Name Firm	Printed Name Firm	Printed Name Firm	Printed Name Firm

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 2 of 3	
ARI Client Company: ANCHOR ENVIRONMENTAL	Phone: 206 287 9130	Date: 3/15/05	Ice Present?
Client Contact: DENNIS HANZLICK / KATHERINE D'ORAZIO		No. of Coolers:	Cooler Temps:
Client Project Name: USACE - PSR RAS			
Client Project #: 020202-01 BG11	Samplers: KDO / BP		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	TOC 9060	SVOC 8270	PCB AROCLORS	METALS	ARCHIVE				Notes/Comments
RAS-11-GS	3/8/05	11:13	SE	3	X	X	X	X	X				Metals = As, Cd, Cr, Cu, Pb, Zn, Hg
RAS-12-GS	3/9/05	8:50	SE	3	X	X	X	X	X				
RAS-13-GS	3/8/05	14:52	SE	3	X	X	X	X	X				
RAS-14A-GS	3/9/05	16:02	SE	3	X	X	X	X	X				
RAS-15-GS	3/9/05	13:56	SE	2	X	X	X	X	X				
RAS-16-GS	3/9/05	14:18	SE	2	X	X	X	X	X				
RAS-17A-GS	3/9/05	16:49	SE	3	X	X	X	X	X				
RAS-18-GS	3/9/05	15:29	SE	2	X	X	X	X	X				
RAS-19A-GS	3/9/05	15:06	SE	2	X	X	X	X	X				
RAS-20A-GS	3/9/05	11:29	SE	3	X	X	X	X	X				

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Katherine D'Orazio	(Signature)	(Signature)	(Signature)
	Printed Name: KATHERINE D'ORAZIO	Printed Name:	Printed Name:	Printed Name:
	Company: ANCHOR ENV.	Company:	Company:	Company:
	Date & Time: 3/15/05 15:15	Date & Time:	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Columbia Analytical Services INC.
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SR#: ______ PAGE 3 OF 3 COC # ______

PROJECT NAME: USACE - Pacific Sound Resources RA5
PROJECT NUMBER: 020202-01 BGII
PROJECT MANAGER: Dennis Hanzlick
COMPANY/ADDRESS: ~~1423~~ Anchor Environmental LLC
1423 3rd Ave, Suite 300
CITY/STATE/ZIP: Seattle, WA 98101
E-MAIL ADDRESS: dhanzlick@anchorenv.com
PHONE # 206 287 9130 FAX# 206 287 9131
SAMPLER'S SIGNATURE

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS		Semivolatile Organics by GC/MS 625☐ 8270☒ 8270LL☐	Volatile Organics 624☐ 8260☐ 8021☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐ BTEX☐	Fuel Fingerprint (FIQ) ☐ NW-HCID Screen	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCB's Aroclors☒ Congeners☐	Pesticides/Herbicides 608☐ 8081A☐ 8141A☐ 8151A☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	PAHS 8310☐ SIM☐	Metals, Total or Dissolved (See list below)	Cyanide☐ Hex-Chrom☐	pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS (circle)	NH3-N, COD, Total-P, TKN, TOC, DOC (circle) NO2+NO3	TOX 9020☐ AOX 1650☐ 506☐	TOC 9060 ☒	Archive			REMARKS
RA5-21-GS	3/9/05	10:01		SE	3		X					X				X					X	X			
RA5-FW	3/10/05	12:45		FW	1																	X			
RA5-FB	3/10/05	12:45		FB	1																	X			

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
X III. Data Validation Report (includes all raw data)
___ IV. CLP Deliverable Report
X V. EDD

INVOICE INFORMATION

P.O. # ______
Bill To: ______

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 Day
X Standard (10-15 working days)
___ Provide FAX Results
______ Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: ______ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Katherine DDrasic; Date/Time: 3/10/05 14:30	Signature: [illegible]; Date/Time: [illegible]	Signature; Date/Time	Signature; Date/Time
Printed Name: Katherine DDrasic; Firm: Anchor Env.	Printed Name: [illegible]; Firm: [illegible]	Printed Name; Firm	Printed Name; Firm

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: STD	Page: 3	of 3
ARI Client Company: ANCHOR ENVIRONMENTAL	Phone: (206) 287-9130	Date: 3/15/05	Ice Present?
Client Contact: DENNIS HANZLICK / KATHERINE D'ORAZIO		No. of Coolers:	Cooler Temps:
Client Project Name: USACE - PSR RAS			
Client Project #: 020202-01 BAll	Samplers: KDO, BP		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	TOC 9060	SVOC 8270	PCB AROCLORS	METALS	ARCHIVE				Notes/Comments
													Metals = As, Cd, Cr, Cu Pb, Zn, Hg
RAS-21-GS	3/9/05	10:01	SE	3	X	X	X	X	X				
RAS-FW	3/10/05	12:45	FW	1					X				
RAS-FB	3/10/05	12:45	FB	1					X				

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Katherine D'Orazio	(Signature)	(Signature)	(Signature)
	Printed Name: KATHERINE D'ORAZIO	Printed Name:	Printed Name:	Printed Name:
	Company: ANCHOR ENV.	Company:	Company:	Company:
	Date & Time: 3/15/05 15:15	Date & Time:	Date & Time:	Date & Time:

***Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

APPENDIX D

SURFACE SEDIMENT QUALITY: CHEMISTRY LABORATORY DATA SHEETS

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client: Anchor Environmental
Project: USACE-PSR RA5/020202-01/BG 11
Sample Matrix: Sediment

Service Request: K2501854

Total Solids

Prep Method: NONE
Analysis Method: 160.3M
Test Notes:

Units: PERCENT
Basis: Wet

Sample Name	Lab Code	Date Collected	Date Received	Date Analyzed	Result	Result Notes
RA5-1-GS	K2501854-001	03/08/2005	03/16/2005	03/17/2005	64.0	
RA5-2-GS	K2501854-002	03/08/2005	03/16/2005	03/17/2005	59.2	
RA5-3-GS	K2501854-003	03/08/2005	03/16/2005	03/17/2005	67.5	
RA5-4-GS	K2501854-004	03/08/2005	03/16/2005	03/17/2005	69.4	
RA5-5-GS	K2501854-005	03/08/2005	03/16/2005	03/17/2005	66.4	
RA5-6-GS	K2501854-006	03/08/2005	03/16/2005	03/17/2005	68.7	
RA5-7-GS	K2501854-007	03/09/2005	03/16/2005	03/17/2005	63.2	
RA5-8-GS	K2501854-008	03/08/2005	03/16/2005	03/17/2005	62.3	
RA5-9-GS	K2501854-009	03/09/2005	03/16/2005	03/17/2005	69.6	
RA5-10-GS	K2501854-010	03/08/2005	03/16/2005	03/17/2005	56.9	
RA5-11-GS	K2501854-011	03/08/2005	03/16/2005	03/17/2005	68.2	
RA5-12-GS	K2501854-012	03/09/2005	03/16/2005	03/17/2005	59.1	
RA5-13-GS	K2501854-013	03/08/2005	03/16/2005	03/17/2005	72.9	
RA5-14A-GS	K2501854-014	03/09/2005	03/16/2005	03/17/2005	61.3	
RA5-15-GS	K2501854-015	03/09/2005	03/16/2005	03/17/2005	69.4	
RA5-16-GS	K2501854-016	03/09/2005	03/16/2005	03/17/2005	75.1	
RA5-17A-GS	K2501854-017	03/09/2005	03/16/2005	03/17/2005	66.9	
RA5-18-GS	K2501854-018	03/09/2005	03/16/2005	03/17/2005	65.5	
RA5-19A-GS	K2501854-019	03/09/2005	03/16/2005	03/17/2005	73.9	
RA5-20A-GS	K2501854-020	03/09/2005	03/16/2005	03/17/2005	63.6	
RA5-21-GS	K2501854-021	03/09/2005	03/16/2005	03/17/2005	64.4	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Anchor Environmental
Project: USACE-PSR RA5/020202-01/BG 11
Sample Matrix: Sediment

Service Request: K2501854
Date Collected: 03/08-03/09/05
Date Received: 03/16/05

Carbon, Total Organic

Prep Method: NONE
Analysis Method: PSEP
Test Notes:

Units: PERCENT
Basis: Dry

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
RA5-1-GS	K2501854-001	0.05	0.02	1	NA	03/22/05	2.03	
RA5-2-GS	K2501854-002	0.05	0.02	1	NA	03/22/05	2.36	
RA5-3-GS	K2501854-003	0.05	0.02	1	NA	03/22/05	1.11	
RA5-4-GS	K2501854-004	0.05	0.02	1	NA	03/22/05	1.20	
RA5-5-GS	K2501854-005	0.05	0.02	1	NA	03/22/05	1.11	
RA5-6-GS	K2501854-006	0.05	0.02	1	NA	03/22/05	0.63	
RA5-7-GS	K2501854-007	0.05	0.02	1	NA	03/22/05	1.45	
RA5-8-GS	K2501854-008	0.05	0.02	1	NA	03/22/05	2.57	
RA5-9-GS	K2501854-009	0.05	0.02	1	NA	03/22/05	0.81	
RA5-10-GS	K2501854-010	0.05	0.02	1	NA	03/22/05	2.46	
RA5-11-GS	K2501854-011	0.05	0.02	1	NA	03/22/05	1.26	
RA5-12-GS	K2501854-012	0.05	0.02	1	NA	03/22/05	2.30	
RA5-13-GS	K2501854-013	0.05	0.02	1	NA	03/22/05	1.44	
RA5-14A-GS	K2501854-014	0.05	0.02	1	NA	03/22/05	2.05	
RA5-15-GS	K2501854-015	0.05	0.02	1	NA	03/22/05	1.17	
RA5-16-GS	K2501854-016	0.05	0.02	1	NA	03/22/05	0.49	
RA5-17A-GS	K2501854-017	0.05	0.02	1	NA	03/22/05	1.29	
RA5-18-GS	K2501854-018	0.05	0.02	1	NA	03/22/05	1.42	
RA5-19A-GS	K2501854-019	0.05	0.02	1	NA	03/22/05	0.30	
RA5-20A-GS	K2501854-020	0.05	0.02	1	NA	03/22/05	1.74	
RA5-21-GS	K2501854-021	0.05	0.02	1	NA	03/22/05	1.46	
Method Blank	K2501854-MB	0.05	0.02	1	NA	03/22/05	ND	
Method Blank	K2501854-MB	0.05	0.02	1	NA	03/22/05	ND	

Approved By: ____________________ Date: 5/13/04

1A/020597p

01854WET.sy1 - Sample 05/13/05

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client:	Anchor Environmental	Service Request:	K2501854
Project No.:	020202-01/BG 11	Date Collected:	03/08/05
Project Name:	USACE-PSR RA5	Date Received:	03/16/05
Matrix:	SEDIMENT	Units:	MG/KG
		Basis:	Dry

Sample Name: RA5-1-GS Lab Code: K2501854-001

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.12	0.11	10	3/28/05	4/7/05	9.33		
Cadmium	6020	0.112	0.016	10	3/28/05	4/7/05	0.178		
Chromium	6020	0.45	0.09	10	3/28/05	4/7/05	31.9		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	30.3		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	7.32		
Mercury	7471A	0.015	0.006	1	3/21/05	3/22/05	0.054		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	53.6		

% Solids: 64.0

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/08/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-2-GS   Lab Code: K2501854-002

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	0.94	0.09	10	3/28/05	4/7/05	9.89		
Cadmium	6020	0.094	0.013	10	3/28/05	4/7/05	0.206		
Chromium	6020	0.38	0.08	10	3/28/05	4/7/05	35.5		
Copper	6020	0.19	0.04	10	3/28/05	4/7/05	36.6		
Lead	6020	0.09	0.04	10	3/28/05	4/7/05	8.74		
Mercury	7471A	0.016	0.006	1	3/21/05	3/22/05	0.054		
Zinc	6020	0.9	0.4	10	3/28/05	4/7/05	60.9		

% Solids: 59.2

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client:	Anchor Environmental	Service Request:	K2501854
Project No.:	020202-01/BG 11	Date Collected:	03/08/05
Project Name:	USACE-PSR RA5	Date Received:	03/16/05
Matrix:	SEDIMENT	Units:	MG/KG
		Basis:	Dry

Sample Name: RA5-3-GS   Lab Code: K2501854-003

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.06	0.11	10	3/28/05	4/7/05	6.92		
Cadmium	6020	0.106	0.015	10	3/28/05	4/7/05	0.144		
Chromium	6020	0.42	0.08	10	3/28/05	4/7/05	31.2		
Copper	6020	0.21	0.04	10	3/28/05	4/7/05	23.4		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	7.03		
Mercury	7471A	0.016	0.007	1	3/21/05	3/22/05	0.050		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	45.8		

% Solids: 67.5

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/08/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-4-GS   Lab Code: K2501854-004

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.02	0.10	10	3/28/05	4/7/05	6.60		
Cadmium	6020	0.102	0.014	10	3/28/05	4/7/05	0.082	B	
Chromium	6020	0.41	0.08	10	3/28/05	4/7/05	24.8		
Copper	6020	0.20	0.04	10	3/28/05	4/7/05	19.5		
Lead	6020	0.10	0.04	10	3/28/05	4/7/05	5.20		
Mercury	7471A	0.014	0.006	1	3/21/05	3/22/05	0.033		
Zinc	6020	1.0	0.4	10	3/28/05	4/7/05	41.0		

% Solids: 69.4

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client:	Anchor Environmental	Service Request:	K2501854
Project No.:	020202-01/BG 11	Date Collected:	03/08/05
Project Name:	USACE-PSR RA5	Date Received:	03/16/05
Matrix:	SEDIMENT	Units:	MG/KG
		Basis:	Dry

Sample Name: RA5-5-GS   Lab Code: K2501854-005

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.08	0.11	10	3/28/05	4/7/05	5.97		
Cadmium	6020	0.108	0.015	10	3/28/05	4/7/05	0.149		
Chromium	6020	0.43	0.09	10	3/28/05	4/7/05	26.8		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	26.8		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	7.31		
Mercury	7471A	0.018	0.007	1	3/21/05	3/22/05	0.263		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	48.5		

% Solids: 66.4

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/08/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-6-GS

Lab Code: K2501854-006

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.03	0.10	10	3/28/05	4/7/05	5.47		
Cadmium	6020	0.103	0.014	10	3/28/05	4/7/05	0.086	B	
Chromium	6020	0.41	0.08	10	3/28/05	4/7/05	26.3		
Copper	6020	0.21	0.04	10	3/28/05	4/7/05	22.0		
Lead	6020	0.10	0.04	10	3/28/05	4/7/05	4.39		
Mercury	7471A	0.012	0.005	1	3/21/05	3/22/05	0.347		
Zinc	6020	1.0	0.4	10	3/28/05	4/7/05	43.3		

% Solids: 68.7

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client:	Anchor Environmental	Service Request:	K2501854
Project No.:	020202-01/BG 11	Date Collected:	03/09/05
Project Name:	USACE-PSR RA5	Date Received:	03/16/05
Matrix:	SEDIMENT	Units:	MG/KG
		Basis:	Dry

Sample Name: RA5-7-GS Lab Code: K2501854-007

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.13	0.11	10	3/28/05	4/7/05	8.63		
Cadmium	6020	0.113	0.016	10	3/28/05	4/7/05	0.177		
Chromium	6020	0.45	0.09	10	3/28/05	4/7/05	33.5		
Copper	6020	0.23	0.05	10	3/28/05	4/7/05	29.7		
Lead	6020	0.11	0.05	10	3/28/05	4/7/05	6.94		
Mercury	7471A	0.016	0.006	1	3/21/05	3/22/05	0.073		
Zinc	6020	1.1	0.5	10	3/28/05	4/7/05	54.5		

% Solids: 63.2

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/08/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-8-GS   Lab Code: K2501854-008

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.13	0.11	10	3/28/05	4/7/05	9.12		
Cadmium	6020	0.113	0.016	10	3/28/05	4/7/05	0.157		
Chromium	6020	0.45	0.09	10	3/28/05	4/7/05	39.2		
Copper	6020	0.23	0.05	10	3/28/05	4/7/05	27.2		
Lead	6020	0.11	0.05	10	3/28/05	4/7/05	5.87		
Mercury	7471A	0.018	0.007	1	3/21/05	3/22/05	0.040		
Zinc	6020	1.1	0.5	10	3/28/05	4/7/05	49.8		

% Solids: 62.3

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client:	Anchor Environmental	Service Request:	K2501854
Project No.:	020202-01/BG 11	Date Collected:	03/09/05
Project Name:	USACE-PSR RA5	Date Received:	03/16/05
Matrix:	SEDIMENT	Units:	MG/KG
		Basis:	Dry

Sample Name: RA5-9-GS　　Lab Code: K2501854-009

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.02	0.10	10	3/28/05	4/7/05	8.23		
Cadmium	6020	0.102	0.014	10	3/28/05	4/7/05	0.107		
Chromium	6020	0.41	0.08	10	3/28/05	4/7/05	27.0		
Copper	6020	0.20	0.04	10	3/28/05	4/7/05	23.9		
Lead	6020	0.10	0.04	10	3/28/05	4/7/05	5.58		
Mercury	7471A	0.017	0.007	1	3/21/05	3/22/05	0.035		
Zinc	6020	1.0	0.4	10	3/28/05	4/7/05	46.2		

Solids: 69.6

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental

Project No.: 020202-01/BG 11

Project Name: USACE-PSR RA5

Matrix: SEDIMENT

Service Request: K2501854

Date Collected: 03/08/05

Date Received: 03/16/05

Units: MG/KG

Basis: Dry

Sample Name: RA5-10-GS

Lab Code: K2501854-010

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	0.97	0.10	10	3/28/05	4/7/05	10.5		
Cadmium	6020	0.097	0.014	10	3/28/05	4/7/05	0.255		
Chromium	6020	0.39	0.08	10	3/28/05	4/7/05	37.5		
Copper	6020	0.19	0.04	10	3/28/05	4/7/05	38.4		
Lead	6020	0.10	0.04	10	3/28/05	4/7/05	9.34		
Mercury	7471A	0.018	0.007	1	3/21/05	3/22/05	0.066		
Zinc	6020	1.0	0.4	10	3/28/05	4/7/05	60.6		

% Solids: 56.9

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/08/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-11-GS

Lab Code: K2501854-011

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.05	0.11	10	3/28/05	4/7/05	10.9		
Cadmium	6020	0.105	0.015	10	3/28/05	4/7/05	0.158		
Chromium	6020	0.42	0.08	10	3/28/05	4/7/05	23.3		
Copper	6020	0.21	0.04	10	3/28/05	4/7/05	21.8		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	6.01		
Mercury	7471A	0.017	0.007	1	3/21/05	3/22/05	0.038		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	42.0		

% Solids: 68.2

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-12-GS

Lab Code: K2501854-012

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	0.94	0.09	10	3/28/05	4/7/05	11.7		
Cadmium	6020	0.094	0.013	10	3/28/05	4/7/05	0.243		
Chromium	6020	0.37	0.07	10	3/28/05	4/7/05	33.5		
Copper	6020	0.19	0.04	10	3/28/05	4/7/05	33.7		
Lead	6020	0.09	0.04	10	3/28/05	4/7/05	8.21		
Mercury	7471A	0.019	0.008	1	3/21/05	3/22/05	0.065		
Zinc	6020	0.9	0.4	10	3/28/05	4/7/05	56.1		

% Solids: 59.1

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/08/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-13-GS   Lab Code: K2501854-013

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.13	0.11	10	3/28/05	4/7/05	6.92		
Cadmium	6020	0.113	0.016	10	3/28/05	4/7/05	0.092	B	
Chromium	6020	0.45	0.09	10	3/28/05	4/7/05	26.0		
Copper	6020	0.23	0.05	10	3/28/05	4/7/05	21.4		
Lead	6020	0.11	0.05	10	3/28/05	4/7/05	5.48		
Mercury	7471A	0.014	0.006	1	3/21/05	3/22/05	0.029		
Zinc	6020	1.1	0.5	10	3/28/05	4/7/05	42.0		

% Solids: 72.9

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client:	Anchor Environmental	Service Request:	K2501854
Project No.:	020202-01/BG 11	Date Collected:	03/09/05
Project Name:	USACE-PSR RA5	Date Received:	03/16/05
Matrix:	SEDIMENT	Units:	MG/KG
		Basis:	Dry

Sample Name: RA5-14A-GS Lab Code: K2501854-014

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.14	0.11	10	3/28/05	4/7/05	10.0		
Cadmium	6020	0.114	0.016	10	3/28/05	4/7/05	0.204		
Chromium	6020	0.46	0.09	10	3/28/05	4/7/05	36.3		
Copper	6020	0.23	0.05	10	3/28/05	4/7/05	34.4		
Lead	6020	0.11	0.05	10	3/28/05	4/7/05	9.11		
Mercury	7471A	0.017	0.007	1	3/21/05	3/22/05	0.060		
Zinc	6020	1.1	0.5	10	3/28/05	4/7/05	60.4		

% Solids: 61.3

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-15-GS

Lab Code: K2501854-015

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.02	0.10	10	3/28/05	4/7/05	5.28		
Cadmium	6020	0.102	0.014	10	3/28/05	4/7/05	0.086	B	
Chromium	6020	0.41	0.08	10	3/28/05	4/7/05	22.7		
Copper	6020	0.20	0.04	10	3/28/05	4/7/05	20.3		
Lead	6020	0.10	0.04	10	3/28/05	4/7/05	4.50		
Mercury	7471A	0.017	0.007	1	3/21/05	3/22/05	0.030		
Zinc	6020	1.0	0.4	10	3/28/05	4/7/05	38.9		

Solids: 69.4

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-16-GS   Lab Code: K2501854-016

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.11	0.11	10	3/28/05	4/7/05	5.67		
Cadmium	6020	0.111	0.016	10	3/28/05	4/7/05	0.100	B	
Chromium	6020	0.44	0.09	10	3/28/05	4/7/05	23.5		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	18.2		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	6.66		
Mercury	7471A	0.012	0.005	1	3/21/05	3/22/05	0.032		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	43.0		

% Solids: 75.1

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-17A-GS   Lab Code: K2501854-017

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.06	0.11	10	3/28/05	4/7/05	6.77		
Cadmium	6020	0.106	0.015	10	3/28/05	4/7/05	0.139		
Chromium	6020	0.42	0.08	10	3/28/05	4/7/05	28.9		
Copper	6020	0.21	0.04	10	3/28/05	4/7/05	24.1		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	5.23		
Mercury	7471A	0.018	0.007	1	3/21/05	3/22/05	0.051		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	45.0		

% Solids: 66.9

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-18-GS
Lab Code: K2501854-018

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.09	0.11	10	3/28/05	4/7/05	7.15		
Cadmium	6020	0.109	0.015	10	3/28/05	4/7/05	0.157		
Chromium	6020	0.44	0.09	10	3/28/05	4/7/05	32.0		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	28.2		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	6.54		
Mercury	7471A	0.016	0.007	1	3/21/05	3/22/05	0.043		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	48.0		

% Solids: 65.5

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-19A-GS   Lab Code: K2501854-019

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.10	0.11	10	3/28/05	4/7/05	5.86		
Cadmium	6020	0.110	0.015	10	3/28/05	4/7/05	0.078	B	
Chromium	6020	0.44	0.09	10	3/28/05	4/7/05	21.4		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	18.1		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	8.65		
Mercury	7471A	0.016	0.007	1	3/21/05	3/22/05	0.045		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	44.9		

Solids: 73.9

Comments:

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-20A-GS   Lab Code: K2501854-020

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.12	0.11	10	3/28/05	4/7/05	8.66		
Cadmium	6020	0.112	0.016	10	3/28/05	4/7/05	0.179		
Chromium	6020	0.45	0.09	10	3/28/05	4/7/05	28.2		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	26.4		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	6.11		
Mercury	7471A	0.018	0.007	1	3/21/05	3/22/05	0.072		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	48.2		

% Solids: 63.6

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected: 03/09/05
Date Received: 03/16/05
Units: MG/KG
Basis: Dry

Sample Name: RA5-21-GS Lab Code: K2501854-021

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	1.11	0.11	10	3/28/05	4/7/05	8.53		
Cadmium	6020	0.111	0.016	10	3/28/05	4/7/05	0.198		
Chromium	6020	0.44	0.09	10	3/28/05	4/7/05	35.4		
Copper	6020	0.22	0.04	10	3/28/05	4/7/05	30.9		
Lead	6020	0.11	0.04	10	3/28/05	4/7/05	7.30		
Mercury	7471A	0.017	0.007	1	3/21/05	3/22/05	0.178		
Zinc	6020	1.1	0.4	10	3/28/05	4/7/05	53.4		

% Solids: 64.4

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Project No.: 020202-01/BG 11
Project Name: USACE-PSR RA5
Matrix: SEDIMENT

Service Request: K2501854
Date Collected:
Date Received:
Units: MG/KG
Basis: Dry

Sample Name: Method Blank
Lab Code: K2501854-MB

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	0.50	0.05	5	3/28/05	4/7/05	0.05	U	
Cadmium	6020	0.050	0.007	5	3/28/05	4/7/05	0.007	U	
Chromium	6020	0.20	0.04	5	3/28/05	4/7/05	0.14	B	
Copper	6020	0.10	0.02	5	3/28/05	4/7/05	0.02	U	
Lead	6020	0.05	0.02	5	3/28/05	4/7/05	0.02	U	
Mercury	7471A	0.020	0.008	1	3/21/05	3/22/05	0.008	U	
Zinc	6020	0.5	0.2	5	3/28/05	4/7/05	0.2	B	

% Solids: 100.0

Comments:

METALS
-1-
INORGANIC ANALYSIS DATA SHEET

Client: Anchor Environmental
Service Request: K2501854
Project No.: 020202-01/BG 11
Date Collected:
Project Name: USACE-PSR RA5
Date Received:
Matrix: SEDIMENT
Units: MG/KG
Basis: Dry

Sample Name: Method Blank
Lab Code: K2501854-MB2

Analyte	Analysis Method	MRL	MDL	Dil.	Date Extracted	Date Analyzed	Result	C	Q
Arsenic	6020	0.50	0.05	5	3/28/05	4/7/05	0.05	U	
Cadmium	6020	0.050	0.007	5	3/28/05	4/7/05	0.007	U	
Chromium	6020	0.20	0.04	5	3/28/05	4/7/05	0.15	B	
Copper	6020	0.10	0.02	5	3/28/05	4/7/05	0.02	U	
Lead	6020	0.05	0.02	5	3/28/05	4/7/05	0.02	U	
Mercury	7471A	0.020	0.008	1	3/21/05	3/22/05	0.008	U	
Zinc	6020	0.5	0.2	5	3/28/05	4/7/05	0.2	U	

% Solids: 100.0

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-1-GS	**Units:**	ug/Kg
Lab Code:	K2501854-001	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1221	ND	U	20	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1232	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1242	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1248	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1254	**5.1**	**J**	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1260	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	103	20-161	03/28/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-2-GS	**Units:**	ug/Kg
Lab Code:	K2501854-002	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.2	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1221	ND	U	20	2.2	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1232	ND	U	10	2.2	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1242	ND	U	10	2.2	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1248	ND	U	10	2.2	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1254	**6.0**	J	10	2.2	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1260	ND	U	10	2.2	1	03/21/05	03/28/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	104	20-161	03/28/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-3-GS	**Units:**	ug/Kg
Lab Code:	K2501854-003	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.0	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1221	ND	U	20	2.0	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1232	ND	U	10	2.0	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1242	ND	U	10	2.0	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1248	ND	U	10	2.0	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1254	**6.6**	**JP**	10	2.0	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1260	ND	U	10	2.0	1	03/21/05	03/28/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	107	20-161	03/28/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-4-GS	**Units:**	ug/Kg
Lab Code:	K2501854-004	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1221	ND	U	20	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1232	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1242	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1248	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1254	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1260	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	83	20-161	03/24/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-5-GS	**Units:**	ug/Kg
Lab Code:	K2501854-005	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.0	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1221	ND	U	20	2.0	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1232	ND	U	10	2.0	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1242	ND	U	10	2.0	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1248	ND	U	10	2.0	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1254	**210**		10	2.0	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1260	ND	U	10	2.0	1	03/21/05	03/24/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	95	20-161	03/24/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
mple Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-6-GS	**Units:**	ug/Kg
Lab Code:	K2501854-006	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1221	ND	U	20	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1232	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1242	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1248	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1254	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1260	ND	U	10	1.9	1	03/21/05	03/24/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
ecachlorobiphenyl	97	20-161	03/24/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-7-GS	**Units:**	ug/Kg
Lab Code:	K2501854-007	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1221	ND	U	20	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1232	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1242	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1248	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1254	**7.3**	J	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1260	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	108	20-161	03/28/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-8-GS	**Units:**	ug/Kg
Lab Code:	K2501854-008	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1221	ND	U	20	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1232	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1242	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1248	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1254	**5.0**	**J**	10	2.1	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1260	ND	U	10	2.1	1	03/21/05	03/28/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	99	20-161	03/28/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-9-GS	**Units:**	ug/Kg
Lab Code:	K2501854-009	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.9	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1221	ND	U	20	1.9	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1232	ND	U	10	1.9	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1242	ND	U	10	1.9	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1248	ND	U	10	1.9	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1254	**3.5**	JP	10	1.9	1	03/21/05	03/28/05	KWG0504432	
Aroclor 1260	ND	U	10	1.9	1	03/21/05	03/28/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	106	20-161	03/28/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
mple Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-10-GS	**Units:**	ug/Kg
Lab Code:	K2501854-010	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.3	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1221	ND	Ui	20	3.1	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1232	ND	Ui	10	4.5	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1242	ND	Ui	10	10	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1248	ND	Ui	10	5.9	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1254	ND	Ui	10	6.5	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1260	ND	Ui	10	3.4	1	03/21/05	03/30/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
ecachlorobiphenyl	94	20-161	03/30/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-11-GS	**Units:**	ug/Kg
Lab Code:	K2501854-011	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	Ui	10	2.2	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1221	ND	Ui	20	8.4	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1232	ND	Ui	10	4.0	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1242	ND	Ui	10	2.8	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1248	ND	Ui	10	8.8	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1254	ND	Ui	10	5.8	1	03/21/05	03/30/05	KWG0504432	
Aroclor 1260	ND	Ui	10	2.3	1	03/21/05	03/30/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	98	20-161	03/30/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-12-GS	**Units:**	ug/Kg
Lab Code:	K2501854-012	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	Ui	10	2.4	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1221	ND	Ui	20	5.6	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1232	ND	Ui	10	6.6	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1242	ND	Ui	10	3.8	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1248	ND	Ui	10	8.2	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1254	**8.1**	J	10	2.2	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1260	**3.1**	JP	10	2.2	1	03/21/05	03/30/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	92	20-161	03/30/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-13-GS	**Units:**	ug/Kg
Lab Code:	K2501854-013	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	20	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	95	20-161	03/25/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-14A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-014	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.2	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1221	ND	Ui	20	3.7	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1232	ND	U	10	2.2	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1242	ND	U	10	2.2	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1248	ND	Ui	10	4.2	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1254	ND	Ui	10	6.5	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1260	ND	Ui	10	3.3	1	03/21/05	03/30/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	93	20-161	03/30/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-15-GS	**Units:**	ug/Kg
Lab Code:	K2501854-015	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.9	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	20	1.9	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	10	1.9	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	10	1.9	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	ND	U	10	1.9	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	**6.0**	J	10	1.9	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	ND	U	10	1.9	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	94	20-161	03/25/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-16-GS	**Units:**	ug/Kg
Lab Code:	K2501854-016	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	20	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	**18**		10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	**22**	P	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	**21**		10	1.8	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	98	20-161	03/25/05	Acceptable

Comments:

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-17A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-017	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.0	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	20	2.0	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	10	2.0	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	10	2.0	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	ND	U	10	2.0	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	4.4	J	10	2.0	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	ND	U	10	2.0	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	99	20-161	03/25/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-18-GS	**Units:**	ug/Kg
Lab Code:	K2501854-018	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	Ui	10	2.3	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1221	ND	Ui	20	6.0	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1232	ND	U	10	2.0	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1242	ND	U	10	2.0	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1248	ND	Ui	10	3.3	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1254	ND	Ui	10	3.6	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1260	ND	Ui	10	2.1	1	03/21/05	03/30/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	96	20-161	03/30/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-19A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-019	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	20	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	ND	U	10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	**12**		10	1.8	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	**10**	J	10	1.8	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	97	20-161	03/25/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-20A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-020	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.1	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1221	ND	Ui	20	4.4	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1232	ND	Ui	10	3.6	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1242	ND	U	10	2.1	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1248	ND	Ui	10	3.1	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1254	ND	Ui	10	5.0	1	03/21/05	03/30/05	KWG0504433	
Aroclor 1260	ND	U	10	2.1	1	03/21/05	03/30/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	93	20-161	03/30/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Polychlorinated Biphenyls (PCBs)

Sample Name:	RA5-21-GS	**Units:**	ug/Kg
Lab Code:	K2501854-021	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.1	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	20	2.1	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	10	2.1	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	10	2.1	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	ND	U	10	2.1	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	**7.0**	J	10	2.1	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	**3.2**	JP	10	2.1	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	96	20-161	03/25/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Polychlorinated Biphenyls (PCBs)

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG0504432-4	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	5.7	1.3	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1221	ND	U	12	1.3	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1232	ND	U	5.7	1.3	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1242	ND	U	5.7	1.3	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1248	ND	U	5.7	1.3	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1254	ND	U	5.7	1.3	1	03/21/05	03/24/05	KWG0504432	
Aroclor 1260	ND	U	5.7	1.3	1	03/21/05	03/24/05	KWG0504432	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	102	20-161	03/24/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Polychlorinated Biphenyls (PCBs)

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG0504433-4	**Basis:**	Dry
Extraction Method:	EPA 3540C	**Level:**	Low
Analysis Method:	8082		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	5.9	1.3	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1221	ND	U	12	1.3	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1232	ND	U	5.9	1.3	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1242	ND	U	5.9	1.3	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1248	ND	U	5.9	1.3	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1254	ND	U	5.9	1.3	1	03/21/05	03/25/05	KWG0504433	
Aroclor 1260	ND	U	5.9	1.3	1	03/21/05	03/25/05	KWG0504433	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	98	20-161	03/25/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client: Anchor Environmental
Project: USACE-PSR RA5/020202-01/BG 11
Sample Matrix: Sediment

Service Request: K2501854
Date Collected: 03/08/2005
Date Received: 03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name: RA5-1-GS
Lab Code: K2501854-001
Extraction Method: EPA 3541
Analysis Method: 8270C

Units: ug/Kg
Basis: Dry
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**13**	J	30	3.0	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	9.9	5.4	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**16**		9.9	4.6	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.6	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**3.9**	J	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	ND	U	9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	ND	U	9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**1.7**	J	9.9	1.6	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	ND	U	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluorene	ND	U	9.9	2.7	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	99	14	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**8.7**	J	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**3.1**	J	9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**21**		9.9	3.5	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**17**		9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**9.7**	J	9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**10**		9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**11**		9.9	4.0	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	ND	U	9.9	4.0	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**6.7**	J	9.9	2.5	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**3.5**	J	9.9	3.0	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	9.9	3.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	ND	U	9.9	3.6	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	53	24-113	04/06/05	Acceptable
2-Fluorophenol	47	30-115	04/06/05	Acceptable
Nitrobenzene-d5	51	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	62	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	69	23-113	04/06/05	Acceptable
Terphenyl-d14	68	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-1-GS	**Units:**	ug/Kg
Lab Code:	K2501854-001	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-2-GS	**Units:**	ug/Kg
Lab Code:	K2501854-002	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	22	J	30	3.3	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	5.8	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	93		10	4.9	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	9.3	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	15		10	2.2	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	7.6	J	10	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	4.7	J	10	2.4	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	17		10	1.7	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	7.5	J	10	2.2	1	03/21/05	04/06/05	KWG0504420	
Fluorene	18		10	2.9	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	15	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	65		10	2.2	1	03/21/05	04/06/05	KWG0504420	
Anthracene	92		10	2.4	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	140		10	3.8	1	03/21/05	04/06/05	KWG0504420	
Pyrene	110		10	2.2	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	50		10	2.4	1	03/21/05	04/06/05	KWG0504420	
Chrysene	66		10	2.4	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	63		10	4.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	22		10	4.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	46		10	2.8	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	24		10	3.3	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	5.3	J	10	3.8	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	13		10	3.9	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	61	24-113	04/06/05	Acceptable
2-Fluorophenol	52	30-115	04/06/05	Acceptable
Nitrobenzene-d5	58	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	65	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	82	23-113	04/06/05	Acceptable
Terphenyl-d14	75	39-124	04/06/05	Acceptable

Comments:

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-2-GS	**Units:**	ug/Kg
Lab Code:	K2501854-002	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-3-GS	**Units:**	ug/Kg
Lab Code:	K2501854-003	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**8.8**	J	30	2.9	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	5.1	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**8.0**	J	10	4.3	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.2	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**25**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**3.7**	J	10	1.8	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**5.9**	J	10	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**8.0**	J	10	1.5	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**5.7**	J	10	2.0	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**7.7**	J	10	2.6	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	13	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**32**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**15**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**60**		10	3.3	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**88**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**31**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**48**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**45**		10	3.8	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**18**		10	3.8	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**32**		10	2.4	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**17**		10	2.9	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	**4.7**	J	10	3.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**14**		10	3.5	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	54	24-113	04/06/05	Acceptable
2-Fluorophenol	44	30-115	04/06/05	Acceptable
Nitrobenzene-d5	43	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	57	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	81	23-113	04/06/05	Acceptable
Terphenyl-d14	77	39-124	04/06/05	Acceptable

Comments:

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-3-GS	**Units:**	ug/Kg
Lab Code:	K2501854-003	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-4-GS	**Units:**	ug/Kg
Lab Code:	K2501854-004	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	16	J	30	2.8	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	4.9	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	14		10	4.2	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.0	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	11		10	1.9	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	2.2	J	10	1.8	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	3.4	J	10	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	5.1	J	10	1.5	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	4.1	J	10	1.9	1	03/21/05	04/06/05	KWG0504420	
Fluorene	6.3	J	10	2.5	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	13	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	24		10	1.9	1	03/21/05	04/06/05	KWG0504420	
Anthracene	12		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	36		10	3.2	1	03/21/05	04/06/05	KWG0504420	
Pyrene	36		10	1.9	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	8.8	J	10	2.1	1	03/21/05	04/06/05	KWG0504420	
Chrysene	13		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	15		10	3.7	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	6.8	J	10	3.7	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	10		10	2.4	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	6.1	J	10	2.8	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	10	3.2	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	6.5	J	10	3.4	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	60	24-113	04/06/05	Acceptable
2-Fluorophenol	52	30-115	04/06/05	Acceptable
Nitrobenzene-d5	60	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	69	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	80	23-113	04/06/05	Acceptable
Terphenyl-d14	80	39-124	04/06/05	Acceptable

Comments:

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-4-GS	**Units:**	ug/Kg
Lab Code:	K2501854-004	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-5-GS	**Units:**	ug/Kg
Lab Code:	K2501854-005	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**9.2**	J	30	2.9	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	5.2	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**10**		10	4.4	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.3	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**32**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**9.6**	J	10	1.9	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**4.8**	J	10	2.2	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**14**		10	1.6	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**14**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**16**		10	2.6	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	13	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**51**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**21**		10	2.2	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**75**		10	3.4	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**80**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**27**		10	2.2	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**34**		10	2.2	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**42**		10	3.8	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**14**		10	3.8	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**27**		10	2.5	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**15**		10	2.9	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	**4.1**	J	10	3.4	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**13**		10	3.5	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	54	24-113	04/06/05	Acceptable
2-Fluorophenol	47	30-115	04/06/05	Acceptable
Nitrobenzene-d5	52	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	60	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	72	23-113	04/06/05	Acceptable
Terphenyl-d14	73	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-5-GS	**Units:**	ug/Kg
Lab Code:	K2501854-005	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-6-GS	**Units:**	ug/Kg
Lab Code:	K2501854-006	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	30	2.8	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	9.9	5.0	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**16**		9.9	4.3	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.1	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**4.3**	J	9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	ND	U	9.9	1.8	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**2.8**	J	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**2.2**	J	9.9	1.5	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	ND	U	9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Fluorene	ND	U	9.9	2.5	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	99	13	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**8.2**	J	9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**3.0**	J	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**17**		9.9	3.3	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**15**		9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**19**		9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**18**		9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**23**		9.9	3.7	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**6.9**	J	9.9	3.7	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**17**		9.9	2.4	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**7.9**	J	9.9	2.8	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	9.9	3.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**6.1**	J	9.9	3.4	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	68	24-113	04/06/05	Acceptable
2-Fluorophenol	56	30-115	04/06/05	Acceptable
Nitrobenzene-d5	61	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	73	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	90	23-113	04/06/05	Acceptable
Terphenyl-d14	83	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-6-GS	**Units:**	ug/Kg
Lab Code:	K2501854-006	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-7-GS	**Units:**	ug/Kg
Lab Code:	K2501854-007	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	30	3.1	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	5.4	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**20**		10	4.6	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.8	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**40**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**17**		10	1.9	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**4.3**	J	10	2.3	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**58**		10	1.6	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**34**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**46**		10	2.7	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	14	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**100**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**31**		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**110**		10	3.5	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**85**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**37**		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**38**		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**47**		10	4.0	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**20**		10	4.0	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**36**		10	2.6	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**18**		10	3.1	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	**5.1**	J	10	3.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**14**		10	3.7	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	61	24-113	04/06/05	Acceptable
2-Fluorophenol	46	30-115	04/06/05	Acceptable
Nitrobenzene-d5	44	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	47	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	81	23-113	04/06/05	Acceptable
Terphenyl-d14	76	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-7-GS	**Units:**	ug/Kg
Lab Code:	K2501854-007	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-8-GS	**Units:**	ug/Kg
Lab Code:	K2501854-008	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	49		30	3.1	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	5.5	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	15		10	4.7	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.9	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	16		10	2.1	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	2.9	J	10	2.0	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	2.4	J	10	2.3	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	7.1	J	10	1.7	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	4.7	J	10	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluorene	ND	U	10	2.8	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	14	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	25		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Anthracene	15		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	48		10	3.6	1	03/21/05	04/06/05	KWG0504420	
Pyrene	50		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	36		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Chrysene	60		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	50		10	4.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	16		10	4.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	58		10	2.6	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	27		10	3.1	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	22		10	3.6	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	37		10	3.7	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	55	24-113	04/06/05	Acceptable
2-Fluorophenol	44	30-115	04/06/05	Acceptable
Nitrobenzene-d5	42	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	54	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	81	23-113	04/06/05	Acceptable
Terphenyl-d14	80	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-8-GS	**Units:**	ug/Kg
Lab Code:	K2501854-008	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-9-GS	**Units:**	ug/Kg
Lab Code:	K2501854-009	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	30	2.8	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	9.9	4.9	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**9.6**	**J**	9.9	4.2	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.0	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**7.2**	**J**	9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**2.4**	**J**	9.9	1.8	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**2.4**	**J**	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**4.3**	**J**	9.9	1.5	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**4.4**	**J**	9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**6.1**	**J**	9.9	2.5	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	99	13	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**37**		9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**6.3**	**J**	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**44**		9.9	3.2	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**34**		9.9	1.9	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**10**		9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**14**		9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**16**		9.9	3.6	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**6.0**	**J**	9.9	3.6	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**9.2**	**J**	9.9	2.3	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**6.1**	**J**	9.9	2.8	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	9.9	3.2	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**5.2**	**J**	9.9	3.4	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	48	24-113	04/06/05	Acceptable
2-Fluorophenol	40	30-115	04/06/05	Acceptable
Nitrobenzene-d5	39	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	50	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	66	23-113	04/06/05	Acceptable
Terphenyl-d14	65	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-9-GS	**Units:**	ug/Kg
Lab Code:	K2501854-009	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-10-GS	**Units:**	ug/Kg
Lab Code:	K2501854-010	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**22**	J	30	3.4	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	6.0	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**46**		10	5.1	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	9.7	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**7.5**	J	10	2.3	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**3.8**	J	10	2.2	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**4.7**	J	10	2.5	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**3.6**	J	10	1.8	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**3.6**	J	10	2.3	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**4.8**	J	10	3.0	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	15	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**17**		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**6.0**	J	10	2.5	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**32**		10	3.9	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**27**		10	2.3	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**16**		10	2.5	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**24**		10	2.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**19**		10	4.4	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**7.7**	J	10	4.4	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**13**		10	2.9	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**6.2**	J	10	3.4	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	10	3.9	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**6.6**	J	10	4.1	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	66	24-113	04/06/05	Acceptable
2-Fluorophenol	54	30-115	04/06/05	Acceptable
Nitrobenzene-d5	58	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	53	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	82	23-113	04/06/05	Acceptable
Terphenyl-d14	78	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-10-GS	**Units:**	ug/Kg
Lab Code:	K2501854-010	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-11-GS	**Units:**	ug/Kg
Lab Code:	K2501854-011	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	30	2.8	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	5.0	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**14**		10	4.3	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.1	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**4.5**	J	10	2.0	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**2.2**	J	10	1.8	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**2.8**	J	10	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**4.2**	J	10	1.5	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**2.6**	J	10	2.0	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**6.9**	J	10	2.5	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	13	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**68**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**15**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**120**		10	3.3	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**150**		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**88**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**120**		10	2.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**80**		10	3.7	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**27**		10	3.7	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**78**		10	2.4	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**37**		10	2.8	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	**12**		10	3.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**32**		10	3.4	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	59	24-113	04/06/05	Acceptable
2-Fluorophenol	51	30-115	04/06/05	Acceptable
Nitrobenzene-d5	47	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	57	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	85	23-113	04/06/05	Acceptable
Terphenyl-d14	81	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-11-GS	**Units:**	ug/Kg
Lab Code:	K2501854-011	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-12-GS	**Units:**	ug/Kg
Lab Code:	K2501854-012	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	30	3.3	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	9.9	5.8	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	**38**		9.9	5.0	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	9.4	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	**22**		9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	**5.6**	J	9.9	2.1	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	**6.3**	J	9.9	2.4	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	**10**		9.9	1.7	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	**6.0**	J	9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Fluorene	**12**		9.9	2.9	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	99	15	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	**46**		9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Anthracene	**13**		9.9	2.4	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	**57**		9.9	3.8	1	03/21/05	04/06/05	KWG0504420	
Pyrene	**55**		9.9	2.2	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	**35**		9.9	2.4	1	03/21/05	04/06/05	KWG0504420	
Chrysene	**44**		9.9	2.4	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	**38**		9.9	4.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	**13**		9.9	4.3	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	**29**		9.9	2.8	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**14**		9.9	3.3	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	**3.8**	J	9.9	3.8	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	**13**		9.9	3.9	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	53	24-113	04/06/05	Acceptable
2-Fluorophenol	45	30-115	04/06/05	Acceptable
Nitrobenzene-d5	49	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	54	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	72	23-113	04/06/05	Acceptable
Terphenyl-d14	68	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-12-GS	**Units:**	ug/Kg
Lab Code:	K2501854-012	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-13-GS	**Units:**	ug/Kg
Lab Code:	K2501854-013	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	9.0	J	30	2.7	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	10	4.7	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	13		10	4.0	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	7.6	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	4.4	J	10	1.8	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	ND	U	10	1.7	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	ND	U	10	2.0	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	2.7	J	10	1.4	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	ND	U	10	1.8	1	03/21/05	04/06/05	KWG0504420	
Fluorene	3.2	J	10	2.4	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	100	12	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	14		10	1.8	1	03/21/05	04/06/05	KWG0504420	
Anthracene	3.5	J	10	2.0	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	30		10	3.1	1	03/21/05	04/06/05	KWG0504420	
Pyrene	22		10	1.8	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	9.7	J	10	2.0	1	03/21/05	04/06/05	KWG0504420	
Chrysene	11		10	2.0	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	11		10	3.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	4.4	J	10	3.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	8.5	J	10	2.2	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	4.9	J	10	2.7	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	10	3.1	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	ND	U	10	3.2	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	52	24-113	04/06/05	Acceptable
2-Fluorophenol	45	30-115	04/06/05	Acceptable
Nitrobenzene-d5	43	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	58	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	81	23-113	04/06/05	Acceptable
Terphenyl-d14	76	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/08/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-13-GS	**Units:**	ug/Kg
Lab Code:	K2501854-013	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-14A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-014	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**33**		30	3.1	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	10	5.6	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	**75**		10	4.8	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	9.0	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	**13**		10	2.2	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	**3.8**	J	10	2.0	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	**3.4**	J	10	2.3	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	**5.0**	J	10	1.7	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	**4.6**	J	10	2.2	1	03/21/05	04/07/05	KWG0504420	
Fluorene	**5.6**	J	10	2.8	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	100	14	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	**23**		10	2.2	1	03/21/05	04/07/05	KWG0504420	
Anthracene	**12**		10	2.3	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	**38**		10	3.6	1	03/21/05	04/07/05	KWG0504420	
Pyrene	**71**		10	2.2	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	**13**		10	2.3	1	03/21/05	04/07/05	KWG0504420	
Chrysene	**16**		10	2.3	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	**33**		10	4.1	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	**9.4**	J	10	4.1	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	**21**		10	2.7	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**12**		10	3.1	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	**3.6**	J	10	3.6	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	**7.2**	J	10	3.8	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	64	24-113	04/07/05	Acceptable
2-Fluorophenol	52	30-115	04/07/05	Acceptable
Nitrobenzene-d5	54	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	54	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	92	23-113	04/07/05	Acceptable
Terphenyl-d14	82	39-124	04/07/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-14A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-014	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-15-GS	**Units:**	ug/Kg
Lab Code:	K2501854-015	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**42**		30	2.8	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	10	4.9	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	**12**		10	4.2	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.0	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	**18**		10	1.9	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	**8.9**	J	10	1.8	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	**5.2**	J	10	2.1	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	**11**		10	1.5	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	**11**		10	1.9	1	03/21/05	04/07/05	KWG0504420	
Fluorene	**13**		10	2.5	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	100	13	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	**59**		10	1.9	1	03/21/05	04/07/05	KWG0504420	
Anthracene	**25**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	**80**		10	3.2	1	03/21/05	04/07/05	KWG0504420	
Pyrene	**66**		10	1.9	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	**31**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Chrysene	**29**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	**56**		10	3.7	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	**19**		10	3.7	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	**33**		10	2.4	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**14**		10	2.8	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	**4.5**	J	10	3.2	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	**9.7**	J	10	3.4	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	56	24-113	04/07/05	Acceptable
2-Fluorophenol	48	30-115	04/07/05	Acceptable
Nitrobenzene-d5	51	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	68	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	96	23-113	04/07/05	Acceptable
Terphenyl-d14	89	39-124	04/07/05	Acceptable

Comments:

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-15-GS	**Units:**	ug/Kg
Lab Code:	K2501854-015	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-16-GS	**Units:**	ug/Kg
Lab Code:	K2501854-016	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	13	J	28	2.6	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	9.3	4.6	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	4.8	J	9.3	3.9	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	47	7.4	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	3.4	J	9.3	1.8	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	ND	U	9.3	1.6	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	ND	U	9.3	1.9	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	1.8	J	9.3	1.4	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	ND	U	9.3	1.8	1	03/21/05	04/07/05	KWG0504420	
Fluorene	ND	U	9.3	2.3	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	93	12	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	13		9.3	1.8	1	03/21/05	04/07/05	KWG0504420	
Anthracene	5.8	J	9.3	1.9	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	36		9.3	3.0	1	03/21/05	04/07/05	KWG0504420	
Pyrene	39		9.3	1.8	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	12		9.3	1.9	1	03/21/05	04/07/05	KWG0504420	
Chrysene	17		9.3	1.9	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	16		9.3	3.4	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	5.8	J	9.3	3.4	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	9.6		9.3	2.2	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	5.5	J	9.3	2.6	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	9.3	3.0	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	ND	U	9.3	3.1	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	46	24-113	04/07/05	Acceptable
2-Fluorophenol	39	30-115	04/07/05	Acceptable
Nitrobenzene-d5	42	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	51	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	86	23-113	04/07/05	Acceptable
Terphenyl-d14	92	39-124	04/07/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-16-GS	**Units:**	ug/Kg
Lab Code:	K2501854-016	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-17A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-017	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**23**	J	30	2.9	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	10	5.1	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	**16**		10	4.4	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.3	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	**12**		10	2.0	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	**7.3**	J	10	1.8	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	**4.2**	J	10	2.1	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	**28**		10	1.5	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	**13**		10	2.0	1	03/21/05	04/07/05	KWG0504420	
Fluorene	**21**		10	2.6	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	100	13	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	**80**		10	2.0	1	03/21/05	04/07/05	KWG0504420	
Anthracene	**26**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	**310**		10	3.3	1	03/21/05	04/07/05	KWG0504420	
Pyrene	**230**		10	2.0	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	**110**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Chrysene	**150**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	**73**		10	3.8	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	**36**		10	3.8	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	**49**		10	2.4	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**25**		10	2.9	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	**7.1**	J	10	3.3	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	**5.8**	J	10	3.5	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	57	24-113	04/07/05	Acceptable
2-Fluorophenol	47	30-115	04/07/05	Acceptable
Nitrobenzene-d5	47	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	59	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	87	23-113	04/07/05	Acceptable
Terphenyl-d14	78	39-124	04/07/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-17A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-017	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-18-GS	**Units:**	ug/Kg
Lab Code:	K2501854-018	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**21**	**J**	30	3.0	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	9.9	5.2	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	**30**		9.9	4.5	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.4	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	**14**		9.9	2.0	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	**6.7**	**J**	9.9	1.9	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	**2.9**	**J**	9.9	2.2	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	**15**		9.9	1.6	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	**14**		9.9	2.0	1	03/21/05	04/07/05	KWG0504420	
Fluorene	**32**		9.9	2.6	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	99	13	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	**82**		9.9	2.0	1	03/21/05	04/07/05	KWG0504420	
Anthracene	**73**		9.9	2.2	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	**82**		9.9	3.4	1	03/21/05	04/07/05	KWG0504420	
Pyrene	**66**		9.9	2.0	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	**28**		9.9	2.2	1	03/21/05	04/07/05	KWG0504420	
Chrysene	**33**		9.9	2.2	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	**27**		9.9	3.9	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	**8.5**	**J**	9.9	3.9	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	**22**		9.9	2.5	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**12**		9.9	3.0	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	9.9	3.4	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	**7.4**	**J**	9.9	3.6	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	54	24-113	04/07/05	Acceptable
2-Fluorophenol	42	30-115	04/07/05	Acceptable
Nitrobenzene-d5	41	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	54	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	90	23-113	04/07/05	Acceptable
Terphenyl-d14	83	39-124	04/07/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-18-GS	**Units:**	ug/Kg
Lab Code:	K2501854-018	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-19A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-019	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	12	J	30	2.6	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	10	4.7	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	ND	U	10	4.0	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	7.5	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	7.2	J	10	1.8	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	3.0	J	10	1.7	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	3.5	J	10	1.9	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	3.9	J	10	1.4	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	3.2	J	10	1.8	1	03/21/05	04/07/05	KWG0504420	
Fluorene	4.5	J	10	2.4	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	100	12	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	17		10	1.8	1	03/21/05	04/07/05	KWG0504420	
Anthracene	8.7	J	10	1.9	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	34		10	3.0	1	03/21/05	04/07/05	KWG0504420	
Pyrene	39		10	1.8	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	14		10	1.9	1	03/21/05	04/07/05	KWG0504420	
Chrysene	17		10	1.9	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	25		10	3.4	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	9.4	J	10	3.4	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	19		10	2.2	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	12		10	2.6	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	3.4	J	10	3.0	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	6.9	J	10	3.2	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	51	24-113	04/07/05	Acceptable
2-Fluorophenol	42	30-115	04/07/05	Acceptable
Nitrobenzene-d5	44	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	50	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	79	23-113	04/07/05	Acceptable
Terphenyl-d14	95	39-124	04/07/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-19A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-019	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-20A-GS	**Units:**	ug/Kg
Lab Code:	K2501854-020	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	30	3.0	1	03/21/05	04/07/05	KWG0504420	
2-Methylphenol	ND	U	10	5.4	1	03/21/05	04/07/05	KWG0504420	
4-Methylphenol†	**34**		10	4.6	1	03/21/05	04/07/05	KWG0504420	
2,4-Dimethylphenol	ND	U	50	8.7	1	03/21/05	04/07/05	KWG0504420	
Naphthalene	**21**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
2-Methylnaphthalene	**3.9**	J	10	1.9	1	03/21/05	04/07/05	KWG0504420	
Acenaphthylene	**2.7**	J	10	2.3	1	03/21/05	04/07/05	KWG0504420	
Acenaphthene	**5.4**	J	10	1.6	1	03/21/05	04/07/05	KWG0504420	
Dibenzofuran	**4.8**	J	10	2.1	1	03/21/05	04/07/05	KWG0504420	
Fluorene	**7.3**	J	10	2.7	1	03/21/05	04/07/05	KWG0504420	
Pentachlorophenol	ND	U	100	14	1	03/21/05	04/07/05	KWG0504420	
Phenanthrene	**20**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Anthracene	**8.0**	J	10	2.3	1	03/21/05	04/07/05	KWG0504420	
Fluoranthene	**50**		10	3.5	1	03/21/05	04/07/05	KWG0504420	
Pyrene	**47**		10	2.1	1	03/21/05	04/07/05	KWG0504420	
Benz(a)anthracene	**11**		10	2.3	1	03/21/05	04/07/05	KWG0504420	
Chrysene	**14**		10	2.3	1	03/21/05	04/07/05	KWG0504420	
Benzo(b)fluoranthene	**17**		10	4.0	1	03/21/05	04/07/05	KWG0504420	
Benzo(k)fluoranthene	**5.3**	J	10	4.0	1	03/21/05	04/07/05	KWG0504420	
Benzo(a)pyrene	**11**		10	2.6	1	03/21/05	04/07/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	**6.3**	J	10	3.0	1	03/21/05	04/07/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	10	3.5	1	03/21/05	04/07/05	KWG0504420	
Benzo(g,h,i)perylene	ND	U	10	3.7	1	03/21/05	04/07/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	54	24-113	04/07/05	Acceptable
2-Fluorophenol	44	30-115	04/07/05	Acceptable
Nitrobenzene-d5	46	23-120	04/07/05	Acceptable
2-Fluorobiphenyl	61	25-121	04/07/05	Acceptable
2,4,6-Tribromophenol	99	23-113	04/07/05	Acceptable
Terphenyl-d14	92	39-124	04/07/05	Acceptable

Comments:

Client: Anchor Environmental
Project: USACE-PSR RA5/020202-01/BG 11
Sample Matrix: Sediment

Service Request: K2501854
Date Collected: 03/09/2005
Date Received: 03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name: RA5-20A-GS
Lab Code: K2501854-020

Units: ug/Kg
Basis: Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-21-GS	**Units:**	ug/Kg
Lab Code:	K2501854-021	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	**28**	J	35	3.0	1	03/21/05	04/04/05	KWG0504419	
2-Methylphenol	ND	U	12	5.3	1	03/21/05	04/04/05	KWG0504419	
4-Methylphenol†	**34**		12	4.6	1	03/21/05	04/04/05	KWG0504419	
2,4-Dimethylphenol	ND	U	58	8.6	1	03/21/05	04/04/05	KWG0504419	
Naphthalene	**13**		12	2.1	1	03/21/05	04/04/05	KWG0504419	
2-Methylnaphthalene	**5.8**	J	12	1.9	1	03/21/05	04/04/05	KWG0504419	
Acenaphthylene	**5.2**	J	12	2.2	1	03/21/05	04/04/05	KWG0504419	
Acenaphthene	**7.0**	J	12	1.6	1	03/21/05	04/04/05	KWG0504419	
Dibenzofuran	**5.5**	J	12	2.1	1	03/21/05	04/04/05	KWG0504419	
Fluorene	**8.0**	J	12	2.7	1	03/21/05	04/04/05	KWG0504419	
Pentachlorophenol	ND	U	120	14	1	03/21/05	04/04/05	KWG0504419	
Phenanthrene	**31**		12	2.1	1	03/21/05	04/04/05	KWG0504419	
Anthracene	**10**	J	12	2.2	1	03/21/05	04/04/05	KWG0504419	
Fluoranthene	**52**		12	3.5	1	03/21/05	04/04/05	KWG0504419	
Pyrene	**45**		12	2.1	1	03/21/05	04/04/05	KWG0504419	
Benz(a)anthracene	**20**		12	2.2	1	03/21/05	04/04/05	KWG0504419	
Chrysene	**27**		12	2.2	1	03/21/05	04/04/05	KWG0504419	
Benzo(b)fluoranthene	**22**		12	3.9	1	03/21/05	04/04/05	KWG0504419	
Benzo(k)fluoranthene	**7.9**	J	12	3.9	1	03/21/05	04/04/05	KWG0504419	
Benzo(a)pyrene	**15**		12	2.5	1	03/21/05	04/04/05	KWG0504419	
Indeno(1,2,3-cd)pyrene	**7.6**	J	12	3.0	1	03/21/05	04/04/05	KWG0504419	
Dibenz(a,h)anthracene	ND	U	12	3.5	1	03/21/05	04/04/05	KWG0504419	
Benzo(g,h,i)perylene	**6.8**	J	12	3.6	1	03/21/05	04/04/05	KWG0504419	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	52	24-113	04/04/05	Acceptable
2-Fluorophenol	38	30-115	04/04/05	Acceptable
Nitrobenzene-d5	34	23-120	04/04/05	Acceptable
2-Fluorobiphenyl	50	25-121	04/04/05	Acceptable
2,4,6-Tribromophenol	84	23-113	04/04/05	Acceptable
Terphenyl-d14	61	39-124	04/04/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	03/09/2005
Sample Matrix:	Sediment	**Date Received:**	03/16/2005

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	RA5-21-GS	**Units:**	ug/Kg
Lab Code:	K2501854-021	**Basis:**	Dry

† **Analyte Comments**

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG0504419-5	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	2.3	J	15	1.9	1	03/21/05	03/31/05	KWG0504419	
2-Methylphenol	ND	U	5.0	3.4	1	03/21/05	03/31/05	KWG0504419	
4-Methylphenol†	ND	U	5.0	2.9	1	03/21/05	03/31/05	KWG0504419	
2,4-Dimethylphenol	ND	U	25	5.5	1	03/21/05	03/31/05	KWG0504419	
Naphthalene	ND	U	5.0	1.3	1	03/21/05	03/31/05	KWG0504419	
2-Methylnaphthalene	ND	U	5.0	1.2	1	03/21/05	03/31/05	KWG0504419	
Acenaphthylene	ND	U	5.0	1.4	1	03/21/05	03/31/05	KWG0504419	
Acenaphthene	ND	U	5.0	1.0	1	03/21/05	03/31/05	KWG0504419	
Dibenzofuran	ND	U	5.0	1.3	1	03/21/05	03/31/05	KWG0504419	
Fluorene	ND	U	5.0	1.7	1	03/21/05	03/31/05	KWG0504419	
Pentachlorophenol	ND	U	50	8.5	1	03/21/05	03/31/05	KWG0504419	
Phenanthrene	ND	U	5.0	1.3	1	03/21/05	03/31/05	KWG0504419	
Anthracene	ND	U	5.0	1.4	1	03/21/05	03/31/05	KWG0504419	
Fluoranthene	ND	U	5.0	2.2	1	03/21/05	03/31/05	KWG0504419	
Pyrene	ND	U	5.0	1.3	1	03/21/05	03/31/05	KWG0504419	
Benz(a)anthracene	ND	U	5.0	1.4	1	03/21/05	03/31/05	KWG0504419	
Chrysene	ND	U	5.0	1.4	1	03/21/05	03/31/05	KWG0504419	
Benzo(b)fluoranthene	ND	U	5.0	2.5	1	03/21/05	03/31/05	KWG0504419	
Benzo(k)fluoranthene	ND	U	5.0	2.5	1	03/21/05	03/31/05	KWG0504419	
Benzo(a)pyrene	ND	U	5.0	1.6	1	03/21/05	03/31/05	KWG0504419	
Indeno(1,2,3-cd)pyrene	ND	U	5.0	1.9	1	03/21/05	03/31/05	KWG0504419	
Dibenz(a,h)anthracene	ND	U	5.0	2.2	1	03/21/05	03/31/05	KWG0504419	
Benzo(g,h,i)perylene	ND	U	5.0	2.3	1	03/21/05	03/31/05	KWG0504419	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	82	24-113	03/31/05	Acceptable
2-Fluorophenol	68	30-115	03/31/05	Acceptable
Nitrobenzene-d5	79	23-120	03/31/05	Acceptable
2-Fluorobiphenyl	80	25-121	03/31/05	Acceptable
2,4,6-Tribromophenol	82	23-113	03/31/05	Acceptable
Terphenyl-d14	101	39-124	03/31/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG0504419-5	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG0504420-5	**Basis:**	Dry
Extraction Method:	EPA 3541	**Level:**	Low
Analysis Method:	8270C		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Phenol	ND	U	18	1.9	1	03/21/05	04/06/05	KWG0504420	
2-Methylphenol	ND	U	5.7	3.4	1	03/21/05	04/06/05	KWG0504420	
4-Methylphenol†	ND	U	5.7	2.9	1	03/21/05	04/06/05	KWG0504420	
2,4-Dimethylphenol	ND	U	29	5.5	1	03/21/05	04/06/05	KWG0504420	
Naphthalene	ND	U	5.7	1.3	1	03/21/05	04/06/05	KWG0504420	
2-Methylnaphthalene	ND	U	5.7	1.2	1	03/21/05	04/06/05	KWG0504420	
Acenaphthylene	ND	U	5.7	1.4	1	03/21/05	04/06/05	KWG0504420	
Acenaphthene	ND	U	5.7	1.0	1	03/21/05	04/06/05	KWG0504420	
Dibenzofuran	ND	U	5.7	1.3	1	03/21/05	04/06/05	KWG0504420	
Fluorene	ND	U	5.7	1.7	1	03/21/05	04/06/05	KWG0504420	
Pentachlorophenol	ND	U	57	8.5	1	03/21/05	04/06/05	KWG0504420	
Phenanthrene	ND	U	5.7	1.3	1	03/21/05	04/06/05	KWG0504420	
Anthracene	ND	U	5.7	1.4	1	03/21/05	04/06/05	KWG0504420	
Fluoranthene	ND	U	5.7	2.2	1	03/21/05	04/06/05	KWG0504420	
Pyrene	ND	U	5.7	1.3	1	03/21/05	04/06/05	KWG0504420	
Benz(a)anthracene	ND	U	5.7	1.4	1	03/21/05	04/06/05	KWG0504420	
Chrysene	ND	U	5.7	1.4	1	03/21/05	04/06/05	KWG0504420	
Benzo(b)fluoranthene	ND	U	5.7	2.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(k)fluoranthene	ND	U	5.7	2.5	1	03/21/05	04/06/05	KWG0504420	
Benzo(a)pyrene	ND	U	5.7	1.6	1	03/21/05	04/06/05	KWG0504420	
Indeno(1,2,3-cd)pyrene	ND	U	5.7	1.9	1	03/21/05	04/06/05	KWG0504420	
Dibenz(a,h)anthracene	ND	U	5.7	2.2	1	03/21/05	04/06/05	KWG0504420	
Benzo(g,h,i)perylene	ND	U	5.7	2.3	1	03/21/05	04/06/05	KWG0504420	*

* See Case Narrative

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Phenol-d6	59	24-113	04/06/05	Acceptable
2-Fluorophenol	53	30-115	04/06/05	Acceptable
Nitrobenzene-d5	58	23-120	04/06/05	Acceptable
2-Fluorobiphenyl	71	25-121	04/06/05	Acceptable
2,4,6-Tribromophenol	74	23-113	04/06/05	Acceptable
Terphenyl-d14	86	39-124	04/06/05	Acceptable

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	Anchor Environmental	**Service Request:**	K2501854
Project:	USACE-PSR RA5/020202-01/BG 11	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA

Semi-Volatile Organic Compounds by GC/MS

Sample Name:	Method Blank	**Units:**	ug/Kg
Lab Code:	KWG0504420-5	**Basis:**	Dry

† Analyte Comments

4-Methylphenol	This analyte cannot be separated from 3-Methylphenol.

Comments:

APPENDIX E

THROUGH-CAP CORES: FIELD LOG NOTES, CORE COLLECTION LOG FORMS, CORE LOGGING FORMS, AND PHOTOGRAPHS

March 22 2005

0800 Arrived at Don Armeni boat launch. Met Dale, Bill, Dave Browning. DH & KD departed for Seattle office.

Wx - Sunny High winds white caps

Field Crew
- Bryan Patterson — Sampler
- Dale Dickinson — Sampler
- Dave Browning — Field Lead
- Bill Jaworski — Skipper

PPE level D Modified
- raingear
- hard hat
- eye protection
- PFD
- steel toed boots

Mar 22, 2005

0900 Attempted to locate RAS-5. Wind too high. Bow moving up/down +- 4 feet. Too dangerous. Return to Don Armeni. Will wait ~1 hour.

0915 Called DH and KD to inform them of situation.

0920 Left site. Ctrp in a.m.

End of page BP

March 23, 2005

0815 Wx sunny
moderate wind
high 40's.

Field Crew BP
DD
BJ
DB

PPE level same as 22 Mar 05

0838 First attempt at RA5-~~8~~ 1 BP

RA5-5 - core attempt #1 158 fsw REJECT
47 35.1825 122 22 2434
retention 2'10"
reject inadequate penetration
Looked at sample. Approx
6-8" cap sand over native
silt layer

0900 Telephone discussion with B4.

23 Mar 05

BP1 ~~ACCEPT~~ BP

0910 RA5-~~8~~ 1 core attempt 2 164 fsw
47°35.1921 122° 22.2453
2'10" penetration
BJ said felt like 2.5' penetration
Once cut cutter head, found cap
material.
REJECT

0945 RA5-5 attempt 1 164 fsw REJECT
ATB sand. Lot of water draining
from cutter head.
2'5" penetration. ATB Sand.
Dumped material had 6-8" cap
then native.
47 35.2433 122 22.1230

1017 Called Brenda Bachman. Left
message.

1024 RA5-5 attempt 2 166 fsw ACCEPT
47°35.2443 122° 22.1269
good clay lumps on cutter head.
Indicates native
5' penetration. Cut off cutter head.
4'7.5" remain.

23 March 05

1102 RAS-18 attempt 1 fsw 168 ACCEPT
47° 35.1917 122 22.3431
penetration 4'1"
ATB thin layer of cap sand on top.

1130 RAS-2 attempt 1 fsw 146 REJECT
47 35.1933 N 122 22.1916 W
Rock in catcher. 2" diameter
no sample in tube.

1155 RAS-2 attempt 2 fsw 144 ~~REJECT~~ BP ACCEPT
47 35.1922 N 122 22.1902 W
Bent core tube. Crashed half way up tube.
penetration 2'9"

Approx 6" of top layer got cut off. capped top piece. Therefore 2 sections of core. bottom of core has light grey/white sand and rock. Did not reach native.

1230 Lunch break. Spoke with DH.

23 March 05

1323 RAS-3 attempt 1 187 fsw ACCEPT
47 35.2401 122° 22.2445
penetration 46"

1356 RAS-4 attempt 1 fsw 176 ACCEPT
47 35. 2428 122 22.1927
~~1356~~ Att RAS-4 penetration 49"

1431 RAS-17 attempt 1 fsw 205
47° 35 2908 N 122° 22. 3415 W
ACCEPT

1504 RAS-6 attempt 1 fsw 154 ~~REJECT~~ BP RETAIN
Crocked core tube. Organic debris and at surface. 16" penetration
Retained sample but will retry.

1542 RAS-7 attempt 1 fsw 407
transducer not working.
Need to troubleshoot.
End of days activities

BP

24 March 05

0800 KD & RD picked up core tube for stations RA5-1, 2, 3, 4, 5, 6, 17, 18. departed for lab.

0830 field crew departed dock at Don Armeni. DD, BP, DB, BJ

0838 Check in call from DH.

0849 RA5-7 attempt 1 fsw 211 ACCEPT
47 35.2912 122 22.2716
penetration 44" retain 40"

0917 RA5-8 attempt 1 fsw ACCEPT
47 35.2937 122 22.1983
penetration 4'10"

0946 RA5-9 attempt 1 192 fsw ACCEPT
moved to location of successful van veen grab
47 35.2936 122 22.1235

24 Mar 05

1013 RA5-10 attempt 1 175 fsw ACCEPT
penetrate 4'11"
47 35.2947 122 22.0516

1034 RA5-11 attempt 1 161 fsw ACCEPT
47 35.2965 122 21.9769
5'4" retain 5'2"
Cut into 2 sections 4'3" 1'2"

1101 RA5-12 attempt 1 209 fsw REJECT
47 35.3441 122 22.1242
2'9" penetration

1126 RA5-12 attempt 2 209 fsw ACCEPT
47 35.3433 122° 22.1205
3'5" penetration

1150 RA5-13 attempt 1 fsw 170 accept
47 35.3452 122 21.9554
penetration 46"

1210 RA5-19 attempt 1 fsw 139 ACCEPT
47° 35.3136 122° 21.8752
Penetrate 5'1" cut 2 sections

1300 Lunch Break. DD departs for dive. DH, RD, KD on site to pick up core tubes: RA5-7, 8, 9, 10, 11, 12, 13, 19.

1315 depart dock for RA5-20

1325 At RA5-20 attempt #1 reject
47° 35, 3246' 122° 22.1972
reject - only 33" long - dump and observe

1355 RA5-20 attempt #2 keep
47° 35.3247 122° 22.1989

1418 RA5-21 attempt #1 keep
47° 35.3469 122° 22,0432

1452 RA5-14a grab 2 location
47° 35.3904 122° 22.2655 w
accept

1525 to dock for Dale Dickinson to return aboard

DJM

1534 RA5-15 attempt #1 ~~keep~~
47° 35.3927' 122 22.1729 W

1604 RA5-16 attempt #1
47° 35, 4404' 122 22.~~2490~~ 2490
keep

1625 we have finished coring and are returning to the dock

1630 at the dock - begin unloading gear

1636 BT copied disk. End of Sampling Operation.

End of Page

BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 1	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.1925N 122° 22.2434W attempt 1 reject	Long/Easting:	47 35.1921 122° 22.2453 reject
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	158 Sounder	Leadline	
Project Depth	~~-160~~ BP -154	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	0838	0910	
(A) Measured Water Depth	158	164	
(B) Tide Height		5.3	
(C) Mudline Elevation		-158.7	
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	2'10"	2'10" (5') estimated	
Description of Core Drive	Rejected sample inadequate pen.	once cutter hard cut, encountered cap	
Refusal Encountered?			
Total Core Length			

Core Characteristics

Sediment Type Cap (native silty sand)	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color Cap (native olive grey)	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: Surface dark olive brown, silty fine sand, scattered organics
attempt 2: no sheen. Retain 2'6". Found cap. Mod. sorted dark grey medium sand, shell fragments.

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 2	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47 35.1922	Long/Easting:	122°22.1902
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-143	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1130	1155	
(A) Measured Water Depth	146	144	
(B) Tide Height	5.7'	6.3	
(C) Mudline Elevation	-140.3	-137.7	
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7'	7'	
Description of Core Drive	REJECT	tube cracked. ACCEPT ~~REJECT~~ BP	
Refusal Encountered?			
Total Core Length	0	2'9"	

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: Rock in catcher on attempt 1. Empty tube. REJECT
att 1: light grey rock dust matches rocks.
att 2: light grey rock and sand at bottom of core. Did not reach native

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 3	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.2401	Long/Easting:	122° 22.2445
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-180	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1323		
(A) Measured Water Depth	187		
(B) Tide Height	8.2'		
(C) Mudline Elevation	-178.8		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7' on slope		
Description of Core Drive	Accept		
Refusal Encountered?			
Total Core Length	41"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic creosote	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: Sheen in surface water. Outside of core tube had silty sand coating. Bottom of core tube had mod sheen. F/M sand with some silt. dark olive color.

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 4	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47 35. 2428	Long/Easting:	122 22.1927
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-170	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1356		
(A) Measured Water Depth	176		
(B) Tide Height	8.7		
(C) Mudline Elevation	-167.3		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7		
Description of Core Drive	Accept		
Refusal Encountered?			
Total Core Length	49"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: F sand, silt in bottom layer. Organics. dark olive

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 5	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47°35.2443	Long/Easting:	122°22.1269
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-160	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	0945	1021	
(A) Measured Water Depth	164	166	
(B) Tide Height	4.9	5	
(C) Mudline Elevation	-159.1	-161	
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	~~2.5~~ 6'	7'	
Description of Core Drive	REJECT	ACCEPT	
Refusal Encountered?			
Total Core Length	2'5"	5' Rep 4' 7.5"	

Core Characteristics

Sediment Type CAP.	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color CAP.	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor CAP.	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic creosote	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous		sheen on surface water.	

Comments: attempt 1: Cap 6-8" thick. Native silty sand. organics: Mod. sheen. H_2S Mod. odor. wood debris. Gravel

attempt 2: Native silty sand. dark olive

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 6	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing		Long/Easting:	
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	- 140	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1504		
(A) Measured Water Depth	154		
(B) Tide Height			
(C) Mudline Elevation			
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	4'		
Description of Core Drive	Cracked tube rocks encountered		
Refusal Encountered?	at depth		
Total Core Length	16"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: attempt 1: debris, sand at surface. Cracked tube. Rocks at depth. Grey/white sand. Cap material on top of rock. Will

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 7	**Date:**	24 ~~23~~ BP March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47 35.2912	Long/Easting:	122 22.2716
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounded	Leadline	
Project Depth	-207	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	~~1542~~ BP 0849		
(A) Measured Water Depth	~~216~~ BP 211		
(B) Tide Height	4.9		
(C) Mudline Elevation	-206.1		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	6'		
Description of Core Drive			
Refusal Encountered?			
Total Core Length	44" 40" retain		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous:			

Comments:
mod. sheen on surface. Some sand mixed in with silts/native material.
native in cutter head. slight sheen. Mod. H_2S creosote odor. Silty sand. dark olive

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5-8	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.2937 N	Long/Easting:	122° 22.1983 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-198	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	0917		
(A) Measured Water Depth			
(B) Tide Height	4.4'		
(C) Mudline Elevation			
(-A+B = C include sign of tide height as reported)			
Estimated Penetration			
Description of Core Drive	ACCEPT		
Refusal Encountered?			
Total Core Length	4'10" 4'2 retain		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: Cap material ATB consistent through core. M sand. olive. Slight sheen at cutter head. No fines stuck to outside of core.

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 9	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47°35.2956 N	Long/Easting:	122°22.1235 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-190	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	0946		
(A) Measured Water Depth	192		
(B) Tide Height	4.1		
(C) Mudline Elevation	187.9		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7		
Description of Core Drive	ACCEPT		
Refusal Encountered?			
Total Core Length	4'5"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong Creosote H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: Strong sheen @ base.

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 10	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.2947 N	Long/Easting:	122° 22.0566 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-170	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1013		
(A) Measured Water Depth	175		
(B) Tide Height	3.9		
(C) Mudline Elevation	-171.1		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7'		
Description of Core Drive			
Refusal Encountered?			
Total Core Length	4' 7" retain		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments:
- encountered native at Core - Clay, silty sand light olive, organics
- Core was transition from Cap to native. Silts on outside of core

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 11	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47°35.2965 N	Long/Easting:	122°21.9769 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-155	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1034		
(A) Measured Water Depth	161		
(B) Tide Height	4.0'		
(C) Mudline Elevation	-157.0		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7		
Description of Core Drive			
Refusal Encountered?	no		
Total Core Length	5'6"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: Cut into 2 Sections

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 12	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	2ND 47° 35.3433 / 1ST 47° 35.3441 N	Long/Easting	2ND → 122° 22.1205 / 1ST → 122° 22.1242 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-209	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1101	1126	
(A) Measured Water Depth	209	209	
(B) Tide Height	4.1'	4.3	
(C) Mudline Elevation	-204.9	-204.7	
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	hit something ~4'	7'	
Description of Core Drive	Reject		
Refusal Encountered?			
Total Core Length	1' 9" penetration	3' 1"	

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: attempt 1: Rejected. 6-8" cap on surface. 2" grey/white sand fr RA4 cap. Remainder native. silty sand: no sheen. no odor.

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 13	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.3452 N	Long/Easting:	122° 21.9554 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-170	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1150		
(A) Measured Water Depth	170		
(B) Tide Height	5.0		
(C) Mudline Elevation	-165		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration			
Description of Core Drive	Accept		
Refusal Encountered?			
Total Core Length	46"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments:

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 14a	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.3904	Long/Easting:	122° 22.2655W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	NA	**Overdredge**	NA

	Attempt 1	Attempt 2	Attempt 3
Time:	1452		
(A) Measured Water Depth	240		
(B) Tide Height	+ 9.2		
(C) Mudline Elevation	-231.		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7 ft		
Description of Core Drive	continuous		
Refusal Encountered?	no		
Total Core Length	4 ft 10 inches		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: 4 inches were cut off bottom. dark sand is in the catcher.

Recorded by: D. Hanglick

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

DMH 24 March 05

Station ID:	RA5- 15	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.3927'	Long/Easting:	122° 22.1729'
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	NA	**Overdredge**	NA

	Attempt 1	Attempt 2	Attempt 3
Time:	1534		
(A) Measured Water Depth	240 ft		
(B) Tide Height	+ 9.6		
(C) Mudline Elevation	-231.4		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7 ft		
Description of Core Drive	continuous		
Refusal Encountered?	no		
Total Core Length	5 ft 11"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: 4 inches were cut to remove cutter from bottom, cutter has dark, organic, silty clay with petroleum odor and visible creosote sheen.

Recorded by: D. Hanzlick

ANCHOR
ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 16	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.4404'	Long/Easting:	122° 22.2490'
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	NA	**Overdredge**	NA

	Attempt 1	Attempt 2	Attempt 3
Time:	1604		
(A) Measured Water Depth	25.6		
(B) Tide Height	+ 1.0		
(C) Mudline Elevation	-24.6		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7 ft		
Description of Core Drive	continuous		
Refusal Encountered?	no		
Total Core Length	4 ft		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: 4 inches were cut off the bottom to remove the cutter. cutter has ~~dk~~ dark silty-clay with very little fine sand. Moderate H_2S odor. Looks like native material at bottom.

Recorded by: D. Hanzlick

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 17	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.2908	Long/Easting:	122° 22.3415
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	~200	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1431		
(A) Measured Water Depth	205		
(B) Tide Height	9.1		
(C) Mudline Elevation	-195.9		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7'		
Description of Core Drive	ACCEPT		
Refusal Encountered?			
Total Core Length	40"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: actual length 44". Cut off 4" for cutter fingers.

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- 18	**Date:**	23 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.1917 N	Long/Easting:	122 22.3431 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-158	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1102		
(A) Measured Water Depth	168		
(B) Tide Height	5.3		
(C) Mudline Elevation	-152.7		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7'		
Description of Core Drive			
Refusal Encountered?			
Total Core Length	4' 1"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: ATB thin layer of cap sand on Top

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5- ~~BP~~ 19	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.3136 N	Long/Easting:	122° 21.8752 W
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	-135	**Overdredge**	

	Attempt 1	Attempt 2	Attempt 3
Time:	1210		
(A) Measured Water Depth	139		
(B) Tide Height	5.3		
(C) Mudline Elevation	-133.7		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration			
Description of Core Drive	Accept		
Refusal Encountered?			
Total Core Length	5'1"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments:

- Saw sand on surface
- clayey sand / silt on base
- cut into 2 sections

Recorded by: BP

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID: RA5- 20

Date: 24 March 2005

Project Name: *Pacific Sound Resources RA-5 Cap Monitoring*

Project Number: *020202-01 BG 11 T 3* #1

Coordinates:
Lat/Northing 47° 35.3246 N #1
Long/Easting: 122° 22.1972 See comments for #2 lat/long

Vertical Datum MLLW MLW Other:

Depth Measurement Sounder Leadline

Project Depth NA **Overdredge** NA

	Attempt 1	Attempt 2	Attempt 3
Time:	~~212~~ 1325	1355	
(A) Measured Water Depth	212	214	
(B) Tide Height	7.7	+ 7.7	
(C) Mudline Elevation	-204.3	-206.3	
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	5 ft	6 ft	
Description of Core Drive	continuous	continuous	
Refusal Encountered?	no	no	
Total Core Length	33 inches	39 inches	

Core Characteristics

Sediment Type	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter	cobble, gravel, sand C M F , silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			
Comments:	approx 1 ft of cap over 1.8 ft of native. black 1/2" layer in the contact	47° 35.3247 122° 22.1989 keep	

Recorded by: D. Hanzlick

ANCHOR ENVIRONMENTAL, L.L.C.

Sediment Core Collection Form

Station ID:	RA5-21	**Date:**	24 March 2005
Project Name:	*Pacific Sound Resources RA-5 Cap Monitoring*	**Project Number:**	*020202-01 BG 11 T 3*
Coordinates: Lat/Northing	47° 35.3469	Long/Easting:	122° 22.0432
Vertical Datum	MLLW	MLW	Other:
Depth Measurement	Sounder	Leadline	
Project Depth	NA	**Overdredge**	NA

	Attempt 1	Attempt 2	Attempt 3
Time:	1418		
(A) Measured Water Depth	198 ft		
(B) Tide Height	+ 8.7		
(C) Mudline Elevation	− 189.3		
(-A+B = C include sign of tide height as reported)			
Estimated Penetration	7 ft		
Description of Core Drive	slight pause at about 5 ft in		
Refusal Encountered?	no		
Total Core Length	4 ft 10"		

Core Characteristics

Sediment Type	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter	cobble, gravel, sand C M F, silt clay, organic matter
Sediment Color	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine	gray, black, brown brown surface, olivine
Sediment Odor	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic	None, slight, mod, strong H_2S, petroleum, septic
Any Layering Homogeneous			

Comments: 5" is cut off the bottom to remove cutter. Clayey silt, dark with mod. H_2S smell at bottom of core

Recorded by: D. Hanzlick

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-1	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☑ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	28" logged (7)	Average % Compaction =	

Depth in (in) (Theoretical / Actual) Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
2			dk, gray, wet, SILT (0/5/95) (slight pet odor) ↳ overlying water had sheen
		2	dk gray, moist M to F SAND w/ some shells (5/95/0) (top 3" has twigs & veg)
			@8" to 10" - lense of v. shelly sand (20/80/0)
10		10	dk gray, moist M to F SAND w/ occas. shell fragments (5/95/0)
20			
28			
30			EofC @ 28"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-2	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☒ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☒ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	38" logged (1)	Average % Compaction =	

Depth in (in.) (Theoretical / Actual) Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
0–4			gray, moist, med to fine sand w/ gravel 1"ϕ (G/S/F → 30/70/0)
4–28		4	gray, moist, coarse gravel/cobbles and med to fine sand ↳ see photo @ 23" (G/S/F → 65/35/0)
28–38		28	mokA, dark gray, to gray & white, coarse to fine grvl w/ coarse sand (G/S/F → 90/10/0)
38			EofC @ 38"

Depth scale marks: 4, 10, 20, 28, 30, 38, 40

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-3	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	40" logged (5)	Average % Compaction =	

Depth in ( ) Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			(wood debris on surface) dark gray moist, M to F sand (5/90/5)
5		5	transition to/with next layer (photo)
9, 10		pet odor 9 & sheen	dk gray, moist (m. stiff) clayey silt w/occas grvl (top 3" is wet & v. soft) (3/2/95)
20, 22			@22" layer grades to sandy (0/15/85)
			@25" - 1.5" lense of veg (twigs/leaves) & grades to v. sandy (0/30/70)
28, 30		28	dark gray, moist, F sand (0/100/0)
40			E of C @ 40"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-4	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	44" logged (4)	Average % Compaction =	

Depth in ( ) Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			(wood debris on surface)
			moist, dark gray, M to F sand w/ occas. shell fragments (5/90/5)
9 / 10		9 / 10	1" lense of lt/gray F sand.
			moist to wet, dark ~~olive~~ gray (VF) sandy, soft, silty clay w/ occas wood debris in top 4" (0/30/70)
20			
22			@ 22" grades to moist v. fine sand & silt (0/50/50)
25		25	dark gray, moist F sand (0/97/3)
30			
40			
			E of C 44"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5 -5	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	56" logged (3)	Average % Compaction =	

Depth in (in) — Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			wet, dark olive gray, v. fine sand & silty clay w/ wood debris & veg. & occasional grvl. / sheen present & slight pet odor (15/~~45~~40)
10		10	- grades to soft clay (no debris/veg) (0/5/95)
			@13" to 19" grades to sand/grvl/clay mix. (40/40/20)
20			
22		22	v. dark gray, moist, med to fine sand (no pet odor or sheen) (0/90/10)
30			
40			
			@48" grades to moist plastic silt (0/15/85)

↓ E of C @ 56"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-6	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☑ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	22" logged w/ nose cone (6)	Average % Compaction =	

Theoretical / Depth in (in.) / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			gray to dk gray, moist, M to F sand (0/100/0)
8		8	top 1.5" of layer, lt. gray F sand (0/100/0)
10			gray to dk gray, moist (C to F) sandy, coarse grvl & cobbles (75/25/0)
15			@16" grades to slightly sandy (90/10/0)
22			EofC @22"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-7	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	38" logged (9)	Average % Compaction =	

Depth in ( ) Core Sections (Theoretical / Actual)	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
1		1	1" of dk gray, moist M to F sand w/ shell frags (0/90/10) (sheen in overlying core water)
			dk olive gray, wet, v. soft sandy silt (0/15/85)
6		6	@ 3" → 1" lense of lt gray FSAND (0/100/0)
10			dk olive gray, moist, soft, clayey SILT w/ visible sheen & staining (0/5/95)
16		16	top of x-sition — v. gravelly & abundant wood debris/veg (40/25/35)
18		18	dk gray, moist silt (0/10/90)
20			
28		28	dk gray, moist silty (v. F to) F sand (0/15/85)
30			
38			E of C @ 38"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job USACE- Pacific Sound Resources RA5	Date 24 Mar-05
Job No. 020202-01 BG 11 T 3	Core Pushed By Bill Jaworski
Exploration No. RA5-8	Core Logged By Rebecca Desrosiers
Core No.	Type of Core ☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core	Diameter of Core (inches)
Cored Length (feet; from log)	Core Quality ☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet) 53" logged (12)	Average % Compaction =

Depth in (in.) Core Sections (Theoretical / Actual)	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			dk gray, moist M to F sand (0/100/0)
10			
12		12	lt gray, dry to moist, dense F sand (0/100/0)
15		15	2" dk gray clayey SILT w/veg
			Olive gray, moist clayey SILT w/ occas grvl (2/0/98) strong pet odor & staining
20			
30			
			@ 36" - 1" lense of wood debris & grvl.
34			
40			dk gray, moist F to VF sand (0/95/5) slight pet odor

E of C @ 53"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-9	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	50" logged (15)	Average % Compaction =	

Depth in (in.) — Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			dk gray, moist M to F sand (0/100/0)
7			@7" - 1" lense of lt gray F sand
10		8 — sheen & pet odor	dk gray to black sandy clayey SILT (0/15/85)
14		14	dk olivish gray, moist, (sometimes wet) sandy clayey SILT (0/15/85)
			@18" - lense of wood debris
20			
			@24" - ~3" lense of fine grvl/coarse sand
30			@32" - dark staining; pore water is v. irridescant also grades to non sandy (0/5/95)
40			dark gray, moist, V.F. sand (0/90/10)
50			End of C @50"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-10	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	50" logged (16)	Average % Compaction =	

Core Sections: Theoretical / Depth in (in) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			dk gray, moist, M to F Sand (0/100/0)
7		7	(xsition marked by 1/2" black lense of below layer)
10			dark gray, moist, sandy clayey SILT (0/10/90) soft
20			
30		30	dk gray, moist clayey SILT (0/0/100) stiffer than above layer
40			
41		41	dk gray to black F Sand (0/100/0) moist
50			EofC @ 50"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-11	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	62.5" logged. (13)	Average % Compaction =	

Depth in ( ) Core Sections (Theoretical / Actual)	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			(1/2" lense of gray silty M to F sand) gray, moist, F sand (0/100/0)
4		4	olive gray, v. soft wet to moist, sandy clayey SILT (0/10/90) w/ wood debris & twigs in upper 6" of layer
10			
20			
30		30	- grades to moist & soft and non-sandy (0/0/100)
38			dk gray, moist F sand w/ some silt (0/90/10) & occas. wood debris in upper layer
40			
50			

Eof C C 62.5'

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job . USACE- Pacific Sound Resources RA5		Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-12	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet) 35" logged	(10)	Average % Compaction =	

Core Sections: Theoretical / Depth in (in.) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			dk gray, moist, M to F sand (0/100/0)
6		6	
		8	2" xsition (mixture of upper/lower)
10			dk olive gray, moist, soft clayey SILT (0/0/100) — ~3" lense of gravel, wood debris w/ mixed w/SILT (30/10/60) (grvl may be from RA4, but appears somewhat different than obsv. in other cores)
20			
22		22	- silt grades to slightly sandy (0/7/93)
30			
35			E of C @ 35"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-13	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	40" logged (11)	Average % Compaction =	

Depth in (in.) Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			top 1" - dk gray wet cohesive SILT (0/0/100)
			3" dk gray, moist M to F sand w/ abundant shell frags. (10/90/0)
4		4	2" transition dk gray sand & silt (5/40/55) SILT
10		9	moist, lt gray, v. dense sandy, clayey SILT (like siltstone) (0/15/85)
12		12	dk gray, moist, C to F sand (0/100/0) (upper 3" are silty 0/85/15)
20			
24		24	dk olive gray, moist to wet, soft clayey SILT (0/5/95)
30			@30" - 4" cobble
35			- increasing stiffness (moist)
			@37" - lense of shell frags
40			
46			E of C @ 46"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	25 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-14A	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	51" logged (19)	Average % Compaction =	

Depth in (IN) — Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
0			dk gray, moist, F gravelly, C to F SAND w/ occas. shell & wood debris (20/80/0)
4		4	(1" lense of vege top of layer — twigs/leaves) dk gray, moist, soft, plastic SILT and C to F SAND w/ occas. grvls. (0/40/60)
10			
13		13	(2" piece wood debris @ xsition) dk gray, moist, M to F SAND w/ occas. shell frags & veg (twigs/leaves) (5/95/0)
20			
30			
40			
45	45	strong pet odor - slight sheen	dk gray to black, moist, F SAND (upper 3" contains dense impacted veg - twigs, debris) (0/100/0) ↳ neglecting

51"

EofC @ 51"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	25 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski P1 of 2
Exploration No.	RA5-15	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	67" logged (20)	Average % Compaction =	

Core Sections: Theoretical / Depth in (IN.) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
0			(wood debris on surface) dk gray, moist, F. SAND w/ occas. veg (twigs) (0/100/0)
6, 10, 20, 30		6	dk gray, moist, m. stiff, sandy, plastic SILT w/ occas. wood debris, veg, & grvl/cobbles (5/15/80)
32		32	dk. olive gray, moist, V.F. SAND & SILT (0/80/20)
37, 40		37 pet odor	dk olive gray, moist, soft, sandy, plastic SILT (0/15/85)
47		47	dk olive gray, moist, soft, V. sandy, plastic SILT (0/20/80)

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	26 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski P.2 of 2
Exploration No.	RA5-15	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core	See P1	Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)		Average % Compaction =	

Core Sections: Theoretical / Depth in ( ) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
50			
52		52	
		strong pet odor + vis. sheen	dk olive gray, moist, soft to M. stiff, v. plastic SILT w/ visible sheen (0/5/95)
60			
67			
70			E of C @ 67"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job USACE- Pacific Sound Resources RA5	Date 25 Mar-05
Job No. 020202-01 BG 11 T 3	Core Pushed By Bill Jaworski
Exploration No. RA5-16	Core Logged By Rebecca Desrosiers
Core No.	Type of Core ☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core	Diameter of Core (inches)
Cored Length (feet; from log)	Core Quality ☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet) 44" logged (18)	Average % Compaction =

Depth in (IN.) Theoretical / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			(wood debris on surface) dk gray, moist, F.SAND w/ fine wood debris + veg(twigs) throughout (15/80/5) ↳ debris
10			
13		13	olive gray, moist, soft, sandy, plastic SILT w/occas. grvl. (10/15/75) @ ~18" piece of trash (plastic)
20			
30		30	olive gray, moist, gravelly, sandy, plastic SILT (35/15/50) ↳ coarse w/ some cobbles
35		35	olive gray, moist, soft, sandy, plastic SILT w/occas. grvl. ↳ (slightly firmer than above) (0/10/90)
40			
44			E of C @ 44"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-17	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☐ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	38" logged (8)	Average % Compaction =	

Core Sections: Theoretical / Depth in (in) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			Dk gray, moist M to F Sand (0/100/0)
8		8	above xsition - 1" lense of lt. gray F sand
10			(heavy wood debris @ xsition)
			olive gray, wet, soft clayey SILT w/ occas grvl. (0/0/100)
14			@14", becomes moist (slightly stiffer) (may have v.v. F sand in matrix) (0/10/90)
20			
30			
36			EoC C @ 36"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RAS-18	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☒ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	39.5" logged (2)	Average % Compaction =	

Core Sections: Theoretical / Depth in (in.) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
0			dark gray, moist, fine sand & silt (0/60/40) @4" → 1" pocket of gray fine sand (photo) (0/90/10) from 6" to 8" → lense of red, coarse 'sand sized' chards
10		10	dark gray, moist to wet, ~~SILT~~ & v. fine sand (0/30/70) w/ visible gas voids (~1/4"Ø)
20			
30		30	— grades to moist
40			EofC @ 39.5"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	24 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RAS-19	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	61" logged (14)	Average % Compaction =	

Theoretical / Depth in ( ) / Actual — Core Sections	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			moist, dk gray, M to F Sand w/ trace shell frags. (0/100/0)
4		4	1" lense of moist Lt gray F Sand (0/100/0)
			dk olive gray, moist to wet, sandy clayey silt (0/20/80) w/ occasional gravel
10			
16		16	dk olive gray, moist, F Sand & silt (0/50/50) w/ occas wood debris
20			
24		24	dk olive gray, moist clayey (plastic) silt (0/0/100) (soft) w/ occas. shell frags.
30			@ 32" grades to m. stiff
40			@ 40" grades to soft w/ thin lense of shell frags
			@ 46" slightly firmer (to bottom of core @ 61")
50			

61" — E of C @ 61"

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	25 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5 - 20	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☑ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	33" logged 17	Average % Compaction =	

Depth in (IN.) Core Sections (Theoretical / Actual)	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			dk gray, moist M to F sand w/ occas. shell frags. (5/95/0) (upper 2" somewhat fibrous)
10			@10" roots present
12		12	olive gray, moist, soft, sandy clayey silt (plastic) (0/10/90)
			@17" intact shell (½")
19, 20		19	olive gray, moist, soft, gravelly, sandy, plastic SILT w/ occas. shell frags. (30/20/50)
			@23" intact shell (2")
28, 30		28	olive gray, moist, soft, plastic SILT mixed w/ 'cobble-size' conglomerates (photo) (55/5/40)
33			E of C @ 33"
40			

Visual Classification of Subsurface Core

ANCHOR ENVIRONMENTAL, L.L.C.

Job	USACE- Pacific Sound Resources RA5	Date	25 Mar-05
Job No.	020202-01 BG 11 T 3	Core Pushed By	Bill Jaworski
Exploration No.	RA5-21	Core Logged By	Rebecca Desrosiers
Core No.		Type of Core	☑ Vibracore ☐ Piston Core ☐ Other
Water Depth/Elevation of Core		Diameter of Core (inches)	
Cored Length (feet; from log)		Core Quality	☐ Good ☐ Fair ☐ Poor ☐ Disturbed
Core Recovery (feet)	52" logged (21)	Average % Compaction =	

Core Sections: Theoretical / Depth in (IN.) / Actual	Sample Interval	Sample Analytes	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
			dk. gray, moist, F. SAND (0/100/0)
7		7	lt. gray. moist, V.F. SAND (0/100/0)
9, 10		9	(photo of xsition-black seam)
			dk. olive gray, moist, soft, sandy plastic SILT (0/20/80) w/ occas. LG. wood debris
20			@ 20" - piece of conglomerate (photo)
23		23	dk. olive gray, moist, soft, V. sandy, coarse plastic SILT w/ occas. C. grvl & abundant wood debris (10/40/50)
			@ ~26" → 3.5" piece of wood debris over 1" lense of C to M sand
30			
33		33 slight pet odor	olive gray, moist, soft to M. stiff, plastic SILT (0/0/100)
40			
52			

E of C @ 52"

APPENDIX F

SUB-BOTTOM PROFILE AND MULTI-BEAM BATHYMETRIC SURVEY REPORTS

Golder Associates Inc.

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www.golder.com

April 22, 2005

Our Ref.: 053-1472.000

Anchor Environmental, L.L.C.
1423 3rd Avenue, Suite 300
Seattle, WA 98101

Attention: Dennis Hanzlick, Ph.D.

RE: REPORT ON THE MARINE GEOPHYSICAL INVESTIGATION RA5, ELLIOTT BAY

Dear Dr. Hanzlick:

This letter report, and the attached maps, present the results of the geophysical investigation conducted in support of the PSR RA5 construction monitoring project located in Elliott Bay (Figure 1).

SURVEY OBJECTIVE

The objective of the geophysical investigation was to use a high-frequency subbottom profiler (3.5 to 10 KHz) to attempt to map the thickness of the sediment cap placed on the seabed at two sites. The subsurface data, depicting the cap thickness, was to be used to generate an isopach map (sediment thickness map) of the cap material.

FIELD OPERATIONS AND METHODS

Navigation

The geophysical investigation was conducted from a 26-foot survey boat outfitted with differential GPS for navigation. The navigation system consists of a Trimble PRO XRS receiver, IBM Computer and operated under CRA Model CATNAV hydrographic software.

The differential global positioning system (DGPS) was used to determine the vessel's location in real-time, and to plot the vessel's position along pre-selected survey lines. The pre-plotted survey lines, and the actual survey lines traversed, were displayed in real time on a video monitor. The navigation computer transmitted event marks to the geophysical recording instruments every 20 seconds in order to correlate the geophysical data with the survey vessel position during data analysis and mapping.

Subbottom Profiler System (SBP)

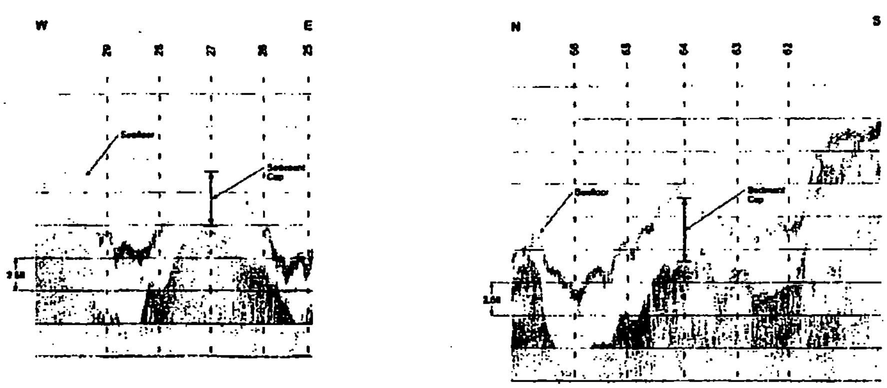
The subbottom data were collected with a GeoAcoustics 3.5 to 10 KHz SBP system. The SBP system provided very high resolution images, 0.5 foot of resolution, through fine-grained sediment and achieved a maximum of 15 to 20 feet of subsurface penetration. (Figures 2 and 3). The data were displayed on an EPC Model 1086-500 graphic recorder and archived on a Chesapeake digital acquisition system. The graphic recorder and digital acquisition system were interfaced with the navigation system to provide real time position on all archived and printed data.

Survey Coverage

The SBP, and bathymetric data were obtained at the same time on 34 transects oriented NW-SE and 12 transects oriented SW-NE (Map 1). The interval between transects was approximately 50 feet and 100 feet respectively.

DATA ANALYIS

The SBP data were analyzed by determining what subsurface reflectors, or reflection characteristic would most likely represent cap material. SBP data from other projects, such as the data shown below, were used as reference for interpretation. Cap material is generally acoustically transparent (light colored image, no internal reflectors) and usually uniformly distributed as shown in the image below. In addition, data from the through-core samples were correlated, where possible, with the interpreted SBP data.



SPB PROFILE OF SEDIMENT CAP OVER
CONFINED AQUATIC DISPOSAL SITE, PUGET SOUND

Golder Associates

RESULTS OF THE SBP SURVEY

The results of the bathymetric survey are presented on Map 2 and the results of the interpreted SBP data are presented on Map 3.

There was no evidence of a uniformly distributed, acoustically transparent sediment layer that would potentially represent the cap material on the SBP data. There were however, several localized zones of acoustically transparent material, 1 to 3 feet in thickness throughout the site (Figure 2 and Map 3). These are interpreted as possibly representing cap material. There was also a very large mound of material on the western edge of the site. This feature, shown on Figure 3, is very evident on the contour maps. The cause of this mound is unknown (Maps 2 and 3).

The lack of geophysical evidence for the presence of uniform cap material may result from several conditions. These are:

1. Cap material was not placed on this site or placed in the manner that was specified.
2. The cap material may have acoustic properties similar to the native soil and consequently is undetectable.
3. The cap material may have been eroded or been transported downslope by a series of submarine slides.
4. A combination of 2 and 3 above.

Please contact me if you have any questions regarding our investigation or this report. We have appreciated working with you on this challenging project.

Sincerely,

GOLDER ASSOCIATES INC.

D.I Sylwester

Dick Sylwester
Associate/Senior Geophysicist

RES/se

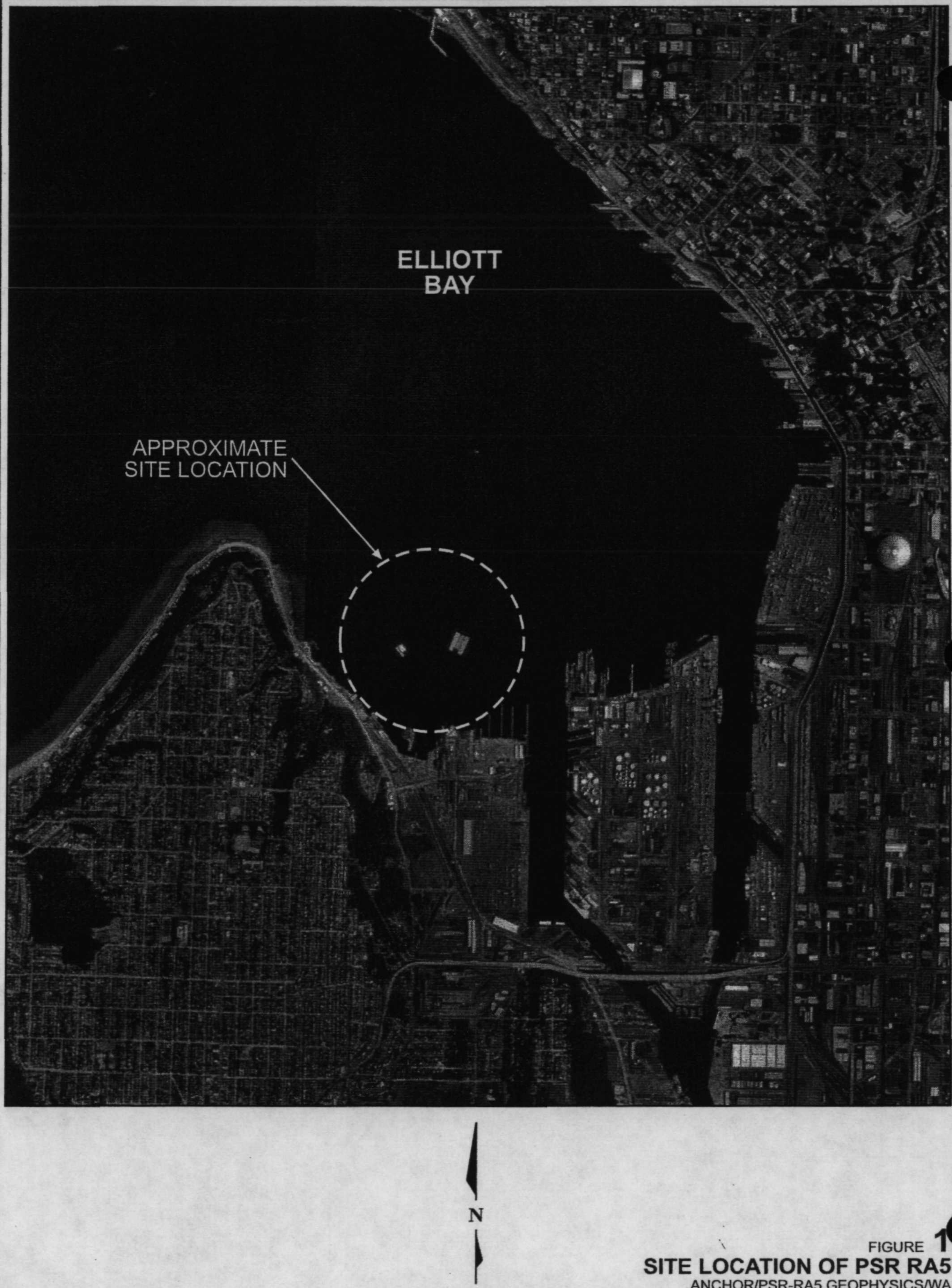


FIGURE 1

SITE LOCATION OF PSR RA5

ANCHOR/PSR-RA5 GEOPHYSICS/WA

0531472000fg03.fh11 | Mod: 04/20/05 | EL

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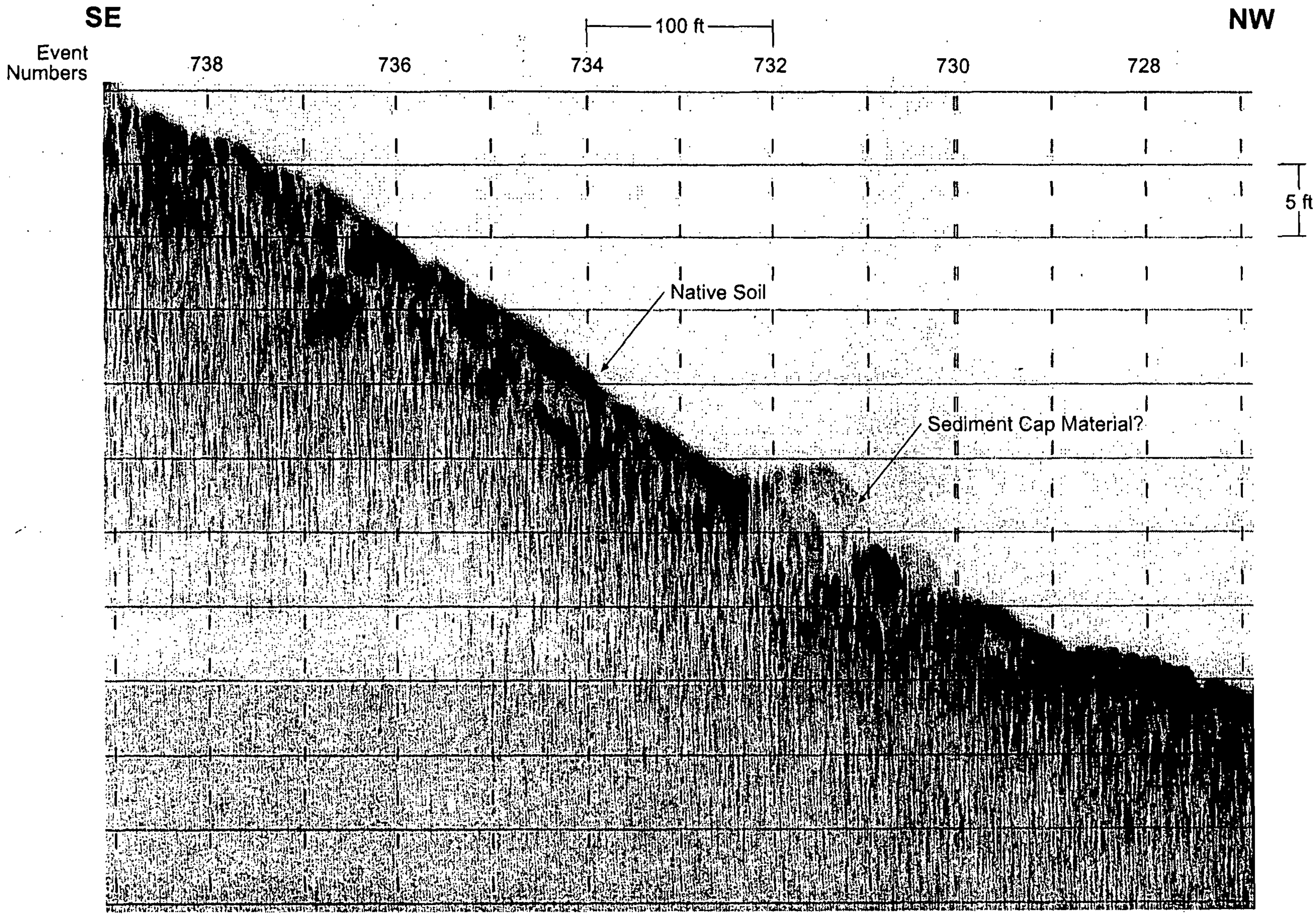
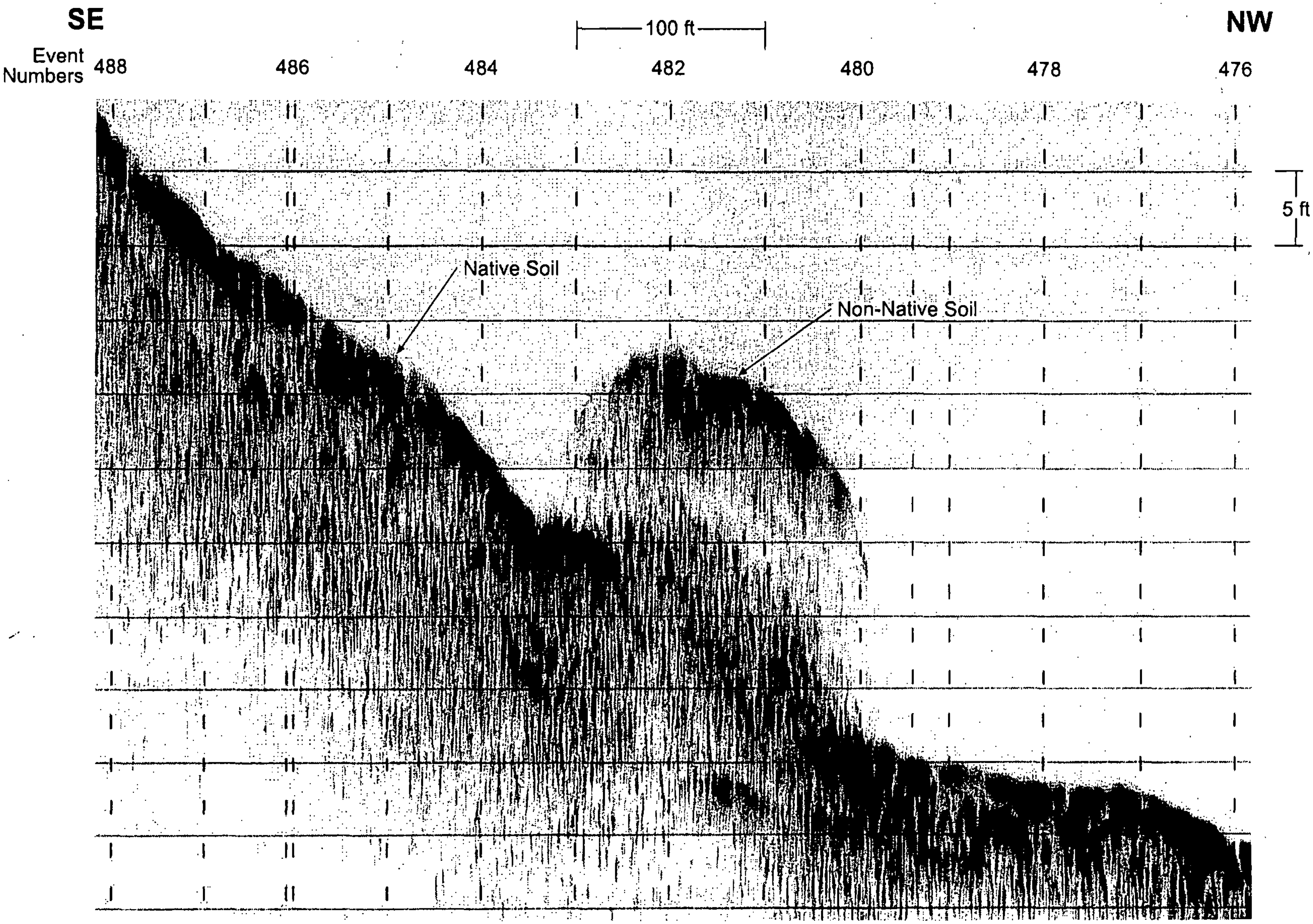


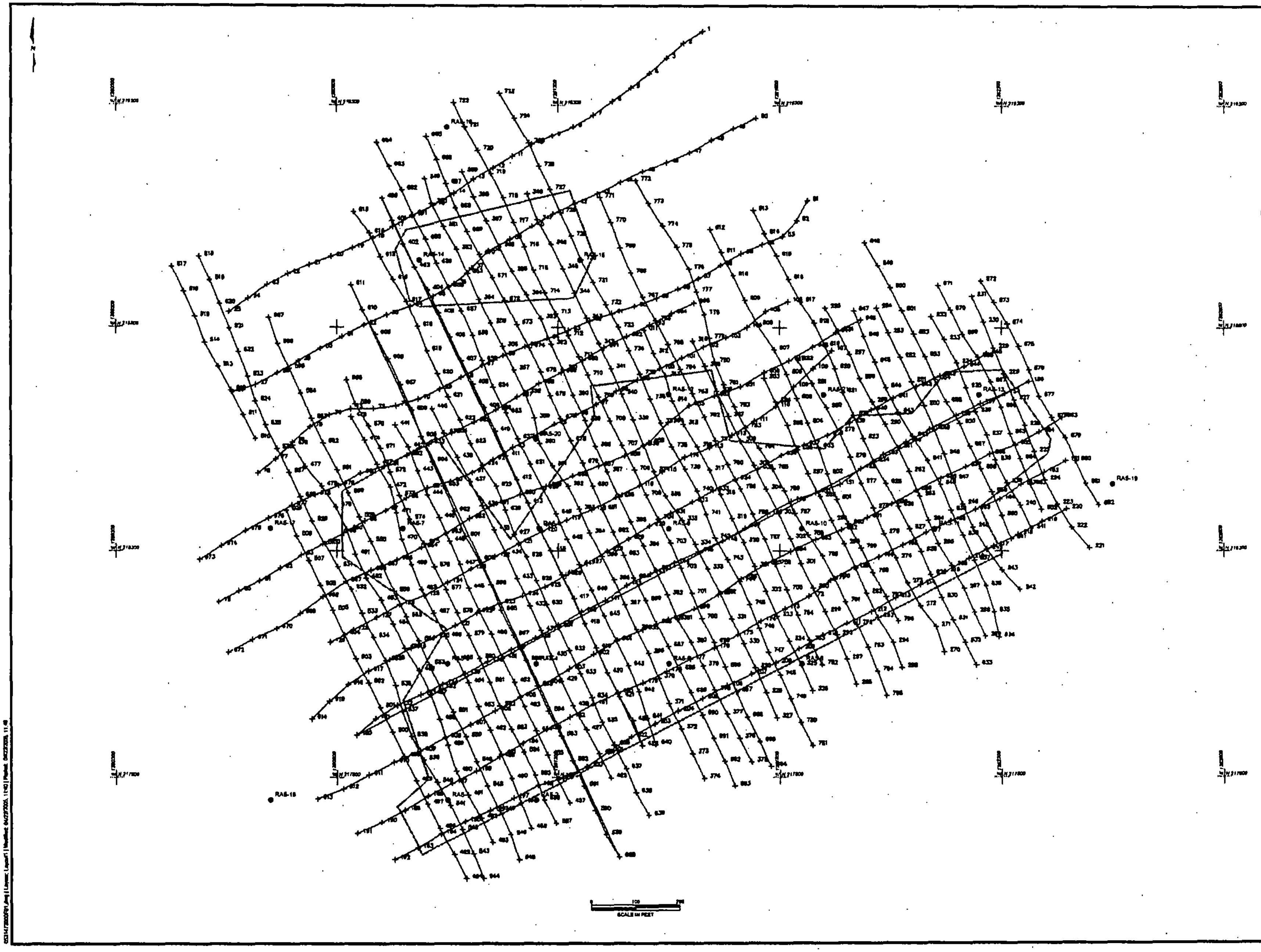
See Map 3 for location.

FIGURE 2
SUBBOTTOM PROFILE OVER INTERPRETED CAP MATERIAL
ANCHOR/PSR RA5 GEOPHYSICS/WA



See Map 3 for location.

FIGURE **3**
SUBBOTTOM PROFILE OVER LARGE MOUND OF NON-NATIVE SOIL
ANCHOR/PSR RA5 GEOPHYSICS/WA



KEY MAP

LEGEND

TRACKLINES AND EVENT NUMBERS

THROUGH CAP CORES

RAS BOUNDARY

INSTRUMENTATION

DATASONIC SBP (3-12 KHZ)
EPC MODEL 1086 GRAPHIC RECORDER
SONY MODEL 208 DIGITAL ACQUISITION
RESON MODEL 8124 MULTIBEAM (1-8" 200 KHZ)
TRIMBLE AG 132

GEODETIC PARAMETERS

VERT DATUM MLLW
HORIZ DATUM WA STATE NORTH ZONE NAD 83 US SURVEY FEET

Golder Associates

CRA-NW

SUBMITTED TO:

ANCHOR ENVIRONMENTAL, LLC

PROJECT:

PSR RAS

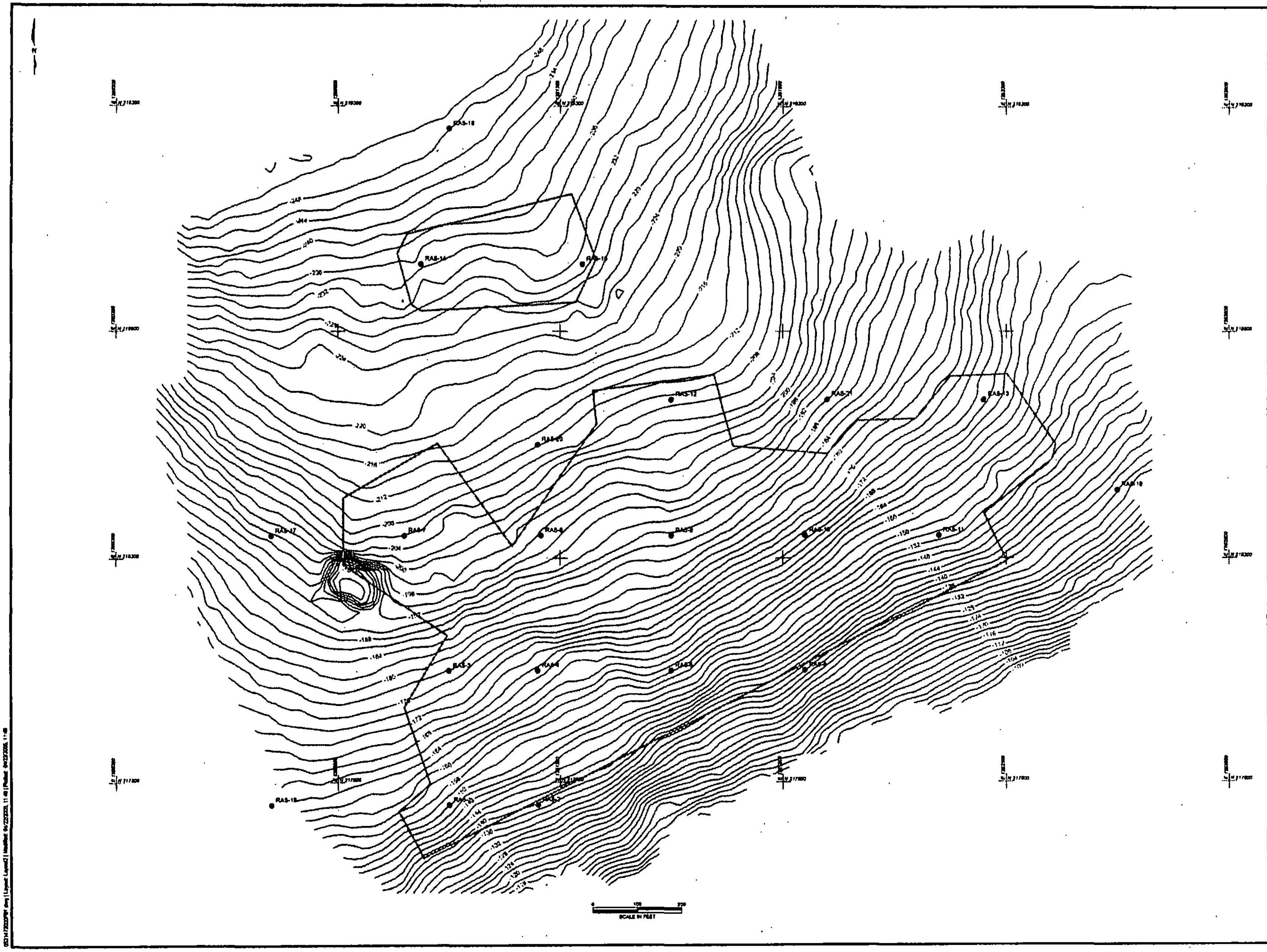
TITLE:

TRACKLINE MAP

REV	DATE	REVISION DESCRIPTION	SIGNED
-	-	-	-

PROJECT No.		053-1472
FILE No.		0531472000P01.dwg
REV. 0	SCALE	AS SHOWN
DESIGN	-	-
CADD	SMB	04/13/05
CHECK	-	-
REVIEW	-	-

MAP 1



KEY MAP

LEGEND

BATHYMETRY DEPTH IN FEET

THROUGH CAP CORES

RAS BOUNDARY

INSTRUMENTATION

DATASONIC SBP (3-12 KH3)
EPC MODEL 1086 GRAPHIC RECORDER
SONY MODEL 208 DIGITAL ACQUISITION
RESON MODEL 8124 MULTIBEAM (1-8" 200 KH3)
TRIMBLE AG 132

GEODETIC PARAMETERS

VERT DATUM MLLW
HORIZ. DATUM WA STATE NORTH ZONE NAD 83 US SURVEY FEET

Golder Associates

SUBMITTED TO:

ANCHOR ENVIRONMENTAL, LLC

PROJECT:

PSR RAS

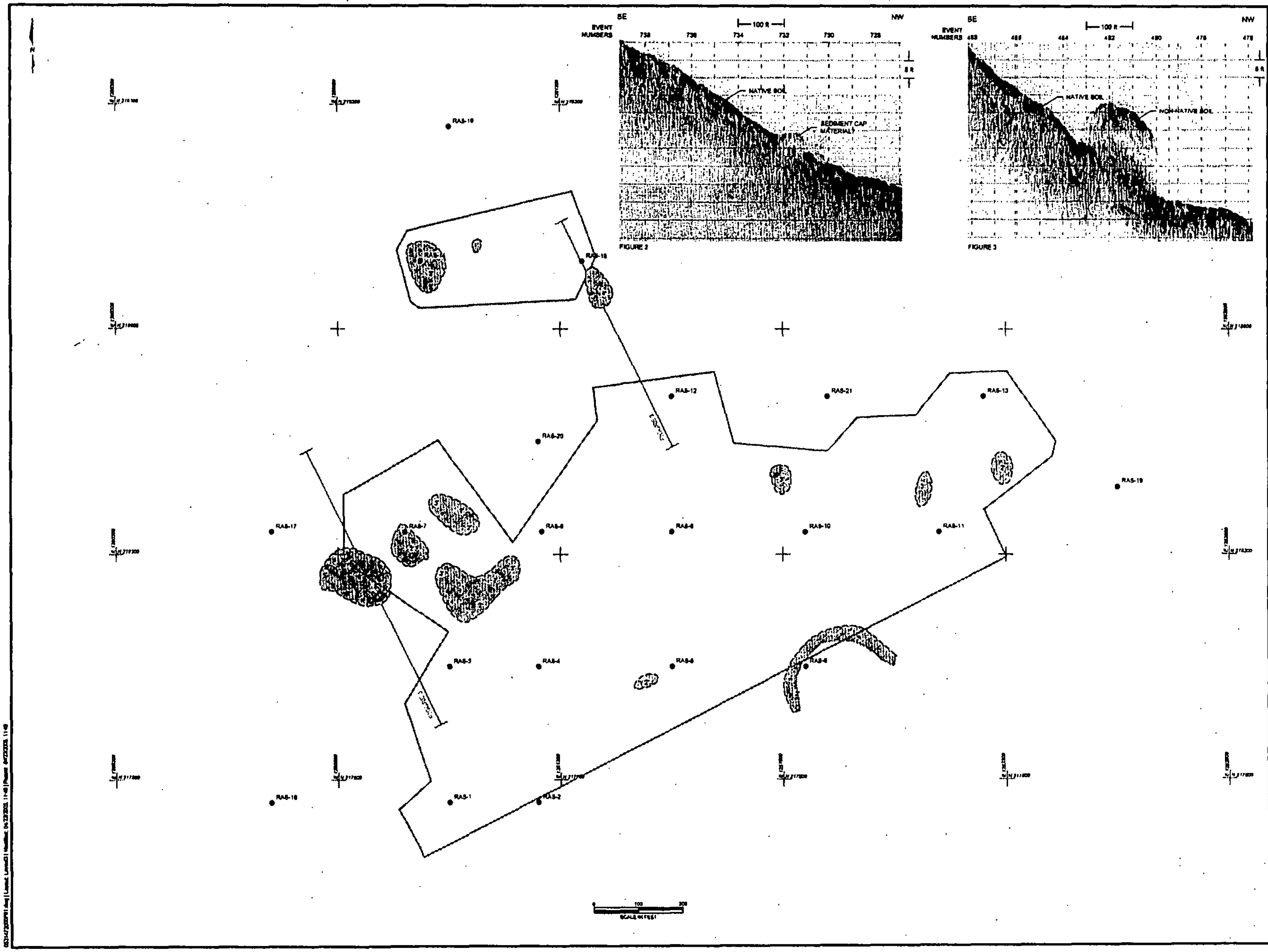
TITLE:

BATHYMETRY MAP

REV	DATE	REVISION DESCRIPTION	SIGNED
-	-	-	-

PROJECT No.		063-1473
FILE No.		0631472000P01.dwg
REV. 0	SCALE	AS SHOWN
DESIGN	-	-
CADD	EMB	04/13/06
CHECK	-	-
REVIEW	-	-

MAP 2



KEY MAP

LEGEND

- THROUGH CAP CORES
- RAS BOUNDARY
- SEE FIGURES FOR SBP IMAGES
- APPROXIMATE BOUNDARY OF INTERPRETED CAP MATERIAL AND MAXIMUM THICKNESS IN FEET, DASHED LINE REPRESENTS 0 FEET OF MATERIAL

INSTRUMENTATION

DATASONIC SBP (3-12 KHZ)
EPC MODEL 1086 GRAPHIC RECORDER
SONY MODEL 208 DIGITAL ACQUISITION
RESON MODEL 8124 MULTIBEAM (1-5° 200 KHZ)
TRIMBLE AG 132

GEODETIC PARAMETERS

VERT. DATUM: MLLW
HORIZ. DATUM: WA STATE NORTH ZONE NAD 83 US SURVEY FEET

Golder Associates

CRA-NW

SUBMITTED TO:

ANCHOR ENVIRONMENTAL, LLC

PROJECT:

PSR RA5

TITLE:

CAP MATERIAL MAP

REV	DATE	REVISION DESCRIPTION	SIGNED
-	-	-	-

PROJECT No.		053-1473
FILE No.		0531473000P01.dwg
REV. 0	SCALE	AS SHOWN
DESIGN	-	-
CADD	SMS	04/13/05
CHECK	-	-
REVIEW	-	-

MAP 3

CHRIS RANSOME & ASSOCIATES, INC. CRA-NW

BATHYMETRY SURVEY

in

South Elliot Bay, Washington

for

Anchor Environmental L L C

Condition Survey Report

Date: May 4, 2005

CRA-NW Job# 05027

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Seattle, Wa. 98133
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File:
R05017a_ael

Hydrographic Survey in South Elliot Bay, Seattle, WA.

Introduction:
CRA-NW was selected to perform a bathymetric survey of two areas labeled PSR - 5A/B a section in the SW corner of Elliot Bay in Puget Sound located in Seattle, WA. This survey was to determine the current bottom conditions at that time.

Methodology:
The bathymetry data was collected using a state-of-the-art multi beam automated hydrographic system. The Reson SeaBat 8124, also called a multi beam system, collects data in a swath configuration. This gives a higher resolution and larger data set compared to a single transducer echo sounder. This system consists of a single transducer multi beam array. Coupled with a motion sensor, heading sensor, DGPS positioning system, and velocimeter. The complete system produces accurate depth measurements (IHO standards) over a 120 degree swath. The motion sensor accurately tracks the sonar beam in addition it will also correct for the DGPS antenna movement that is mounted directly over the swath transducer thereby reducing offset induced errors. This data set was then reduced for heave, pitch, and roll. A sound velocity and a tide table was applied to the data along with **CRA-NW**'s latest 'Windows' based binning program, **CatBox**. This software was written specifically to process the high amount of data that a swath system generates. In addition single beam data was collected and was used as a secondary check. This data is then contoured for further validity.

Project Limitations:
This survey was a straight forward hydrographic survey. There were no obstructions in the survey area. Weather was cool, little wind, and only local boat wake noise. Data was collected initially along contours for the swath data and then again normal to the first data set for the sub-bottom data acquisition.

Deliverables:
A contour chart of the depth data was overlaid onto the project limitations or boundary provided by Anchor Environmental. In addition previous NOAA data for the area was provided from a March 2002 survey and **CRA-NW** calculated a depth difference or Isopach map to compliment the contour chart.

Field Activity:
Apr. 06, 2005- Mobilization to the project site and multi beam data acquisition.
Apr. 07, 2005- Begin data editing and processing.
Apr. 22, 2005- Began sending draft copies of data sets via email to the Anchor.
Mar. 23, 2005- Revised data was emailed to the MCS.
May. 04, 2005- Report sent to client via email.

Personnel:

Senior Hydrographer- K. Craig Keener AK. RLS / ACSM of **CRA-NW.**
Junior Hydrographer- Alex Howden of **CRA-CAN**.

Equipment:
The following equipment or equivalent will be provided:

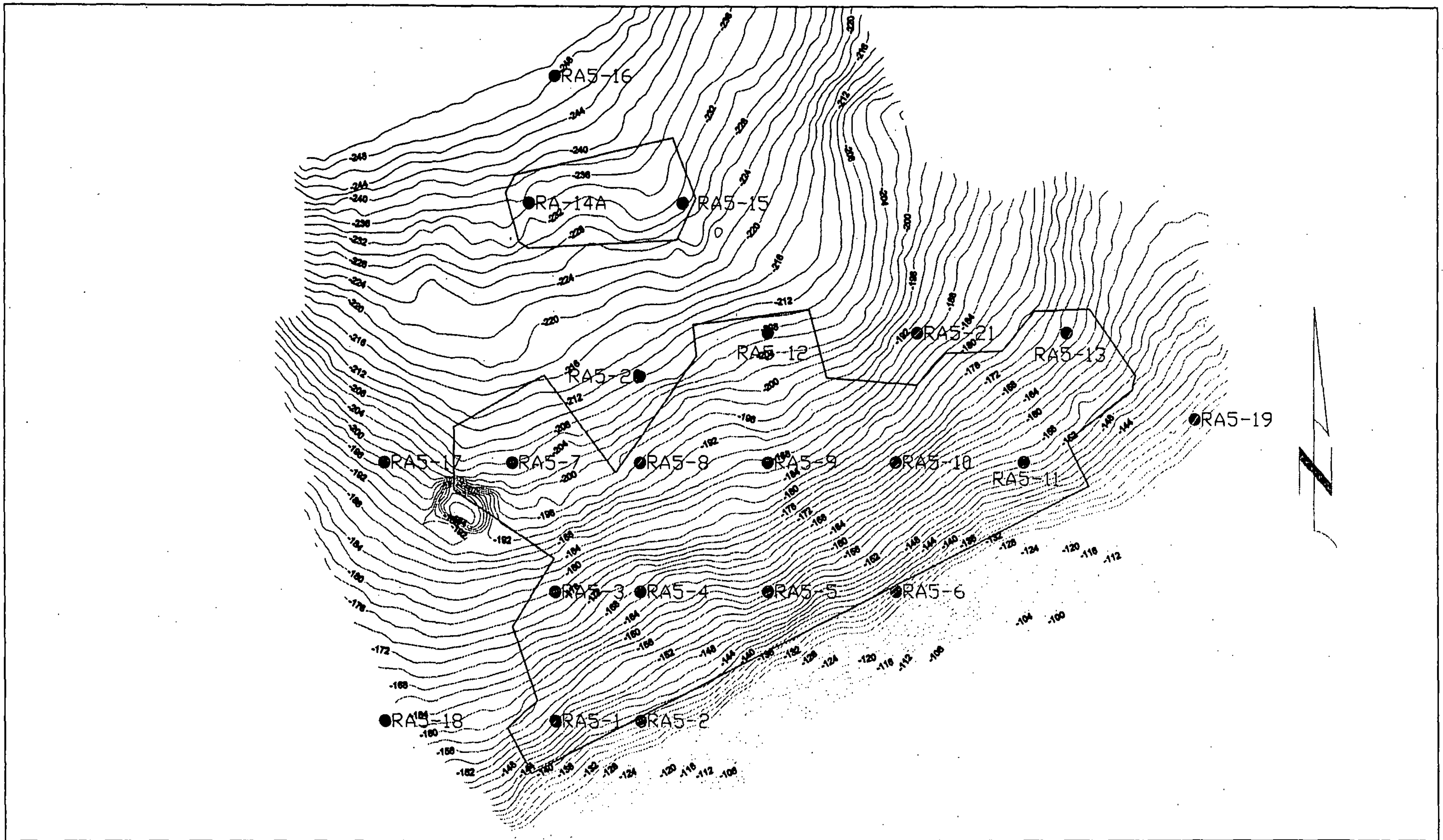
1. Reson 8124 swath sounding system with 1.5 degree, extended range, and side scan options.
2. HySweep acquisition software.
3. AML SV*Plus* velocimeter.
4. SeaTex MRU-5 motion sensor (heave, pitch, roll)
5. SG Brown Meridian Surveyor Gyro Compass or KVH 1000AC digital compass.
6. Coastal Oceanographics HySweep logging system ('windows' based).
7. **CRA-NW** CatNav Navigation system ('windows' based).
8. **CRA-NW** CatBox binning/editing software ('windows' based).
9. Trimble Ag132 12 channel GPS receiver w/USCG or Omnistar correctors.
10. Optional: Endeco 1029 automated tide gauge.
11. 21' boat survey ready with truck.

Horizontal Datum:
A Trimble Ag132 with OmniStar differential correctors was used for real time positioning of the vessel. All data was collected in NAD-83 Washington State Plane North zone #4601 with coordinates in US survey feet.

Vertical Datum:
The vertical datum is MLLW based upon NOAA's tide gauge located in the ferry terminal building in Seattle, WA.

Velocity Profile:
Available upon request.

Tide Data:
Available upon request.



NOTES:

1. HORIZONTAL COORDINATES ARE IN WASHINGTON STATE PLANE GRID, NORTH ZONE, NAD-83 DATUM IN U.S. SURVEY FEET.
2. DEPTH DATUM IS MLLW IN U.S. SURVEY FEET, BASED ON NOAA GUAGE NO. [illegible] SEATTLE, WASHINGTON.
3. BASE MAP REFERENCE: [illegible] FROM ANCHOR ENVIRONMENTAL, LLC
4. STANDARD FIELD CALIBRATION PROCEDURES WERE PERFORMED. THE SURVEY AND RESULTS ARE WITHIN MANUFACTURERS SPECIFICATIONS.
5. CONTOUR INTERVAL IS 2.0', CONTOUR LABELS ARE ORIENTED DOWN HILL.
6. THE INFORMATION DEPICTED ON THE CHART REPRESENTS THE RESULTS OF SURVEY EXECUTED DURING THE PERIOD OF APRIL, 2005. THIS DATA CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.

RA-NW

NO.	DATE	DESCRIPTION	DRWN	CHK'D	APP'D
X	[illegible]	ANCHOR_ELLIOT_BAY_BATHYMETRY	[illegible]	[illegible]	-

ISSUE & REVISIONS

CLIENT: ANCHOR_ENVIRONMENTAL_LLC

APPROVED: DATE [illegible]

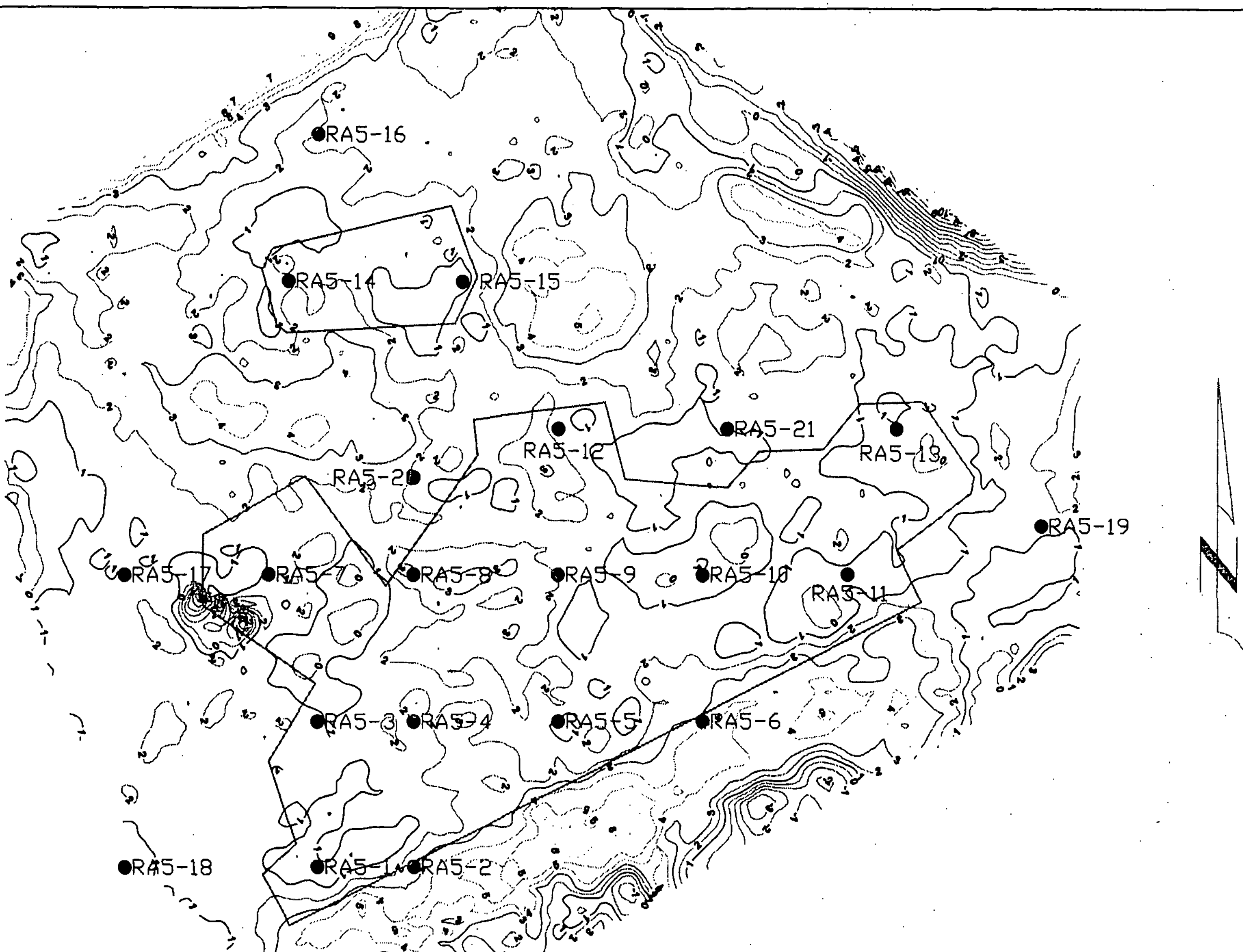
PROJECT: HYDROGRAPHIC_SURVEY ELLIOT_BAY_SEATTLE,WA.

SURVEYED BY: [illegible] PROCESSED BY: [illegible]

SURVEY DATE: [illegible] PROCESSING DATE: [illegible]

DRAWING TITLE: CONTOUR PLOT OF ELLIOT BAY SEATTLE, WA.

DRAWING SCALE:	JOB NO.:	DRAWING NO.:	REV.:
1"=100'	[illegible]	[illegible]	A



NOTES:

1. HORIZONTAL COORDINATES ARE IN WASHINGTON STATE PLANE GRID, NORTH ZONE, NAD-83 DATUM IN U.S. SURVEY FEET.
2. DEPTH DATUM IS MLLW IN U.S. SURVEY FEET. BASED ON NOAA GUAGE NO. [illegible] SEATTLE, WASHINGTON.
3. BASE MAP REFERENCE: [illegible] FROM ANCHOR ENVIRONMENTAL, LLC
4. STANDARD FIELD CALIBRATION PROCEDURES WERE PERFORMED. THE SURVEY AND RESULTS ARE WITHIN MANUFACTURERS SPECIFICATIONS.
5. CONTOUR INTERVAL IS 1.0', CONTOUR LABELS ARE ORIENTED UPHILL.
6. THE INFORMATION DEPICTED ON THE CHART REPRESENTS THE RESULTS OF SURVEY EXECUTED DURING THE PERIOD OF APRIL [illegible]. THIS DATA CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.

CRA-NW

NO.	DATE	DESCRIPTION ISSUE & REVISIONS	DRWN	CHK'D	APP'D
X	[illegible]	ANCHOR_ELLIOT_BAY_BATHYMETRY			

CLIENT: ANCHOR_ENVIRONMENTAL_LLC

APPROVED: DATE [illegible]

PROJECT: HYDROGRAPHIC_SURVEY ELLIOT_BAY_SEATTLE,WA.

SURVEYED BY: [illegible] PROCESSED BY: [illegible]

SURVEY DATE: [illegible] PROCESSING DATE: [illegible]

DRAWING TITLE:

ISOPACH CONTOUR OF ELLIOT BAY SEATTLE, WA.

DRAWING SCALE	JOB NO.	DRAWING NO.	REV.
1"=100'	[illegible]	[illegible]	[illegible]

Appendix F

Memorandum: Chemical Isolation Evaluation of RA5 Cap Engineering During Construction Support, PSR Superfund Site

URS

July 6, 2005

To: Miriam Gilmer, Seattle District, USACE

From: David Schuchardt, Integral Consulting, Inc.
Dave Walker, URS Group, Inc.

Cc: Wendy L.S. Oresik, URS Group, Inc.
Kara Steward, URS Group, Inc.

Subject: Chemical Isolation Evaluation of RA5 Cap Engineering During Construction Support, PSR Superfund Site

Re: Contract No. DACA67-02-D-2003, Delivery Order No. 0017, Modification 0006

Integral Consulting, Inc. and URS have conducted a preliminary evaluation of chemical isolation performance for the as-constructed RA5 cap at the Pacific Sound Resources Superfund Site. This memorandum describes our approach, results, and recommendations.

APPROACH

Inputs to the 1-dimensional advective/diffusive contaminant transport model used in the design (EPA 2003) were modified to assess the projected long-term RA5 cap performance based on as-constructed conditions. The as-constructed cap thickness, chemistry, and total organic carbon (TOC) results (Anchor 2005) were used in this analysis.

Interpreted as-constructed cap thickness is based solely on results of through-cap coring presented in Figure 4 of Anchor's report. The other measurement techniques for cap thickness (sub-bottom profiling and differential multibeam bathymetry) are not considered accurate or reliable considering the acoustic properties of the cap material and the water depths in RA5.

The design cap chemical isolation model was modified previously, as documented in an Engineering During Construction (EDC) memorandum for RAs 1-4 (Schuchardt 2004). This revised analysis for RA5 builds upon the information and assumptions from both the original design (EPA 2003) and the RA1-4 EDC (Schuchardt 2004). Table 1 summarizes the key modeling assumptions used in the Basis of Design, RA1-4 EDC, and this RA5 EDC. The primary parameters that have been modified compared to the RA5 design model are the concentrations of contaminants and dissolved organic carbon in the porewater, the contaminant biodegradation rates, and the cap TOC.

This RA5 EDC modeling focuses on two LPAHs (naphthalene and acenaphthene) and PCBs (as Aroclor-1254). Naphthalene and PCBs were identified as the limiting chemicals in the previous modeling efforts. Acenaphthene has been modeled because it becomes the limiting chemical under certain biodegradation assumptions.

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The model has also been updated to account for colloidal transport of contaminants through the cap. Dissolved organic carbon (DOC) concentrations in porewater have not been measured at this site. A nominal value of 10 milligrams per liter (mg/L) was used, consistent with the range of measured values in other estuarine sediments (e.g., 5.8 to 21.5 mg/L measured by Carr, et al. 2001). This refinement has a small effect on the modeled transport of PCBs, and essentially no effect on LPAHs.

A key modification for this RA5 EDC modeling is a re-examination of biodegradation rates. The EDC model for RAs 1-4 (Schuchardt 2004) used the lowest literature value for all PAHs (under anaerobic aquatic conditions). For acenaphthene, this conservative approach was carried forward to this analysis because the literature biodegradation rates for this chemical are estimates. However, for naphthalene, literature biodegradation rates (under anaerobic aquatic conditions) are based on rates actually measured in estuarine sediments, and results are available as a function of pH (Howard et al. 1991). Therefore, the best estimate of naphthalene biodegradation was taken from Howard and interpolated to the actual porewater pH at PSR (pH = 7.7).

Remedial investigation (RI) and pre-design investigation data were reviewed to assess porewater concentrations and groundwater velocity. Porewater concentrations used in the design were measured from cores collected in RAs 1-4. Because sediment concentrations in RA5 tend to be lower than in RAs 1-4, the best estimate porewater concentrations are calculated based on RA5 sediment data. The values used in the design for groundwater velocity are considered to be the best available values and were not modified.

Chemical isolation was evaluated for a design life of 100 years, which is the timeframe specified by EPA. Two scenarios were analyzed to evaluate the sensitivity of the model to uncertainties in input parameters. The "Best Estimate" scenario is based on conservative estimates of average parameter values. The "Reasonable Worst Case" uses higher values of contaminant concentrations in porewater and porewater velocity and a lower value of the biodegradation rate for naphthalene. Since the "Reasonable Worst Case" scenario is based on low-probability values for three parameters occurring at the same location, it is anticipated that this scenario would represent a very small percentage of the total RA5 area.

Table 2 summarizes the numerical values of key input parameters used in this analysis and the RA5 analysis conducted for the design. The concentrations of naphthalene and acenaphthene used for the "Reasonable Worst Case" are the 95 upper confidence limits (UCLs) of the mean concentrations measured in RA1-4 porewater. The concentration of PCBs used for the "Reasonable Worst Case" is estimated from the single detection of PCBs in sediment at a carbon-normalized concentration exceeding the sediment quality standards (Sample RA5-05). The value of the biodegradation rate used for naphthalene for the "Reasonable Worst Case" is the lowest literature value for all PAHs, as described above. Additional documentation of input parameter estimation is provided in Attachment 1.

RESULTS

Based on the model results using our best estimate assumptions, a minimum 6-inch (15 cm) cap thickness in RA5 is needed to provide the required 100-year design life (assuming the entire cap functions as the chemical isolation layer Ti). Model outputs are provided in Attachment 2. However, this approach assumes the entire cap thickness functions as the chemical isolation layer

(Ti) and does not fully address potential exposures in the bioturbation zone thickness (Tb) and at the point of compliance, as discussed below.

The "reasonable worst case" input assumptions result in a somewhat thicker cap requirement: a minimum 10-inch (25 cm) Ti would be required under these assumptions.

Additivity of Ti and Tb, and Point of Compliance Issues. Consistent with the RA1-4 EDC, contaminant concentrations have been evaluated at the top of the cap (L=0). This is a non-conservative assumption, because the point of compliance is the biologically-active zone (L=0-10 cm). In RAs 1-4, this distinction was insignificant considering the overall cap thickness. However, in RA5, this 0-10 cm point of compliance represents 75% of the modeled minimum cap thickness (Ti = 15 cm). According to the model, a 0-10 cm sample collected from a 15-cm thick cap would be contaminated earlier than 100 years.

The original RA5 cap design considered Ti and Tb to be additive, which is the suggested approach in USACE/EPA cap design guidance. This approach would yield a required cap thickness of 15 cm +10 cm = 25 cm (10 inches). This approach would be conservative because two potentially important processes are not explicitly considered in the 1-D USACE cap model:

- **Sedimentation.** Sedimentation rates in RA5 are anticipated to be 0.06 to 0.12 cm/yr (Ecology 2005). Over the 100-year cap design life, an estimated 6 to 12 cm of clean sediment would be deposited on the existing cap surface. Thus at 100 years, (when the as-constructed cap surface is modeled to just reach the SQS), the compliance interval (0-10 cm) is expected to largely or entirely consist of the newly-deposited clean sediment.
- **Enhanced Biodiffusion.** The biologically-active zone facilitates contaminant diffusion out of the cap surface, which would reduce sediment concentrations in the 0-10 cm compliance interval.

Considering the effects of sedimentation and biodiffusion, it is believed that it would be very conservative to add an additional 10-cm to the required cap thickness to account for Tb. Based on best professional judgement, half of the Tb value (5 cm, or 2 inches) should be added to the modeled Ti to provide a reasonably conservative total thickness. That is, Ti and Tb can reasonably be considered to have a partially overlapping function. Under this approach, a minimum 8-inch thick cap is expected to satisfy the 100-year design life objective under our best estimate assumptions. Areas that exceed the minimum 8-inch thickness requirement are depicted in Figure 1.

CONCLUSIONS AND RECOMMENDATIONS

1) Additional cap material would need to be placed to provide the recommended minimum 8-inch cap thickness throughout RA5. This minimum recommended thickness assumes that the additional cap material has similar TOC as the current material. As shown in Figure 1, additional cap material would need to be placed over approximately 50 percent of RA5a to achieve the recommended minimum thickness. No additional cap material placement is needed in RA5b.

2) The cap thickness data suggest downslope flow of dredged material occurred as the cap was placed. This phenomenon cannot be modeled by STFATE. During the design, no suitable model was identified to assess downslope flow of dredged material during placement. Alternative placement methods and/or materials should be examined to minimize this effect.

3) Ti and Tb were considered to be additive in the original design. However, sedimentation and enhanced biodiffusion are expected to be significant processes over the design life of the cap, and it is reasonable to assume some overlap in the function of Ti and Tb. The 8-inch minimum thickness recommendation could be further refined with an explicit evaluation of these additional transport processes. Relatively straightforward models such as USACE RECOVERY, USACE CAP, or models developed by Danny Reible are recommended if this analysis is needed.

4) Finally, the models described above could be used to evaluate the performance of the cap in areas with less than 8-inches of cap thickness. However, if the results of these models are used as a basis for using a cap thickness of less than 8 inches in some areas, this could be interpreted as a change in the nature of the remedy from "capping" to "enhanced natural recovery" in those areas. If pursued, this approach would likely require EPA to prepare an Explanation of Significant Differences (ESD) explaining the change in remedy.

REFERENCES

Anchor. 2005. Data Report. Construction Monitoring of RA5 Marine Sediment Unit, PSR Superfund Site. Prepared for Seattle District, USACE. May 2005.

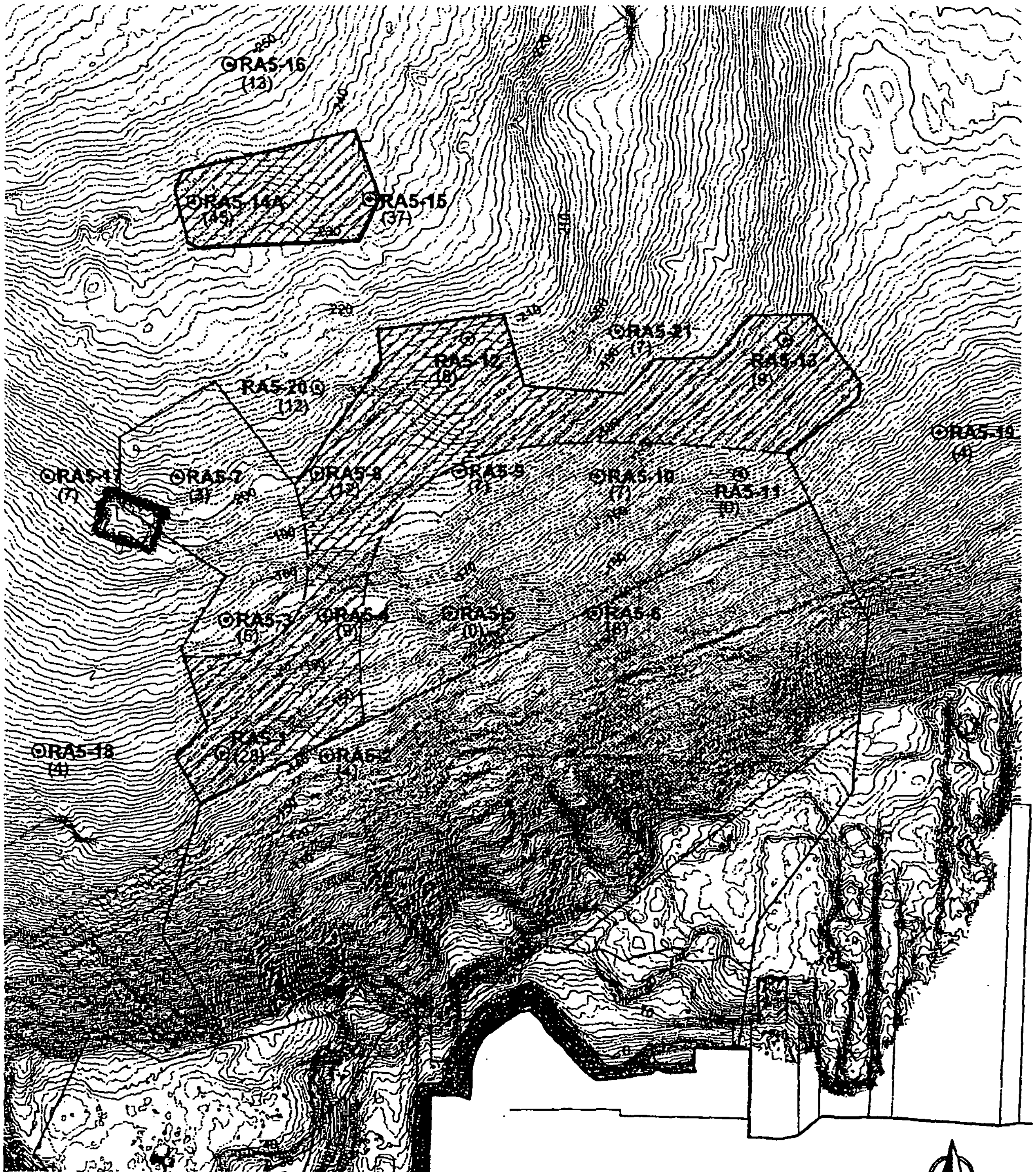
Carr et al. 2001. Survey Data Report in Support of the Sediment Ecological Risk Assessment at the Calcasieu Estuary, Louisiana: Sediment Porewater Toxicity Tests and Dissolved Organic Carbon Analysis of Pore Water. Prepared for Environmental Protection Agency Region 6.

Ecology. 1995. Elliott Bay Waterfront Recontamination Study, Vol. 1: Field Investigation Report, Ecology Publication #95-335. July 1995.

EPA. 2003. Final Design Submittal, PSR Superfund Site. February 2003.

Howard, et al. 1991. Handbook of Environmental Degradation Rates.

Schuchardt, D. 2004. Discussion of Modeling Results for TOC Requirements, PSR EDC. Memorandum to Miriam Gilmer and Travis Shaw, Seattle District USACE. May 6, 2004.



8-inch cap thickness isopleth

Estimated area of cap thickness ≥ 8 inches

⊙RA5-1 Through-Cap Core Location and Number

(12) Estimated RA5 Cap Thickness (in inches)

0 300
Scale in Feet

Figure 1
Comparison of As-Constructed and Recommended Minimum Cap Thickness

Job No. 33756117

URS

Pacific Sound Resources
Marine Sediment Unit

Table 1
Summary of Modeling Assumptions

Model Parameter	Basis of Design (RA5)	EDC Modification (RAs 1-4)	Revised RA5 Analysis	Comments
Analytes Modeled	PAHs, Aroclor 1254, mercury	PAHs, Aroclor 1254	Naphthalene, Acenaphthene, Aroclor 1254	Revised RA5 model analyzes the 2 LPAHs with greatest mobility. RI indicates total PCBs are below SQS in RA5.
Limiting Analyte	Naphthalene	Aroclor 1254	Acenaphthene	Revised RA5 model indicates acenaphthene is limiting analyte
Porewater Concentrations	Measured Porewater	Measured Porewater for PAHs, calculated for PCBs	Calculated Porewater based on RA5 sediment concentrations	Measured porewater was located in RA1-4, where higher sediment concentrations existed.
Groundwater Velocity	Measured Discharge	Measured Discharge	Measured Discharge	No changes. Model is insensitive to this parameter in low-velocity regime (Pe ~1)
Biodegradation (PAHs only)	Assumed Zero	Literature Values	Literature Values (revised)	Literature value for anaerobic aqueous conditions are used. For RA5 analysis, naphthalene value adjusted to pH of PSR sediments.
Isolation Layer Function	Additive to other cap functions	Entire cap is considered	Entire cap is considered	Entire cap is considered
TOC content of cap	Assumed 1 percent	Measured upland source material	Measured RA5 cap material	Mean measured TOC in RA5 cap is 1.67%
Carbon-normalization	Yes, per SMS	No, per SMS (1)	Yes, per SMS	All cap material in RA5 has >0.5 % TOC
Consolidation Losses (Ti, consol)	Based on design cap thickness	Based on design cap thickness	Based on Actual cap thickness	Thinner cap induces less consolidation. Negligible effect on results.
Point of Compliance (sediment)	Top of chemical Isolation layer	Top of cap	Top of cap	See discussion in text on 0-10 cm point of compliance
Point of Compliance (porewater)	Top of chemical Isolation layer	Top of cap	Top of cap	See discussion in text on 0-10 cm point of compliance
Kd,cap calculation	Kd = Koc*foc	Kd = Koc*foc	Kd = Koc*foc/(1+pocKoc)	Model updated to account for colloidal transport, dissolved organic carbon assumed at 10 mg/L
Design Life	140 years was conservatively modeled for design thickness (2)	Modeled life >100 years based on actual thicknesses and materials in RA1-4	Modeled based on actual materials in RA5 and minimum 100-year design life	Required minimum thickness is modeled

Notes:
(1) High-TOC material that may deposit atop cap over time was evaluated for carbon-normalized concentrations
(2) EPA specified a minimum 100-year design life

Table 2
Numerical Values of Model Input Parameters

		Best Estimate		Reasonable worst case			RA5 Design	
Parameter	Units	Naphthalene	Acenaphthene	Aroclor 1254	Naphthalene	Acenaphthene	Naphthalene	Acenaphthene
Chemical parameters								
Organic carbon partition coefficient, Koc	ml/g	2,000	7,080	64,000	2,000	7,080	2,000	7,080
Binary diffusivity (1)	cm2/sec	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
First-order decay constant (2)	1/day	**0.025**	**0.0017**	0	**0.0017**	**0.0017**	0	0
Allowable sediment concentration in biologically active zone	mg/kg OC	99	16	12	99	16	99	16
Allowable porewater concentration in biologically active zone (3)	ug/l	2,350	970	0.03	2,350	970	2,350	970
Cap parameters								
Fraction organic carbon, foc,cap (4)	unitless	**0.0167**	**0.0167**	**0.0167**	**0.0167**	**0.0167**	0.01	0.01
Total porosity, n	unitless	0.45	0.45	0.45	0.45	0.45	0.45	
Effective porosity, ne	unitless	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Sediment-water partition coefficient, Kd	l/kg	33	110	652	33	110	20	71
Seepage velocity, v (5)	ft/day	0.0002	0.0002	0.0004	0.0004	0.0004	0.0002	0.0002
Organic carbon content of groundwater, poc (6)	ug/l	10	10	10	10	10	0	0
Dispersivity, d (7)	ft	=0.01*L	=0.01*L	=0.01*L	=0.01*L	=0.01*L	0.03	0.03
Native sediment parameters								
Chemical concentration in sediment (8)	ug/kg OC	Not used	Not used	18,910	Not used	Not used	Not used	Not used
Chemical concentration in sediment (9)	ug/kg dry	6700	2,600	Not used	Not used	Not used	Not used	Not used
Fraction organic carbon in sediment, foc,sed (10)	unitless	0.0152	0.0152	0.0111	Not used	Not used	Not used	Not used
Chemical concentration in porewater, Co (11)	ug/l	**214**	**26**	0.48	725	132	725	132
Consolidation depth of sediment (12)	ft	0.375	0.375	0.375	0.375	0.375	1.417	1.417

Bold denotes parameter significantly modified for this EDC

Notes

1. Palermo et al 1998
2. Mackay, et al. 1992; Howard et al. 1991. Lowest anaerobic aqueous value used for Acenaphthene. pH-adjusted value used for Naphthalene under Best Estimate conditions.
3. LOEL for naphthalene & acenaphthene; WQC for Arochlor 1254
4. Mean value for RA5
5. Based on pre-design measurements (maximum = 0.0002 feet per day)
6. Based on range of measured values in other estuarine sediments (Carr, et al. 2001)
7. T. Meyers 2002 (USACE)
8. Maximum post-construction concentration
9. 95UCL measured (RI data)
10. 95LCL measured (RI data)
11. Calulated from measured sediment concentration, Koc, and poc for best estimate; measured porewater 95 UCLin Ras 1-4 for PAHs reasonable worst case
12. Table B-5 of design; assumes 1.5-ft thick cap

Attachment 1

Parameter Estimation Calculation Sheets

integral consulting inc.

CREATED BY Saluskan E DATE 6/30/05

CHECKED BY ______ DATE ______

PROJECT PSR EDC - RA5

SUBJECT Porewater Concentrations

Aroclor 1254

$$C_0 = \frac{C_{sed}}{K_{oc}\, f_{oc,sed}} * (1 + \rho_{oc} K_{oc})$$

$C_{sed} = 78 \frac{mg}{kg\,OC}$ (max detected @ EB-08)

$C_{sed} = 8.9\ mg/kg\,OC$ (max detect in RA5 - RI fig 5-1) @EB-77

$C_{sed} = 18.9\ mg/kg\,OC$ (max detect in RA5 - Anchor)

1.64

$$C_0 = \frac{18.9 \frac{mg}{kg\,OC}}{64{,}000\ L/kg} \left(1 + 10 \frac{mg}{L} \cdot 64000 \frac{L}{kg} \cdot \frac{kg}{10^6\ mg}\right)$$

$= 0.00048\ mg/L = 0.48\ \mu g/L$ (theoretical)

Naphthalene

$C_0 = 725\ \mu g/L$ (measured 95% UCL)

$C_{sed} = 548\ mg/kg\,OC$ (max detected @ EB-084)

$$C_0 = \frac{548\ mg/kg\,OC}{2000\ L/kg} \left(1 + \frac{10\ mg}{L} \times 2000 \frac{L}{kg} \times \frac{kg}{10^6\ mg}\right)$$

$= 1.02$, neglect DOC correction for naphthalene

$= 0.27\ mg/L$

$= 270\ \mu g/L$ Theoretical max

integral consulting inc.

CREATED BY DRS DATE 6/30/05

CHECKED BY DATE

PROJECT

SUBJECT Porewater Concentrations in RA 5

Napthalene:

	Measured in Cores (RA1-4) (1)	Measured/Calc'd in RA 5a (2)
Sediment	$\bar{C}_{sed} = 28.4$ mg/kg	$\bar{C}_{sed} = 5.36$ mg/kg
	$= 438$ mg/kg OC	$= 319$ mg/kg OC
	$C_{sed,max} = 130$ mg/kg	$C_{sed,max} = 11.9$ mg/kg
Porewater	$\bar{C}_o = 363$ mg/L	calculated 95 UCL $C_o = 214$ mg/L
	$C_{o,95UCL} = 725$ mg/L	

∴ RA1-4 Pre-design cores encountered substantially higher Sediment concentrations than those measured in RA5

Best estimate C_o should be based on RA5a Sediment Concentrations

(1) Design App. B - Table C-1

(2) RI Sediment Concentrations tabulated by URS

integral consulting inc.

CREATED BY DRS DATE 6/30/05

CHECKED BY DATE

PROJECT PSR EDC

SUBJECT Biodegradation Rates

$$\frac{C}{C_0} = 0.5 = e^{-\lambda t^{1/2}}$$

$$\frac{.693}{t^{1/2}} = \lambda$$

Literature values are measured for anaerobic estuarine sed. @ varying pH

Naphthalene: Anaerobic $t_{1/2}$ = 258 days (pH 5) λ = 0.0027 d^{-1}

$t_{1/2}$ = 25 days (pH 8) λ = 0.028 d^{-1}

PSR porewater had $\overline{pH}$ = 7.7

Interpolating to pH 7.7

$$\lambda = 0.0027 + (0.028 - 0.0027) * \frac{7.7-5}{8-5} = 0.025\ d^{-1}$$ (Best Estimate)

Acenaphthene: Literature values are estimated from aerobic conditions

∴ use lowest est. $t_{1/2}$ = 408 d λ = 0.0017 d^{-1}

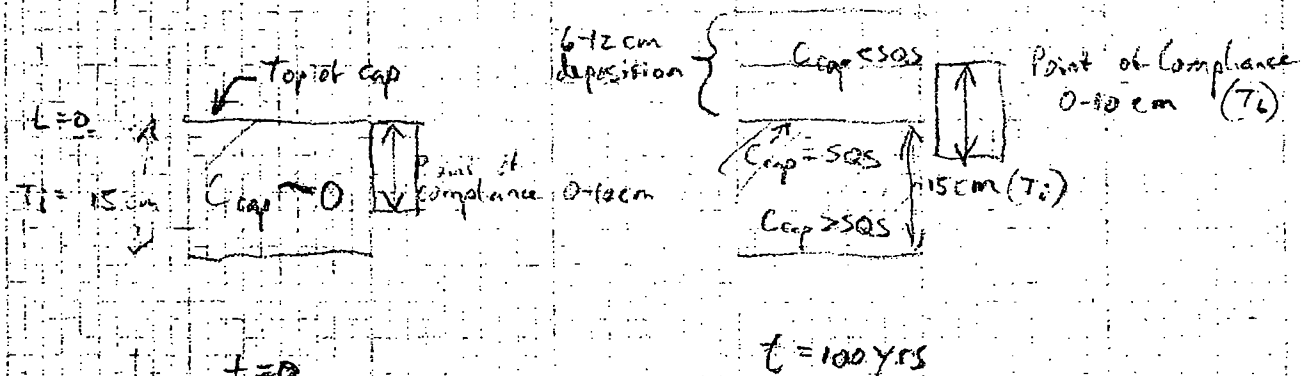
integral consulting inc.

CREATED BY DRG DATE 6/30/05
CHECKED BY DATE
PROJECT PSR EDC-RAS

SUBJECT Effect of Sedimentation

- No Site-Specific sedimentation Rates
- 0.06-0.12 cm/y (Seattle Waterfront, Elliott Bay/Duwamish Restoration Program)
- At $t = 100$ yrs, expect 6-12 cm deposition atop RAS cap

∴ This factor partially offsets the non-conservative assumption of evaluating compliance with SQS at the top of the cap



Recommend adding 5 cm T_b to T_i

Remaining Source of Conservatism: Enhanced biodiffusion will reduce C_{cap} in 0-10 cm mixed layer

Attachment 2
Chemical Isolation Model Output

Reasonable Worst Case Chemical Isolation Analysis for Naphthalene
PSR Superfund Site - RA5a

Advective-Dispersive Transport Formulae:

Kd=foc*Koc	Walton 1991, p.186
R=1+(Kd,cap*p)/ne	Walton 1991, p.184
p=g(1-n)	Krynine and Judd, 1957, p.138
v=K*i/ne	linear velocity calculation
Co=C* *(1+pocKoc)	USEPA 1998
Csed(x,t)=C(x,t)*Kd,cap	Partitioning definition [see note 2]
D = Dw(n^1/3) + dv	[see note 1]
d = 0.01*L	T. Meyers 2002 (USACE)
C/Co= B(x,t) = (0.5*EXP(W)*ERFC(X))+(0.5*EXP(Y)*ERFC(Z))	Van Genuchten and Alves (1982)
W = ((v-m)*x)/(2*D)	
X = (R*x-m*t)/(SQRT(4*D*R*t))	
Y = ((v+m)*x)/(2*D)	
Z = (R*x+m*t)/(SQRT(4*D*R*t))	
m= v*(SQRT(1+((4*u*D)/v^2))	
ERFC()= 1-ERF()	

1D TRANSPORT SOLUTION
Adapted from spreadsheet provided by M. Easterly, USACE

INPUT-SHADED CELLS

	Hydraulic Calculations			Transport Calculations			Chemical Data			
Data:	Kh	[illegible]	ft/d	Koc	2000	ml/g	Naphthalene			
	n	0.45		foc	0.0167		Kd (theoretica	32.7	L/kg	
				poc	10	mg/L	C*	30000	ug/L	
	ne	0.45		R	107.06		Kd, cap	32.7	L/kg	
	g	2.65	gm/cm3	u	0.0027	/d (3)	SQS	99	mg/kgOC	
	DL,sed	0.375	ft	d	0.0083333	ft	WQC	2,350	ug/L	(LOEL)
	L	0.83	ft	Co	725	ug/L (4)	Dw	5.0E-06	cm2/sec	
Results:	p	1.4575	gm/cm3	d	0.254	cm				
	i		ft/ft	u	3.125E-08	/s				
	v	0.0004	ft/d (5)	Kd,cap	32.7	ml/g				
	v	1.411E-07	cm/s	D	3.9E-06	cm2/sec				
				m	7.095E-07	cm/sec	(m=v for u=0)			

Variables:

C(x,t)	Porewater concentration in cap (ug/L)
Co	influent porewater concentration (ugL)
C*	Solubility in water (ug/L)
Csed(x,t)	cap sediment concentration (mg/kgOC)
d	dispersivity (cm)
D	dispersion coefficient (cm2/s)
Dw	binary diffusivity of chemical in water (cm2/s)
DL,sed	consolidation depth of sediment (ft)
foc	cap material organic carbon fraction (/)
g	mass particle density (gm/cm3)
HL	half life (d)
i	head gradient (not used)
Kd	theoretical distribution coefficient (L/kg)
Kd,cap	cap distribution coefficient (L/kg)
Koc	soil-water partition coefficient (g/g)
L	thickness of cap (ft)
n	porosity (/)
ne	effective porosity (/)
p	bulk density (gm/cm3)
R	retardation factor (/)
SQS	State Sediment Quality Standard (mg/kg or mg/kgOC)
t	time (s)
Ti,consol	Cap thickness lost due to expression of porewater during consolidation (ft)
u	first order decay constant (1/d)
v	average linear groundwater velocity (cm/s) (measured)
x	distance from cap bottom (cm)
WQC	State Water Quality Criterion (ug/L)

Conversions:

1 µg =	1.000E-06 gm
1 % wt =	1.0 1g/100ml
1 % wt =	1.00E+04 mg/L
1 mg/L =	1000 ug/l
1 day =	86400 sec
1 foot =	30.48 cm
1 ft/day =	0.00035278 cm/sec

ANALYSIS OF CAP LOSSES DURING CONSOLIDATION

Formula for Short-Term Contaminant Migration Due to Consolidation

Ti,consol = DLsed / (n+p*Kd,cap) USEPA 1998

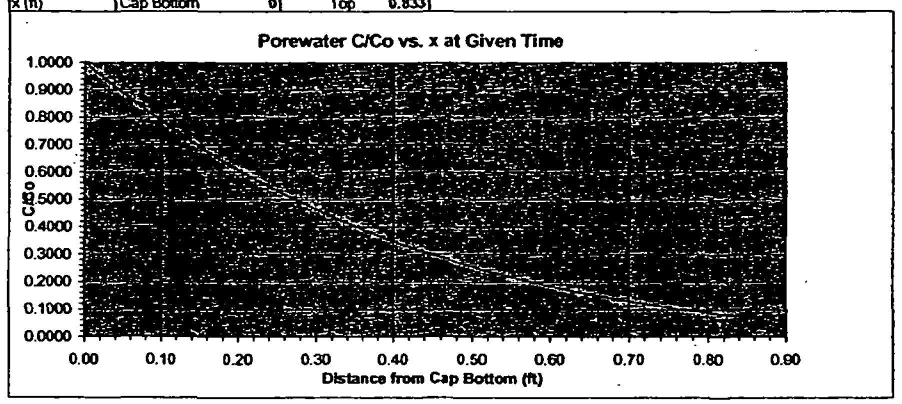
Cap thickness lost due to expression of porewater during consolidation (ft)

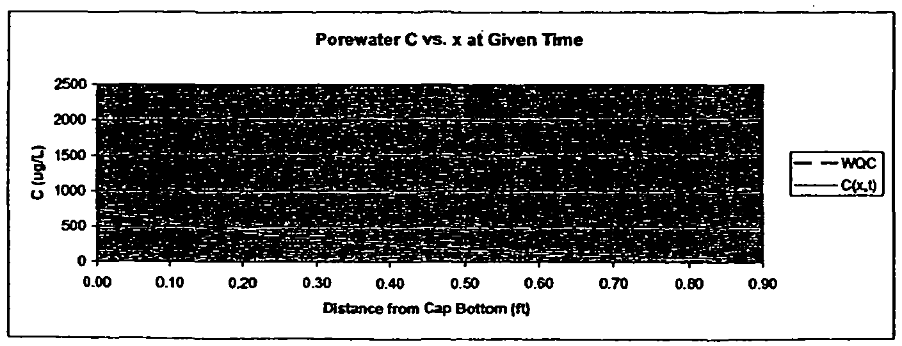
Ti,consol = 0.008 feet (typically negligible)

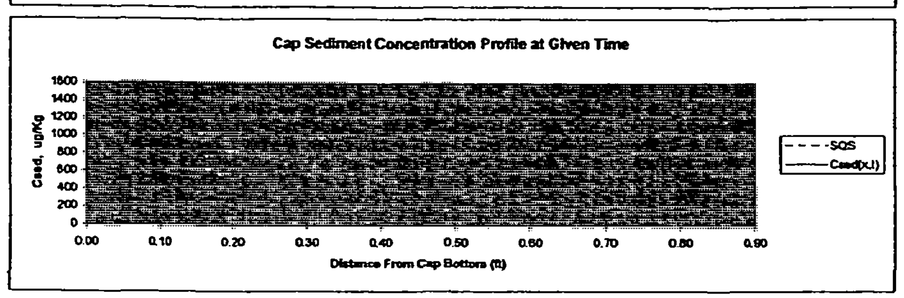
CONCENTRATION PROFILES THROUGH CAP AT GIVEN TIME

Concentration vs. distance output specifications

t	36500	days =	100	yr
x (ft)	Cap Bottom	0	Top	0.833



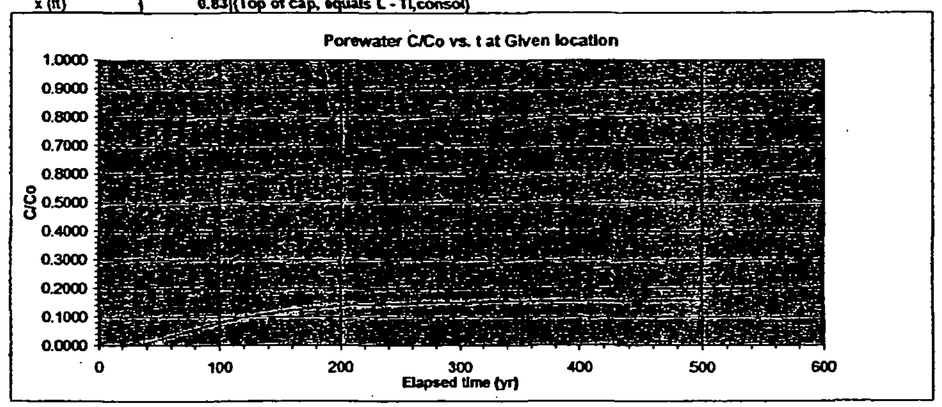


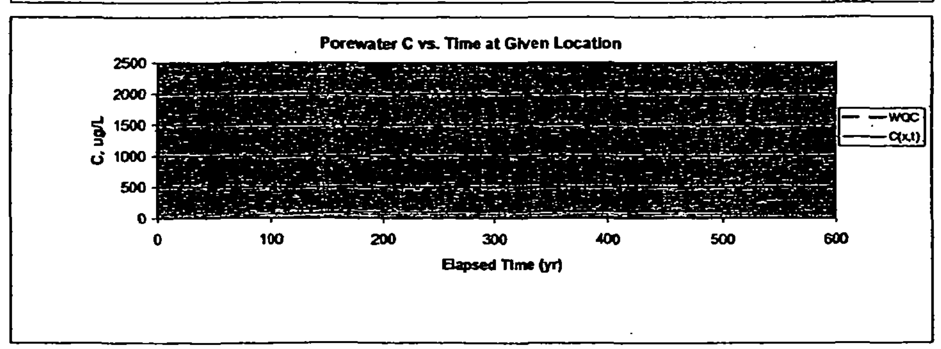


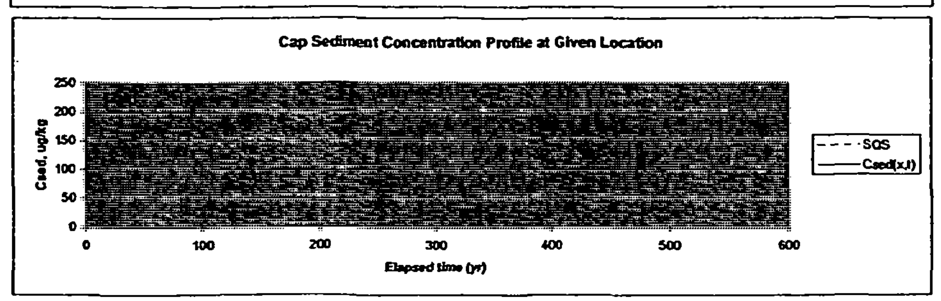
CONCENTRATION PROFILES AT TOP OF CAP

Concentration vs. time output specifications

t (yr)	Start	0	Finish	500
x (ft)	0.83	(Top of cap, equals L - Ti,consol)		







Reasonable Worst Case Chemical Isolation Analysis for Naphthalene
PSR Superfund Site - RA5a

INPUT				CALCULATIONS						OUTPUT				
t (day)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
36500	3.15E+09	0.00	0.0	0.000	-9.79E-01	1.8338	0.000E+00	0.979	0.166	1.0000	2350	725.00	99	1421.57
36500	3.15E+09	0.02	0.5	-0.037	-9.55E-01	1.823	5.586E-02	1.003	0.156	0.9608	2350	696.57	99	1365.82
36500	3.15E+09	0.03	1.0	-0.075	-9.31E-01	1.812	1.117E-01	1.027	0.147	0.9229	2350	669.08	99	1311.92
36500	3.15E+09	0.05	1.5	-0.112	-9.08E-01	1.801	1.676E-01	1.050	0.137	0.8862	2350	642.50	99	1259.81
36500	3.15E+09	0.07	2.0	-0.149	-8.84E-01	1.789	2.235E-01	1.074	0.129	0.8508	2350	616.81	99	1209.43
36500	3.15E+09	0.08	2.5	-0.187	-8.60E-01	1.776	2.793E-01	1.098	0.120	0.8165	2350	591.97	99	1160.72
36500	3.15E+09	0.10	3.0	-0.224	-8.36E-01	1.763	3.352E-01	1.122	0.113	0.7834	2350	567.95	99	1113.63
36500	3.15E+09	0.12	3.6	-0.261	-8.12E-01	1.749	3.910E-01	1.146	0.105	0.7514	2350	544.73	99	1068.10
36500	3.15E+09	0.13	4.1	-0.299	-7.89E-01	1.735	4.469E-01	1.169	0.098	0.7204	2350	522.29	99	1024.09
36500	3.15E+09	0.15	4.6	-0.336	-7.65E-01	1.721	5.028E-01	1.193	0.092	0.6905	2350	500.59	99	981.56
36500	3.15E+09	0.17	5.1	-0.373	-7.41E-01	1.705	5.586E-01	1.217	0.085	0.6616	2350	479.63	99	940.45
36500	3.15E+09	0.18	5.6	-0.411	-7.17E-01	1.690	6.145E-01	1.241	0.079	0.6336	2350	459.37	99	900.73
36500	3.15E+09	0.20	6.1	-0.448	-6.93E-01	1.673	6.704E-01	1.265	0.074	0.6066	2350	439.80	99	862.34
36500	3.15E+09	0.22	6.6	-0.485	-6.70E-01	1.656	7.262E-01	1.288	0.068	0.5805	2350	420.89	99	825.27
36500	3.15E+09	0.23	7.1	-0.523	-6.46E-01	1.639	7.821E-01	1.312	0.063	0.5553	2350	402.62	99	789.46
36500	3.15E+09	0.25	7.6	-0.560	-6.22E-01	1.621	8.379E-01	1.336	0.059	0.5310	2350	384.99	99	754.88
36500	3.15E+09	0.27	8.1	-0.597	-5.98E-01	1.602	8.938E-01	1.360	0.054	0.5075	2350	367.96	99	721.49
36500	3.15E+09	0.28	8.6	-0.635	-5.74E-01	1.583	9.497E-01	1.384	0.050	0.4849	2350	351.53	99	689.27
36500	3.15E+09	0.30	9.1	-0.672	-5.51E-01	1.564	1.006E+00	1.407	0.047	0.4630	2350	335.67	99	658.18
36500	3.15E+09	0.32	9.7	-0.709	-5.27E-01	1.544	1.061E+00	1.431	0.043	0.4419	2350	320.38	99	628.19
36500	3.15E+09	0.33	10.2	-0.747	-5.03E-01	1.523	1.117E+00	1.455	0.040	0.4216	2350	305.63	99	599.27
36500	3.15E+09	0.35	10.7	-0.784	-4.79E-01	1.502	1.173E+00	1.479	0.037	0.4019	2350	291.41	99	571.39
36500	3.15E+09	0.37	11.2	-0.821	-4.55E-01	1.481	1.229E+00	1.503	0.034	0.3830	2350	277.71	99	544.53
36500	3.15E+09	0.38	11.7	-0.859	-4.32E-01	1.458	1.285E+00	1.526	0.031	0.3648	2350	264.51	99	518.65
36500	3.15E+09	0.40	12.2	-0.896	-4.08E-01	1.436	1.341E+00	1.550	0.028	0.3473	2350	251.80	99	493.73
36500	3.15E+09	0.42	12.7	-0.933	-3.84E-01	1.413	1.397E+00	1.574	0.026	0.3304	2350	239.57	99	469.75
36500	3.15E+09	0.43	13.2	-0.971	-3.60E-01	1.390	1.452E+00	1.598	0.024	0.3142	2350	227.81	99	446.68
36500	3.15E+09	0.45	13.7	-1.008	-3.36E-01	1.366	1.508E+00	1.622	0.022	0.2986	2350	216.49	99	424.49
36500	3.15E+09	0.47	14.2	-1.045	-3.13E-01	1.342	1.564E+00	1.645	0.020	0.2838	2350	205.62	99	403.17
36500	3.15E+09	0.48	14.7	-1.082	-2.89E-01	1.317	1.620E+00	1.669	0.018	0.2692	2350	195.17	99	382.69
36500	3.15E+09	0.50	15.2	-1.120	-2.65E-01	1.292	1.676E+00	1.693	0.017	0.2554	2350	185.14	99	363.02
36500	3.15E+09	0.52	15.7	-1.157	-2.41E-01	1.267	1.732E+00	1.717	0.015	0.2421	2350	175.51	99	344.15
36500	3.15E+09	0.53	16.3	-1.194	-2.17E-01	1.242	1.788E+00	1.741	0.014	0.2294	2350	166.28	99	326.05
36500	3.15E+09	0.55	16.8	-1.232	-1.94E-01	1.216	1.843E+00	1.764	0.013	0.2172	2350	157.44	99	308.70
36500	3.15E+09	0.57	17.3	-1.269	-1.70E-01	1.190	1.899E+00	1.788	0.011	0.2056	2350	148.96	99	292.08
36500	3.15E+09	0.58	17.8	-1.306	-1.46E-01	1.164	1.955E+00	1.812	0.010	0.1943	2350	140.85	99	276.17
36500	3.15E+09	0.60	18.3	-1.344	-1.22E-01	1.137	2.011E+00	1.836	0.009	0.1838	2350	133.08	99	260.95
36500	3.15E+09	0.62	18.8	-1.381	-9.85E-02	1.111	2.067E+00	1.859	0.009	0.1733	2350	125.66	99	246.40
36500	3.15E+09	0.63	19.3	-1.418	-7.47E-02	1.084	2.123E+00	1.883	0.008	0.1635	2350	118.57	99	232.49
36500	3.15E+09	0.65	19.8	-1.456	-5.09E-02	1.057	2.179E+00	1.907	0.007	0.1542	2350	111.80	99	219.22
36500	3.15E+09	0.67	20.3	-1.493	-2.71E-02	1.031	2.235E+00	1.931	0.006	0.1453	2350	105.34	99	206.55
36500	3.15E+09	0.68	20.8	-1.530	-3.32E-03	1.004	2.290E+00	1.955	0.006	0.1368	2350	99.18	99	194.47
36500	3.15E+09	0.70	21.3	-1.568	2.05E-02	0.977	2.346E+00	1.978	0.005	0.1287	2350	93.31	99	182.96
36500	3.15E+09	0.72	21.8	-1.605	4.43E-02	0.950	2.402E+00	2.002	0.005	0.1210	2350	87.72	99	172.01
36500	3.15E+09	0.73	22.4	-1.642	6.81E-02	0.923	2.458E+00	2.026	0.004	0.1137	2350	82.41	99	161.59
36500	3.15E+09	0.75	22.9	-1.680	9.19E-02	0.897	2.514E+00	2.050	0.004	0.1067	2350	77.36	99	151.68
36500	3.15E+09	0.77	23.4	-1.717	1.16E-01	0.870	2.570E+00	2.074	0.003	0.1001	2350	72.56	99	142.27
36500	3.15E+09	0.78	23.9	-1.754	1.39E-01	0.844	2.626E+00	2.097	0.003	0.0938	2350	68.00	99	133.34
36500	3.15E+09	0.80	24.4	-1.792	1.63E-01	0.817	2.681E+00	2.121	0.003	0.0878	2350	63.68	99	124.87
36500	3.15E+09	0.82	24.9	-1.829	1.87E-01	0.791	2.737E+00	2.145	0.002	0.0822	2350	59.59	99	116.85
36500	3.15E+09	0.83	25.4	-1.866	2.11E-01	0.766	2.793E+00	2.169	0.002	0.0769	2350	55.72	99	109.25

INPUT				CALCULATIONS						OUTPUT				
t (yr)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
0	0.00E+00	0.83	25.2	-1.849	#DIV/0!	#DIV/0!	2.767E+00	#DIV/0!	#DIV/0!	#DIV/0!	2350	#DIV/0!	99	#DIV/0!
10.0	3.15E+08	0.83	25.2	-1.849	3.42E+00	1.3E-06	2.767E+00	4.037	0.000	0.0000	2350	0.00	99	0.00
20.0	6.31E+08	0.83	25.2	-1.849	2.20E+00	0.00188	2.767E+00	3.074	0.000	0.0003	2350	0.19	99	0.37
30.0	9.46E+08	0.83	25.2	-1.849	1.62E+00	0.0223	2.767E+00	2.688	0.000	0.0029	2350	2.10	99	4.12
40.0	1.26E+09	0.83	25.2	-1.849	1.24E+00	0.07839	2.767E+00	2.483	0.000	0.0097	2350	7.04	99	13.81
50.0	1.58E+09	0.83	25.2	-1.849	9.75E-01	0.16805	2.767E+00	2.359	0.001	0.0200	2350	14.48	99	28.40
60.0	1.89E+09	0.83	25.2	-1.849	7.63E-01	0.2803	2.767E+00	2.280	0.001	0.0321	2350	23.27	99	45.63
70.0	2.21E+09	0.83	25.2	-1.849	5.90E-01	0.40424	2.767E+00	2.228	0.002	0.0448	2350	32.46	99	63.64
80.0	2.52E+09	0.83	25.2	-1.849	4.42E-01	0.53171	2.767E+00	2.194	0.002	0.0571	2350	41.42	99	81.22
90.0	2.84E+09	0.83	25.2	-1.849	3.14E-01	0.65726	2.767E+00	2.171	0.002	0.0687	2350	49.82	99	97.69
100.0	3.15E+09	0.83	25.2	-1.849	2.00E-01	0.77758	2.767E+00	2.158	0.002	0.0793	2350	57.50	99	112.75
110.0	3.47E+09	0.83	25.2	-1.849	9.71E-02	0.89078	2.767E+00	2.151	0.002	0.0888	2350	64.40	99	126.28
120.0	3.78E+09	0.83	25.2	-1.849	3.60E-03	0.99594	2.767E+00	2.148	0.002	0.0973	2350	70.55	99	138.32
130.0	4.10E+09	0.83	25.2	-1.849	-8.24E-02	1.09278	2.767E+00	2.150	0.002	0.1048	2350	75.97	99	148.96
140.0	4.42E+09	0.83	25.2	-1.849	-1.62E-01	1.18138	2.767E+00	2.155	0.002	0.1114	2350	80.74	99	158.31
150.0	4.73E+09	0.83	25.2	-1.849	-2.37E-01	1.26206	2.767E+00	2.161	0.002	0.1171	2350	84.92	99	166.50
160.0	5.05E+09	0.83	25.2	-1.849	-3.06E-01	1.33529	2.767E+00	2.170	0.002	0.1222	2350	88.57	99	173.67
170.0	5.36E+09	0.83	25.2	-1.849	-3.72E-01	1.40157	2.767E+00	2.181	0.002	0.1266	2350	91.76	99	179.93
180.0	5.68E+09	0.83	25.2	-1.849	-4.35E-01	1.46146	2.767E+00	2.192	0.002	0.1304	2350	94.55	99	185.39
190.0	5.99E+09	0.83	25.2	-1.849	-4.94E-01	1.51549	2.767E+00	2.205	0.002	0.1338	2350	96.98	99	190.16
200.0	6.31E+09	0.83	25.2	-1.849	-5.51E-01	1.56418	2.767E+00	2.218	0.002	0.1367	2350	99.10	99	194.32
210.0	6.62E+09	0.83	25.2	-1.849	-6.05E-01	1.60802	2.767E+00	2.232	0.002	0.1392	2350	100.96	99	197.95
220.0	6.94E+09	0.83	25.2	-1.849	-6.57E-01	1.64747	2.767E+00	2.247	0.001	0.1415	2350	102.57	99	201.12
230.0	7.25E+09	0.83	25.2	-1.849	-7.07E-01	1.68295	2.767E+00	2.262	0.001	0.1434	2350	103.98	99	203.89
240.0	7.57E+09	0.83	25.2	-1.849	-7.56E-01	1.71486	2.767E+00	2.278	0.001	0.1451	2350	105.22	99	206.31
250.0	7.88E+09	0.83	25.2	-1.849	-8.02E-01	1.74355	2.767E+00	2.293	0.001	0.1466	2350	106.30	99	208.43
260.0	8.20E+09	0.83	25.2	-1.849	-8.48E-01	1.76933	2.767E+00	2.310	0.001	0.1479	2350	107.24	99	210.28
270.0	8.51E+09	0.83	25.2	-1.849	-8.91E-01	1.79251	2.767E+00	2.326	0.001	0.1491	2350	108.07	99	211.90
280.0	8.83E+09	0.83	25.2	-1.849	-9.34E-01	1.81334	2.767E+00	2.343	0.001	0.1501	2350	108.79	99	213.32
290.0	9.15E+09	0.83	25.2	-1.849	-9.75E-01	1.83206	2.767E+00	2.359	0.001	0.1509	2350	109.43	99	214.56
300.0	9.46E+09	0.83	25.2	-1.849	-1.02E+00	1.84889	2.767E+00	2.376	0.001	0.1517	2350	109.98	99	215.65
310.0	9.78E+09	0.83	25.2	-1.849	-1.05E+00	1.86401	2.767E+00	2.393	0.001	0.1524	2350	110.47	99	216.61
320.0	1.01E+10	0.83	25.2	-1.849	-1.09E+00	1.87761	2.767E+00	2.410	0.001	0.1530	2350	110.90	99	217.45
330.0	1.04E+10	0.83	25.2	-1.849	-1.13E+00	1.88984	2.767E+00	2.427	0.001	0.1535	2350	111.28	99	218.19
340.0	1.07E+10	0.83	25.2	-1.849	-1.17E+00	1.90083	2.767E+00	2.444	0.001	0.1539	2350	111.61	99	218.84
350.0	1.10E+10	0.83	25.2	-1.849	-1.20E+00	1.91071	2.767E+00	2.462	0.000	0.1543	2350	111.90	99	219.42
360.0	1.14E+10	0.83	25.2	-1.849	-1.24E+00	1.9196	2.767E+00	2.479	0.000	0.1547	2350	112.16	99	219.92
370.0	1.17E+10	0.83	25.2	-1.849	-1.27E+00	1.92759	2.767E+00	2.496	0.000	0.1550	2350	112.39	99	220.36
380.0	1.20E+10	0.83	25.2	-1.849	-1.30E+00	1.93478	2.767E+00	2.513	0.000	0.1553	2350	112.58	99	220.76
390.0	1.23E+10	0.83	25.2	-1.849	-1.34E+00	1.94125	2.767E+00	2.530	0.000	0.1555	2350	112.76	99	221.10
400.0	1.26E+10	0.83	25.2	-1.849	-1.37E+00	1.94708	2.767E+00	2.547	0.000	0.1557	2350	112.92	99	221.40
410.0	1.29E+10	0.83	25.2	-1.849	-1.40E+00	1.95232	2.767E+00	2.564	0.000	0.1559	2350	113.05	99	221.67
420.0	1.32E+10	0.83	25.2	-1.849	-1.43E+00	1.95703	2.767E+00	2.582	0.000	0.1561	2350	113.17	99	221.91
430.0	1.36E+10	0.83	25.2	-1.849	-1.46E+00	1.96128	2.767E+00	2.599	0.000	0.1562	2350	113.28	99	222.12
440.0	1.39E+10	0.83	25.2	-1.849	-1.49E+00	1.9651	2.767E+00	2.616	0.000	0.1564	2350	113.38	99	222.31
450.0	1.42E+10	0.83	25.2	-1.849	-1.52E+00	1.96854	2.767E+00	2.632	0.000	0.1565	2350	113.46	99	222.47
460.0	1.45E+10	0.83	25.2	-1.849	-1.55E+00	1.97164	2.767E+00	2.649	0.000	0.1566	2350	113.53	99	222.61
470.0	1.48E+10	0.83	25.2	-1.849	-1.58E+00	1.97443	2.767E+00	2.666	0.000	0.1567	2350	113.60	99	222.74
480.0	1.51E+10	0.83	25.2	-1.849	-1.61E+00	1.97694	2.767E+00	2.683	0.000	0.1568	2350	113.66	99	222.86
490.0	1.55E+10	0.83	25.2	-1.849	-1.63E+00	1.97921	2.767E+00	2.700	0.000	0.1568	2350	113.71	99	222.96
500.0	1.58E+10	0.83	25.2	-1.849	-1.66E+00	1.98125	2.767E+00	2.716	0.000	0.1569	2350	113.75	99	223.05

Note 1: Adapted from Equation B-28, Guidance for Subaqueous Dredged Material Capping. Equation differs by a factor of porosity due to definition of terms

Note 2: Calculated Csed(x,t) is divided by foc to obtain carbon-normalized concentrations

Note 3: Mackay, et al. 1992; Howard et al. 1991. Lowest value for anaerobic groundwater used.

Note 4: 95% Upper Confidence Limit of measured porewater concentrations

Note 5: Highest measured porewater velocity

Best Estimate Chemical Isolation Analysis for Naphthalene
PSR Superfund Site - RA5a

Advective-Dispersive Transport Formulae:

Kd=foc*Koc	Walton 1991, p.186
R=1+(Kd,cap*p)/ne	Walton 1991, p.184
p=g(1-n)	Krynine and Judd, 1957, p.138
v=K*i/ne	linear velocity calculation
Co=C* *(1+pocKoc)	USEPA 1998
Csed(x,t)=C(x,t)*Kd,cap	Partitioning definition [see note 2]
D = Dw(n^1/3) + dv	[see note 1]
d = 0.01*L	T. Meyers 2002 (USACE)
C/Co= B(x,t) = (0.5*EXP(W)*ERFC(X))+(0.5*EXP(Y)*ERFC(Z))	Van Genuchten and Alves (1982)
W = ((v-m)*x)/(2*D)	
X = (R*x-m*t)/(SQRT(4*D*R*t))	
Y = ((v+m)*x)/(2*D)	
Z = (R*x+m*t)/(SQRT(4*D*R*t))	
m= v*(SQRT(1+((4*u*D)/v^2))	
ERFC()= 1-ERF()	

1D TRANSPORT SOLUTION
Adapted from spreadsheet provided by
M. Easterly, USACE

INPUT SHADED CELLS

	Hydraulic Calculations			Transport Calculations			Chemical Data			
Data:	Kh	[illegible]	ft/d	Koc	2000	ml/g	Naphthalene			
	n	0.45		foc	0.0167		Kd (theoretica	32.7	L/kg	
				poc	10	mg/L	C*	30000	ug/L	
	ne	0.45		R	107.06		Kd, cap	32.7	L/kg	
	g	2.65	gm/cm3	u	0.0250	/d (3)	SQS	[illegible]	mg/kgOC	
	DL,sed	0.375	ft	d	0.005	ft	WQC	2,350	ug/L	(LOEL)
	L	0.50	ft	Co	225	ug/L (4)	Dw	5.0E-06	cm2/sec	
Results:	p	1.4575	gm/cm3	d	0.1524	cm				
	i		ft/ft	u	2.894E-07	/s				
	v	0.0002	ft/d (5)	Kd,cap	32.7	ml/g				
	v	7.056E-08	cm/s	D	3.8E-06	cm2/sec				
				m	2.11E-06	cm/sec	(m=v for u=0)			

Variables:

C(x,t)	Porewater concentration in cap (ug/L)
Co	influent porewater concentration (ugL)
C*	Solubility in water (ug/L)
Csed(x,t)	cap sediment concentration (mg/kgOC)
d	dispersivity (cm)
D	dispersion coefficient (cm2/s)
Dw	binary diffusivity of chemical in water (cm2/s)
DL,sed	consolidation depth of sediment (ft)
foc	cap material organic carbon fraction (/)
g	mass particle density (gm/cm3)
HL	half life (d)
i	*head gradient (not used)*
Kd	theoretical distribution coefficient (L/kg)
Kd,cap	cap distribution coefficient (L/kg)
Koc	soil-water partition coefficient (g/g)
L	thickness of cap (ft)
n	porosity (/)
ne	effective porosity (/)
p	bulk density (gm/cm3)
R	retardation factor (/)
SQS	State Sediment Quality Standard (mg/kg or mg/kgOC)
t	time (s)
Tl,consol	Cap thickness lost due to expression of porewater during consolidation (ft)
u	first order decay constant (1/d)
v	average linear groundwater velocity (cm/s) (measured)
x	distance from cap bottom (cm)
WQC	State Water Quality Criterion (ug/L)

Conversions:

1 µg =	1.000E-06 gm
1 % wt =	1.0 1g/100ml
1 % wt =	1.00E+04 mg/L
1 mg/L =	1000 ug/l
1 day =	86400 sec
1 foot =	30.48 cm
1 ft/day =	0.00035278 cm/sec

ANALYSIS OF CAP LOSSES DURING CONSOLIDATION

Formula for Short-Term Contaminant Migration Due to Consolidation

Ti,consol = DLsed / (n+p*Kd,cap) USEPA 1998

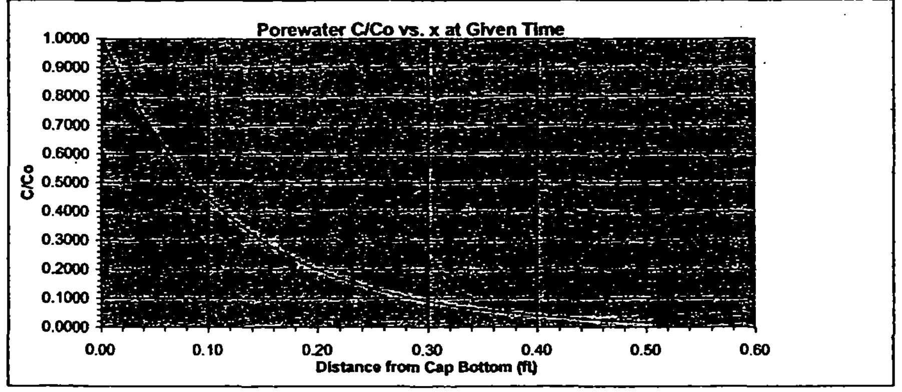
Cap thickness lost due to expression of porewater *during consolidation (ft)*

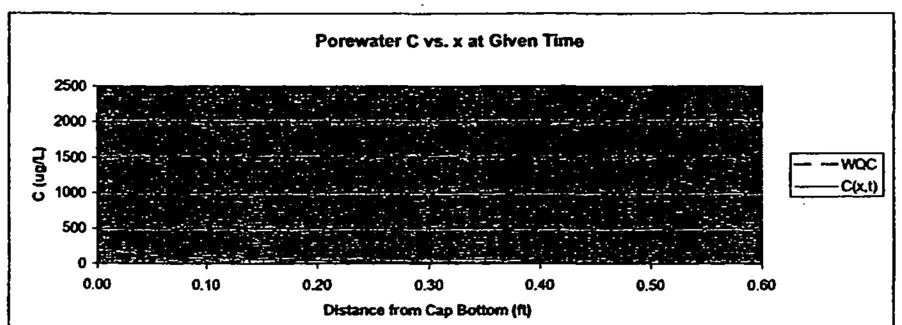
Tl,consol = 0.008 feet (typically negligible)

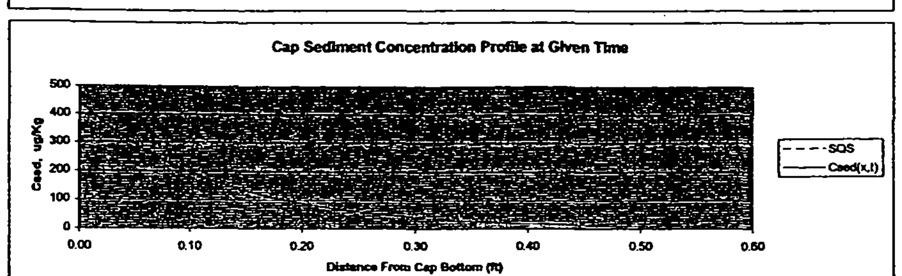
CONCENTRATION PROFILES THROUGH CAP AT GIVEN TIME

Concentration vs. distance output specifications

t	36500 days =	100	yr
x (ft)	Cap Bottom 0	Top	0.500



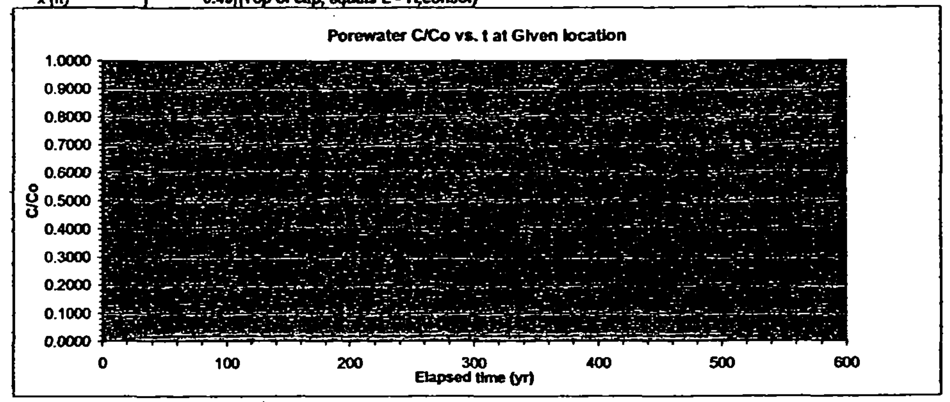


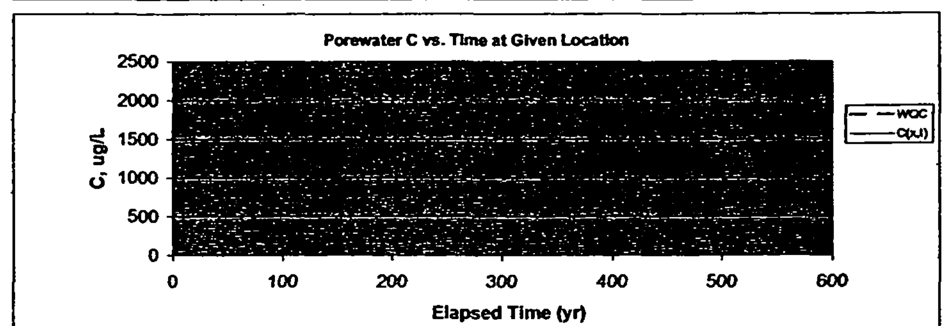


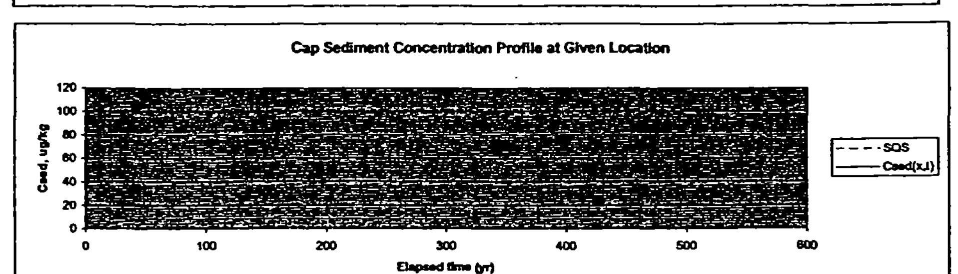
CONCENTRATION PROFILES AT TOP OF CAP

Concentration vs. time output specifications

t (yr)	Start 0	Finish	500
x (ft)	0.49	(Top of cap, equals L - Tl,consol)	







Best Estimate Chemical Isolation Analysis for Naphthalene
PSR Superfund Site - RA5a

INPUT				CALCULATIONS						OUTPUT				
t (day)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
36500	3.15E+09	0.00	0.0	0.000	-2.92E+00	1.99996	0.000E+00	2.921	0.000	1.0000	2350	224.80	99	440.79
36500	3.15E+09	0.01	0.3	-0.081	-2.91E+00	2.000	8.649E-02	2.935	0.000	0.9223	2350	207.33	99	406.54
36500	3.15E+09	0.02	0.6	-0.162	-2.89E+00	2.000	1.730E-01	2.950	0.000	0.8506	2350	191.22	99	374.95
36500	3.15E+09	0.03	0.9	-0.243	-2.88E+00	2.000	2.595E-01	2.964	0.000	0.7845	2350	176.36	99	345.81
36500	3.15E+09	0.04	1.2	-0.324	-2.86E+00	2.000	3.460E-01	2.978	0.000	0.7236	2350	162.66	99	318.94
36500	3.15E+09	0.05	1.5	-0.404	-2.85E+00	2.000	4.324E-01	2.993	0.000	0.6673	2350	150.02	99	294.16
36500	3.15E+09	0.06	1.8	-0.485	-2.84E+00	2.000	5.189E-01	3.007	0.000	0.6155	2350	138.36	99	271.30
36500	3.15E+09	0.07	2.1	-0.566	-2.82E+00	2.000	6.054E-01	3.021	0.000	0.5677	2350	127.61	99	250.22
36500	3.15E+09	0.08	2.4	-0.647	-2.81E+00	2.000	6.919E-01	3.036	0.000	0.5235	2350	117.69	99	230.77
36500	3.15E+09	0.09	2.7	-0.728	-2.79E+00	2.000	7.784E-01	3.050	0.000	0.4829	2350	108.55	99	212.84
36500	3.15E+09	0.10	3.0	-0.809	-2.78E+00	2.000	8.649E-01	3.064	0.000	0.4453	2350	100.11	99	196.30
36500	3.15E+09	0.11	3.4	-0.890	-2.76E+00	2.000	9.514E-01	3.079	0.000	0.4107	2350	92.33	99	181.05
36500	3.15E+09	0.12	3.7	-0.971	-2.75E+00	2.000	1.038E+00	3.093	0.000	0.3788	2350	85.16	99	166.98
36500	3.15E+09	0.13	4.0	-1.052	-2.73E+00	2.000	1.124E+00	3.107	0.000	0.3494	2350	78.54	99	154.00
36500	3.15E+09	0.14	4.3	-1.132	-2.72E+00	2.000	1.211E+00	3.122	0.000	0.3222	2350	72.44	99	142.04
36500	3.15E+09	0.15	4.6	-1.213	-2.71E+00	2.000	1.297E+00	3.136	0.000	0.2972	2350	66.81	99	131.00
36500	3.15E+09	0.16	4.9	-1.294	-2.69E+00	2.000	1.384E+00	3.150	0.000	0.2741	2350	61.62	99	120.82
36500	3.15E+09	0.17	5.2	-1.375	-2.68E+00	2.000	1.470E+00	3.165	0.000	0.2528	2350	56.83	99	111.43
36500	3.15E+09	0.18	5.5	-1.456	-2.66E+00	2.000	1.557E+00	3.179	0.000	0.2332	2350	52.41	99	102.77
36500	3.15E+09	0.19	5.8	-1.537	-2.65E+00	2.000	1.643E+00	3.193	0.000	0.2150	2350	48.34	99	94.79
36500	3.15E+09	0.20	6.1	-1.618	-2.63E+00	2.000	1.730E+00	3.208	0.000	0.1983	2350	44.58	99	87.42
36500	3.15E+09	0.21	6.4	-1.699	-2.62E+00	2.000	1.816E+00	3.222	0.000	0.1829	2350	41.12	99	80.63
36500	3.15E+09	0.22	6.7	-1.780	-2.61E+00	2.000	1.903E+00	3.236	0.000	0.1687	2350	37.92	99	74.36
36500	3.15E+09	0.23	7.0	-1.860	-2.59E+00	2.000	1.989E+00	3.251	0.000	0.1556	2350	34.98	99	68.58
36500	3.15E+09	0.24	7.3	-1.941	-2.58E+00	2.000	2.076E+00	3.265	0.000	0.1435	2350	32.26	99	63.25
36500	3.15E+09	0.25	7.6	-2.022	-2.56E+00	2.000	2.162E+00	3.279	0.000	0.1324	2350	29.75	99	58.34
36500	3.15E+09	0.26	7.9	-2.103	-2.55E+00	2.000	2.249E+00	3.294	0.000	0.1221	2350	27.44	99	53.81
36500	3.15E+09	0.27	8.2	-2.184	-2.53E+00	2.000	2.335E+00	3.308	0.000	0.1126	2350	25.31	99	49.62
36500	3.15E+09	0.28	8.5	-2.265	-2.52E+00	2.000	2.422E+00	3.322	0.000	0.1038	2350	23.34	99	45.77
36500	3.15E+09	0.29	8.8	-2.346	-2.51E+00	2.000	2.508E+00	3.337	0.000	0.0958	2350	21.53	99	42.21
36500	3.15E+09	0.30	9.1	-2.427	-2.49E+00	2.000	2.595E+00	3.351	0.000	0.0883	2350	19.85	99	38.93
36500	3.15E+09	0.31	9.4	-2.508	-2.48E+00	2.000	2.681E+00	3.365	0.000	0.0815	2350	18.31	99	35.91
36500	3.15E+09	0.32	9.8	-2.589	-2.46E+00	2.000	2.768E+00	3.380	0.000	0.0751	2350	16.89	99	33.12
36500	3.15E+09	0.33	10.1	-2.669	-2.45E+00	1.999	2.854E+00	3.394	0.000	0.0693	2350	15.58	99	30.54
36500	3.15E+09	0.34	10.4	-2.750	-2.43E+00	1.999	2.941E+00	3.408	0.000	0.0639	2350	14.37	99	28.17
36500	3.15E+09	0.35	10.7	-2.831	-2.42E+00	1.999	3.027E+00	3.422	0.000	0.0589	2350	13.25	99	25.98
36500	3.15E+09	0.36	11.0	-2.912	-2.41E+00	1.999	3.114E+00	3.437	0.000	0.0544	2350	12.22	99	23.96
36500	3.15E+09	0.37	11.3	-2.993	-2.39E+00	1.999	3.200E+00	3.451	0.000	0.0501	2350	11.27	99	22.10
36500	3.15E+09	0.38	11.6	-3.074	-2.38E+00	1.999	3.287E+00	3.465	0.000	0.0462	2350	10.39	99	20.38
36500	3.15E+09	0.39	11.9	-3.155	-2.36E+00	1.999	3.373E+00	3.480	0.000	0.0426	2350	9.59	99	18.80
36500	3.15E+09	0.40	12.2	-3.236	-2.35E+00	1.999	3.460E+00	3.494	0.000	0.0393	2350	8.84	99	17.34
36500	3.15E+09	0.41	12.5	-3.317	-2.33E+00	1.999	3.546E+00	3.508	0.000	0.0363	2350	8.15	99	15.99
36500	3.15E+09	0.42	12.8	-3.397	-2.32E+00	1.999	3.632E+00	3.523	0.000	0.0335	2350	7.52	99	14.75
36500	3.15E+09	0.43	13.1	-3.478	-2.31E+00	1.999	3.719E+00	3.537	0.000	0.0309	2350	6.94	99	13.60
36500	3.15E+09	0.44	13.4	-3.559	-2.29E+00	1.999	3.805E+00	3.551	0.000	0.0285	2350	6.40	99	12.54
36500	3.15E+09	0.45	13.7	-3.640	-2.28E+00	1.999	3.892E+00	3.566	0.000	0.0262	2350	5.90	99	11.57
36500	3.15E+09	0.46	14.0	-3.721	-2.26E+00	1.999	3.978E+00	3.580	0.000	0.0242	2350	5.44	99	10.67
36500	3.15E+09	0.47	14.3	-3.802	-2.25E+00	1.999	4.065E+00	3.594	0.000	0.0223	2350	5.02	99	9.84
36500	3.15E+09	0.48	14.6	-3.883	-2.23E+00	1.998	4.151E+00	3.609	0.000	0.0206	2350	4.63	99	9.08
36500	3.15E+09	0.49	14.9	-3.964	-2.22E+00	1.998	4.238E+00	3.623	0.000	0.0190	2350	4.27	99	8.37
36500	3.15E+09	0.50	15.2	-4.045	-2.20E+00	1.998	4.324E+00	3.637	0.000	0.0175	2350	3.94	99	7.72

INPUT				CALCULATIONS						OUTPUT				
t (yr)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
0	0.00E+00	0.49	15.0	-3.982	#DIV/0!	#DIV/0!	4.257E+00	#DIV/0!	#DIV/0!	#DIV/0!	2350	#DIV/0!	99	#DIV/0!
10.0	3.15E+08	0.49	15.0	-3.982	1.31E+00	0.06476	4.257E+00	3.153	0.000	0.0009	2350	0.20	99	0.39
20.0	6.31E+08	0.49	15.0	-3.982	2.70E-01	0.70231	4.257E+00	2.883	0.000	0.0082	2350	1.83	99	3.60
30.0	9.46E+08	0.49	15.0	-3.982	-3.13E-01	1.34163	4.257E+00	2.887	0.000	0.0141	2350	3.17	99	6.21
40.0	1.26E+09	0.49	15.0	-3.982	-7.33E-01	1.69985	4.257E+00	2.962	0.000	0.0168	2350	3.79	99	7.42
50.0	1.58E+09	0.49	15.0	-3.982	-1.07E+00	1.8692	4.257E+00	3.063	0.000	0.0180	2350	4.04	99	7.92
60.0	1.89E+09	0.49	15.0	-3.982	-1.35E+00	1.9442	4.257E+00	3.173	0.000	0.0184	2350	4.13	99	8.11
70.0	2.21E+09	0.49	15.0	-3.982	-1.60E+00	1.97646	4.257E+00	3.287	0.000	0.0186	2350	4.17	99	8.18
80.0	2.52E+09	0.49	15.0	-3.982	-1.82E+00	1.99012	4.257E+00	3.401	0.000	0.0186	2350	4.19	99	8.21
90.0	2.84E+09	0.49	15.0	-3.982	-2.03E+00	1.99587	4.257E+00	3.514	0.000	0.0186	2350	4.19	99	8.22
100.0	3.15E+09	0.49	15.0	-3.982	-2.22E+00	1.99828	4.257E+00	3.626	0.000	0.0187	2350	4.19	99	8.22
110.0	3.47E+09	0.49	15.0	-3.982	-2.39E+00	1.99928	4.257E+00	3.736	0.000	0.0187	2350	4.19	99	8.22
120.0	3.78E+09	0.49	15.0	-3.982	-2.56E+00	1.9997	4.257E+00	3.844	0.000	0.0187	2350	4.19	99	8.22
130.0	4.10E+09	0.49	15.0	-3.982	-2.71E+00	1.99987	4.257E+00	3.949	0.000	0.0187	2350	4.19	99	8.22
140.0	4.42E+09	0.49	15.0	-3.982	-2.86E+00	1.99995	4.257E+00	4.052	0.000	0.0187	2350	4.19	99	8.22
150.0	4.73E+09	0.49	15.0	-3.982	-3.00E+00	1.99998	4.257E+00	4.153	0.000	0.0187	2350	4.19	99	8.22
160.0	5.05E+09	0.49	15.0	-3.982	-3.14E+00	1.99999	4.257E+00	4.252	0.000	0.0187	2350	4.19	99	8.22
170.0	5.36E+09	0.49	15.0	-3.982	-3.27E+00	2	4.257E+00	4.349	0.000	0.0187	2350	4.19	99	8.22
180.0	5.68E+09	0.49	15.0	-3.982	-3.39E+00	2	4.257E+00	4.445	0.000	0.0187	2350	4.19	99	8.22
190.0	5.99E+09	0.49	15.0	-3.982	-3.51E+00	2	4.257E+00	4.538	0.000	0.0187	2350	4.19	99	8.22
200.0	6.31E+09	0.49	15.0	-3.982	-3.63E+00	2	4.257E+00	4.630	0.000	0.0187	2350	4.19	99	8.22
210.0	6.62E+09	0.49	15.0	-3.982	-3.75E+00	2	4.257E+00	4.720	0.000	0.0187	2350	4.19	99	8.22
220.0	6.94E+09	0.49	15.0	-3.982	-3.86E+00	2	4.257E+00	4.808	0.000	0.0187	2350	4.19	99	8.22
230.0	7.25E+09	0.49	15.0	-3.982	-3.97E+00	2	4.257E+00	4.895	0.000	0.0187	2350	4.19	99	8.22
240.0	7.57E+09	0.49	15.0	-3.982	-4.07E+00	2	4.257E+00	4.981	0.000	0.0187	2350	4.19	99	8.22
250.0	7.88E+09	0.49	15.0	-3.982	-4.17E+00	2	4.257E+00	5.065	0.000	0.0187	2350	4.19	99	8.22
260.0	8.20E+09	0.49	15.0	-3.982	-4.27E+00	2	4.257E+00	5.147	0.000	0.0187	2350	4.19	99	8.22
270.0	8.51E+09	0.49	15.0	-3.982	-4.37E+00	2	4.257E+00	5.229	0.000	0.0187	2350	4.19	99	8.22
280.0	8.83E+09	0.49	15.0	-3.982	-4.47E+00	2	4.257E+00	5.309	0.000	0.0187	2350	4.19	99	8.22
290.0	9.15E+09	0.49	15.0	-3.982	-4.56E+00	2	4.257E+00	5.389	0.000	0.0187	2350	4.19	99	8.22
300.0	9.46E+09	0.49	15.0	-3.982	-4.65E+00	2	4.257E+00	5.467	0.000	0.0187	2350	4.19	99	8.22
310.0	9.78E+09	0.49	15.0	-3.982	-4.74E+00	2	4.257E+00	5.544	0.000	0.0187	2350	4.19	99	8.22
320.0	1.01E+10	0.49	15.0	-3.982	-4.83E+00	2	4.257E+00	5.620	0.000	0.0187	2350	4.19	99	8.22
330.0	1.04E+10	0.49	15.0	-3.982	-4.92E+00	2	4.257E+00	5.695	0.000	0.0187	2350	4.19	99	8.22
340.0	1.07E+10	0.49	15.0	-3.982	-5.00E+00	2	4.257E+00	5.769	0.000	0.0187	2350	4.19	99	8.22
350.0	1.10E+10	0.49	15.0	-3.982	-5.09E+00	2	4.257E+00	5.842	0.000	0.0187	2350	4.19	99	8.22
360.0	1.14E+10	0.49	15.0	-3.982	-5.17E+00	2	4.257E+00	5.914	0.000	0.0187	2350	4.19	99	8.22
370.0	1.17E+10	0.49	15.0	-3.982	-5.25E+00	2	4.257E+00	5.985	0.000	0.0187	2350	4.19	99	8.22
380.0	1.20E+10	0.49	15.0	-3.982	-5.33E+00	2	4.257E+00	6.056	0.000	0.0187	2350	4.19	99	8.22
390.0	1.23E+10	0.49	15.0	-3.982	-5.41E+00	2	4.257E+00	6.126	0.000	0.0187	2350	4.19	99	8.22
400.0	1.26E+10	0.49	15.0	-3.982	-5.49E+00	2	4.257E+00	6.195	0.000	0.0187	2350	4.19	99	8.22
410.0	1.29E+10	0.49	15.0	-3.982	-5.57E+00	2	4.257E+00	6.263	0.000	0.0187	2350	4.19	99	8.22
420.0	1.32E+10	0.49	15.0	-3.982	-5.64E+00	2	4.257E+00	6.331	0.000	0.0187	2350	4.19	99	8.22
430.0	1.36E+10	0.49	15.0	-3.982	-5.72E+00	2	4.257E+00	6.397	0.000	0.0187	2350	4.19	99	8.22
440.0	1.39E+10	0.49	15.0	-3.982	-5.79E+00	2	4.257E+00	6.464	0.000	0.0187	2350	4.19	99	8.22
450.0	1.42E+10	0.49	15.0	-3.982	-5.86E+00	2	4.257E+00	6.529	0.000	0.0187	2350	4.19	99	8.22
460.0	1.45E+10	0.49	15.0	-3.982	-5.94E+00	2	4.257E+00	6.594	0.000	0.0187	2350	4.19	99	8.22
470.0	1.48E+10	0.49	15.0	-3.982	-6.01E+00	2	4.257E+00	6.658	0.000	0.0187	2350	4.19	99	8.22
480.0	1.51E+10	0.49	15.0	-3.982	-6.08E+00	2	4.257E+00	6.722	0.000	0.0187	2350	4.19	99	8.22
490.0	1.55E+10	0.49	15.0	-3.982	-6.15E+00	2	4.257E+00	6.785	0.000	0.0187	2350	4.19	99	8.22
500.0	1.58E+10	0.49	15.0	-3.982	-6.22E+00	2	4.257E+00	6.847	0.000	0.0187	2350	4.19	99	8.22

Note 1: Adapted from Equation B-28, Guidance for Subaqueous Dredged Material Capping. Equation differs by a factor of porosity due to definition of terms
Note 2: Calculated Csed(x,t) is divided by foc to obtain carbon-normalized concentrations
Note 3: Howard et al. 1991. Interpolated based on measured sediment pH.
Note 4: Calculated from 95% Upper Confidence Limit of measured sediment concentrations and TOC concentrations
Note 5: Average measured porewater velocity

Best Estimate Chemical Isolation Analysis for Acenaphthene
PSR Superfund Site - RA5a

Advective-Dispersive Transport Formulae:

Kd=foc*Koc	Walton 1991, p.186
R=1+(Kd,cap*p)/ne	Walton 1991, p.184
p=g(1-n)	Krynine and Judd, 1957, p.138
v=K*i/ne	linear velocity calculation
Co=C* *(1+pocKoc)	USEPA 1998
Csed(x,t)=C(x,t)*Kd,cap	Partitioning definition [see note 2]
D = Dw(n^1/3) + dv	[see note 1]
d = 0.01*L	T. Meyers 2002 (USACE)
C/Co= B(x,t) = (0.5*EXP(W)*ERFC(X))+(0.5*EXP(Y)*ERFC(Z))	Van Genuchten and Alves (1982)
W = ((v-m)*x)/(2*D)	
X = (R*x-m*t)/(SQRT(4*D*R*t))	
Y = ((v+m)*x)/(2*D)	
Z = (R*x+m*t)/(SQRT(4*D*R*t))	
m= v*(SQRT(1+((4*u*D)/v^2))	
ERFC()= 1-ERF()	

1D TRANSPORT SOLUTION
Adapted from spreadsheet provided by
M. Easterly, USACE

Variables:

		Conversions:	
C(x,t)	Porewater concentration in cap (ug/L)	1 µg =	1.000E-06 gm
Co	influent porewater concentration (ugL)	1 % wt =	1.0 1g/100ml
C*	Solubility in water (ug/L)	1 % wt =	1.00E+04 mg/L
Csed(x,t)	cap sediment concentration (mg/kgOC)	1 mg/L =	1000 ug/l
d	dispersivity (cm)	1 day =	86400 sec
D	dispersion coefficient (cm2/s)		
Dw	binary diffusivity of chemical in water (cm2/s)		
DL,sed	consolidation depth of sediment (ft)		
foc	cap material organic carbon fraction (/)	1 foot =	30.48 cm
g	mass particle density (gm/cm3)	1 ft/day =	0.00035278 cm/sec
HL	half life (d)		
i	head gradient (not used)		
Kd	theoretical distribution coefficient (L/kg)		
Kd,cap	cap distribution coefficient (L/kg)		
Koc	soil-water partition coefficient (g/g)		
L	thickness of cap (ft)		
n	porosity (/)		
ne	effective porosity (/)		
p	bulk density (gm/cm3)		
R	retardation factor (/)		
SQS	State Sediment Quality Standard (mg/kg or mg/kgOC)		
t	time (s)		
Ti,consol	Cap thickness lost due to expression of porewater during consolidation (ft)		
u	first order decay constant (1/d)		
v	average linear groundwater velocity (cm/s) (measured)		
x	distance from cap bottom (cm)		
WQC	State Water Quality Criterion (ug/L)		

ANALYSIS OF CAP LOSSES DURING CONSOLIDATION

Formula for Short-Term Contaminant Migration Due to Consolidation

Ti,consol = DLsed / (n+p*Kd,cap)	USEPA 1998

Cap thickness lost due to expression of porewater during consolidation (ft)

Ti,consol =	0.002 feet	(typically negligible)

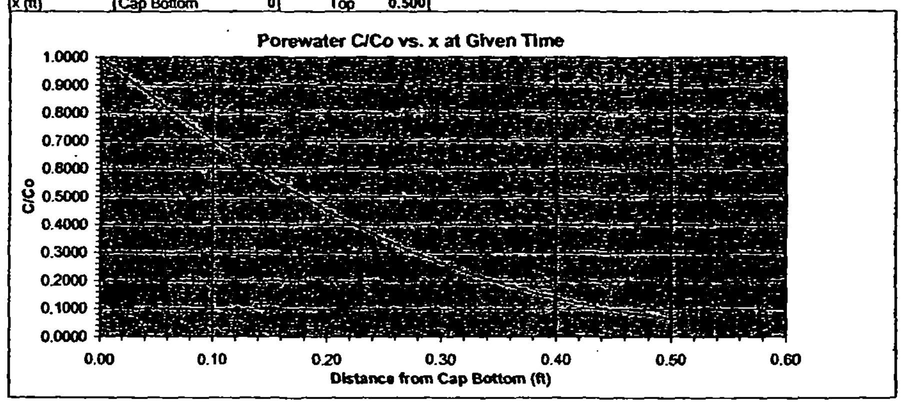
INPUT SHADED CELLS

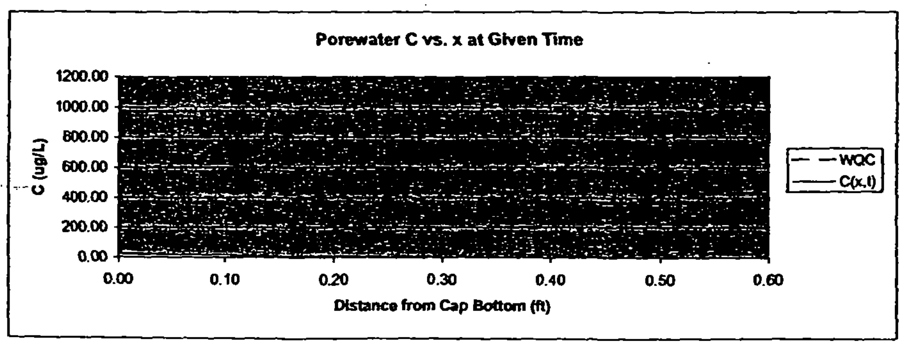
	Hydraulic Calculations			Transport Calculations			Chemical Data			
Data:	Kh	[illegible]	ft/d	Koc	7080	ml/g	Acenaphthene			
	n	0.45		foc	0.0167		Kd (theoretica	110.4	L/kg	
				poc	310	mg/L	C*	4240	ug/L	
	ne	0.45		R	358.63		Kd, cap	110.4	L/kg	
	g	2.65	gm/cm3	u	0.0017	/d (3)	SQS	16	mg/kgOC	
	DL,sed	0.375	ft	d	0.005	ft	WQC	970	ug/L	(LOEL)
	L	0.50	ft	Co	526	ug/L (4)	Dw	5.0E-06	cm2/sec	
Results:	p	1.4575	gm/cm3	d	0.1524	cm				
	i		ft/ft	u	1.968E-08	/s				
	v	0.0002	ft/d (5)	Kd,cap	110.4	ml/g				
	v	7.056E-08	cm/s	D	3.8E-06	cm2/sec				
				m	5.544E-07	cm/sec	(m=v for u=0)			

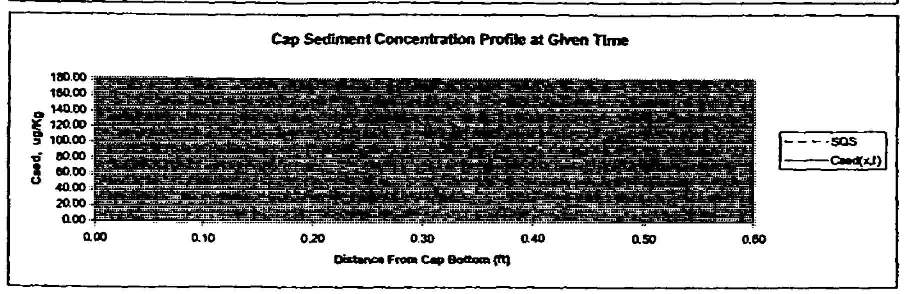
CONCENTRATION PROFILES THROUGH CAP AT GIVEN TIME

Concentration vs. distance output specifications

t	36500 days =	100 yr	
x (ft)	Cap Bottom 0	Top	0.500



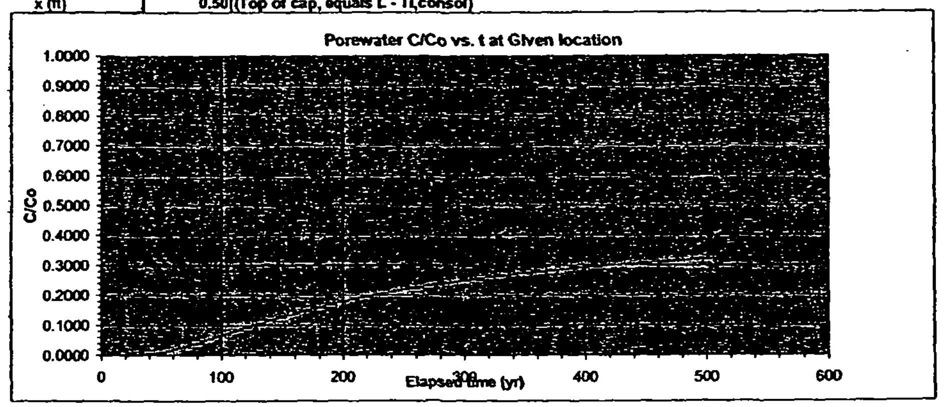


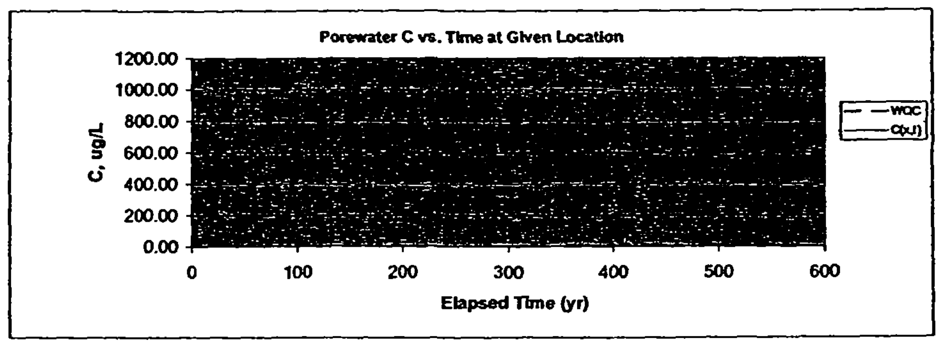


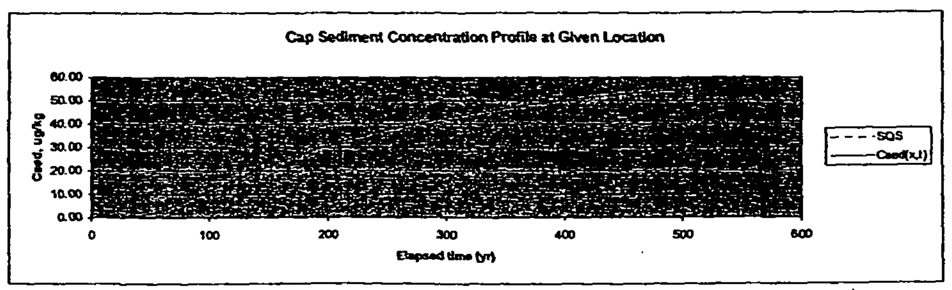
CONCENTRATION PROFILES AT TOP OF CAP

Concentration vs. time output specifications

t (yr)	Start 0	Finish	500
x (ft)	0.50	(Top of cap, equals L - Ti,consol)	







Best Estimate Chemical Isolation Analysis for Acenaphthene
PSR Superfund Site - RA5a

INPUT				CALCULATIONS						OUTPUT				
t (day)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
36500	3.15E+09	0.00	0.0	0.000	-4.19E-01	1.44687	0.000E+00	0.419	0.553	1.0000	970.00	25.87	16.00	171.05
36500	3.15E+09	0.01	0.3	-0.019	-3.93E-01	1.422	2.479E-02	0.446	0.529	0.9683	970.00	25.05	16.00	165.63
36500	3.15E+09	0.02	0.6	-0.038	-3.67E-01	1.396	4.958E-02	0.472	0.505	0.9369	970.00	24.24	16.00	160.27
36500	3.15E+09	0.03	0.9	-0.058	-3.41E-01	1.370	7.437E-02	0.498	0.481	0.9059	970.00	23.44	16.00	154.96
36500	3.15E+09	0.04	1.2	-0.077	-3.14E-01	1.344	9.915E-02	0.524	0.458	0.8752	970.00	22.64	16.00	149.71
36500	3.15E+09	0.05	1.5	-0.096	-2.88E-01	1.316	1.239E-01	0.550	0.436	0.8450	970.00	21.86	16.00	144.53
36500	3.15E+09	0.06	1.8	-0.115	-2.62E-01	1.289	1.487E-01	0.577	0.415	0.8151	970.00	21.09	16.00	139.42
36500	3.15E+09	0.07	2.1	-0.134	-2.36E-01	1.261	1.735E-01	0.603	0.394	0.7856	970.00	20.32	16.00	134.38
36500	3.15E+09	0.08	2.4	-0.154	-2.10E-01	1.233	1.983E-01	0.629	0.374	0.7566	970.00	19.57	16.00	129.42
36500	3.15E+09	0.09	2.7	-0.173	-1.83E-01	1.205	2.231E-01	0.655	0.354	0.7280	970.00	18.83	16.00	124.53
36500	3.15E+09	0.10	3.0	-0.192	-1.57E-01	1.176	2.479E-01	0.682	0.335	0.7000	970.00	18.11	16.00	119.73
36500	3.15E+09	0.11	3.4	-0.211	-1.31E-01	1.147	2.727E-01	0.708	0.317	0.6724	970.00	17.40	16.00	115.02
36500	3.15E+09	0.12	3.7	-0.230	-1.05E-01	1.118	2.975E-01	0.734	0.299	0.6454	970.00	16.70	16.00	110.40
36500	3.15E+09	0.13	4.0	-0.249	-7.85E-02	1.088	3.223E-01	0.760	0.282	0.6189	970.00	16.01	16.00	105.86
36500	3.15E+09	0.14	4.3	-0.269	-5.23E-02	1.059	3.470E-01	0.786	0.266	0.5930	970.00	15.34	16.00	101.43
36500	3.15E+09	0.15	4.6	-0.288	-2.61E-02	1.029	3.718E-01	0.813	0.250	0.5676	970.00	14.68	16.00	97.09
36500	3.15E+09	0.16	4.9	-0.307	1.29E-04	1.000	3.966E-01	0.839	0.235	0.5428	970.00	14.04	16.00	92.85
36500	3.15E+09	0.17	5.2	-0.326	2.63E-02	0.970	4.214E-01	0.865	0.221	0.5186	970.00	13.42	16.00	88.71
36500	3.15E+09	0.18	5.5	-0.345	5.26E-02	0.941	4.462E-01	0.891	0.207	0.4951	970.00	12.81	16.00	84.68
36500	3.15E+09	0.19	5.8	-0.365	7.88E-02	0.911	4.710E-01	0.918	0.194	0.4721	970.00	12.21	16.00	80.76
36500	3.15E+09	0.20	6.1	-0.384	1.05E-01	0.882	4.958E-01	0.944	0.182	0.4498	970.00	11.64	16.00	76.94
36500	3.15E+09	0.21	6.4	-0.403	1.31E-01	0.853	5.206E-01	0.970	0.170	0.4281	970.00	11.08	16.00	73.23
36500	3.15E+09	0.22	6.7	-0.422	1.57E-01	0.824	5.453E-01	0.996	0.159	0.4071	970.00	10.53	16.00	69.64
36500	3.15E+09	0.23	7.0	-0.441	1.84E-01	0.795	5.701E-01	1.022	0.148	0.3867	970.00	10.00	16.00	66.15
36500	3.15E+09	0.24	7.3	-0.461	2.10E-01	0.767	5.949E-01	1.049	0.138	0.3670	970.00	9.49	16.00	62.78
36500	3.15E+09	0.25	7.6	-0.480	2.36E-01	0.738	6.197E-01	1.075	0.129	0.3479	970.00	9.00	16.00	59.51
36500	3.15E+09	0.26	7.9	-0.499	2.62E-01	0.711	6.445E-01	1.101	0.119	0.3295	970.00	8.52	16.00	56.36
36500	3.15E+09	0.27	8.2	-0.518	2.89E-01	0.683	6.693E-01	1.127	0.111	0.3118	970.00	8.07	16.00	53.33
36500	3.15E+09	0.28	8.5	-0.537	3.15E-01	0.656	6.941E-01	1.153	0.103	0.2946	970.00	7.62	16.00	50.40
36500	3.15E+09	0.29	8.8	-0.557	3.41E-01	0.630	7.189E-01	1.180	0.095	0.2782	970.00	7.20	16.00	47.58
36500	3.15E+09	0.30	9.1	-0.576	3.67E-01	0.604	7.437E-01	1.206	0.088	0.2624	970.00	6.79	16.00	44.88
36500	3.15E+09	0.31	9.4	-0.595	3.93E-01	0.578	7.684E-01	1.232	0.081	0.2472	970.00	6.39	16.00	42.28
36500	3.15E+09	0.32	9.8	-0.614	4.20E-01	0.553	7.932E-01	1.258	0.075	0.2326	970.00	6.02	16.00	39.79
36500	3.15E+09	0.33	10.1	-0.633	4.46E-01	0.528	8.180E-01	1.285	0.069	0.2187	970.00	5.66	16.00	37.41
36500	3.15E+09	0.34	10.4	-0.653	4.72E-01	0.504	8.428E-01	1.311	0.064	0.2054	970.00	5.31	16.00	35.13
36500	3.15E+09	0.35	10.7	-0.672	4.98E-01	0.481	8.676E-01	1.337	0.059	0.1927	970.00	4.98	16.00	32.96
36500	3.15E+09	0.36	11.0	-0.691	5.24E-01	0.458	8.924E-01	1.363	0.054	0.1806	970.00	4.67	16.00	30.89
36500	3.15E+09	0.37	11.3	-0.710	5.51E-01	0.436	9.172E-01	1.389	0.049	0.1690	970.00	4.37	16.00	28.91
36500	3.15E+09	0.38	11.6	-0.729	5.77E-01	0.415	9.420E-01	1.416	0.045	0.1580	970.00	4.09	16.00	27.03
36500	3.15E+09	0.39	11.9	-0.748	6.03E-01	0.394	9.668E-01	1.442	0.041	0.1476	970.00	3.82	16.00	25.25
36500	3.15E+09	0.40	12.2	-0.768	6.29E-01	0.373	9.915E-01	1.468	0.038	0.1377	970.00	3.56	16.00	23.55
36500	3.15E+09	0.41	12.5	-0.787	6.56E-01	0.354	1.016E+00	1.494	0.035	0.1283	970.00	3.32	16.00	21.96
36500	3.15E+09	0.42	12.8	-0.806	6.82E-01	0.335	1.041E+00	1.521	0.032	0.1194	970.00	3.09	16.00	20.43
36500	3.15E+09	0.43	13.1	-0.825	7.08E-01	0.317	1.066E+00	1.547	0.029	0.1111	970.00	2.87	16.00	19.00
36500	3.15E+09	0.44	13.4	-0.844	7.34E-01	0.299	1.091E+00	1.573	0.026	0.1031	970.00	2.67	16.00	17.64
36500	3.15E+09	0.45	13.7	-0.864	7.60E-01	0.282	1.115E+00	1.599	0.024	0.0957	970.00	2.48	16.00	16.37
36500	3.15E+09	0.46	14.0	-0.883	7.87E-01	0.266	1.140E+00	1.625	0.022	0.0887	970.00	2.29	16.00	15.16
36500	3.15E+09	0.47	14.3	-0.902	8.13E-01	0.250	1.165E+00	1.652	0.020	0.0820	970.00	2.12	16.00	14.03
36500	3.15E+09	0.48	14.6	-0.921	8.39E-01	0.235	1.190E+00	1.678	0.018	0.0758	970.00	1.96	16.00	12.97
36500	3.15E+09	0.49	14.9	-0.940	8.65E-01	0.221	1.215E+00	1.704	0.016	0.0700	970.00	1.81	16.00	11.98
36500	3.15E+09	0.50	15.2	-0.960	8.92E-01	0.207	1.239E+00	1.730	0.014	0.0646	970.00	1.67	16.00	11.05

INPUT				CALCULATIONS						OUTPUT				
t (yr)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
0	0.00E+00	0.50	15.2	-0.955	#DIV/0!	#DIV/0!	1.234E+00	#DIV/0!	#DIV/0!	#DIV/0!	970.00	#DIV/0!	16.00	#DIV/0!
10.0	3.15E+08	0.50	15.2	-0.955	3.99E+00	1.6E-08	1.234E+00	4.259	0.000	0.0000	970.00	0.00	16.00	0.00
20.0	6.31E+08	0.50	15.2	-0.955	2.73E+00	0.00011	1.234E+00	3.105	0.000	0.0000	970.00	0.00	16.00	0.01
30.0	9.46E+08	0.50	15.2	-0.955	2.15E+00	0.00233	1.234E+00	2.612	0.000	0.0008	970.00	0.02	16.00	0.14
40.0	1.26E+09	0.50	15.2	-0.955	1.80E+00	0.011	1.234E+00	2.328	0.001	0.0038	970.00	0.10	16.00	0.65
50.0	1.58E+09	0.50	15.2	-0.955	1.55E+00	0.0285	1.234E+00	2.142	0.002	0.0097	970.00	0.25	16.00	1.66
60.0	1.89E+09	0.50	15.2	-0.955	1.36E+00	0.05449	1.234E+00	2.009	0.004	0.0182	970.00	0.47	16.00	3.11
70.0	2.21E+09	0.50	15.2	-0.955	1.21E+00	0.08738	1.234E+00	1.910	0.007	0.0287	970.00	0.74	16.00	4.90
80.0	2.52E+09	0.50	15.2	-0.955	1.08E+00	0.12536	1.234E+00	1.834	0.009	0.0404	970.00	1.05	16.00	6.91
90.0	2.84E+09	0.50	15.2	-0.955	9.78E-01	0.16682	1.234E+00	1.773	0.012	0.0530	970.00	1.37	16.00	9.06
100.0	3.15E+09	0.50	15.2	-0.955	8.65E-01	0.21040	1.234E+00	1.724	0.015	0.0658	970.00	1.70	16.00	11.26
110.0	3.47E+09	0.50	15.2	-0.955	8.04E-01	0.25537	1.234E+00	1.684	0.017	0.0787	970.00	2.04	16.00	13.47
120.0	3.78E+09	0.50	15.2	-0.955	7.32E-01	0.30074	1.234E+00	1.651	0.020	0.0915	970.00	2.37	16.00	15.65
130.0	4.10E+09	0.50	15.2	-0.955	6.66E-01	0.34607	1.234E+00	1.623	0.022	0.1039	970.00	2.69	16.00	17.78
140.0	4.42E+09	0.50	15.2	-0.955	6.07E-01	0.39098	1.234E+00	1.599	0.024	0.1160	970.00	3.00	16.00	19.84
150.0	4.73E+09	0.50	15.2	-0.955	5.52E-01	0.4352	1.234E+00	1.579	0.026	0.1276	970.00	3.30	16.00	21.82
160.0	5.05E+09	0.50	15.2	-0.955	5.01E-01	0.47854	1.234E+00	1.562	0.027	0.1387	970.00	3.59	16.00	23.73
170.0	5.36E+09	0.50	15.2	-0.955	4.54E-01	0.52087	1.234E+00	1.548	0.028	0.1494	970.00	3.86	16.00	25.55
180.0	5.68E+09	0.50	15.2	-0.955	4.10E-01	0.5621	1.234E+00	1.535	0.030	0.1595	970.00	4.13	16.00	27.29
190.0	5.99E+09	0.50	15.2	-0.955	3.69E-01	0.60221	1.234E+00	1.525	0.031	0.1692	970.00	4.38	16.00	28.94
200.0	6.31E+09	0.50	15.2	-0.955	3.30E-01	0.64115	1.234E+00	1.516	0.032	0.1784	970.00	4.62	16.00	30.52
210.0	6.62E+09	0.50	15.2	-0.955	2.93E-01	0.67892	1.234E+00	1.508	0.033	0.1872	970.00	4.84	16.00	32.02
220.0	6.94E+09	0.50	15.2	-0.955	2.58E-01	0.71553	1.234E+00	1.502	0.034	0.1955	970.00	5.06	16.00	33.44
230.0	7.25E+09	0.50	15.2	-0.955	2.24E-01	0.751	1.234E+00	1.496	0.034	0.2034	970.00	5.26	16.00	34.80
240.0	7.57E+09	0.50	15.2	-0.955	1.93E-01	0.78535	1.234E+00	1.492	0.035	0.2109	970.00	5.46	16.00	36.08
250.0	7.88E+09	0.50	15.2	-0.955	1.62E-01	0.8186	1.234E+00	1.488	0.035	0.2181	970.00	5.64	16.00	37.31
260.0	8.20E+09	0.50	15.2	-0.955	1.33E-01	0.85079	1.234E+00	1.485	0.036	0.2249	970.00	5.82	16.00	38.47
270.0	8.51E+09	0.50	15.2	-0.955	1.05E-01	0.88195	1.234E+00	1.483	0.036	0.2314	970.00	5.99	16.00	39.58
280.0	8.83E+09	0.50	15.2	-0.955	7.81E-02	0.91211	1.234E+00	1.482	0.036	0.2375	970.00	6.15	16.00	40.63
290.0	9.15E+09	0.50	15.2	-0.955	5.21E-02	0.9413	1.234E+00	1.480	0.036	0.2434	970.00	6.30	16.00	41.64
300.0	9.46E+09	0.50	15.2	-0.955	2.70E-02	0.96956	1.234E+00	1.480	0.036	0.2490	970.00	6.44	16.00	42.59
310.0	9.78E+09	0.50	15.2	-0.955	2.72E-03	0.99693	1.234E+00	1.479	0.036	0.2543	970.00	6.58	16.00	43.50
320.0	1.01E+10	0.50	15.2	-0.955	-2.08E-02	1.02342	1.234E+00	1.480	0.036	0.2594	970.00	6.71	16.00	44.37
330.0	1.04E+10	0.50	15.2	-0.955	-4.35E-02	1.04909	1.234E+00	1.480	0.036	0.2642	970.00	6.84	16.00	45.19
340.0	1.07E+10	0.50	15.2	-0.955	-6.56E-02	1.07396	1.234E+00	1.481	0.036	0.2688	970.00	6.95	16.00	45.98
350.0	1.10E+10	0.50	15.2	-0.955	-8.71E-02	1.09803	1.234E+00	1.482	0.036	0.2732	970.00	7.07	16.00	46.73
360.0	1.14E+10	0.50	15.2	-0.955	-1.08E-01	1.12138	1.234E+00	1.483	0.036	0.2774	970.00	7.18	16.00	47.45
370.0	1.17E+10	0.50	15.2	-0.955	-1.28E-01	1.144	1.234E+00	1.485	0.036	0.2814	970.00	7.28	16.00	48.14
380.0	1.20E+10	0.50	15.2	-0.955	-1.48E-01	1.16593	1.234E+00	1.487	0.035	0.2852	970.00	7.38	16.00	48.79
390.0	1.23E+10	0.50	15.2	-0.955	-1.67E-01	1.1872	1.234E+00	1.489	0.035	0.2889	970.00	7.47	16.00	49.42
400.0	1.26E+10	0.50	15.2	-0.955	-1.86E-01	1.20783	1.234E+00	1.491	0.035	0.2924	970.00	7.56	16.00	50.01
410.0	1.29E+10	0.50	15.2	-0.955	-2.05E-01	1.22784	1.234E+00	1.494	0.035	0.2957	970.00	7.65	16.00	50.59
420.0	1.32E+10	0.50	15.2	-0.955	-2.23E-01	1.24725	1.234E+00	1.496	0.034	0.2989	970.00	7.73	16.00	51.13
430.0	1.36E+10	0.50	15.2	-0.955	-2.40E-01	1.26609	1.234E+00	1.499	0.034	0.3020	970.00	7.81	16.00	51.66
440.0	1.39E+10	0.50	15.2	-0.955	-2.58E-01	1.28438	1.234E+00	1.502	0.034	0.3049	970.00	7.89	16.00	52.16
450.0	1.42E+10	0.50	15.2	-0.955	-2.75E-01	1.30214	1.234E+00	1.505	0.033	0.3077	970.00	7.96	16.00	52.64
460.0	1.45E+10	0.50	15.2	-0.955	-2.91E-01	1.31938	1.234E+00	1.508	0.033	0.3104	970.00	8.03	16.00	53.10
470.0	1.48E+10	0.50	15.2	-0.955	-3.07E-01	1.33613	1.234E+00	1.511	0.033	0.3130	970.00	8.10	16.00	53.54
480.0	1.51E+10	0.50	15.2	-0.955	-3.23E-01	1.35239	1.234E+00	1.514	0.032	0.3155	970.00	8.16	16.00	53.97
490.0	1.55E+10	0.50	15.2	-0.955	-3.39E-01	1.3682	1.234E+00	1.518	0.032	0.3179	970.00	8.22	16.00	54.37
500.0	1.58E+10	0.50	15.2	-0.955	-3.54E-01	1.38356	1.234E+00	1.521	0.031	0.3202	970.00	8.28	16.00	54.76

Note 1: Adapted from Equation B-28, Guidance for Subaqueous Dredged Material Capping. Equation differs by a factor of porosity due to definition of terms
Note 2: Calculated Csed(x,t) is divided by foc to obtain carbon-normalized concentrations
Note 3: Mackay, et al. 1992; Howard et al. 1991. Lowest value for anaerobic groundwater used.
Note 4: Calculated from 95% Upper Confidence Limit of measured sediment concentrations and TOC concentrations
Note 5: Average measured porewater velocity

Reasonable Worst Case Chemical Isolation Analysis for Acenaphthene
PSR Superfund Site - RA5a

Advective-Dispersive Transport Formulae:

Kd=foc*Koc	Walton 1991, p.186
R=1+(Kd,cap*p)/ne	Walton 1991, p.184
p=g(1-n)	Krynine and Judd,1957, p.138
v=K*i/ne	linear velocity calculation
Co=C* *(1+pocKoc)	USEPA 1998
Csed(x,t)=C(x,t)*Kd,cap	Partitioning definition [see note 2]
D = Dw(n^1/3) + dv	[see note 1]
d = 0.01*L	T. Meyers 2002 (USACE)
C/Co= B(x,t) = (0.5*EXP(W)*ERFC(X))+(0.5*EXP(Y)*ERFC(Z))	Van Genuchten and Alves (1982)
W = ((v-m)*x)/(2*D)	
X = (R*x-m*t)/(SQRT(4*D*R*t))	
Y = ((v+m)*x)/(2*D)	
Z = (R*x+m*t)/(SQRT(4*D*R*t))	
m= v*(SQRT(1+((4*u*D)/v^2))	
ERFC()= 1-ERF()	

1D TRANSPORT SOLUTION
Adapted from spreadsheet provided by
M. Easterly, USACE

INPUT SHADED CELLS

	Hydraulic Calculations			Transport Calculations			Chemical Data			
Data:	Kh	[illegible]	ft/d	Koc	7080	ml/g	Acenaphthene			
	n	0.45		foc	0.0167		Kd (theoretica	110.4	L/kg	
				poc	10	mg/L	C*	4240	ug/L	
	ne	0.45		R	358.63		Kd, cap	110.4	L/kg	
	g	2.65	gm/cm3	u	0.0017	/d (3)	SQS	16	mg/kgOC	
	DL,sed	0.375	ft	d	0.0083333	ft	WQC	970	ug/L	(LOEL)
	L	0.83	ft	Co	132	ug/L (4)	Dw	5.0E-06	cm2/sec	
Results:	p	1.4575	gm/cm3	d	0.254	cm				
	i		ft/ft	u	1.968E-08	/s				
	v	0.0004	ft/d (5)	Kd,cap	110.4	ml/g				
	v	1.411E-07	cm/s	D	3.9E-06	cm2/sec				
				m	5.695E-07	cm/sec	(m=v for u=0)			

Variables:

C(x,t)	Porewater concentration in cap (ug/L)
Co	influent porewater concentration (ugL)
C*	Solubility in water (ug/L)
Csed(x,t)	cap sediment concentration (mg/kgOC)
d	dispersivity (cm)
D	dispersion coefficient (cm2/s)
Dw	binary diffusivity of chemical in water (cm2/s)
DL,sed	consolidation depth of sediment (ft)
foc	cap material organic carbon fraction (/)
g	mass particle density (gm/cm3)
HL	half life (d)
i	head gradient (not used)
Kd	theoretical distribution coefficient (L/kg)
Kd,cap	cap distribution coefficient (L/kg)
Koc	soil-water partition coefficient (g/g)
L	thickness of cap (ft)
n	porosity (/)
ne	effective porosity (/)
p	bulk density (gm/cm3)
R	retardation factor (/)
SQS	State Sediment Quality Standard (mg/kg or mg/kgOC)
t	time (s)
Ti,consol	Cap thickness lost due to expression of porewater during consolidation (ft)
u	first order decay constant (1/d)
v	average linear groundwater velocity (cm/s) (measured)
x	distance from cap bottom (cm)
WQC	State Water Quality Criterion (ug/L)

Conversions:

1 µg =	1.000E-06 gm
1 % wt =	1.0 1g/100ml
1 % wt =	1.00E+04 mg/L
1 mg/L =	1000 ug/l
1 day =	86400 sec
1 foot =	30.48 cm
1 ft/day =	0.00035278 cm/sec

ANALYSIS OF CAP LOSSES DURING CONSOLIDATION

Formula for Short-Term Contaminant Migration Due to Consolidation

Ti,consol = DLsed / (n+p*Kd,cap) USEPA 1998

Cap thickness lost due to expression of porewater during consolidation (ft)

Ti,consol = 0.002 feet (typically negligible)

CONCENTRATION PROFILES THROUGH CAP AT GIVEN TIME

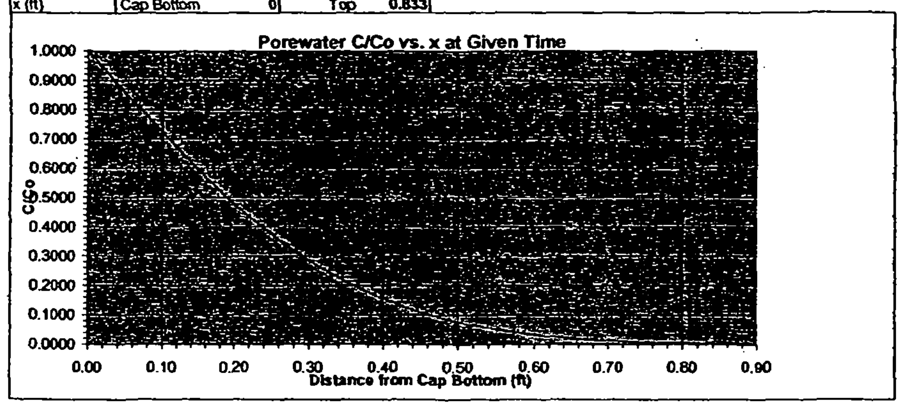
Concentration vs. distance output specifications

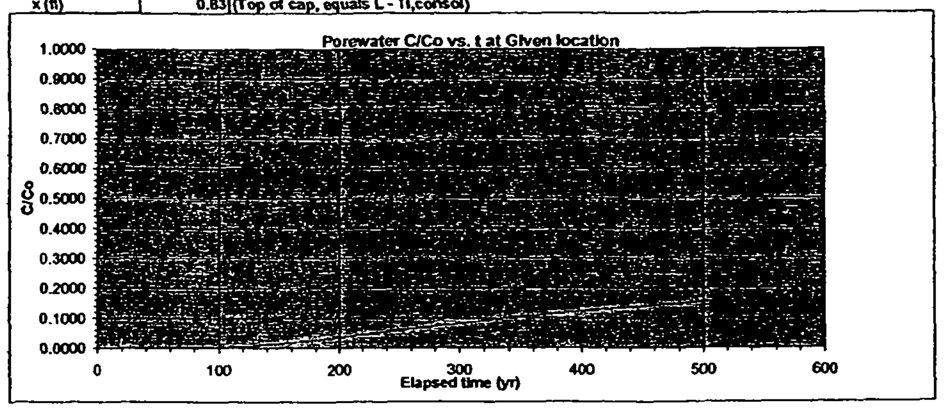
t	36500	days =	100	yr
x (ft)	Cap Bottom	0	Top	0.833

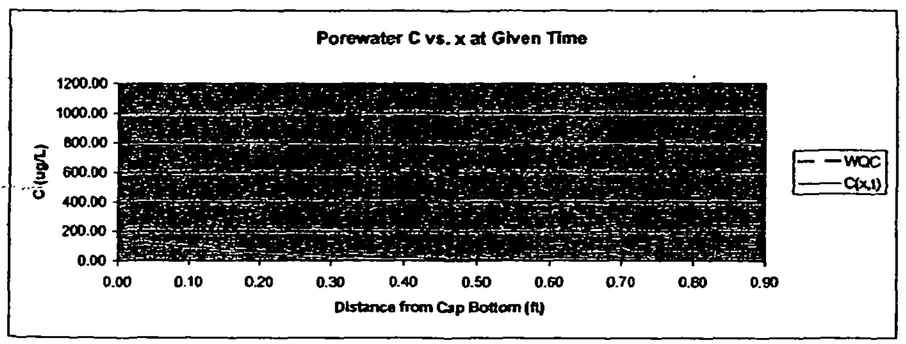
CONCENTRATION PROFILES AT TOP OF CAP

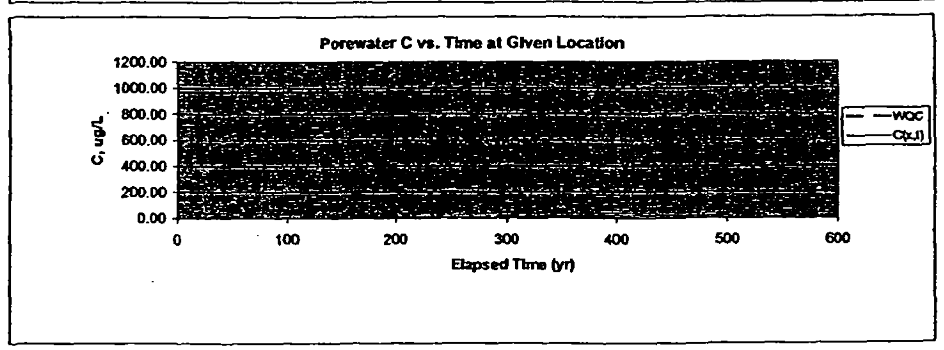
Concentration vs. time output specifications

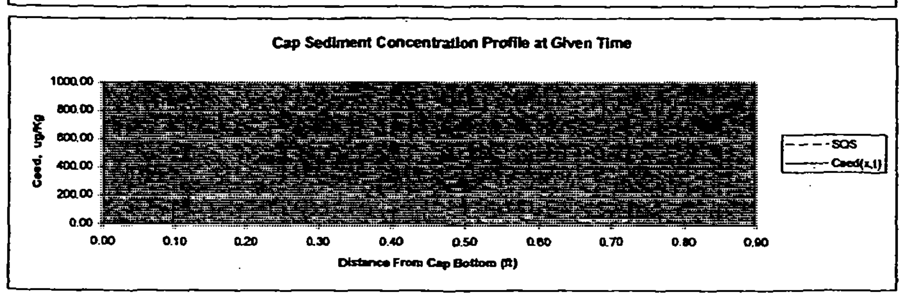
t (yr)	Start	0	Finish	500
x (ft)	0.83	(Top of cap, equals L - Ti,consol)		

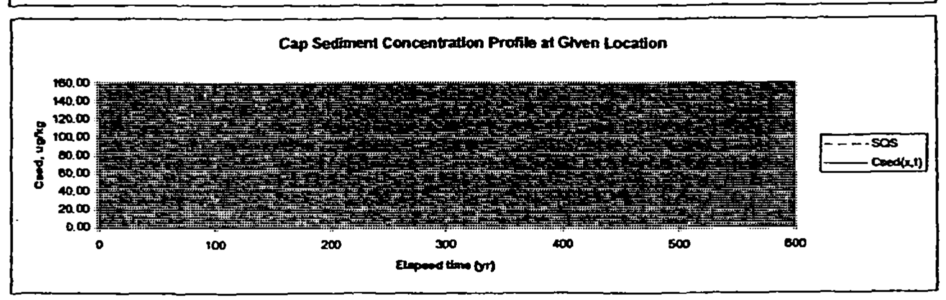












Reasonable Worst Case Chemical Isolation Analysis for Acenaphthene
PSR Superfund Site - RA5a

INPUT				CALCULATIONS						OUTPUT				
t (day)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
36500	3.15E+09	0.00	0.0	0.000	-4.29E-01	1.45627	0.000E+00	0.429	0.544	1.0000	970.00	132.00	16.00	872.77
36500	3.15E+09	0.02	0.5	-0.028	-3.86E-01	1.415	4.667E-02	0.473	0.504	0.9516	970.00	125.60	16.00	830.48
36500	3.15E+09	0.03	1.0	-0.056	-3.42E-01	1.372	9.334E-02	0.516	0.465	0.9036	970.00	119.28	16.00	788.65
36500	3.15E+09	0.05	1.5	-0.084	-2.99E-01	1.327	1.400E-01	0.560	0.428	0.8563	970.00	113.03	16.00	747.35
36500	3.15E+09	0.07	2.0	-0.113	-2.55E-01	1.282	1.867E-01	0.604	0.393	0.8097	970.00	106.88	16.00	706.68
36500	3.15E+09	0.08	2.5	-0.141	-2.12E-01	1.235	2.333E-01	0.647	0.360	0.7639	970.00	100.84	16.00	666.74
36500	3.15E+09	0.10	3.0	-0.169	-1.68E-01	1.188	2.800E-01	0.691	0.329	0.7191	970.00	94.92	16.00	627.62
36500	3.15E+09	0.12	3.6	-0.197	-1.24E-01	1.140	3.267E-01	0.734	0.298	0.6753	970.00	89.14	16.00	589.40
36500	3.15E+09	0.13	4.1	-0.225	-8.09E-02	1.091	3.733E-01	0.778	0.271	0.6327	970.00	83.51	16.00	552.18
36500	3.15E+09	0.15	4.6	-0.253	-3.73E-02	1.042	4.200E-01	0.821	0.245	0.5913	970.00	78.05	16.00	516.04
36500	3.15E+09	0.17	5.1	-0.281	6.21E-03	0.993	4.667E-01	0.865	0.221	0.5512	970.00	72.76	16.00	481.05
36500	3.15E+09	0.18	5.6	-0.309	4.98E-02	0.944	5.133E-01	0.908	0.199	0.5125	970.00	67.65	16.00	447.28
36500	3.15E+09	0.20	6.1	-0.338	9.33E-02	0.895	5.600E-01	0.952	0.178	0.4753	970.00	62.74	16.00	414.80
36500	3.15E+09	0.22	6.6	-0.366	1.37E-01	0.847	6.067E-01	0.996	0.159	0.4396	970.00	58.02	16.00	383.65
36500	3.15E+09	0.23	7.1	-0.394	1.80E-01	0.799	6.534E-01	1.039	0.142	0.4055	970.00	53.52	16.00	353.88
36500	3.15E+09	0.25	7.6	-0.422	2.24E-01	0.751	7.000E-01	1.083	0.126	0.3730	970.00	49.23	16.00	325.52
36500	3.15E+09	0.27	8.1	-0.450	2.68E-01	0.705	7.467E-01	1.126	0.111	0.3421	970.00	45.16	16.00	298.60
36500	3.15E+09	0.28	8.6	-0.478	3.11E-01	0.660	7.934E-01	1.170	0.098	0.3129	970.00	41.31	16.00	273.13
36500	3.15E+09	0.30	9.1	-0.506	3.55E-01	0.616	8.400E-01	1.213	0.086	0.2854	970.00	37.68	16.00	249.11
36500	3.15E+09	0.32	9.7	-0.535	3.98E-01	0.673	8.867E-01	1.257	0.075	0.2596	970.00	34.26	16.00	226.55
36500	3.15E+09	0.33	10.2	-0.563	4.42E-01	0.532	9.334E-01	1.300	0.066	0.2354	970.00	31.07	16.00	205.42
36500	3.15E+09	0.35	10.7	-0.591	4.85E-01	0.492	9.800E-01	1.344	0.057	0.2128	970.00	28.09	16.00	185.71
36500	3.15E+09	0.37	11.2	-0.619	5.29E-01	0.454	1.027E+00	1.388	0.050	0.1918	970.00	25.32	16.00	167.39
36500	3.15E+09	0.38	11.7	-0.647	5.72E-01	0.418	1.073E+00	1.431	0.043	0.1723	970.00	22.75	16.00	150.42
36500	3.15E+09	0.40	12.2	-0.675	6.16E-01	0.384	1.120E+00	1.476	0.037	0.1544	970.00	20.38	16.00	134.75
36500	3.15E+09	0.42	12.7	-0.703	6.60E-01	0.351	1.167E+00	1.518	0.032	0.1379	970.00	18.20	16.00	120.35
36500	3.15E+09	0.43	13.2	-0.731	7.03E-01	0.320	1.213E+00	1.562	0.027	0.1228	970.00	16.20	16.00	107.14
36500	3.15E+09	0.45	13.7	-0.760	7.47E-01	0.291	1.260E+00	1.605	0.023	0.1090	970.00	14.38	16.00	95.09
36500	3.15E+09	0.47	14.2	-0.788	7.90E-01	0.264	1.307E+00	1.649	0.020	0.0964	970.00	12.72	16.00	84.13
36500	3.15E+09	0.48	14.7	-0.816	8.34E-01	0.238	1.353E+00	1.692	0.017	0.0850	970.00	11.22	16.00	74.19
36500	3.15E+09	0.50	15.2	-0.844	8.77E-01	0.215	1.400E+00	1.736	0.014	0.0747	970.00	9.86	16.00	65.22
36500	3.15E+09	0.52	15.7	-0.872	9.21E-01	0.193	1.447E+00	1.780	0.012	0.0655	970.00	8.64	16.00	57.14
36500	3.15E+09	0.53	16.3	-0.900	9.64E-01	0.173	1.493E+00	1.823	0.010	0.0572	970.00	7.55	16.00	49.91
36500	3.15E+09	0.55	16.8	-0.928	1.01E+00	0.154	1.540E+00	1.867	0.008	0.0498	970.00	6.57	16.00	43.44
36500	3.15E+09	0.57	17.3	-0.957	1.05E+00	0.137	1.587E+00	1.910	0.007	0.0432	970.00	5.70	16.00	37.69
36500	3.15E+09	0.58	17.8	-0.985	1.10E+00	0.121	1.633E+00	1.954	0.006	0.0373	970.00	4.93	16.00	32.60
36500	3.15E+09	0.60	18.3	-1.013	1.14E+00	0.107	1.680E+00	1.997	0.005	0.0322	970.00	4.25	16.00	28.10
36500	3.15E+09	0.62	18.8	-1.041	1.18E+00	0.095	1.727E+00	2.041	0.004	0.0277	970.00	3.65	16.00	24.13
36500	3.15E+09	0.63	19.3	-1.069	1.23E+00	0.083	1.773E+00	2.084	0.003	0.0237	970.00	3.13	16.00	20.66
36500	3.15E+09	0.65	19.8	-1.097	1.27E+00	0.073	1.820E+00	2.128	0.003	0.0202	970.00	2.67	16.00	17.63
36500	3.15E+09	0.67	20.3	-1.125	1.31E+00	0.063	1.867E+00	2.172	0.002	0.0172	970.00	2.27	16.00	14.99
36500	3.15E+09	0.68	20.8	-1.153	1.36E+00	0.055	1.913E+00	2.215	0.002	0.0146	970.00	1.92	16.00	12.71
36500	3.15E+09	0.70	21.3	-1.182	1.40E+00	0.048	1.960E+00	2.259	0.001	0.0123	970.00	1.62	18.00	10.73
36500	3.15E+09	0.72	21.8	-1.210	1.44E+00	0.041	2.007E+00	2.302	0.001	0.0104	970.00	1.37	16.00	9.03
36500	3.15E+09	0.73	22.4	-1.238	1.49E+00	0.035	2.053E+00	2.346	0.001	0.0087	970.00	1.15	16.00	7.58
36500	3.15E+09	0.75	22.9	-1.266	1.53E+00	0.030	2.100E+00	2.389	0.001	0.0073	970.00	0.96	16.00	6.33
36500	3.15E+09	0.77	23.4	-1.294	1.57E+00	0.026	2.147E+00	2.433	0.001	0.0060	970.00	0.80	16.00	5.28
36500	3.15E+09	0.78	23.9	-1.322	1.62E+00	0.022	2.193E+00	2.476	0.000	0.0050	970.00	0.66	16.00	4.38
36500	3.15E+09	0.80	24.4	-1.350	1.66E+00	0.019	2.240E+00	2.520	0.000	0.0042	970.00	0.55	16.00	3.62
36500	3.15E+09	0.82	24.9	-1.379	1.70E+00	0.016	2.287E+00	2.564	0.000	0.0034	970.00	0.45	16.00	2.99
36500	3.15E+09	0.83	25.4	-1.407	1.75E+00	0.013	2.333E+00	2.607	0.000	0.0028	970.00	0.37	16.00	2.45

INPUT				CALCULATIONS						OUTPUT				
t (yr)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
0	0.00E+00	0.83	25.3	-1.403	#DIV/0!	#DIV/0!	2.327E+00	#DIV/0!	#DIV/0!	#DIV/0!	970.00	#DIV/0!	16.00	#DIV/0!
10.0	3.15E+08	0.83	25.3	-1.403	6.73E+00	0	2.327E+00	7.003	0.000	0.0000	970.00	0.00	16.00	0.00
20.0	6.31E+08	0.83	25.3	-1.403	4.66E+00	4.2E-11	2.327E+00	5.048	0.000	0.0000	970.00	0.00	16.00	0.00
30.0	9.46E+08	0.83	25.3	-1.403	3.73E+00	1.3E-07	2.327E+00	4.200	0.000	0.0000	970.00	0.00	16.00	0.00
40.0	1.26E+09	0.83	25.3	-1.403	3.16E+00	7.7E-06	2.327E+00	3.705	0.000	0.0000	970.00	0.00	16.00	0.00
50.0	1.58E+09	0.83	25.3	-1.403	2.77E+00	9.1E-05	2.327E+00	3.375	0.000	0.0000	970.00	0.00	16.00	0.02
60.0	1.89E+09	0.83	25.3	-1.403	2.47E+00	0.00047	2.327E+00	3.136	0.000	0.0001	970.00	0.01	16.00	0.09
70.0	2.21E+09	0.83	25.3	-1.403	2.24E+00	0.00156	2.327E+00	2.955	0.000	0.0003	970.00	0.05	16.00	0.30
80.0	2.52E+09	0.83	25.3	-1.403	2.04E+00	0.00384	2.327E+00	2.812	0.000	0.0008	970.00	0.11	16.00	0.72
90.0	2.84E+09	0.83	25.3	-1.403	1.88E+00	0.00778	2.327E+00	2.696	0.000	0.0017	970.00	0.22	16.00	1.45
100.0	3.15E+09	0.83	25.3	-1.403	1.74E+00	0.01374	2.327E+00	2.601	0.000	0.0029	970.00	0.38	16.00	2.52
110.0	3.47E+09	0.83	25.3	-1.403	1.62E+00	0.02194	2.327E+00	2.521	0.000	0.0046	970.00	0.60	16.00	3.98
120.0	3.78E+09	0.83	25.3	-1.403	1.51E+00	0.03248	2.327E+00	2.453	0.001	0.0067	970.00	0.88	16.00	5.82
130.0	4.10E+09	0.83	25.3	-1.403	1.42E+00	0.04535	2.327E+00	2.394	0.001	0.0092	970.00	1.22	16.00	8.04
140.0	4.42E+09	0.83	25.3	-1.403	1.33E+00	0.06049	2.327E+00	2.343	0.001	0.0121	970.00	1.60	16.00	10.60
150.0	4.73E+09	0.83	25.3	-1.403	1.25E+00	0.07773	2.327E+00	2.299	0.001	0.0154	970.00	2.04	16.00	13.48
160.0	5.05E+09	0.83	25.3	-1.403	1.17E+00	0.09692	2.327E+00	2.260	0.001	0.0191	970.00	2.52	16.00	16.63
170.0	5.36E+09	0.83	25.3	-1.403	1.11E+00	0.11785	2.327E+00	2.225	0.002	0.0229	970.00	3.03	16.00	20.02
180.0	5.68E+09	0.83	25.3	-1.403	1.04E+00	0.14034	2.327E+00	2.195	0.002	0.0270	970.00	3.57	16.00	23.60
190.0	5.99E+09	0.83	25.3	-1.403	9.84E-01	0.16418	2.327E+00	2.167	0.002	0.0313	970.00	4.14	16.00	27.35
200.0	6.31E+09	0.83	25.3	-1.403	9.28E-01	0.18918	2.327E+00	2.143	0.002	0.0358	970.00	4.72	16.00	31.22
210.0	6.62E+09	0.83	25.3	-1.403	8.76E-01	0.21518	2.327E+00	2.121	0.003	0.0403	970.00	5.32	16.00	35.19
220.0	6.94E+09	0.83	25.3	-1.403	8.27E-01	0.24199	2.327E+00	2.101	0.003	0.0450	970.00	5.93	16.00	39.23
230.0	7.25E+09	0.83	25.3	-1.403	7.81E-01	0.26948	2.327E+00	2.083	0.003	0.0496	970.00	6.55	16.00	43.32
240.0	7.57E+09	0.83	25.3	-1.403	7.37E-01	0.29749	2.327E+00	2.067	0.003	0.0543	970.00	7.17	16.00	47.42
250.0	7.88E+09	0.83	25.3	-1.403	6.95E-01	0.32591	2.327E+00	2.052	0.004	0.0590	970.00	7.79	16.00	51.53
260.0	8.20E+09	0.83	25.3	-1.403	6.55E-01	0.35463	2.327E+00	2.039	0.004	0.0637	970.00	8.41	16.00	55.63
270.0	8.51E+09	0.83	25.3	-1.403	6.16E-01	0.38354	2.327E+00	2.027	0.004	0.0684	970.00	9.03	16.00	59.70
280.0	8.83E+09	0.83	25.3	-1.403	5.79E-01	0.41258	2.327E+00	2.016	0.004	0.0730	970.00	9.64	16.00	63.74
290.0	9.15E+09	0.83	25.3	-1.403	5.44E-01	0.4416	2.327E+00	2.006	0.005	0.0776	970.00	10.24	16.00	67.72
300.0	9.46E+09	0.83	25.3	-1.403	5.10E-01	0.4706	2.327E+00	1.997	0.005	0.0821	970.00	10.84	16.00	71.65
310.0	9.78E+09	0.83	25.3	-1.403	4.77E-01	0.49949	2.327E+00	1.989	0.005	0.0865	970.00	11.42	16.00	75.52
320.0	1.01E+10	0.83	25.3	-1.403	4.46E-01	0.52823	2.327E+00	1.982	0.005	0.0909	970.00	12.00	16.00	79.32
330.0	1.04E+10	0.83	25.3	-1.403	4.16E-01	0.55678	2.327E+00	1.975	0.005	0.0952	970.00	12.56	16.00	83.06
340.0	1.07E+10	0.83	25.3	-1.403	3.86E-01	0.58505	2.327E+00	1.969	0.005	0.0993	970.00	13.11	16.00	86.71
350.0	1.10E+10	0.83	25.3	-1.403	3.58E-01	0.61306	2.327E+00	1.964	0.005	0.1034	970.00	13.65	16.00	90.28
360.0	1.14E+10	0.83	25.3	-1.403	3.30E-01	0.64076	2.327E+00	1.959	0.006	0.1074	970.00	14.18	16.00	93.77
370.0	1.17E+10	0.83	25.3	-1.403	3.03E-01	0.66813	2.327E+00	1.955	0.006	0.1114	970.00	14.70	16.00	97.19
380.0	1.20E+10	0.83	25.3	-1.403	2.77E-01	0.69514	2.327E+00	1.951	0.006	0.1152	970.00	15.20	16.00	100.51
390.0	1.23E+10	0.83	25.3	-1.403	2.52E-01	0.72178	2.327E+00	1.948	0.006	0.1189	970.00	15.69	16.00	103.76
400.0	1.26E+10	0.83	25.3	-1.403	2.27E-01	0.74802	2.327E+00	1.945	0.006	0.1225	970.00	16.17	16.00	106.92
410.0	1.29E+10	0.83	25.3	-1.403	2.03E-01	0.77387	2.327E+00	1.942	0.006	0.1260	970.00	16.64	16.00	110.00
420.0	1.32E+10	0.83	25.3	-1.403	1.80E-01	0.7993	2.327E+00	1.940	0.006	0.1295	970.00	17.09	16.00	113.00
430.0	1.36E+10	0.83	25.3	-1.403	1.57E-01	0.82432	2.327E+00	1.938	0.006	0.1328	970.00	17.53	16.00	115.92
440.0	1.39E+10	0.83	25.3	-1.403	1.35E-01	0.84891	2.327E+00	1.936	0.006	0.1361	970.00	17.96	16.00	118.76
450.0	1.42E+10	0.83	25.3	-1.403	1.13E-01	0.87307	2.327E+00	1.935	0.006	0.1392	970.00	18.38	16.00	121.52
460.0	1.45E+10	0.83	25.3	-1.403	9.17E-02	0.8968	2.327E+00	1.933	0.006	0.1423	970.00	18.78	16.00	124.20
470.0	1.48E+10	0.83	25.3	-1.403	7.09E-02	0.9201	2.327E+00	1.933	0.006	0.1453	970.00	19.18	16.00	126.81
480.0	1.51E+10	0.83	25.3	-1.403	5.06E-02	0.94296	2.327E+00	1.932	0.006	0.1482	970.00	19.56	16.00	129.34
490.0	1.55E+10	0.83	25.3	-1.403	3.07E-02	0.9654	2.327E+00	1.931	0.006	0.1510	970.00	19.93	16.00	131.79
500.0	1.58E+10	0.83	25.3	-1.403	1.12E-02	0.9874	2.327E+00	1.931	0.006	0.1537	970.00	20.29	16.00	134.18

Note 1: Adapted from Equation B-28, Guidance for Subaqueous Dredged Material Capping. Equation differs by a factor of porosity due to definition of terms
Note 2: Calculated Csed(x,t) is divided by foc to obtain carbon-normalized concentrations
Note 3: Mackay, et al. 1992; Howard et al. 1991. Lowest value for anaerobic groundwater used.
Note 4: 95% Upper Confidence Limit of measured porewater concentrations
Note 5: Highest measured porewater velocity

Reasonable Worst Case Chemical Isolation Analysis for Arochlor 1254
PSR Superfund Site - RA5a

Advective-Dispersive Transport Formulae:

Kd=foc*Koc	Walton 1991, p.186
R=1+(Kd,cap*p)/ne	Walton 1991, p.184
p=g(1-n)	Krynine and Judd,1957, p.138
v=K*i/ne	linear velocity calculation
Co=C* *(1+pocKoc)	USEPA 1998
Csed(x,t)=C(x,t)*Kd,cap	Partitioning definition [see note 2]
D = Dw(n^1/3) + dv	[see note 1]
d = 0.01*L	T. Meyers 2002 (USACE)
C/Co= B(x,t) = (0.5*EXP(W)*ERFC(X))+(0.5*EXP(Y)*ERFC(Z))	Van Genuchten and Alves (1982)
W = ((v-m)*x)/(2*D)	
X = (R*x-m*t)/(SQRT(4*D*R*t))	
Y = ((v+m)*x)/(2*D)	
Z = (R*x+m*t)/(SQRT(4*D*R*t))	
m= v*(SQRT(1+((4*u*D)/v^2))	
ERFC()= 1-ERF()	

1D TRANSPORT SOLUTION
Adapted from spreadsheet provided by
M. Easterly, USACE

INPUT SHADED CELLS

	Hydraulic Calculations			Transport Calculations			Chemical Data			
Data:	Kh	[illegible]	ft/d	Koc	64000	ml/g	Arocior 1254			
	n	0.45		foc	0.0167		Kd (theoretical	651.7	L/kg	
				poc	10	mg/L	C*	12	ug/L	
	ne	0.45		R	2111.81		Kd, cap	651.7	L/kg	
	g	2.65	gm/cm3	u	0.0000	/d (3)	SQS	12	mg/kgOC	
	DL,sed	0.375	ft	d	0.0083333	ft	WQC	0.03	ug/L	(LOEL)
	L	0.833	ft	Co	0.48	ug/L (4)	Dw	5.0E-06	cm2/sec	
Results:	p	1.4575	gm/cm3	d	0.254	cm				
	i		ft/ft	u	0	/s				
	v	0.0004	ft/d (5)	Kd,cap	651.7	ml/g				
	v	1.411E-07	cm/s	D	3.9E-06	cm2/sec				
				m	1.411E-07	cm/sec	(m=v for u=0)			

Variables:

C(x,t)	Porewater concentration in cap (ug/L)	1 µg =	1.000E-06 gm
Co	influent porewater concentration (ugL)	1 % wt =	1.0 1g/100ml
C*	Solubility in water (ug/L)	1 % wt =	1.00E+04 mg/L
Csed(x,t)	cap sediment concentration (mg/kgOC)	1 mg/L =	1000 ug/l
d	dispersivity (cm)	1 day =	86400 sec
D	dispersion coefficient (cm2/s)		
Dw	binary diffusivity of chemical in water (cm2/s)		
DL,sed	consolidation depth of sediment (ft)		
foc	cap material organic carbon fraction (/)	1 foot =	30.48 cm
g	mass particle density (gm/cm3)	1 ft/day =	0.00035278 cm/sec
HL	half life (d)		
i	head gradient (not used)		
Kd	theoretical distribution coefficient (L/kg)		
Kd,cap	cap distribution coefficient (L/kg)		
Koc	soil-water partition coefficient (g/g)		
L	thickness of cap (ft)		
n	porosity (/)		
ne	effective porosity (/)		
p	bulk density (gm/cm3)		
R	retardation factor (/)		
SQS	State Sediment Quality Standard (mg/kg or mg/kgOC)		
t	time (s)		
Ti,consol	Cap thickness lost due to expression of porewater during consolidation (ft)		
u	first order decay constant (1/d)		
v	average linear groundwater velocity (cm/s) (measured)		
x	distance from cap bottom (cm)		
WQC	State Water Quality Criterion (ug/L)		

ANALYSIS OF CAP LOSSES DURING CONSOLIDATION

Formula for Short-Term Contaminant Migration Due to Consolidation

Ti,consol = DLsed / (n+p*Kd,cap)   USEPA 1998

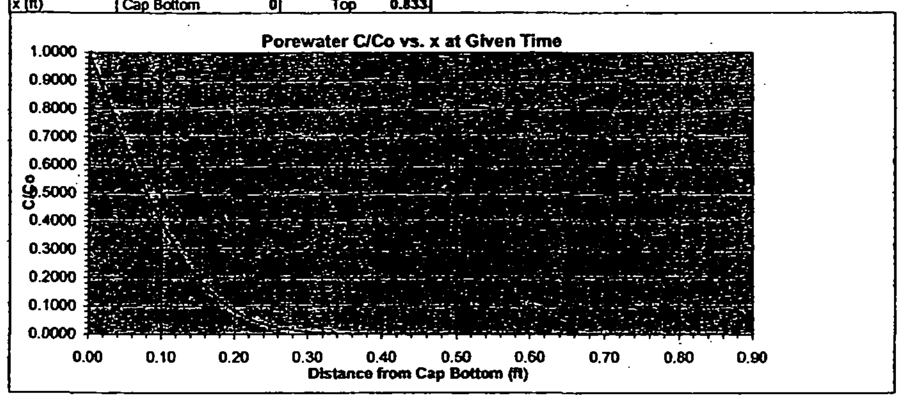
Cap thickness lost due to expression of porewater during consolidation (ft)

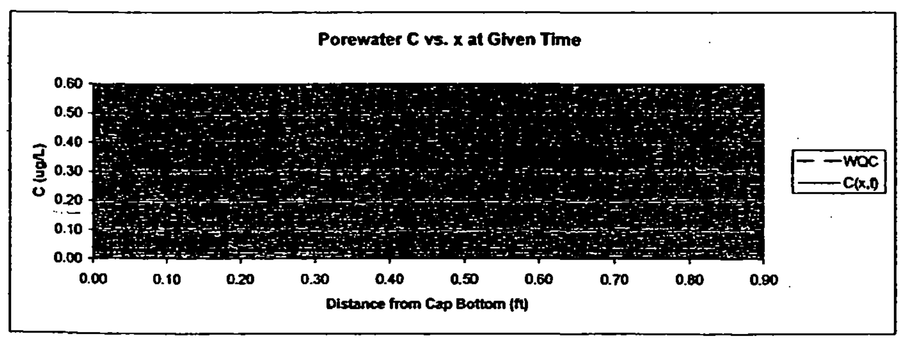
Ti,consol = 0.000 feet (typically negligible)

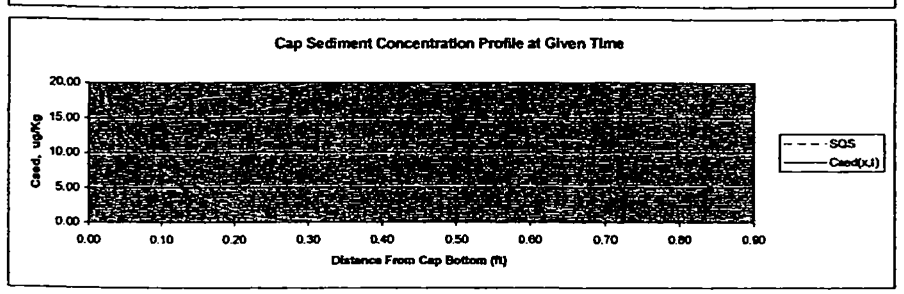
CONCENTRATION PROFILES THROUGH CAP AT GIVEN TIME

Concentration vs. distance output specifications

t	36500	days =	100	yr
x (ft)	Cap Bottom	0	Top	0.833



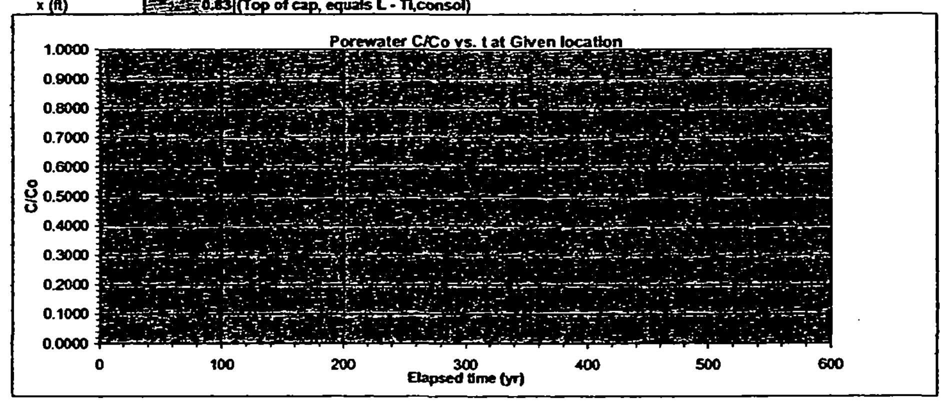


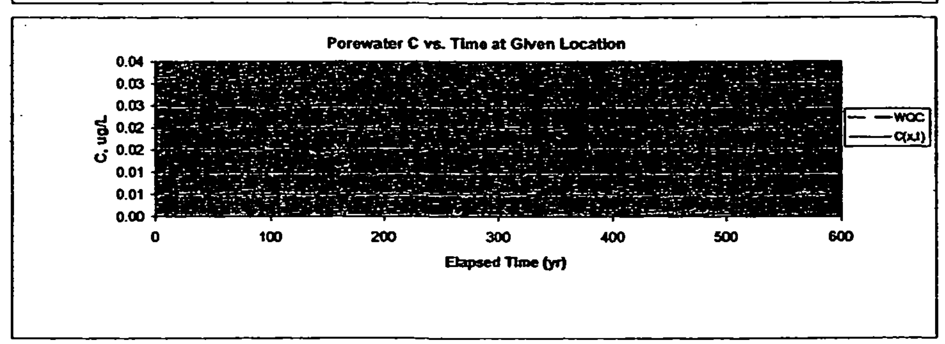


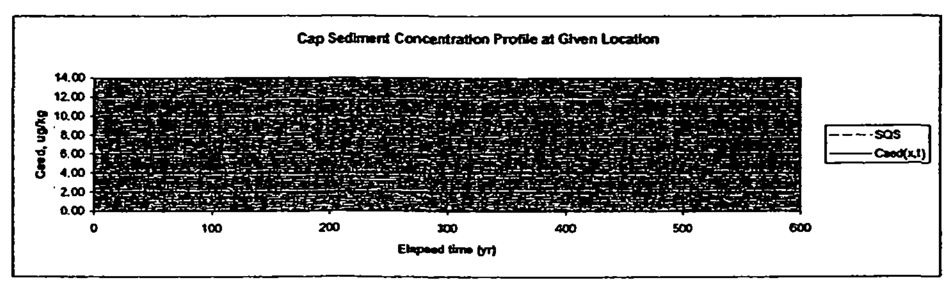
CONCENTRATION PROFILES AT TOP OF CAP

Concentration vs. time output specifications

t (yr)	Start	0	Finish	500
x (ft)	0.83	(Top of cap, equals L - Ti,consol)		







Reasonable Worst Case Chemical Isolation Analysis for Arochlor 1254
PSR Superfund Site - RA5a

INPUT				CALCULATIONS						OUTPUT				
t (day)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
36500	3.15E+09	0.00	0.0	0.000	-4.38E-02	1.04944	0.000E+00	0.044	0.951	1.0000	0.03	0.48	12.00	18.90
36500	3.15E+09	0.02	0.5	0.000	6.18E-02	0.930	1.854E-02	0.150	0.833	0.8892	0.03	0.43	12.00	16.81
36500	3.15E+09	0.03	1.0	0.000	1.68E-01	0.813	3.707E-02	0.255	0.718	0.7790	0.03	0.38	12.00	14.72
36500	3.15E+09	0.05	1.5	0.000	2.73E-01	0.699	5.561E-02	0.361	0.610	0.6719	0.03	0.33	12.00	12.70
36500	3.15E+09	0.07	2.0	0.000	3.79E-01	0.592	7.414E-02	0.467	0.509	0.5703	0.03	0.28	12.00	10.78
36500	3.15E+09	0.08	2.5	0.000	4.85E-01	0.493	9.268E-02	0.572	0.418	0.4760	0.03	0.23	12.00	9.00
36500	3.15E+09	0.10	3.0	0.000	5.90E-01	0.404	1.112E-01	0.678	0.338	0.3906	0.03	0.19	12.00	7.38
36500	3.15E+09	0.12	3.6	0.000	6.96E-01	0.325	1.297E-01	0.784	0.268	0.3149	0.03	0.15	12.00	5.95
36500	3.15E+09	0.13	4.1	0.000	8.02E-01	0.257	1.483E-01	0.889	0.208	0.2493	0.03	0.12	12.00	4.71
36500	3.15E+09	0.15	4.6	0.000	9.07E-01	0.199	1.668E-01	0.995	0.159	0.1938	0.03	0.09	12.00	3.66
36500	3.15E+09	0.17	5.1	0.000	1.01E+00	0.152	1.854E-01	1.101	0.120	0.1479	0.03	0.07	12.00	2.80
36500	3.15E+09	0.18	5.6	0.000	1.12E+00	0.114	2.039E-01	1.206	0.088	0.1107	0.03	0.05	12.00	2.09
36500	3.15E+09	0.20	6.1	0.000	1.22E+00	0.083	2.224E-01	1.312	0.064	0.0813	0.03	0.04	12.00	1.54
36500	3.15E+09	0.22	6.6	0.000	1.33E+00	0.060	2.410E-01	1.418	0.045	0.0588	0.03	0.03	12.00	1.11
36500	3.15E+09	0.23	7.1	0.000	1.44E+00	0.042	2.595E-01	1.524	0.031	0.0414	0.03	0.02	12.00	0.78
36500	3.15E+09	0.25	7.6	0.000	1.54E+00	0.029	2.780E-01	1.629	0.021	0.0286	0.03	0.01	12.00	0.54
36500	3.15E+09	0.27	8.1	0.000	1.65E+00	0.020	2.966E-01	1.735	0.014	0.0194	0.03	0.01	12.00	0.37
36500	3.15E+09	0.28	8.6	0.000	1.75E+00	0.013	3.151E-01	1.841	0.009	0.0129	0.03	0.01	12.00	0.24
36500	3.15E+09	0.30	9.1	0.000	1.86E+00	0.009	3.336E-01	1.946	0.006	0.0084	0.03	0.00	12.00	0.16
36500	3.15E+09	0.32	9.7	0.000	1.96E+00	0.005	3.522E-01	2.052	0.004	0.0054	0.03	0.00	12.00	0.10
36500	3.15E+09	0.33	10.2	0.000	2.07E+00	0.003	3.707E-01	2.158	0.002	0.0034	0.03	0.00	12.00	0.06
36500	3.15E+09	0.35	10.7	0.000	2.18E+00	0.002	3.892E-01	2.263	0.001	0.0021	0.03	0.00	12.00	0.04
36500	3.15E+09	0.37	11.2	0.000	2.28E+00	0.001	4.078E-01	2.369	0.001	0.0012	0.03	0.00	12.00	0.02
36500	3.15E+09	0.38	11.7	0.000	2.39E+00	0.001	4.263E-01	2.475	0.000	0.0007	0.03	0.00	12.00	0.01
36500	3.15E+09	0.40	12.2	0.000	2.49E+00	0.000	4.448E-01	2.580	0.000	0.0004	0.03	0.00	12.00	0.01
36500	3.15E+09	0.42	12.7	0.000	2.60E+00	0.000	4.634E-01	2.686	0.000	0.0002	0.03	0.00	12.00	0.00
36500	3.15E+09	0.43	13.2	0.000	2.70E+00	0.000	4.819E-01	2.792	0.000	0.0001	0.03	0.00	12.00	0.00
36500	3.15E+09	0.45	13.7	0.000	2.81E+00	0.000	5.004E-01	2.898	0.000	0.0001	0.03	0.00	12.00	0.00
36500	3.15E+09	0.47	14.2	0.000	2.92E+00	0.000	5.190E-01	3.003	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.48	14.7	0.000	3.02E+00	0.000	5.375E-01	3.109	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.50	15.2	0.000	3.13E+00	0.000	5.561E-01	3.215	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.52	15.7	0.000	3.23E+00	0.000	5.746E-01	3.320	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.53	16.3	0.000	3.34E+00	0.000	5.931E-01	3.426	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.55	16.8	0.000	3.44E+00	0.000	6.117E-01	3.532	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.57	17.3	0.000	3.55E+00	0.000	6.302E-01	3.637	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.58	17.8	0.000	3.66E+00	0.000	6.487E-01	3.743	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.60	18.3	0.000	3.76E+00	0.000	6.673E-01	3.849	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.62	18.8	0.000	3.87E+00	0.000	6.858E-01	3.954	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.63	19.3	0.000	3.97E+00	0.000	7.043E-01	4.060	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.65	19.8	0.000	4.08E+00	0.000	7.229E-01	4.166	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.67	20.3	0.000	4.18E+00	0.000	7.414E-01	4.272	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.68	20.8	0.000	4.29E+00	0.000	7.599E-01	4.377	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.70	21.3	0.000	4.40E+00	0.000	7.785E-01	4.483	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.72	21.8	0.000	4.50E+00	0.000	7.970E-01	4.589	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.73	22.4	0.000	4.61E+00	0.000	8.155E-01	4.694	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.75	22.9	0.000	4.71E+00	0.000	8.341E-01	4.800	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.77	23.4	0.000	4.82E+00	0.000	8.526E-01	4.906	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.78	23.9	0.000	4.92E+00	0.000	8.712E-01	5.011	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.80	24.4	0.000	5.03E+00	0.000	8.897E-01	5.117	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.82	24.9	0.000	5.14E+00	0.000	9.082E-01	5.223	0.000	0.0000	0.03	0.00	12.00	0.00
36500	3.15E+09	0.83	25.4	0.000	5.24E+00	0.000	9.268E-01	5.328	0.000	0.0000	0.03	0.00	12.00	0.00

INPUT				CALCULATIONS						OUTPUT				
t (yr)	t (sec)	x (ft)	x (cm)	W	X	1-ERF(X)	Y	Z	1-ERF(Z)	B(x,t)	WQC (ug/L)	C(x,t) (ug/L)	SQS (mg/kg OC)	Csed(x,t) (mg/kg OC)
0	0.00E+00	0.83	25.4	0.000	#DIV/0!	#DIV/0!	9.263E-01	#DIV/0!	#DIV/0!	#DIV/0!	0.03	#DIV/0!	12.00	#DIV/0!
10.0	3.15E+08	0.83	25.4	0.000	1.67E+01	0	9.263E-01	16.717	0.000	0.0000	0.03	0.00	12.00	0.00
20.0	6.31E+08	0.83	25.4	0.000	1.18E+01	0	9.263E-01	11.831	0.000	0.0000	0.03	0.00	12.00	0.00
30.0	9.46E+08	0.83	25.4	0.000	9.62E+00	0	9.263E-01	9.668	0.000	0.0000	0.03	0.00	12.00	0.00
40.0	1.26E+09	0.83	25.4	0.000	8.32E+00	0	9.263E-01	8.379	0.000	0.0000	0.03	0.00	12.00	0.00
50.0	1.58E+09	0.83	25.4	0.000	7.44E+00	0	9.263E-01	7.501	0.000	0.0000	0.03	0.00	12.00	0.00
60.0	1.89E+09	0.83	25.4	0.000	6.79E+00	0	9.263E-01	6.853	0.000	0.0000	0.03	0.00	12.00	0.00
70.0	2.21E+09	0.83	25.4	0.000	6.28E+00	0	9.263E-01	6.350	0.000	0.0000	0.03	0.00	12.00	0.00
80.0	2.52E+09	0.83	25.4	0.000	5.87E+00	1.1E-16	9.263E-01	5.945	0.000	0.0000	0.03	0.00	12.00	0.00
90.0	2.84E+09	0.83	25.4	0.000	5.53E+00	5.4E-15	9.263E-01	5.609	0.000	0.0000	0.03	0.00	12.00	0.00
100.0	3.15E+09	0.83	25.4	0.000	5.24E+00	1.3E-13	9.263E-01	5.326	0.000	0.0000	0.03	0.00	12.00	0.00
110.0	3.47E+09	0.83	25.4	0.000	4.99E+00	1.7E-12	9.263E-01	5.082	0.000	0.0000	0.03	0.00	12.00	0.00
120.0	3.78E+09	0.83	25.4	0.000	4.77E+00	1.5E-11	9.263E-01	4.870	0.000	0.0000	0.03	0.00	12.00	0.00
130.0	4.10E+09	0.83	25.4	0.000	4.58E+00	9.1E-11	9.263E-01	4.683	0.000	0.0000	0.03	0.00	12.00	0.00
140.0	4.42E+09	0.83	25.4	0.000	4.41E+00	4.4E-10	9.263E-01	4.516	0.000	0.0000	0.03	0.00	12.00	0.00
150.0	4.73E+09	0.83	25.4	0.000	4.26E+00	1.7E-09	9.263E-01	4.367	0.000	0.0000	0.03	0.00	12.00	0.00
160.0	5.05E+09	0.83	25.4	0.000	4.12E+00	5.6E-09	9.263E-01	4.231	0.000	0.0000	0.03	0.00	12.00	0.00
170.0	5.36E+09	0.83	25.4	0.000	3.99E+00	1.6E-08	9.263E-01	4.108	0.000	0.0000	0.03	0.00	12.00	0.00
180.0	5.68E+09	0.83	25.4	0.000	3.88E+00	4.1E-08	9.263E-01	3.996	0.000	0.0000	0.03	0.00	12.00	0.00
190.0	5.99E+09	0.83	25.4	0.000	3.77E+00	9.6E-08	9.263E-01	3.892	0.000	0.0000	0.03	0.00	12.00	0.00
200.0	6.31E+09	0.83	25.4	0.000	3.67E+00	2.1E-07	9.263E-01	3.797	0.000	0.0000	0.03	0.00	12.00	0.00
210.0	6.62E+09	0.83	25.4	0.000	3.58E+00	4.1E-07	9.263E-01	3.709	0.000	0.0000	0.03	0.00	12.00	0.00
220.0	6.94E+09	0.83	25.4	0.000	3.50E+00	7.6E-07	9.263E-01	3.626	0.000	0.0000	0.03	0.00	12.00	0.00
230.0	7.25E+09	0.83	25.4	0.000	3.42E+00	1.4E-06	9.263E-01	3.549	0.000	0.0000	0.03	0.00	12.00	0.00
240.0	7.57E+09	0.83	25.4	0.000	3.34E+00	2.3E-06	9.263E-01	3.478	0.000	0.0000	0.03	0.00	12.00	0.00
250.0	7.88E+09	0.83	25.4	0.000	3.27E+00	3.7E-06	9.263E-01	3.410	0.000	0.0000	0.03	0.00	12.00	0.00
260.0	8.20E+09	0.83	25.4	0.000	3.21E+00	5.8E-06	9.263E-01	3.347	0.000	0.0000	0.03	0.00	12.00	0.00
270.0	8.51E+09	0.83	25.4	0.000	3.14E+00	8.8E-06	9.263E-01	3.287	0.000	0.0000	0.03	0.00	12.00	0.00
280.0	8.83E+09	0.83	25.4	0.000	3.08E+00	1.3E-05	9.263E-01	3.230	0.000	0.0000	0.03	0.00	12.00	0.00
290.0	9.15E+09	0.83	25.4	0.000	3.03E+00	1.9E-05	9.263E-01	3.176	0.000	0.0000	0.03	0.00	12.00	0.00
300.0	9.46E+09	0.83	25.4	0.000	2.97E+00	2.6E-05	9.263E-01	3.126	0.000	0.0000	0.03	0.00	12.00	0.00
310.0	9.78E+09	0.83	25.4	0.000	2.92E+00	3.6E-05	9.263E-01	3.077	0.000	0.0000	0.03	0.00	12.00	0.00
320.0	1.01E+10	0.83	25.4	0.000	2.87E+00	4.8E-05	9.263E-01	3.031	0.000	0.0000	0.03	0.00	12.00	0.00
330.0	1.04E+10	0.83	25.4	0.000	2.83E+00	6.3E-05	9.263E-01	2.987	0.000	0.0001	0.03	0.00	12.00	0.00
340.0	1.07E+10	0.83	25.4	0.000	2.78E+00	8.3E-05	9.263E-01	2.945	0.000	0.0001	0.03	0.00	12.00	0.00
350.0	1.10E+10	0.83	25.4	0.000	2.74E+00	0.00011	9.263E-01	2.905	0.000	0.0001	0.03	0.00	12.00	0.00
360.0	1.14E+10	0.83	25.4	0.000	2.70E+00	0.00013	9.263E-01	2.867	0.000	0.0001	0.03	0.00	12.00	0.00
370.0	1.17E+10	0.83	25.4	0.000	2.66E+00	0.00017	9.263E-01	2.830	0.000	0.0002	0.03	0.00	12.00	0.00
380.0	1.20E+10	0.83	25.4	0.000	2.62E+00	0.00021	9.263E-01	2.795	0.000	0.0002	0.03	0.00	12.00	0.00
390.0	1.23E+10	0.83	25.4	0.000	2.59E+00	0.00025	9.263E-01	2.761	0.000	0.0002	0.03	0.00	12.00	0.00
400.0	1.26E+10	0.83	25.4	0.000	2.55E+00	0.00031	9.263E-01	2.729	0.000	0.0003	0.03	0.00	12.00	0.01
410.0	1.29E+10	0.83	25.4	0.000	2.52E+00	0.00037	9.263E-01	2.697	0.000	0.0004	0.03	0.00	12.00	0.01
420.0	1.32E+10	0.83	25.4	0.000	2.49E+00	0.00043	9.263E-01	2.667	0.000	0.0004	0.03	0.00	12.00	0.01
430.0	1.36E+10	0.83	25.4	0.000	2.46E+00	0.00051	9.263E-01	2.638	0.000	0.0005	0.03	0.00	12.00	0.01
440.0	1.39E+10	0.83	25.4	0.000	2.43E+00	0.0006	9.263E-01	2.610	0.000	0.0006	0.03	0.00	12.00	0.01
450.0	1.42E+10	0.83	25.4	0.000	2.40E+00	0.0007	9.263E-01	2.583	0.000	0.0007	0.03	0.00	12.00	0.01
460.0	1.45E+10	0.83	25.4	0.000	2.37E+00	0.00081	9.263E-01	2.557	0.000	0.0008	0.03	0.00	12.00	0.01
470.0	1.48E+10	0.83	25.4	0.000	2.34E+00	0.00093	9.263E-01	2.532	0.000	0.0009	0.03	0.00	12.00	0.02
480.0	1.51E+10	0.83	25.4	0.000	2.31E+00	0.00106	9.263E-01	2.507	0.000	0.0010	0.03	0.00	12.00	0.02
490.0	1.55E+10	0.83	25.4	0.000	2.29E+00	0.00121	9.263E-01	2.483	0.000	0.0012	0.03	0.00	12.00	0.02
500.0	1.58E+10	0.83	25.4	0.000	2.26E+00	0.00136	9.263E-01	2.460	0.001	0.0013	0.03	0.00	12.00	0.02

Note 1: Adapted from Equation B-28, Guidance for Subaqueous Dredged Material Capping. Equation differs by a factor of porosity due to definition of terms

Note 2: Calculated Csed(x,t) is divided by foc to obtain carbon-normalized concentrations

Note 3: u [1/day] assumed zero for PCBs

Note 4: Co calculated from PCB detection during construction monitoring (19 mg/kgOC & foc = 1.11% at station RA5-05)

Note 5: Highest measured porewater velocity